2022 Road Needs Study Report

Hastings Highlands

D.M. Wills Project No. 21-4788

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Peterborough
North Bay

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Prepared for
Municipality of Hastings Highlands

Executive Summary

The Municipality of Hastings Highlands (Municipality) retained the services of D.M. Wills Associates (Wills) to undertake a review of the Municipality's existing road network, and assess its physical condition as well as confirm various road attributes. Data collected during the field review was used to develop a prioritized listing of the road network needs, the results of which are documented in this report.

The Municipality's complete road infrastructure system spans a total of 482[1] km primarily within a rural setting, with small areas of semi-urban and urban development. The road network includes surfaces ranging from earth and gravel to hot mix paved (asphalt). The Municipality has approximately 245 km of gravel roads, 4 km of earth roads, 153 km of surface treated roads (Low class bituminous (LCB)), and 79 km of hot mix asphalt paved roads (high class bituminous (HCB)).

An overall road system adequacy has been calculated, consistent with the Ministry of Transportation's (MTO) Inventory Manual for Municipal Road (February,1991) based on a number of road characteristics including:

- Capacity
- Geometrics
- Surface Condition
- Shoulder and Road Widths
- Structural Adequacy
- Drainage
- Maintenance Demand

The overall system adequacy for the 2022 Road Needs Assessment is 91%, considering roads with greater than 50 AADT, per the inventory manual practice.

It should also be noted that a significant portion of the roads identified as deficient are in such condition due to inadequate surface widths; their overall structural adequacy generally being good. These road(s) sections are identified in the Excel provided separately. Additionally, roads with less than 50 AADT (Annual Average Daily Traffic) exhibiting deficiencies are also identified in this document, however, are excluded from the system adequacy calculation.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on the condition rating and traffic demands on each road. Those roads identified as having a "NOW", 1-5 and 6-10 year need (with the exception of drainage improvements) have been included in the capital improvement plan.

[1] The 2016 report covered 486 km of road. The change in length is largely due to better defined limits of assumed road sections, with some minor corrections to individual section lengths.

A total length of approximately 160 km of road were identified as having or structural needs in the "NOW," 1 - 5, and 6 - 10 year periods. The estimated cost to improve these roads is approximately $ 24.5 million. An additional length of approximately 63 km of road is identified as having inadequate surface widths only. Generally, provided no operational or safety concerns are identified, roads with surface width deficiencies are typically addressed / considered at the next full reconstruction cycle.

The Municipality's network includes a previously downloaded portion of Highway 62, which consists of 29 km of HCB road. Approximately 6 km have been recently repaved by the township, but a remaining 8 km is in approaching poor condition, with the remainder in fair condition. The section in poor condition accounts for $3.1 million of the $24.5 million worth of identified road needs. Although the Hastings Highlands has tackled the worst portion of former Highway 62 since the last road needs study, this road still accounts for a significant share of the capital needs program.

Preservation Management

In addition to addressing currently deficient roads (i.e. capital improvements), a dedicated preservation management approach is required, and perhaps even more important, to "keep the good roads good"; the fundamental principle being that it costs much less to maintain a good road than it does to let it fail and then reconstruct it. Ultimately the goal of preservation management is to extend the useful life of a road, maximizing the municipality's investment over the road life-cycle.

Road resurfacing is an effective way of extending the overall life of the pavement structure. A road resurfacing program is therefore recommended in addition to capital improvements.

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a resurfacing program / budget is recommended as follows:

Hot Mix Paved Roads:

- 232.4 km of paved roads (HCB and LCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 11.6 km / year.
- Annual budget to maintain existing HCB, $ 3,062,400: (11.6 km / year x $132,000 / ln **RMP1** x 2 lanes).

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. Typically, gravel roads should be resurfaced on a 3 - 5 year cycle.

Gravel Roads:

- 249 km of gravel and earth roads.
- 75mm gravel every 5 years.
- Annual gravelling of 49.9 km.
- Granular A ($13,000 / km).*

- Annual budget $ 648,700 (49.2 km / year x $13,000 **G**).

** Cost based on supply and application of gravel by external forces.*

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $ 3.7 Million per year.

In order to consistently realize the above service lives, it is essential that a proactive preventative maintenance program is implemented.

Route and Seal:

- Applied once for each new double-lift HCB surface.
- Most HCB surfaces within the Municipality are single lift.
- Should be applied to newly redone Hastings Highlands Road 62 shortly initial cracking occurs.

Slurry Seal / Microsurfacing

- Applied once for every new HCB and LCB surface, on average.
- Can also be applied as a holding strategy to defer more intensive rehabilitation.
- Annual budget to maintain existing HCB, $255,780: (11.6 km / year x $22,000 / **SS**).

Brushing and Ditching Recommendations

- Length of Rural Network 461 km
- Recommended to brush and ditch entire rural network every ten years, 46.0 km / year
- Brushing and Ditching ($5,000 / km). **
- Annual budget to maintain ditches and clear ROW, $230,500: (46.0 km / year x $5,000 / **Brushing and Ditching**).

***Cost based on work performed by contractor, with municipal forces supplying dump trucks and operators as required*

The total preservation management program, (route and seal, slurry seal / microsurfacing, brushing and ditching) is estimated at $ 486 K per year.

It should be noted that investment in preservation management for roads will extend the useful life of the roads with a resulting reduction to the previously noted 10 year capital reconstruction requirement i.e. some road reconstructions will be extended to beyond the 10 year horizon.

The time of inspection plays a significant role in assessing a road's condition. Certain deficiencies, particularly for gravel roads, typically manifest during the "spring break-up" period. By midsummer, regular grading and grooming activities mask base deficiencies on a gravel road. The field work for this study was carried at the end of the season in 2021 by which time the municipality had already begun spring grading. Recently graded roads may be rated higher than their actual structural adequacy.

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1.0 Purpose, Background and Study Method

1.1 Purpose

The purpose of the 2022 Road Needs Study Report is to update the current road inventory and road condition assessments within the Municipality of Hastings Highlands (Municipality). Using this information, a prioritized listing of the road network needs is developed. The information derived from the study and documented in this report will provide assistance to the Municipality for developing and executing a planned road maintenance and improvement program budget.

The Municipality retained the services of D.M. Wills Associates (Wills) to undertake a review of the existing road network, and assess its physical condition as well as confirm various attributes. Data collected as a result of the field review is used to develop a prioritized listing of the road and sidewalk network needs, the results of which are documented in this report.

1.2 Background

The Municipality of Hastings Highlands is located in Hastings County. The municipality is largely rural with some pockets of urban and semi-urban development in many scattered hamlets and villages, the largest of which are Maynooth, Birds Creek, and Lake St. Peter.

In 2016, a Road Needs Study Report was performed to inventory and document the Municipality's existing road assets. That report received a minor update in 2019. This current study (2022) utilizes and builds from the road asset information documented in the 2016 study and 2019 update.

1.3 Study Objectives

Based on the Request for Proposal and discussion with Municipality staff, the following study objectives were identified:

- Provide a current inventory and value of the Municipality's roads, assess road conditions and needs, and develop a priority listing for construction needs and improvements.
- Provide a prioritized list of capital projects for the Municipality to invest in.

To ensure compliance with the latest Ministry of Transportation (MTO) guidelines, the inventories were completed in accordance with the most current edition of the Inventory Manual for Municipal Roads.

1.4 Study Methodology

The procedure utilized to complete the study was generally in accordance with the Ministry of Transportation's Inventory Manual for Municipal Roads (February, 1991).

During the field study the following road characteristics were reviewed and documented to assess the current adequacy of the road:

- Platform Width (overall width of road)
- Surface Width (width of pavement surface)
- Shoulder Width
- Surface Type (gravel, low class bituminous, or high class bituminous)
- Drainage Type (open ditches vs. storm sewers etc.)
- Surface Condition
- Maintenance Demand
- Roadside Environment
- Capacity
- Alignment

Critical Deficiencies

Critical deficiencies represent road characteristics that result in increased maintenance costs or lead to an inadequate level of service. Road sections may be assessed as critically deficient if any one (1) of the following characteristics fall below the minimum tolerable standards defined in the MTO Inventory Manual:

- Surface type - Insufficient surface type for traffic volumes.
- Surface width - Insufficient width of the road surface excluding the shoulders.
- Capacity - Inability of the road to accommodate traffic volumes at peak periods.
- Structural Adequacy - Inability of the road base to support vehicular traffic.
- Drainage - Increased frequency of flooding or excessive maintenance effort required to prevent flooding.

The following parameters were used to assess the adequacy of the road surface type. Road sections with traffic volumes (AADT) in excess of the Minimum Tolerable values for Earth and Gravel in **Table 1**, were noted as critically deficient triggering a "NOW" surface type need as per the Inventory Manual Method.

Table 1 - Surface Type by Annual Average Daily Traffic (AADT)

Surface Type	AADT		
	Inventory Manual		MTO Pavement Design and Rehabilitation Manual[2]
	Tolerable Range	Design Standard	
Earth (E)	<50	-	-
Gravel (G)	<400	0-199	0 - 199
Low Class Bituminous (LCB) / Surface Treatment	-	200-399	200 - 1500
High Class Bituminous (HCB) / Hot Mix	-	400+	>1500

Table 1 provides further guidance with respect to surface type from both the Inventory Manual as well as the MTO Pavement Design and Rehabilitation Manual.

As detailed in **Table 1**, Gravel surfaces are generally considered acceptable for AADT of less than 200 vehicles but may be tolerable up to 400 AADT. Transition to Surface Treatment should be considered above 200 AADT. Gravel road maintenance costs (resurfacing, grading, dust suppression, etc.) versus surface treatment costs are key considerations.

Low Class Bituminous (LCB) i.e. Surface Treatment may be acceptable for traffic volumes between 200 and 1500 AADT. A transition to a Hot Mix or High Class Bituminous surface from Surface Treatment must be considered on a case by case basis. The following factors require consideration:

- Surface Treatment Maintenance Costs.
- Commercial Vehicle Loading.
- Roadside Environment (Urban, Semi-urban, vs. Rural).
- On-street Parking.
- Adjacent Drainage Infrastructure i.e. curb and gutter, catch basins etc.
- Asphalt Availability / Cost.
- Surface / Platform Width.
- Traffic Volume Growth.
- Sub-base Quality.
- Roadbed Frost Susceptibility.
- Future Resurfacing / Rehabilitation Costs.

[2] Ministry of Transportation. Pavement Design and Rehabilitation Manual, Second Edition, 2013, Table 3.3.3 Structural Design Guidelines for Flexible Pavement – Secondary Highways

Vehicle loading is one of the key considerations for pavement design and ultimately the decision between Hot Mix and Surface Treatment. Roads with high levels of commercial traffic require a more substantial pavement structure. The values noted in Table 1, for the "MTO Method" are generally reflective of a highway with 10% commercial vehicles. Roads with AADT in excess of 400 vehicles with a good sub-base and commercial vehicles up to 10% may still perform very well with a Surface Treatment. Existing/past performance of a Surface Treatment can be an excellent indicator when considering the upgrade to Hot Mix.

Surface Width

Surface widths that fall below minimum tolerable standards, as detailed in the MTO Inventory Manual, were noted as critically deficient triggering a "Now" need.

Capacity

An in-depth traffic capacity analysis was not completed as part of the scope of this Road Needs Study. Decisions with respect to expansion of roads should be made within the context of a Transportation Master Plan or Official Plan for the Municipality.

However, from a general perspective, a two lane road can typically provide adequate service up to an AADT of approximately 12,000 vehicles. The functionality of a road from a capacity standpoint is of course dependent upon other factors in combination with volume. Adjacent land uses, number of access points (i.e. entrances and side roads etc.) also have a significant impact on how the road functions.

A rural road with limited entrances and side roads will have a much greater capacity to flow traffic versus an urban street with many entrances and side road intersections. The AADT of 12,000 can be used as a 'rule of thumb' to trigger further analysis on the road capacity and operation. For the purposes of this study, a detailed capacity analysis was not undertaken as part of the scope of work. All roads were assigned to be adequate from a capacity perspective.

Structural Adequacy

In cases where road base or structure is showing distress over more than 20% of the length of the road section, a "Now" need is assessed.

Drainage

A road section is assessed as a "Now" need for drainage generally when a road becomes impassible due to water one or more times a year. This information is not readily accessible from inspection. Characteristics such as ditching, water ponding on or around the road, and evidence of past washouts were used to assess road drainage. As such, a road was given a "Now" need for drainage if there were evident drainage problems that would likely lead to an impassable road during a heavy rain or a rapid snow melt.

2.0 The Road System

2.1 Inventory and Classification

All roads in the municipal road system were inventoried according to the methods outlined in the Inventory Manual for Municipal Roads.

The inventory procedure requires that each road in the system be studied as a separate unit. Initially, the road system was divided into sections so that each conformed, as close as possible, to the following requirements:

- Uniform traffic volume
- Uniform terrain
- Uniform physical conditions
- Uniform adjacent land

Depending on location with respect to the built up areas, roads were classified in a manner generally descriptive of the type of construction as follows:

- Urban - Roads with curb and gutter and storm sewer drainage.
- Semi-Urban - Roads in built up areas (development exceeds 50% of the 50% of the frontage) without curb and gutter or curb and gutter on one (1) side only.
- Rural - Roads with development on less than 50% of the frontage.

Rural roads were further evaluated based on estimated traffic volumes; such as 0 to 50 vehicles per day, 51 to 200, and 201 to 400 etc. For the purpose of this study, traffic volumes were adopted or estimated from existing traffic data, and previous estimates provided by the Municipality.

Table 2 summarizes the total road length in kilometres by surface type and road environment as of December, 2021.

The existing road system consists of 482 km of roadway, 246 km of gravel roads, 4 km of earth road, 153 km of surface treated roads (LCB) and 79 km of HCB (asphalt paved) roads; with all calculations being approximate and rounded to the nearest kilometre.

Table 2 - Road System Inventory

Municipality of Hastings Highlands Road System in Kilometres (As of December 2021)		
A.	**Surface Type**	**Totals***
	Earth	4
	Gravel (loose Top Gravel)	246
	Surface Treatment (LCB & ICB)	153
	Hot Mix Asphalt (HCB)	79
	Total A	**482 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	4
	Gravel (loose Top Gravel)	240
	Surface Treatment (LCB & ICB)	146
	Hot Mix Asphalt (HCB)	71
	Total Rural	**461 km**
(ii)	**Semi-Urban**	
	Gravel (loose Top Gravel)	5
	Surface Treatment (LCB)	7
	Hot Mix Asphalt (HCB)	2
	Total Semi-Urban	**14 km**
(iii)	**Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	6.5
	Total Urban	**6.5 km**
	Total B	**482 km**
**Estimated to the nearest kilometre.*		

3.0 Road Needs

The primary purpose of this study is to develop a list of all roads within the Municipality ranked according to priority with respect to road needs.

The method of evaluating road needs in terms of type, cost and timing of improvements is identified in the Inventory Manual for Municipal Roads.

It is important to note that budgetary restrictions will often influence the level of upgrades to the road system and therefore it is imperative to maximize the improvements based on availability of funds and needs priority.

3.1 Critical Deficiencies

The inventory of the road system revealed that certain road sections are now deficient or will become deficient during the study period.

As noted previously, critical deficiencies include road characteristics which result in increased maintenance costs and which inevitably lead to an inadequate level of service. A road section is critically deficient if any one of the following characteristics fall below the minimum tolerable standards defined in the Inventory Manual.

- Surface type - Incorrect surface type to suit traffic volumes on the roadway.
- Surface width - Insufficient width of the road surface excluding the shoulders.
- Capacity - Inability of the road to accommodate traffic volumes at peak periods.
- Structural Adequacy - Inability of the road base to support vehicular traffic.
- Drainage - Increased frequency of flooding or excessive maintenance effort required to prevent flooding.

Of the 478 km of roads inventoried, a total of 105 km were found to be critically deficient in one (1) or more areas. Of the 105 km, approximately 60 km represents roads with AADT of less than 50 vehicles. Regardless of condition, roads with AADT of fifty (50) or less are typically assigned as "Adequate" (as per the Ministry protocol) for the purpose of the system adequacy calculation.

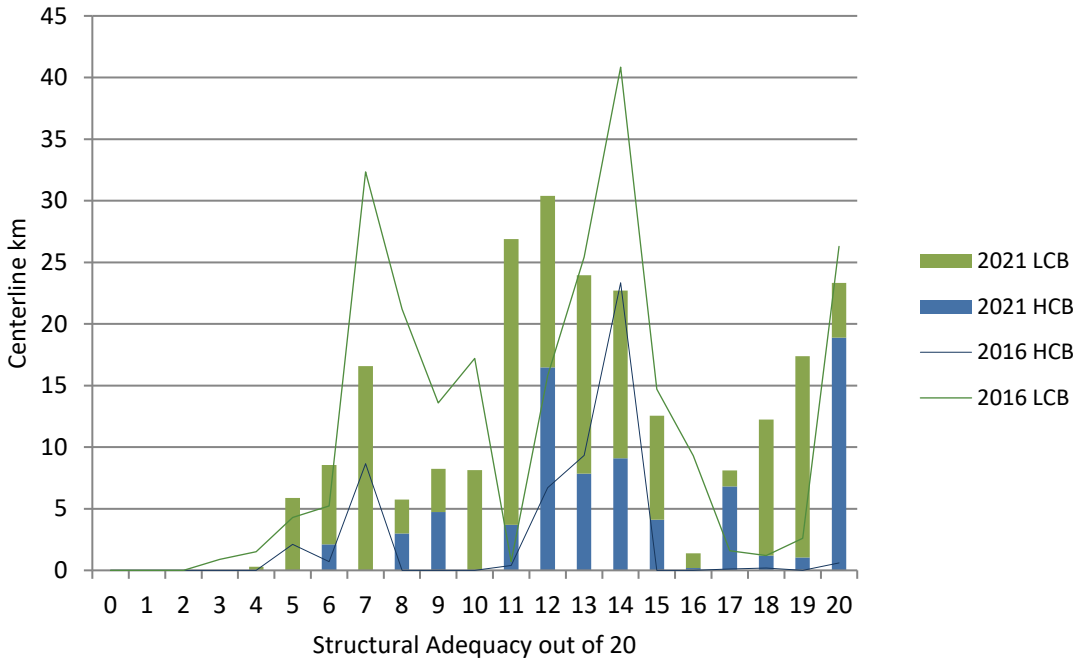
The overall system adequacy for the Municipality's road network, which is based upon the total road kilometres less the identified critically deficient ("NOW" needs) roads, is as follows:

$$\textit{2021 System Adequacy} = \frac{\textit{482- (105 - 60)}}{\textit{482}} \textit{x100\% = 91\%}$$

The above compares favourably to the 2016 system adequacy of 80%. The average surface condition rating of all roads is 7.4/10 while the average structural adequacy rating is 13.5/20 (compared to scores of 7.2 and 12.8 in 2016).

As Figure 1 illustrates, Hastings Highlands has made significant progress in addressing roads in poor or very poor condition since 2016. Roads in fair condition have continued to deteriorate slightly, but many are still potential preservation, resurfacing, or rehabilitation candidates.

Figure 1- Structural Adequacy Distribution



3.2 Priority Ratings of Roads

A mathematical empirical formula was used to calculate the priority rating for each road section. The priority rating is a weighted calculation which takes into account the existing traffic volume and overall condition rating of the road.

This priority analysis is an impartial procedure to place the deficiencies in order of relative need. **A higher priority rating number indicates a relatively greater need for improvement.**

The formula takes into account the current traffic volume (AADT), whether it is from actual road counts or estimated road counts and the Condition Rating (CR) of the road at the time of this Road Needs Study Report. The formula is as follows:

$$\textbf{Priority Rating} = 0.2 \times (100 - CR) \times (AADT + 40)^{0.25}$$

In utilizing the above equation, Wills identified a priority listing for review with Municipality staff. It is important to emphasize that the priority rating calculation considers only CR and traffic volumes.

When developing the recommended capital expenditure plan consideration may be given to the remaining useful service life of a road / roadbed with a view to coordinating major reconstruction efforts at / near the end of the road's life. Furthermore, while a priority rating will give a general idea of which roads should be improved before others, it does not prescribe an exact order for road improvements nor does it determine the timing of preservation and rehabilitation work. For example, it may be wise to defer the full reconstruction of a high priority road ("let the bad roads fail") in favour of resurfacing work on a medium priority road ("keep the good roads good").

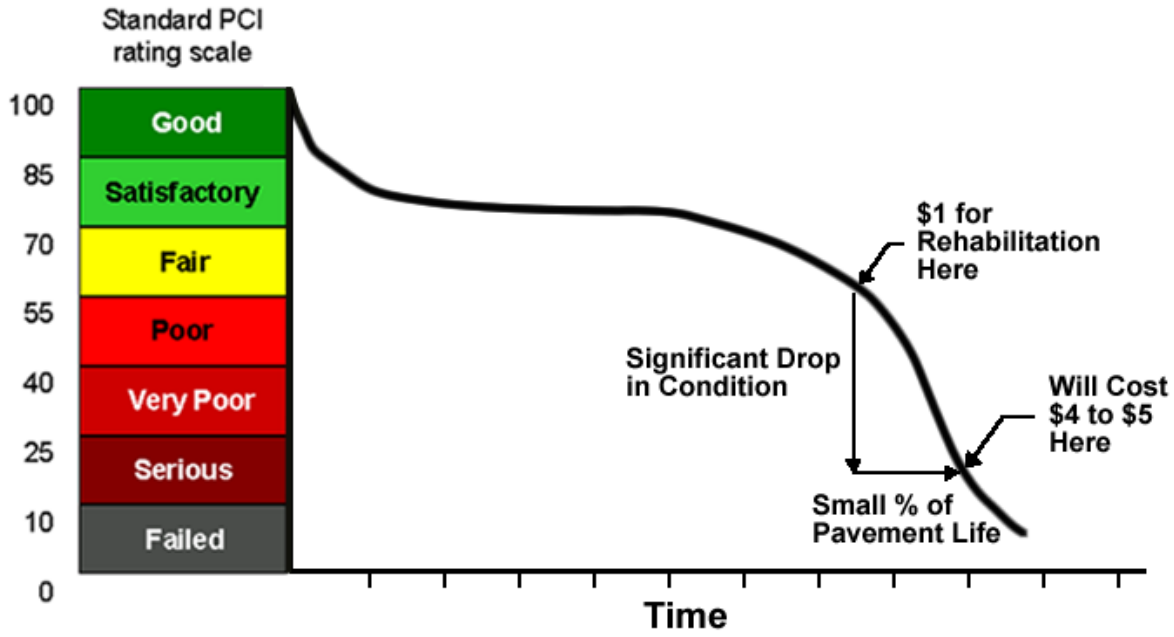
4.0 Roads Best Management Practices

The key to managing a pavement / road network is the timing of maintenance and rehabilitation activities. This idea evolves from the fact that a pavement's structural integrity does not fall constantly with time. A pavement generally provides a constant, acceptable condition for the first part of its service life and then begins to deteriorate very rapidly. In many cases, maintenance and rehabilitation measures are not taken until structural failure or noticeable changes in ride quality become apparent. This is the "fix it once it is already broken" approach.

The unfortunate consequence of this decision is that maintenance and rehabilitation becomes exponentially more expensive over the life of the pavement and is often overlooked until the pavement condition reaches a severe state of distress. There is opportunity for substantial cost savings when intervention is made *before* the pavement becomes severely compromised; i.e. "fix it before it breaks". **Figure 2** illustrates the underlying principle in support of a preservation management approach to pavement infrastructure. The principle also has application to each of the classes of roads maintained by the Municipality. Significant cost savings will result from proactive intervention rather than simply waiting as long as possible before performing maintenance.

Examples of approach to roads management with their associated cost implications over the lifecycle of a road are set out below in **Figure 2** and are provided as an illustration of the benefit of a "preservation management approach".

Figure 2- Typical Service Life of an Asphalt Pavement



4.1 Example Life Cycle Cost Analysis

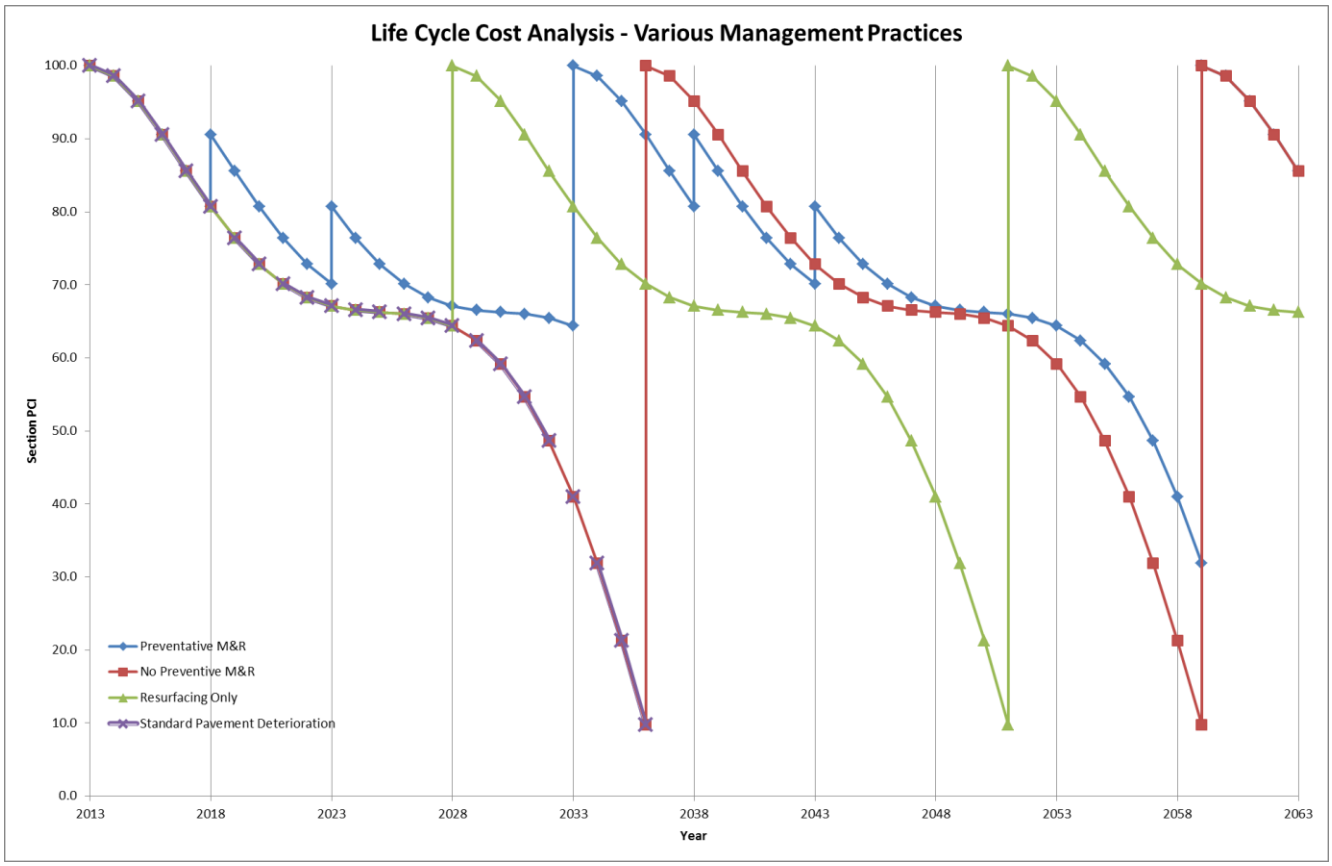
The following life cycle costs analysis compares three (3) different municipalities Municipality 1, Municipality 2 and Municipality 3; each with three (3) distinct approaches to pavement management. For this analysis we will assume each of the three (3) municipalities has 7000 m^2 of pavement, i.e. 1 km of asphalt paved road that is 7 m wide. In each scenario, the road is assumed to have been constructed in 2013 and will operate under normal traffic loading.

The Life Cycle Cost Analysis (LCCA) assumes no user costs. The LCCA uses a discount rate of 2.5% / year.

The LCCA shows the three (3) different municipalities and tracks their pavement management decisions and related condition over the specified time period. Municipality 1 represents decisions made based on strategic preventive maintenance and rehabilitation (M&R), Municipality 2 represents decisions based on no preventive M&R and Municipality 3 represents decisions based on resurfacing only.

Figure 3 below illustrates a time- pavement condition plot for each municipality.

Figure 3 - Time-Condition Plot for 3 Municipalities


Life Cycle Cost Analysis - Various Management Practices
Section PCI
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2013
2018
2023
2028
2033
2038
2043
2048
2053
2058
2063
Year
Preventative M&R
No Preventive M&R
Resurfacing Only
Standard Pavement Deterioration

The costs associated with the corresponding maintenance and rehabilitation decisions are outlined in the following three (3) tables:

Preventive M&R									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
		-- Annual Ditching/Clearing --							
2018	**5**	**Localized Preventive - Rout and Seal**	81-90	Satisfactory-Good	1000	m	$1.50	$1,500.00	**$1,325.78**
2023	**10**	**Global Preventive - Slurry Seal**	70-81	Satisfactory-Good	7000	m^2	$6.50	$45,500.00	**$35,544.53**
2033	**20**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$124,792.78**
2038	**25**	**Localized Preventive - Rout and Seal**	81-88	Satisfactory-Good	4500	m	$1.50	$6,750.00	**$3,640.89**
2043	**30**	**Global Preventive - Slurry Seal**	68-78	Satisfactory-Good	7000	m^2	$6.50	$45,500.00	**$21,691.79**
2048	**35**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$4,424.40**
2053	**40**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$7,821.04**
2058	**45**	**Full Reconstruction**	32-100	Serious-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$107,290.28**
2063	**5**	**Localized Preventive - Rout and Seal**	81-90	Satisfactory-Good	1000	m	$1.50	$1,500.00	**$436.41**
		Final PCI in 2063:	**90**	**Good**				**Net:**	**$306,967.90**
								Residual Value:	**$85,346.08**
								Total Cost:	**$221,621.82**

The policy of Municipality 1 is to strategically intervene with preventative maintenance measures over the course of the pavement's service life. Two (2) significant maintenance measures are performed on the pavement at various times and ultimately extend the service life of the pavement, prorating the total cost of the pavement over a longer period of time. Eventually, a full reconstruction is required and this cycle repeats. The total life cycle costs are substantially less when compared to Municipality 2 and 3, at a total of $221,622 over 50 years.

No Preventive M&R									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
2023	**10**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$8,202.58**
2028	**15**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$14,499.78**
2030	**17**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	20%	m^2	$30.00	$42,000.00	**$27,602.19**
2036	**23**	**Full Reconstruction**	10-100	Poor-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$184,707.88**
2043	**7**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$5,005.80**
2048	**12**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$8,848.79**
2053	**17**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	20%	m^2	$30.00	$42,000.00	**$15,642.09**
2059	**23**	**Full Reconstruction**	10-100	Poor-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$104,673.45**
		Final PCI in 2063:	**86**	**Good**				**Net:**	**$369,182.56**
								Residiual Value:	**$81,552.92**
								Total Cost:	**$287,629.64**

The policy of Municipality 2 is to simply construct the pavement and wait until serious deficiencies begin to appear before acting. This approach unfortunately remains common still today. Over the last period of the pavement's life, maintenance is required to ensure safety and operation until the pavement becomes completely destroyed. Once the pavement has failed, a complete reconstruction is carried out restoring the pavement to new condition. This cycle repeats again until a second reconstruction is required. The total costs are substantial and total $287,630 over 50 years.

Resurfacing Only									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
2028	**15**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$141,191.58**
2051	**23**	**Full Reconstruction**	10-100	Serious-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$127,534.43**
2067	**15**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$53,898.67**
		Final PCI in 2063:	**66**	**Good**				**Net:**	**$322,624.67**
								Residiual Value:	**$62,587.12**
								Total Cost:	**$260,037.55**

The policy of Municipality 3 is periodic resurfacing. The pavement is constructed and time passes until early signs of serious distress are observed. This occurs after the time when preventive maintenance is neither appropriate nor possible, but before the pavement becomes completely destroyed. Resurfacing is performed and restores the pavement to almost new condition. The pavement then deteriorates for the remainder of its life, requiring significant maintenance in the last years before it becomes completely destroyed. A full reconstruction is then carried out and the cycle continues. The total costs are in between that of Municipality 1 and 2 at $260,038 over 50 years.

It may be easy to see upfront cost savings by understanding that as long as any costs associated with maintaining the pavement are deferred as long as possible, money will be saved. The reality is that extending a pavements service life prorates the total cost of the pavement over a longer period of time and ultimately becomes more economical in the long run. If preventive maintenance measures are strategically planned and carried out then the service life of the pavement can be maximized and substantial reconstruction costs can be deferred for longer periods of time. In a time when economy and efficiency are becoming more and more important, this type of proactive management is essential in the management of infrastructure.

4.2 Preservation Management Approach

4.2.1 Gravel Roads

The proposed preservation management approach for this type of road is outlined in the **Table 3** and **Table 4:**

Table 3 - Preservation Management Approach- Gravel Surface

Action	Frequency
Regrade surfaces to maintain smooth / safe driving surface and proper crossfall.	As needed, generally once a month outside of winter for higher volume gravel, or more frequently as necessary; at least 1-2 times per year for lower volume.
Add calcium to tighten surface, retain aggregate and reduce dust.	Each spring on all roads of higher volume and as needed during summer months.
Ditching and brushing of right-of-ways to improve roadbed drainage and safety.	Complete road network every 10 years.

Table 4 - Capital Activities – Gravel Roads

Action	Frequency
Add layer (75 mm) of granular material to road surface.	Every 3-5 years for gravel roads.
Base and sub-base improvements.	As needed or as dictated by traffic volumes.
Reconstruct / convert to hard top.	As dictated by traffic volumes.

4.2.2 Surface Treated Roads

The municipality is planning on converting all surface treated roads to HCB as they reach the end of their useful life.

4.2.3 Asphalt Roads

Asphalt surfaces are the smoothest and most durable hard top surface used by the Municipality however; they are also the most expensive. Asphalt provides a constant, acceptable condition for the initial portion of its service life but then begins to deteriorate rapidly as it ages. Surface defects such as cracking and raveling are the first signs of the deterioration. If left untreated, the pavement will rapidly deteriorate to the point where reconstruction is the only option. A preservation management strategy can mitigate this by applying renewal treatments earlier in the pavements life before the conditions begin to deteriorate too far. **Table 5** below summarizes preservation management activities to be considered for asphalt roads:

Table 5 - Preservation Management Approach – Rural Asphalt Roads

Activity	Age (Years)	Ride Condition Rating	Estimated Service Life Extension (years)
Crack seal (double lift pavements only)	2-6	9	2
Slurry Seal / Microsurface	4-8	8	4-6
Overlay	12-15	6-7	10
Pulverize and Pave	20-25	< 5	20
Reconstruct	30	< 4	30

Note: Slurry seal can be used on lower volume paved roads (less than 1000 vehicles per day). For roads with volumes in excess of 1000 AADT, microsurfacing should be considered.

In addition to the noted preservation approach in **Table 5**, the following best management practices may be employed to extend the service life and reduce life cycle costs of asphalt roads:

1. Review the condition of other infrastructure, particularly underground infrastructure prior to implementing any major renewal or rehabilitation of the pavement. Any repairs or capital upgrades to other infrastructure should be coordinated. This should reduce utility cuts in newer asphalt.
2. Repair potholes in the surface in a timely fashion to prevent saturation and weakening of road base.
3. Undertake regular shouldering program of rural paved roads to promote proper drainage. Poorly maintained shoulders allow surface water to pond and saturate the road base, which weakens the base and leads to cracking at the edge of pavements.
4. Undertake a ditching program to ensure there is adequate drainage for road base on rural roads. This will reduce the likelihood of structural distresses caused by softening of the road base due to poor drainage.
5. Specify the appropriate type of performance graded asphalt cement for the location.
6. Undertake a clearing program to reduce shading of the roadbed and remove roots / vegetation from the road base.

4.3 Application of Preservation Management Approach

The preservation management activities detailed in each of the tables above are not necessarily intended or required to be completed on each and every road. Road deterioration rates and the type of deterioration will dictate when action should be taken and what kind of treatment is most appropriate. The intention of the above is to outline the series of techniques to be considered in an effort to realize and extend the useful service life of the road asset for the lowest overall lifecycle cost while maintaining the highest overall condition. As detailed in the life cycle costs analysis presented above, the preservation management approach to roads is proven to yield the lowest overall life-cycle costs.

Each of the preservation management activities for gravel, surface treatment and asphalt roads identified above (including route and seal, slurry seal, resurfacing etc.) should be considered as part of the regular Road Needs Study Report every five (5) years. Recommendations on the specific treatments required should be documented and prioritized in this report.

5.0 Road Needs Study Summary Table

5.1 Types of Improvements

All roads were examined to appraise the extent and type of improvement necessary.

"Order of Magnitude" construction costs were developed for each of the below options on a per kilometre basis. An estimated cost for isolated frost heave repairs was also considered.

The below alternative rehabilitation strategies are considered preliminary in nature and are intended to assist in providing an order of magnitude cost estimate to rehabilitate the road. Further field investigations and engineering design is required to confirm and develop the rehabilitation strategies for each road.

5.1.1 Asphalt

High Class Bituminous roads (HCB) or hot mix asphalt roads have rehabilitation alternatives ranging from a simple overlay to complete reconstruction. The following is a listing of standard road rehabilitation techniques that were considered for HCB or hot mix asphalt roads.

RO1 Resurfacing, Single-Lift Overlay.

RO2 Resurfacing, Double-Lift Overlay.

RMP1 Resurfacing, Mill and Pave 1-Lift.

RMP2 Resurfacing, Mill and Pave 2-Lifts.

PP1 Pulverize and Pave 1-Lift.

PP2 Pulverize and Pave 2-Lifts.

Recon 1R Excavate and Reconstruct Road and Pave 1-Lift – Rural.

Recon 1S Excavate and Reconstruct Road and Pave 1-Lift – Semi-Urban.

Recon 2S Excavate and Reconstruct Road and Pave 2-Lifts – Semi-Urban.

Recon 2U Excavate and Reconstruct Urban Road and Pave 2-Lifts – Urban.

SS Slurry Seal (Preventative Maintenance).

MS Microsurfacing (Preventative Maintenance).

RS Route and Seal (Preventative Maintenance)

5.1.2 Surface Treatment

Surface treated roads are generally able to be rehabilitated with either a single or double Low Class Bituminous (LCB) overlay treatment. They may also be upgraded to HCB pavement or downgraded to gravel. In some cases, previous resurfacing of LCB roads has occurred, or the LCB surface or road structure has deteriorated to a state where a simple overlay surface treatment is not feasible. In these cases consideration can be given to removal or pulverizing of the existing surface treatment and placement of a new application. In some cases, where it is necessary to improve the overall roadbed structure, the addition of Granular A to build up the road and the reapplication of a surface treatment is recommended. The following is a listing of standard road rehabilitation techniques that were considered for LCB (surface treated) roads:

ST1 Single Surface Treatment.

SS Slurry Seal (Preventative Maintenance).

5.1.3 Gravel

Gravel roads can likewise be upgraded with the reapplication of Gravel (G) or surface treatments (ST1).

5.2 Benchmark Construction Costs

A Unit Price Form found in **Appendix A** is based on average prices for the local area was prepared. The unit prices were used to prepare an array of benchmark construction costs.

For the Municipality of Hastings Highlands, the following design standards (noted in **Table** 6**)** were utilized for development of the benchmark cost estimate for reconstruction. It should be noted that these are suggested standards and therefore should not necessarily be used as standards for detail design of roadway improvements.

Table 6 - Design Standards for Construction Cost Estimates

Functional Classification	Surface Width (m)	Shoulder Width (m)	Granular A Depth (mm)	Granular B Depth (mm)	Hot Mix Depth (mm)*
Rural R200 (50 to 199 vpd)	6.0	1.5	150	450	-
Rural R300 (200 to 399 vpd)	6.0	1.5	150	450	16*
Rural R400 (400 to 999 vpd)	6.5	1.5	150	450	50
Semi - Urban Local Residential	6	1.5	150	450	50
Semi - Urban Local Industrial	6.5	1.5	150	450	50
Urban Local Residential	8.5	-	150	450	100
Urban Local Industrial	9.0	-	150	450	100

Note - Prime and Double Surface Treatment is based on 16 mm of Hot Mix.

6.0 Improvement Plan

6.1 Road Needs

The Road Needs Summary Table is included on the next page, **Table 7** noting the recommended Capital Construction Plan in terms of priorities throughout the Municipality. AADT is based on previous counts / estimates provided by the Municipality. All costs are based on 2022 dollars and should be adjusted for inflation based on program year, for budgeting purposes. The capital improvements are listed based on need (NOW, 1-5 years, 6-10 years, surface upgrades and widening) and in descending priority based on traffic volumes and Condition Rating, as described previously.

Table 7 - Municipality of Hastings Highlands Road Needs

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
NOW Needs										
757	Kamaniskeg Lake Rd	Start of LCB	2.2 km South of the Start of the LCB	2.15	394	*PP1 - Pulverize and Pave 1 Lift*	*$330*	6	7	52
497	Davis Rd	1.9 km North of Highway 62	Frantz Rd	2.3	20	*Recon G - Full Reconstruction 6m Gravel Road*	*$264*	4	5	FALSE
1530	Sararas Rd	Musclow Greenview Rd	Dead End	0.1	20	*Recon 1R - Full Reconstruction + 1 Lift*	*$41*	5	5	FALSE
1520	Maxwell Settlement Rd	Lake Rd	Mountney Rd	2.4	108	*PP1 - Pulverize and Pave 1 Lift*	*$369*	5	7	48
1055	St Matthews St	South Baptiste Lake Rd	Village St	0.03	108	*PP1 - Pulverize and Pave 1 Lift*	*$5*	5	6	46
530	Old Highway 62	Boulter Rd	H.H. Road 62	2.1	40	*Recon 1R - Full Reconstruction + 1 Lift*	*$854*	4	6	69
1045	Dock Rd	Village St	End	0.05	49	*PP1 - Pulverize and Pave 1 Lift*	*$8*	3	4	34
1210	Clarke Rd	South Baptiste Lake Rd	Ojibiway Rd	1.2	162	*PP1 - Pulverize and Pave 1 Lift*	*$184*	4	6	47
1375	Polaris Dr	South Baptiste Lake Rd	Dead End	0.35	108	*PP1 - Pulverize and Pave 1 Lift*	*$54*	6	6	55
240	Mink Lake Rd	HWY. 127	Hammond Rd	5.6	171	*PP1 - Pulverize and Pave 1 Lift*	*$860*	5	7	51
135	Scott Line Rd	Highway 62	4.5 km West of Highway 62	4	162	*PP1 - Pulverize and Pave 1 Lift*	*$614*	6	5	55
1795	Old Hastings Rd	Highway 62	Highway 127	1.2	135	*PP1 - Pulverize and Pave 1 Lift*	*$184*	5	6	46
1410	Elizabeth St	John St	#106	0.53	49	*PP1 - Pulverize and Pave 1 Lift*	*$81*	3	5	33
95	Iron Bridge Rd	Highway 127	End of LCB	0.24	10	*PP1 - Pulverize and Pave 1 Lift*	*$37*	3	4	39
727	Centreview Rd	James Rd	0.9 km West of Siberia Rd	1.35	50	*PP1 - Pulverize and Pave 1 Lift*	*$207*	5	5	49
1045	Dock Rd	Village St	End	0.05	49	*PP1 - Pulverize and Pave 1 Lift*	*$8*	3	4	34

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
747	Hicks Rd	Parisiens Rd	Dead End	1.25	45	*PP1 - Pulverize and Pave 1 Lift*	*$192*	6	6	58
190	Boulter Lake Rd	Mink Lake Rd	Highway 127	1.8	40	*PP1 - Pulverize and Pave 1 Lift*	*$276*	6	6	58
1415	Edward St	South Baptiste Lake Rd	Elizabeth St	0.18	49	*PP1 - Pulverize and Pave 1 Lift*	*$28*	6	6	59
1380	Gemini St	Mira St	Polaris Dr	0.44	49	*PP1 - Pulverize and Pave 1 Lift*	*$68*	6	6	51
725	Centreview Rd	Papineau Lake Rd	2.8 km East of Papineau Lake Rd	2.75	50	*PP1 - Pulverize and Pave 1 Lift*	*$422*	6	7	53
1570	Peever Rd	Highway 62	Dead End	0.6	20	*PP1 - Pulverize and Pave 1 Lift*	*$92*	5	7	48
1370	Mira St	South Baptiste Lake Rd	0.5 km South of South Baptiste Lake Rd	0.58	49	*PP1 - Pulverize and Pave 1 Lift*	*$89*	6	7	62
1095	Woodcox Rd	South Baptiste Lake Rd	0.8 km South of South Baptiste Lake Rd	0.8	49	*PP1 - Pulverize and Pave 1 Lift*	*$123*	7	7	61
745	Hicks Rd	Siberia Rd	Paisiens Rd	1.61	45	*PP1 - Pulverize and Pave 1 Lift*	*$247*	6	7	64
1 - 5 Year Needs										
490	Hastings Highlands Road 62	Robinson Rd	0.22 km West of Musklow Greenview Rd	3	3770	*Recon 1R - Full Reconstruction + 1 Lift*	*$1,220*	6	8	64
540	Hastings Highlands Road 62	0.22 km West of Musclow Greenview Rd	Old Hwy 62	4.74	3770	*Recon 1R - Full Reconstruction + 1 Lift*	*$1,927*	6	9	70
1009	South Baptiste Lake Rd	Redmond Bay Lane	Y Rd	2.7	2548	*PP1 - Pulverize and Pave 1 Lift*	*$415*	6	9	55
1005	South Baptiste Lake Rd	Bowen Road	Brown Crescent	2.85	2548	*PP1 - Pulverize and Pave 1 Lift*	*$438*	7	11	60
1005	South Baptiste Lake Rd	Bowen Road	Brown Crescent	2.85	2548	*PP1 - Pulverize and Pave 1 Lift*	*$438*	7	11	60
275	Northern Pine Rd	Circle Rd	Dead End	0.07	20	*Recon 1R - Full Reconstruction + 1 Lift*	*$28*	6	8	FALSE

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
1060	Village St	Dock Rd	0.9 km East of Fell Road	0.95	183	*PP1 - Pulverize and Pave 1 Lift*	*$146*	6	8	55
1580	Musclow Greenview Rd	Hwy 62	McCormick Rd	6.9	712	*PP1 - Pulverize and Pave 1 Lift*	*$1,060*	7	11	68
250	Mink Lake Rd	Hammond Rd	0.1 km South of Dam Rd	3.2	81	*PP1 - Pulverize and Pave 1 Lift*	*$492*	6	10	61
1612	Graphite Rd	Best Rd	Musclow Greenview Rd	2.8	215	*PP1 - Pulverize and Pave 1 Lift*	*$430*	7	10	58
765	River Rd	0.6 km East of Golfers Ln	Renfrew County Bdry	5.4	162	*PP1 - Pulverize and Pave 1 Lift*	*$829*	7	11	69
1670	New Carlow Rd	East Road Loop	East Municipal Bdry	1.8	50	*PP1 - Pulverize and Pave 1 Lift*	*$276*	5	8	54
1385	Pinegrove St	Mira St	Polaris Dr	0.44	108	*PP1 - Pulverize and Pave 1 Lift*	*$68*	6	10	60
800	Centreview Rd	0.9 km West of Siberia Rd	H.H. Road 62	5.1	252	*PP1 - Pulverize and Pave 1 Lift*	*$783*	7	11	66
425	ANAF Rd	H.H. Road 62	Dead End	0.55	67	*PP1 - Pulverize and Pave 1 Lift*	*$84*	7	9	66
1405	John St	South Baptiste Lake Rd	#52	0.25	20	*PP1 - Pulverize and Pave 1 Lift*	*$38*	6	9	60
150	Williams Lake Rd	Highway 127	1.7 km West of Highway 127	1.7	45	*PP1 - Pulverize and Pave 1 Lift*	*$261*	7	10	67
1675	Old Welsh Rd	Musclow Greenview Rd	East Road Loop	2	50	*PP1 - Pulverize and Pave 1 Lift*	*$307*	6	11	55
1390	Bird Lake Rd	South Baptiste Lake Rd	0.6 km North of South Baptiste Lake Rd	0.6	10	*PP1 - Pulverize and Pave 1 Lift*	*$92*	7	11	68
1395	Wilson Ln	South Baptiste Lake Rd	0.3 km South of South Baptiste Lake Rd	0.33	25	*PP1 - Pulverize and Pave 1 Lift*	*$51*	8	11	74
6 - 10 Year Needs										
1005	South Baptiste Lake Rd	Bowen Road	Brown Crescent	2.85	2548	*PP1 - Pulverize and Pave 1 Lift*	*$438*	7	11	60

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
810	Hastings Highlands Road 62	0.86 km East of Paddy Rd	Centerview Rd	4.04	3770	*RMP1 - Mill & Pave, 1 Lift*	*$1,071*	7	13	72
700	Hastings Highlands Road 62	Old Hwy 62	1.38 km West of Paddy Rd	3.8	3770	*RMP1 - Mill & Pave, 1 Lift*	*$1,007*	7	13	77
785	Hastings Highlands Road 62	1.38 km West of Paddy Rd	0.86 East of Paddy Rd	2.25	3770	*RMP1 - Mill & Pave, 1 Lift*	*$596*	7	14	80
860	Hastings Highlands Road 62	Centerview Rd	Schweig Rd	5.14	3770	*RMP1 - Mill & Pave, 1 Lift*	*$1,362*	7	14	77
755	Kamaniskeg Lake Rd	Siberia Rd	End of LCB	4.1	394	*PP1 - Pulverize and Pave 1 Lift*	*$630*	7	12	60
1543	Musclow Greenview Rd	McClean Rd	H.H. Road 62	0.82	431	*ST1 - Single Surface Treatment*	*$20*	7	13	62
605	Papineau Lake Rd	H.H. Road 62	Davis Ln	4	262	*ST1 - Single Surface Treatment*	*$98*	7	13	63
1690	Hybla Rd	Highway 62	Cross Country Rd	5.7	318	*ST1 - Single Surface Treatment*	*$140*	7	13	69
1540	Musclow Greenview Rd	McCormick Rd	Barlett Rd	6.8	539	*ST1 - Single Surface Treatment*	*$167*	8	14	68
215	Lake St Peter Rd	Highway 127	2.5 km East of Highway 127	2.5	159	*PP1 - Pulverize and Pave 1 Lift*	*$384*	7	12	64
235	High Bush Rd	Lorraine Rd	West 0.4 of Lorraine Rd	0.4	20	*ST1 - Single Surface Treatment*	*$10*	7	13	70

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
520	Boulter Rd	H.H. Road 62	Mayo/Carlowe and Wicklow Bdry	5	170	*ST1 - Single Surface Treatment*	*$123*	7	13	60
217	Lake St Peter Rd	2.5 km East of Highway 127	4.7 km East of Highway 127	2.2	159	*PP1 - Pulverize and Pave 1 Lift*	*$338*	8	12	78
110	Peterson Rd	Williams Lake Rd	Highway 62	5.311	273	*PP1 - Pulverize and Pave 1 Lift*	*$816*	8	12	93
1611	Graphite Rd	Moxam Rd	Best Rd	3.5	215	*ST1 - Single Surface Treatment*	*$86*	7	14	60
1666	East Road Loop	Old Welsh Rd	New Carlow Rd	0.5	89	*PP1 - Pulverize and Pave 1 Lift*	*$77*	6	12	59
1265	Y Ct	Y Rd	0.4 km South of Y Rd	0.3	45	*PP1 - Pulverize and Pave 1 Lift*	*$46*	8	12	88
721	Papineau Lake Rd	Start of LCB	End of LCB	0.7	50	*PP1 - Pulverize and Pave 1 Lift*	*$108*	7	12	66
600	North Cardwell Lake Rd	East Lake Rd	0.3 km North of East Lake Rd	0.2	40	*ST1 - Single Surface Treatment*	*$5*	8	13	78
100	Peterson Rd	West Municipal Bdry	Herschel Forest Rd	5.55	108	*PP1 - Pulverize and Pave 1 Lift*	*$852*	8	12	89
105	Peterson Rd	Herschel Forest Tr	Williams Lake Rd	5.311	108	*PP1 - Pulverize and Pave 1 Lift*	*$816*	8	12	89
1124	North Baptiste Lake Rd	Dog Bay Rd	3.0 km West of Dog Bay Rd	3	81	*ST1 - Single Surface Treatment*	*$74*	7	14	68

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Struct. Adeq.	PCI (Hard Top Only)
1160	Y Rd	South Baptiste Lake Rd	Highway 62	1.7	215	*Preventative Maintenance*	*$0*	9	14	97
595	East Lake Rd	Highway 127	0.2 km East of North Cardwell Lake Rd	1.65	20	*PP1 - Pulverize and Pave 1 Lift*	*$253*	7	12	62
515	Park Rd	Boulter Rd	0.3 km West of Boulter Rd	0.2	10	*ST1 - Single Surface Treatment*	*$5*	7	14	76
1400	Alexander Ct	Wilson Lane	0.1 km East of Wilson Ln	0.12	4	*ST1 - Single Surface Treatment*	*$3*	8	14	77

**Road also listed as a structural need*

Notes:

1. *Rehabilitation strategy to be confirmed by geotechnical investigations at detail design.*

2. *Timing of storm sewer / culvert work should be considered in conjunction with road reconstruction and vice versa, where applicable.*

3. *Costing is zero for roads within the network but maintained by others (i.e. boundary roads).*

6.2 Annual Resurfacing Program

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a resurfacing program / budget is recommended, in addition to the noted capital construction works, as follows:
Hot Mix Paved Roads:

- 232.4 km of paved roads (HCB and LCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 11.6 km / year.
- Annual budget to maintain existing HCB, $ 3,062,400: (11.6 km / year x $132,000 / ln **RMP1** x 2 lanes).

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. Typically, gravel roads should be resurfaced on a 3 - 5 year cycle.

Gravel Roads:

- 249 km of gravel and earth roads.
- 75mm gravel every 5 years.
- Annual gravelling of 49.9 km.
- Granular A ($13,000 / km).*
- Annual budget $ 648,700 (49.2 km / year x $13,000 **G**).

** Cost based on supply and application of gravel by external forces.*

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $ 3.7 Million per year.

6.3 Preservation Management

Preventing water from infiltrating a paved surface can greatly increase the service life of a pavement.

Route and Seal:

- Applied once for each new double-lift HCB surface.
- Most HCB surfaces within the Municipality are single lift.
- Should be applied to newly redone Hastings Highlands Road 62 shortly initial cracking occurs.

Slurry Seal / Microsurfacing

- Applied once for every new HCB and LCB surface, on average.
- Can also be applied as a holding strategy to defer more intensive rehabilitation.
- Annual budget to maintain existing HCB, $255,780: (11.6 km / year x $22,000 / **SS**).

Brushing and Ditching Recommendations

- Length of Rural Network 461 km
- Recommended to brush and ditch entire rural network every ten years, 46.0 km / year
- Brushing and Ditching ($5,000 / km). **
- Annual budget to maintain ditches and clear ROW, $230,500: (46.0 km / year x $5,000 / **Brushing and Ditching**).

***Cost based on work performed by contractor, with municipal forces supplying dump trucks and operators as required*

The total preservation management program, (route and seal, slurry seal / microsurfacing, brushing and ditching) is estimated at $ 486 K per year.

7.0 O. Reg. 588/17 Reporting Requirements

This study meets the reporting requirements under Table 4 of O. Reg. 588/17. For convenience, all items required under Table 4 are presented below, with the exception of mapping.

Table 8 - Road Class Density

Class	Lane-kilometres	Lane-kilometres / Municipal Area[3]	PCI (hard top only)
Arterial	0	0	0
Collector Roads	429	0.44	76.6
Local Roads	536	0.55	71.8
All	965	0.99	75.2

The average PCI for hard top surfaces in the Township is 75.2.

The average surface condition of unpaved roads is 7.6 as per the inventory Manual. This would broadly translate into a road with "good" rating.

Descriptions that illustrate the different levels of road class pavement condition are presented in the tables below:

[3] Municipal area taken as 972.35 km^2 from Statistics Canada. 2017. Hastings Highlands, MU [Census subdivision], Ontario and Ontario [Province] (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017.
https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed June14, 2022).

Table 9 - Qualitative Descriptions of PCI for HCB Roads[4]

PCI Range	Qualitative Description
90 - 100	Pavement is in excellent condition with few cracks. The Ride Condition Rating is excellent with few areas of very slight to slight distortion.
75 - 90	The pavement is in good condition with frequent very slight or slight cracking. The Ride Condition Rating is good with a few slightly rough and uneven sections.
65 - 75	The pavement is in fairly good condition with slight cracking, slight or very slight distortion and a few areas of slight alligatoring. The Ride Condition Rating is fairly good with intermittent rough and uneven sections.
50 - 65	The pavement is in fair condition with intermittent moderate and frequent slight cracking, and with intermittent slight or moderate alligatoring and distortion. The Ride Condition Rating is fair and the surface is slightly rough and uneven.
40 - 50	The pavement is in poor to fair condition with frequent moderate cracking and distortion, and intermittent moderate alligatoring. The Ride Condition Rating is poor to fair and the surface is moderately rough and uneven.
30 - 40	The pavement is in poor to fair condition with frequent moderate alligatoring and extensive moderate cracking and distortion. The Ride Condition Rating is poor to fair and the surface is moderately rough and uneven.
20 - 30	The pavement is in poor condition with moderate alligatoring and extensive severe cracking and distortion. The Ride Condition Rating is poor and the surface is very rough and uneven.
0 - 20	The pavement is in poor to very poor condition with extensive severe cracking, alligatoring and distortion. The Ride Condition Rating is very poor and the surface is very rough and uneven.

[4] Adapted from Table B-1 of the MTO's Manual for Condition Rating of Flexible Pavements, SP-024.

Table 10 - Qualitative Descriptions of PCI for LCB Roads[5]

PCI Range	Qualitative Description
80 - 100	Pavement is in excellent condition with just a few bumps or depressions from slight surface deformation. No surface defects such as streaking, potholes or cracking distresses. The Ride Condition Rating is very good.
60 - 79	Pavement is in good condition with just a few bumps or depressions from slight to moderate surface deformation. Intermittent slight to moderate surface defects and/or cracking distresses. The Ride Condition Rating is good.
40 - 59	Pavement is in fair condition with intermittent to frequent bumps or depressions from slight to moderate surface deformation. Intermittent to frequent moderate surface defects and/or cracking distresses. The Ride Condition Rating is fair.
20 - 39	Pavement is in poor condition with frequent bumps or depressions from moderate surface deformation. Frequent moderate to severe surface defects and/or cracking distresses. Localized slight to moderate alligatoring may be present indicating pavement structural failure. The Ride Condition Rating is poor.
0 - 19	Pavement is in very poor condition with extensive bumps or depressions from moderate to sever surface deformation. Extensive to severe surface defects and/or cracking distresses. Frequent slight to moderate alligatoring may be present, indicating pavement structural failure. The Ride Condition Rating is very poor.

[5] Adapted from Table B-1 of the MTO's Manual for Condition Rating of Surface-Treated Roads, SP-021.

Table 11 - Qualitative Descriptions of Surface Condition for Gravel Roads[6]

Surface Condition	Qualitative Description
10	If the section affords a fully adequate standard of service, with no annoyance or discomfort. Gravel roads rarely score a "10" rating due to their inherent roughness.
7 - 9	If it is possible to maintain the lesser of the Minimum Tolerable Average Operating Speed or the legal Speed Limit with only a noticeable amount of annoyance to the driver due to sway, vibration or steering effort, but with no noticeable feeling of hazard.
4 - 6	If maintaining even the lesser of the Minimum Tolerable Average Speed or the legal Speed Limit results in either a "tug-of-war" with a too-steep crown, or a feeling that the car is taking undue punishment.
1 - 3	If the surface irregularities are so severe that a driver will tend to reduce speed considerably, possibly even steering an irregular course, or if the crown is to steep as to be hazardous in winter.

7.1 Replacement Cost

In conjunction with this Road Needs Study Report, a replacement cost for the road asset was calculated based strictly on roadbed materials, i.e. sub-base, base and surface. Road design standards noted in **Table 6** were used to estimate the existing depth of road bed materials for the purpose of the replacement cost calculation.

The total replacement cost for the Municipality's road infrastructure is approximately $ 673.2 million.

Note, this cost represents the theoretical road bed materials costs only and does not include items such as removal of the existing road bed, installation of signs, pavement markings, lighting, drainage infrastructure, property, etc.

7.2 Asset Age

A single road section typically contains components of multiple ages. The embankment and bottom granulars likely date to the original construction. Base granulars are replaced rarely. Older pavement layers may be overlain by newer ones. For the purpose of this report, a road is considered as new as its oldest layer of hard pavement. Gravel roads are considered to last indefinitely as long as regular refreshment of surface granular occurs (and are thus not 'aged').

Like many Ontario Municipalities, records indicating the age of Hasting Highlands's Road Assets are incomplete.

[6] Adapted from Item 83 from the MTO's Ministry of Transportation's Inventory Manual for Municipal Roads (February 1991).

For this reason, roads with no recorded age are assigned a perceived age based on the PCI. Using an ideal sigmoidal deterioration curve, the age of a surface was estimated based on the formula below:

$$t = \frac{ln\left(\frac{b}{PCI - a} - 1\right) - d}{c}$$

Where a, b, c, and d are constants used to fit the curve to the data,[7] e is Euler's Number, and t represents the perceived age.

Table 12 – Estimated Road Age

Surface Type	Road Age
HCB	7.0
LCB	10.2
All Hard Tops	9.1
Gravel and Earth	-

There are some known problems deriving the age of a road from the PCI. For newer pavements especially, the perceived age is less accurate: LCB generally roads skew older while HCB roads skew younger than the true age.

8.0 Summary

D.M. Wills Associates (Wills) undertook a review of the Municipality of Hastings Highlands's (Municipality) existing road network to assess its physical condition and confirm various road attributes. Data collected as a result of the field review was used to develop a prioritized listing of the road network needs based primarily on condition and traffic volumes.

Wills undertook the field study in the fall of 2021. A visual assessment of each road within the Municipality was undertaken to assess surface and structural distress. A Condition Rating (CR) was calculated based on the identified deficiencies.

An overall road system adequacy has been calculated, consistent with the MTO Inventory Manual for Municipal Road (February 1991), based on a number of road characteristics including:

- Capacity
- Geometrics

[7] Which are taken as 25, 79.56, 0.1645, and -2.8 for HCB Roads, and 15, 89.15, 0.2469, and -3.02 for LCB roads

- Surface Condition
- Shoulder and Road Widths
- Structural Adequacy
- Drainage
- Maintenance Demand

The overall system adequacy for the 2021 Road Needs Assessment is 91%.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on the condition rating and traffic demands on each road. Those roads identified as having a "NOW", 1-5 and 6-10 year need (with the exception of drainage improvements) have been included in the capital improvement plan.

A total length of approximately 160 km of road were identified as having or structural needs in the "NOW," 1 - 5, and 6 - 10 year periods. The estimated cost to improve these roads is approximately $ 24.5 million. An additional length of approximately 63 km of road is identified as having inadequate surface widths only. Generally, provided no operational or safety concerns are identified, roads with surface width deficiencies are typically addressed / considered at the next full reconstruction cycle.

The Municipality's network includes a previously downloaded portion of Highway 62, which consists of 29 km of HCB road. Approximately 6 km have been recently repaved by the township, but a remaining 8 km is in approaching poor condition, with the remainder in fair condition. The section in poor condition accounts for $3.1 million of the $ 24.5 million worth of identified road needs. Although the Hastings Highlands has tackled the worst portion of former Highway 62 since the last road needs study, this road still accounts for a significant share of the capital needs program.

Resurfacing

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $ 3.1 million per year.

Implementation / continuation of a road and roadside preventative maintenance program are strongly recommended. In addition, an annual budget of $ 486 K is recommended for Preservation Management activities such as Slurry Seal / Microsurfacing as well as brushing and ditching the network on a regular basis. Preservation Management activities will help to decrease or slow the typical degradation rates of the roads and to maintain system adequacy. A concerted effort and funding for regular road maintenance can reduce the annual resurfacing / reconstruction requirements by prolonging the useful service life of a road.

The time of inspection plays a significant role in assessing a road's condition. Certain deficiencies, particularly for gravel roads, are only obvious during the "spring break-up" period. By midsummer, any evidence to suggest these deficiencies may have disappeared due to regular grading and grooming activities and general drying of the roadbed. The field work for this study was carried out in in the fall of 2021, by which time

the Municipality had already begun spring grading. Recently graded roads may be rated higher than their actual structural adequacy.

We trust the above and attached information will be of benefit to the Municipality and appreciate the opportunity to assist the Municipality in developing its road improvement plan.

Respectfully submitted,

Eric St. Pierre, P.Eng Transportation Engineer	William Fitzgerald P.Eng. Transportation Engineer

Statement of Limitations

This report has been prepared by D.M. Wills Associates on behalf of the Municipality of Hastings Highlands. The conclusions and recommendations in this report are based on available background documentation and discussions with applicable Municipality staff at the time of preparation.

The report is intended to document the 2021 Roads Needs Study Report findings and assist the Municipality in developing budgetary plans for investment into their road network.

Any use which a third party makes of this report, other than as a Road Needs Study Report is the responsibility of such third parties. D.M. Wills Associates Limited accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or action taken based on using this report for purposes other than as a summary of the 2021 Road Needs Study Report findings.

Appendix

Unit Price Form