Road Needs Study Report - 2017

Township of Cramahe

D.M. Wills Project No.17-4623

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Peterborough

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Prepared for
Township of Cramahe

Executive Summary

The Township of Cramahe (Township) retained the services of D.M. Wills Associates (Wills) to undertake a review of the Township'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 Township's complete road infrastructure system spans a total of 221.3 km primarily within a rural setting, with small areas of urban and semi-urban development. The road network includes surfaces ranging from gravel to hot mix paved (asphalt). The Township has approximately 85.5 km of gravel roads, 112.0 km of surface treated roads (Low class bituminous (LCB)), and 23.8 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) (Inventory Manual) 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 2017 Road Needs Assessment is 81%, considering roads with greater than 50 AADT, per the Inventory Manual methodology.

It should be noted that a significant portion of the roads identified as deficient are such due to inadequate surface widths or surface types; their overall structural adequacy generally being good. These road(s) sections are identified in the document.

The overall system adequacy, excluding roads with inadequate surface widths or surface types, is 95%.

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 calculations as per the inventory manual methodology.

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" or 1-5 year need have been included in the capital improvement plan for reconstruction.

A total length of approximately 31.6 km of roads were identified as having surface type or structural needs in the "NOW," or 1 – 5 year periods. The estimated cost to improve these roads is approximately $ 6.6 M. An additional length of approximately 15.3 km of road is identified as having inadequate surface widths or surface type. Generally, provided no operational or safety concerns are identified, roads with surface width and / or type deficiencies are typically addressed / considered at the next full reconstruction cycle.

Preservation Management

In addition to addressing currently deficient roads (i.e. capital reconstruction), 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 Township'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:

- 23.8 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 1.2 km / year.
- **Annual budget $333,600**: (1.2 km / year x $139,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 112.0 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 16.0 km / year.
- **Annual budget $400,000** (16.0 km / year x $25,000 / km **ST1**).

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:

- 85.5 km of earth / gravel roads.
- 75 mm gravel every 3-5 years.
- Annual gravelling of 28.5 km.
- Granular A ($12,000 / km).
- **Annual budget $399,000** (28.5 km / year x $14,000 **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 $1,132,600 per year.

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, 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 August 2017, by which time the township had already completed spring grading. Recently graded roads may be rated higher than their actual structural adequacy.

Further, it is recommended that regular maintenance in the form of roadside ditch cleanout and clearing be undertaken in order to extend the useful service life of the existing roads.

Road System Inventory

Township of Cramahe Road System in Kilometers (As of August 2017)		
A.	**Surface Type**	**Totals***
	Earth	0
	Gravel (loose Top Gravel)	85
	Surface Treatment (LCB & ICB)	112
	Hot Mix Asphalt (HCB)	24
	Total A	**221 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
	Gravel (loose Top Gravel)	84
	Surface Treatment (LCB & ICB)	98
	Hot Mix Asphalt (HCB)	12
	Total Rural	**194 km**
(ii)	**Semi-Urban**	
	Gravel (loose Top Gravel)	1
	Surface Treatment (LCB)	14
	Hot Mix Asphalt (HCB)	4
	Total Semi-Urban	**19 km**
(iii)	**Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	8
	Total Urban	**8 km**
	Total B	**221 km**
**Estimated to the nearest kilometre.*		

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1.0 Purpose, Background and Study Method

1.1 Purpose

The purpose of the 2017 Road Needs Study Report is to update the current road inventory and road condition assessments within the Township of Cramahe (Township). 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 Township for developing and executing a planned road maintenance and improvement program budget.

The Township 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 Township of Cramahe is located in Northumberland County and is bisected by Highway 401. The Village of Colborne is the Township's largest and main population centre. Outside of Colborne, the Township is largely rural with some scattered semi-urban developments.

In 2011, a Road Needs Study Report was performed to inventory and document the Township's existing road assets. Additionally, in 2013 an Asset Management Plan was produced, which included an updated road asset inventory. This current study (2017) utilizes and builds from the road asset information documented in both the 2011 Road Needs Study, and the 2013 Asset Management Plan.

1.3 Study Objectives

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

- Provide a current inventory and value of the Township'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 Township 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 MTO'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 (assigned based on Ride Condition Rating for this Study)
- 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.

<u>Surface Type</u>

The following parameters were used to assess the adequacy of the road surface type.

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

AADT	Surface Type Recommended
0 – 200	Gravel (G)
201 – 400	Low Class Bituminous (LCB)
> 400	High Class Bituminous (HCB)

Note that these ranges are guidelines and not necessarily meant to be rigidly applied. If a Low Class Bituminous (LCB) road has a higher than recommended AADT (Annual Average Daily Traffic), but is performing at a desirable level, it may not need to be upgraded to High Class Bituminous (HCB). Similarly, if a section of gravel road requires excessive maintenance (for example, on steep grades); LCB may be justified at lower traffic levels. Additionally, urban roads may require consideration for HCB surfaces to support drainage infrastructure i.e. curb & gutter, despite having low AADT.

Roads with traffic volumes (AADT) in excess of the values recommended above for various surface types were noted as critically deficient triggering a "Now" need.

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 Township.

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 Township.

Table 2 summarizes the total road length in kilometres by surface type and road environment as of August, 2017.

The existing road system consists of 221 km of roadway, 85 km of gravel roads, 112 km of surface treated roads (LCB) and 24 km of HCB (asphalt paved) roads; with all calculations being approximate and rounded to the nearest kilometre.

Table 2 - Road System Inventory

Township of Cramahe Road System in Kilometres (As of September 2017)		
A.	**Surface Type**	**Totals***
	Earth	0
	Gravel (loose Top Gravel)	85
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	Total A	**221 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
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	Total B	**221 km**
**Estimated to the nearest kilometre.*		

3.0 Road Needs

The primary purpose of the study is to develop a list of all roads within the Township 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 221 km of roads inventoried, a total of 57 km were found to be critically deficient in one (1) or more areas. Of the 57 km, approximately 14 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 Township's road network, which is based upon the total road kilometres less the identified critically deficient ("NOW" needs) roads, is as follows:

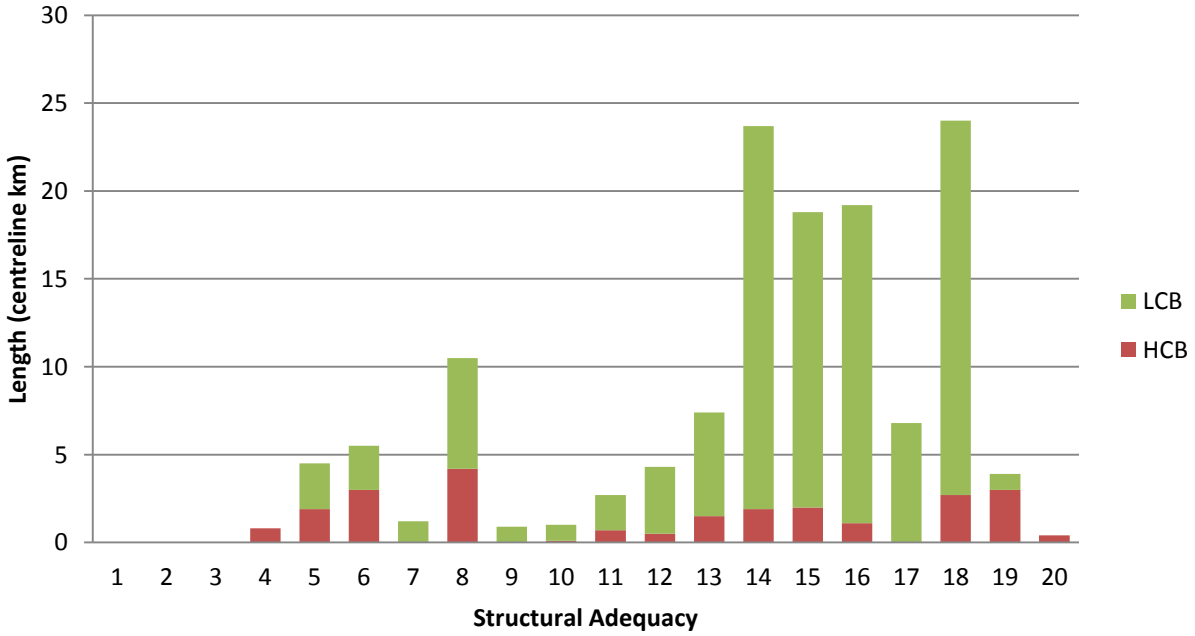
$$\textbf{2017 System Adequacy} = \frac{221 - (57 - 14)}{221} \times 100\% = 81\%$$

The average surface condition rating of all roads is 7.4/10 while the average structural adequacy rating is 14.6/20. This suggests that the typical road has a fair to good riding quality, but just at the point where significant rehabilitation or reconstruction is required.

Looking at the structural adequacy distribution of the township's roads paints a similar picture. A group of roads, over 80%, are in good condition (structural adequacy of 14 and over), and with regular resurfacing and preservative maintenance, should not require reconstruction in the next 10 years. The remaining 20% of the road network, on the other hand, is well distributed over the very poor to fair range (structural adequacy from 4 to 13). Most of these roads will require reconstruction over the next 10 years to fully repair them.

It is therefore recommended that, while the Township endeavors to repair these poor roads as part of its 10-year capital plan, every reasonable effort is made, through preservation management, to prevent the current cohort of good roads from becoming capital needs themselves.

Figure 1- Structural Adequacy Distribution (Hard Top Only)



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 Township 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").

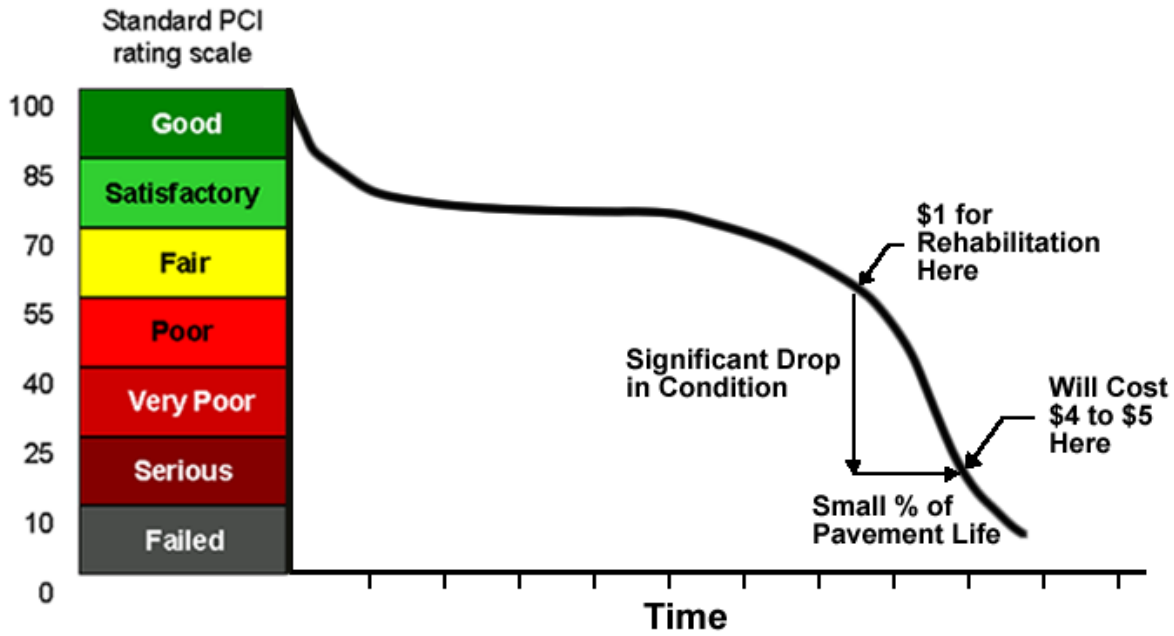
4.0 Roads Best Management Practices

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 1** 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 Township. 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

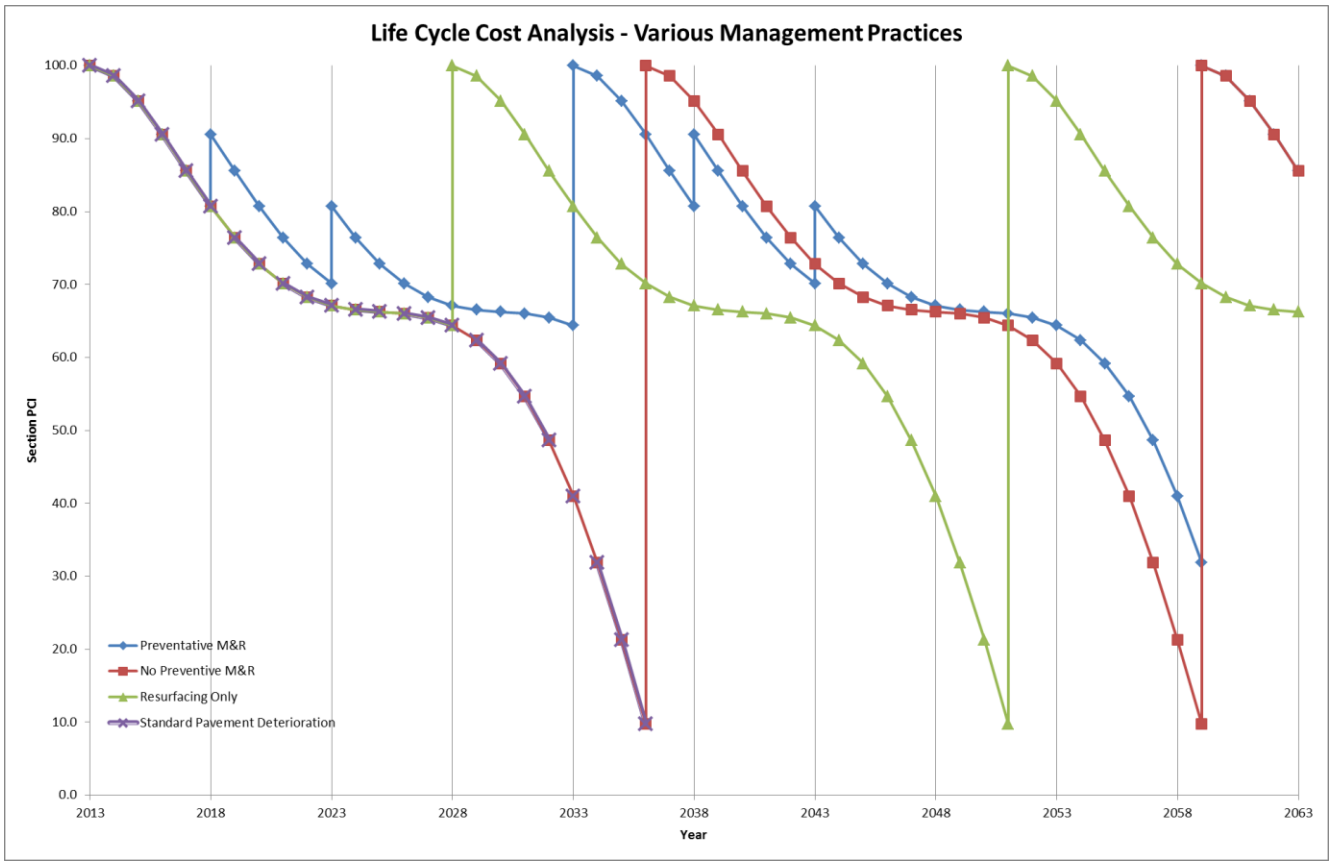
The following life cycle costs analysis compares three (3) different municipalities Municipality 1, Municipality 2 and Municipality 3; each with three (3) distinct approaches to pavement management. For this analysis we will assume each of the three (3) municipalities has 7000 m^2 of pavement, i.e. 1 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



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

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 Township currently maintains approximately 85 km of gravel road. The proposed preservation management approach for this class of road is outlined in the following **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 2-3 times per year for higher volume gravel, or more frequently as necessary; 1-2 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

Surface treated roads have a hard wearing surface that must be preserved in order to be effective. The Township currently maintains 112 km of surface treated roads. Unlike gravel roads, a significant investment has been made in the surface and consequently these roads must be managed properly to obtain the longest possible service life from the surface.

Table 5 - Preservation Management Approach – Surface Treated Roads

Activity	Age (Years)	Ride Condition Rating	Estimated Service Life Extension (Years)
Slurry Seal	3	8	4
Slurry Seal	6	7	3
Double Surface Treatment	10	6	5
Pulverize and DST	14	<4	8

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

1. Surface treatment shall be applied to the entire road platform, from "grass to grass", including any shoulders. This will eliminate grading on surface treated roads, which has a tendency to damage the edge of the surface treatment and cause premature failure of the surface.
2. Suitable new technologies will be utilized where they can be demonstrated to reduce life cycle costs, such as fibre-reinforced surface treatment. This technology can be used to mitigate reflective cracking (if cracks are narrow and inactive) when a single or double surface treatment is applied over an aging surface. It can eliminate the need for pulverizing the underlying surface in certain situations and can reduce overall costs.
3. Assess drainage and culvert needs prior to any significant renewal or rehabilitation strategy and complete any improvements concurrently. This will eliminate the need to cut / excavate a relatively new surface to replace a culvert.
4. Ditching and clearing (brushing) of the right-of-ways (ROW) to improve roadbed drainage and safety.

4.2.3 Asphalt Roads

Asphalt surfaces are the smoothest and most durable hard top surface used by the Township however; they are also the most expensive. The Township currently maintains 24 km of asphalt surface roads. 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 6** below summarizes preservation management activities to be considered for asphalt roads:

Table 6 - Preservation Management Approach – Rural Asphalt Roads

Activity	Age (Years)	Ride Condition Rating	Estimated Service Life Extension (years)
Crack seal	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 above noted preservation approach, 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.), shall be considered as part of the regular Road Needs Study Report every five (5) years. Recommendations on the specific treatments required shall 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.

Upgrade 2U Excavate and Upgrade to Urban Cross-Section 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.

ST2 Double Surface Treatment.

ST2R Double Surface Treatment, with Removal of Existing.

ST2A Double Surface Treatment, over New Granular A.

ST2PA Double Surface Treatment, over Pulverized Existing and New Granular A.

ST2PAW Double Surface Treatment, over Pulverized Existing and New Granular A with 1 m Widening.

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 Township of Cramahe, the following design standards,
Table *7*, 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 7 - 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 8** noting the recommended Capital Construction Plan in terms of priorities throughout the Township. AADT is based on previous counts / estimates provided by the Township. All costs are based on 2017 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 8 - Township of Cramahe Road Needs - Capital Reconstruction

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
130	Durham St.	Victoria Beach Rd.	HWY 2	2.10	399	*ST2A - Double Surface Treatment with Granular A*	*$199*	NOW	ADEQ	ADEQ
143	Alfred St.	Elgin St.	Kensington St.	0.20	199	*Recon 2U - Full Reconstruction + 2 Lifts*	*$162*	NOW	ADEQ	ADEQ
50	Old Percy Rd.	Gould Rd.	Dead End	0.80	199	*Recon 1R - Full Reconstruction + 1 Lift*	*$288*	NOW	ADEQ	ADEQ
47	Pine St.	County Rd. 22	Dead End	0.50	199	*Recon 2U - Full Reconstruction + 2 Lifts*	*$405*	NOW	ADEQ	NOW
85	Colton Dr.	HWY 2	Victoria Beach Rd.	1.90	199	*ST2A - Double Surface Treatment with Granular A*	*$180*	NOW	ADEQ	ADEQ
182	Purdy Rd.	Little Lake Rd.	Herley Rd.	3.60	1691	*Recon 1R - Full Reconstruction + 1 Lift*	*$1,296*	1-5	ADEQ	ADEQ
184	Orchard Rd.	County Rd. 25	Cramahe Township Boundary	1.20	399	*ST2A - Double Surface Treatment with Granular A*	*$114*	NOW	ADEQ	ADEQ
124	Simpson Rd.	Blythe Park Rd.	Colton St.	1.70	199	*ST2A - Double Surface Treatment with Granular A*	*$161*	1-5	ADEQ	ADEQ
172	Ontario St.	Robertson St.	Toronto St.	0.40	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$144*	NOW	ADEQ	ADEQ
153	Arena Rd. (Rotary Centennial Park Dr.)	Division St.	Parking Lot	0.10	199	*Recon 2U - Full Reconstruction + 2 Lifts*	*$81*	1-5	ADEQ	ADEQ
167	Burnham St.	Church St.	Park St.	0.40	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$144*	NOW	ADEQ	ADEQ
48	Gould Rd.	County Rd. 22	County Rd. 22	0.50	199	*Recon 2U - Full Reconstruction + 2 Lifts*	*$405*	6 - 10	ADEQ	ADEQ
41	Haynes Rd	County Rd. 25	End of LCB	0.90	199	*ST2A - Double Surface Treatment with Granular A*	*$85*	1-5	ADEQ	ADEQ
46	Oak St.	Pine St.	Dead End	0.30	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$108*	NOW	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
102	Little Lake Rd.	Purdy Rd.	HWY 2	2.20	399	*Recon 1R - Full Reconstruction + 1 Lift*	*$792*	NOW	ADEQ	ADEQ
164	Cedar St.	Percy St.	Burnham St.	0.20	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$72*	NOW	ADEQ	ADEQ
173	Ontario St.	Robertson St.	House # 1108 (end of HCB)	0.60	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$216*	NOW	ADEQ	ADEQ
147	Victoria St.	Earl St.	William St.	0.20	199	*ST2A - Double Surface Treatment with Granular A*	*$19*	NOW	ADEQ	ADEQ
136	Spencer St.	House #17 (start of LCB)	HWY 2	0.30	199	*ST2A - Double Surface Treatment with Granular A*	*$28*	NOW	ADEQ	ADEQ
126	Victoria Beach Rd.	Colton Dr.	Durham St.	0.90	199	*ST2A - Double Surface Treatment with Granular A*	*$85*	1-5	ADEQ	ADEQ
80	Trottman Rd.	County Rd. 21	Telephone Rd.	2.00	199	*ST2A - Double Surface Treatment with Granular A*	*$190*	1-5	ADEQ	ADEQ
96	Fiddick Rd.	Little Lake Rd.	HWY 2	3.00	199	*ST2A - Double Surface Treatment with Granular A*	*$285*	6 - 10	ADEQ	ADEQ
131	Streamside Dr.	Durham St.	Dead End	0.40	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$144*	1-5	ADEQ	ADEQ
81	Herley Rd.	Telephone Rd.	Purdy Rd.	1.90	199	*ST2A - Double Surface Treatment with Granular A*	*$180*	1-5	ADEQ	ADEQ
138	Parliament St.	Scott St.	House # 93 (end of HCB, Start of LCB)	0.50	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$180*	1-5	ADEQ	ADEQ
151	Arthur St.	Victoria St.	Division St.	0.20	199	*Recon 1S - Full Reconstruction + 1 Lift*	*$72*	1-5	ADEQ	ADEQ
125	Colton Dr.	Victoria Beach Rd.	Dead End	0.10	49	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$13*	1-5	ADEQ	NOW

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
2	Darling Rd.	Pine Grove Rd.	Cramahe Township Boundary	0.80	49	*ST2A - Double Surface Treatment with Granular A*	*$76*	6 - 10	ADEQ	ADEQ
127	Durham St.	Victoria Beach Rd.	Dead End	0.20	49	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$26*	NOW	ADEQ	NOW
109	Keeler Rd.	County Rd.25	County Rd. 25	0.20	49	*ST2A - Double Surface Treatment with Granular A*	*$19*	1-5	ADEQ	ADEQ
165	Maybee Lane	HWY 2	Church St.	0.10	49	*Recon 2U - Full Reconstruction + 2 Lifts*	*$81*	NOW	ADEQ	ADEQ
13	Mitchell Rd.	Campbell Rd.	Stonehaven Rd.	0.80	49	*ST2A - Double Surface Treatment with Granular A*	*$76*	1-5	ADEQ	ADEQ
161	Old Percy Rd.	Toronto Rd.	Dead End	0.20	49	*Recon G - Full Reconstruction 6m Gravel Road*	*$16*	NOW	ADEQ	NOW
152	Thornlea St.	Arthur St.	Dead End	0.20	49	*Recon 1S - Full Reconstruction + 1 Lift*	*$72*	1-5	ADEQ	ADEQ
114	Union Rd.	HWY 2	Dead End	1.60	49	*ST2A - Double Surface Treatment with Granular A*	*$152*	1-5	ADEQ	ADEQ
129	Victoria Beach Rd.	Quarry Entrance	Dead End	0.40	49	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$53*	NOW	ADEQ	NOW

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:

- 23.8 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 1.2 km / year.
- **Annual budget $333,600**: (1.2 km / year x $139,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 112.0 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 16.0 km / year.
- **Annual budget $400,000** (16.0 km / year x $25,000 / km **ST1**).

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:

- 85.5 km of earth / gravel roads.
- 75 mm gravel every 3-5 years.
- Annual gravelling of 28.5 km.
- Granular A ($12,000 / km).
- **Annual budget $399,000** (28.5 km / year x $14,000 **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 $1,132,600 per year.

Relative road preservation / resurfacing priorities for all roads not included in the previous Capital Reconstruction priorities table are listed below in **Table 9,** Township of Cramahe's Resurfacing Priorities. Roads are listed in order of descending preservation priorities.

Table 9 - Township of Cramahe - Resurfacing Priorities

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
159	Church St.	Ontario St.	Elgin St.	0.80	399	*RMP1 - Mill & Pave, 1 Lift*	*$222*	6 - 10	ADEQ	ADEQ
133	Durham St.	Scott St.	Purdy Rd.	1.40	564	*ST2 - Double Surface Treatment*	*$55*	ADEQ	NOW	ADEQ
44	Mill St.	County Rd. 25	Dead End	0.20	199	*RMP1 - Mill & Pave, 1 Lift*	*$55*	6 - 10	ADEQ	ADEQ
174	Lake Rd.	Telephone Rd.	Little Lake Rd.	2.00	399	*ST2 - Double Surface Treatment*	*$79*	6 - 10	ADEQ	ADEQ
166	Victory Lane	HWY 2	Church St.	0.10	399	*RMP1 - Mill & Pave, 1 Lift*	*$28*	6 - 10	ADEQ	ADEQ
91	McDonald Rd.	Lake Rd.	Dead End	0.10	249	*G - Gravel (75mm)*	*$1*	ADEQ	NOW	ADEQ
63	Dingman Rd.	Cowie Rd.	150 m South of Bridge	4.00	199	*ST2 - Double Surface Treatment*	*$158*	ADEQ	ADEQ	ADEQ
105	Bailey Rd.	Little Lake Rd.	Little Lake Rd.	0.60	199	*GW - Gravel Road Widening*	*$14*	ADEQ	ADEQ	NOW
100	Ventress Rd.	Little Lake Rd.	150 m North of Trent Valley Rd.	1.10	199	*G - Gravel (75mm)*	*$15*	ADEQ	ADEQ	ADEQ
87	Walker Rd.	Telephone Rd.	County Rd. 21	2.00	199	*G - Gravel (75mm)*	*$28*	ADEQ	ADEQ	ADEQ
86	Chapman Rd.	Trottman Rd.	Telephone Rd.	2.30	99	*GW - Gravel Road Widening*	*$55*	ADEQ	ADEQ	NOW
179	Brighton-Cramahe Boundary Rd.	Little Lake Rd.	HWY 2	2.50	199	*ST2 - Double Surface Treatment*	*$99*	6 - 10	ADEQ	ADEQ
79	Broomfield Rd.	Trottman Rd.	County Rd. 21	0.20	199	*ST2 - Double Surface Treatment*	*$8*	6 - 10	ADEQ	NOW
56	Old Shelter Valley Rd.	County Rd. 25	Pipeline Rd.	1.70	199	*ST2 - Double Surface Treatment*	*$67*	6 - 10	ADEQ	ADEQ
139	Parliament St.	House # 93 (end of HCB, Start of LCB)	Purdy Rd.	1.00	199	*ST2 - Double Surface Treatment*	*$40*	6 - 10	ADEQ	ADEQ
160	Robertson St.	Toronto Rd.	Ontario St.	0.30	399	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
128	Victoria Beach Rd.	Durham St.	Quarry Entrance	0.60	399	*ST2 - Double Surface Treatment*	*$24*	ADEQ	ADEQ	ADEQ
93	Reddick Rd.	Little Lake Rd.	Dead End	0.90	199	*GW - Gravel Road Widening*	*$21*	ADEQ	ADEQ	NOW
9	Clarke Rd.	County Rd. 25	Campbell Rd.	1.00	199	*G - Gravel (75mm)*	*$14*	ADEQ	ADEQ	ADEQ
168	Elgin St.	HWY 2	Church St.	0.10	199	*RMP1 - Mill & Pave, 1 Lift*	*$28*	6 - 10	ADEQ	ADEQ
107	Jackson Dr.	Purdy Rd.	HWY 2	2.00	199	*ST2 - Double Surface Treatment*	*$79*	6 - 10	ADEQ	ADEQ
162	Park St.	Toronto Rd.	Percy St.	0.20	199	*RMP1 - Mill & Pave, 1 Lift*	*$55*	6 - 10	ADEQ	ADEQ
1	Pine Grove Rd.	County Rd. 25	Darling Rd.	2.40	199	*ST2 - Double Surface Treatment*	*$95*	6 - 10	ADEQ	ADEQ
40	Valley Rd.	Dingman Rd.	Dead End	0.70	199	*GW - Gravel Road Widening*	*$17*	ADEQ	ADEQ	NOW
155	William St.	Victoria St.	Ontario St.	0.60	199	*ST2 - Double Surface Treatment*	*$24*	ADEQ	ADEQ	ADEQ
90	Samis Rd.	Telephone Rd.	Honey Rd.	1.20	99	*GW - Gravel Road Widening*	*$28*	ADEQ	ADEQ	NOW
16	1st Concession Rd.	Mitchell Rd.	Stonehaven Rd.	1.70	199	*GW - Gravel Road Widening*	*$40*	ADEQ	ADEQ	NOW
122	Blythe Park Rd.	C.N. Crossing Rd.	Simpson Rd.	0.90	199	*ST2 - Double Surface Treatment*	*$36*	ADEQ	ADEQ	ADEQ
121	Blythe Park Rd.	HWY 2	C.N. Crossing Rd.	1.00	199	*ST2 - Double Surface Treatment*	*$40*	ADEQ	ADEQ	ADEQ
10	Campbell Rd.	Mitchell Rd.	Cramahe Township Boundary	1.20	199	*G - Gravel (75mm)*	*$17*	ADEQ	ADEQ	ADEQ
68	Maple Grove Rd.	County Rd. 21	Dead End	1.30	199	*G - Gravel (75mm)*	*$18*	ADEQ	ADEQ	ADEQ
45	Norway St.	Pine St.	Dead End	0.30	199	*RO1 - Hot Mix Overlay, 1 Lift*	*$47*	ADEQ	ADEQ	ADEQ
72	Penryn Rd.	150 m South of Bridge	Dead End	3.80	199	*G - Gravel (75mm)*	*$53*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
30	Stoney Lonesome Rd.	County Rd. 25	Campbell Rd.	1.90	199	*G - Gravel (75mm)*	*$26*	ADEQ	ADEQ	ADEQ
19	Red Cloud School Rd.	Mitchell Rd.	Dawson Rd.	3.60	99	*G - Gravel (75mm)*	*$50*	ADEQ	ADEQ	ADEQ
74	Dale Rd.	Penryn Rd.	County Rd. 21	2.20	199	*G - Gravel (75mm)*	*$30*	ADEQ	ADEQ	ADEQ
52	Dunbar Rd.	Jakobi Rd.	Clarkson Rd.	0.20	199	*ST2 - Double Surface Treatment*	*$8*	ADEQ	ADEQ	ADEQ
51	Dunbar Rd.	Clarkson Rd.	Cramahe Township Boundary	0.20	199	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ
169	Elgin St.	Park St.	Purdy Rd.	1.40	199	*ST2 - Double Surface Treatment*	*$55*	ADEQ	ADEQ	ADEQ
142	Elgin St.	HWY 2	Alfred St.	0.30	199	*RO1 - Hot Mix Overlay, 1 Lift*	*$47*	ADEQ	ADEQ	ADEQ
141	Kensington St.	HWY 2	Alfred St.	0.30	199	*RO1 - Hot Mix Overlay, 1 Lift*	*$47*	ADEQ	ADEQ	ADEQ
55	Moore's Rd.	Jakobi Rd.	Cramahe Township Boundary	0.40	199	*G - Gravel (75mm)*	*$6*	ADEQ	ADEQ	ADEQ
39	Phasey Lane	County Rd. 25	Dead End	0.30	199	*GW - Gravel Road Widening*	*$7*	ADEQ	ADEQ	NOW
70	Shiloh Rd.	County Rd. 21	Penryn Rd.	1.90	199	*ST2 - Double Surface Treatment*	*$75*	ADEQ	ADEQ	ADEQ
145	Simmons St.	Elgin St.	Victoria St.	0.20	199	*RO1 - Hot Mix Overlay, 1 Lift*	*$31*	ADEQ	ADEQ	ADEQ
146	Victoria St.	HWY 2	Earl St.	0.90	199	*RO1 - Hot Mix Overlay, 1 Lift*	*$141*	ADEQ	ADEQ	ADEQ
89	Crandall Rd.	Lake Rd.	Honey Rd.	3.20	199	*ST2 - Double Surface Treatment*	*$127*	ADEQ	ADEQ	ADEQ
3	Darling Rd.	Pine Grove Rd.	County Rd. 27	2.60	199	*G - Gravel (75mm)*	*$36*	ADEQ	ADEQ	ADEQ
110	Kelwood Lane	County Rd. 25	House # 105 (start of new HCB)	0.20	199	*ST2 - Double Surface Treatment*	*$8*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
24	Morganston Rd.	Jakobi Rd	Tait Rd.	1.70	199	*ST2 - Double Surface Treatment*	*$67*	ADEQ	ADEQ	ADEQ
58	Old Percy Rd.	Old Shelter Valley Rd.	Dead End	0.60	199	*ST2 - Double Surface Treatment*	*$24*	ADEQ	ADEQ	ADEQ
83	Peters Rd.	HWY 2	C.N. Crossing Rd.	1.00	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
113	Town Line Rd.	County Rd. 31	HWY 2	2.40	199	*ST2 - Double Surface Treatment*	*$95*	ADEQ	ADEQ	ADEQ
132	Durham St.	HWY 2	Scott St.	0.60	564	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
34	Huycke Rd.	County Rd. 25	Pinewood School Rd.	2.90	99	*GW - Gravel Road Widening*	*$69*	ADEQ	ADEQ	NOW
35	Pinewood School Rd.	Parsons Rd.	Cramahe Township Boundary	4.90	99	*GW - Gravel Road Widening*	*$116*	ADEQ	ADEQ	NOW
23	Tait Rd.	Morganston Dr.	Mount Pleasant Rd.	1.50	99	*G - Gravel (75mm)*	*$21*	ADEQ	ADEQ	ADEQ
163	Park St.	Percy St.	Elgin St.	0.40	399	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
181	Little Lake Rd.	Trenear Rd.	Lake Rd.	1.30	999	*RMP1 - Mill & Pave, 1 Lift*	*$360*	6 - 10	ADEQ	ADEQ
117	Barnes Rd.	Beach Rd.	HWY 2	1.70	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
115	Beach Dr.	Union Rd.	Barnes Rd.	2.20	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
64	Dingman Rd.	Cowie Rd.	County Rd. 25	2.60	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
116	Hunt Rd.	Beach Rd.	HWY 2	1.70	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
59	Inglis Rd.	Old Shelter Valley Rd.	Cramahe Township Boundary	0.60	199	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
77	Mutton Rd.	Telephone Rd.	County Rd.21	2.00	99	*G - Gravel (75mm)*	*$28*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
148	Victoria St.	William St.	Soccer Fields	0.30	99	*GW - Gravel Road Widening*	*$7*	ADEQ	ADEQ	NOW
176	Lakeshore Rd.	Union Rd.	Cramahe Township Boundary	0.40	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
21	Dawson Rd.	Morganston Dr.	Cramahe Township Boundary	3.30	99	*G - Gravel (75mm)*	*$46*	ADEQ	ADEQ	ADEQ
4	O'Grady Rd.	Darling Rd	County Rd. 27	0.90	99	*G - Gravel (75mm)*	*$12*	ADEQ	ADEQ	ADEQ
42	Haynes Rd	End of LCB	Cowie Rd.	1.90	199	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
75	Waites Rd.	County Rd. 21	Telephone Rd.	2.00	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
12	Campbell Rd.	Morganston Rd.	Clarke Rd.	2.30	199	*G - Gravel (75mm)*	*$32*	ADEQ	ADEQ	ADEQ
180	Little Lake Rd.	Brighton-Cramahe Boundary Rd	Trenear Rd.	1.80	399	*ST2 - Double Surface Treatment*	*$71*	6 - 10	ADEQ	ADEQ
177	Ontario St.	House # 1108 (end of HCB)	County Rd. 31	0.50	399	*G - Gravel (75mm)*	*$7*	ADEQ	NOW	ADEQ
53	Clarkson Rd.	Dunbar Rd.	Cramahe Township Boundary	1.10	99	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
38	Jones Rd.	County Rd. 25	Cowie Rd.	1.20	99	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
150	Creek St.	Division St.	Victoria St.	0.20	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
144	Elgin St.	Alfred St.	Dead End	0.40	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
194	Ventress Rd.	150m North of Trent Valley Rd.	HWY 2	1.50	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
36	Parsons Rd.	County Rd. 25	Pinewood School Rd.	1.00	99	*G - Gravel (75mm)*	*$14*	ADEQ	ADEQ	ADEQ
33	Bonnett Rd.	Tobacco Rd.	County Rd. 25	1.00	99	*G - Gravel (75mm)*	*$14*	ADEQ	ADEQ	ADEQ
156	Arthur St.	Division St.	Dead End	0.30	199	*Preventative*	-	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
						Maintenance				
43	Cedar St.	Mill St.	County Rd. 25	0.20	199	*RMP1 - Mill & Pave, 1 Lift*	*$55*	6 - 10	ADEQ	ADEQ
135	Spencer St.	Parliament St.	House #17 (start of LCB)	0.30	199	*G - Gravel (75mm)*	*$4*	ADEQ	ADEQ	ADEQ
49	Spring St	Old Percy Rd.	County Rd. 25	0.10	199	*RMP1 - Mill & Pave, 1 Lift*	*$28*	6 - 10	ADEQ	ADEQ
61	Pipeline Rd.	County Rd.25	Old Shelter Valley Rd.	0.90	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
158	King St. W	Toronto Rd.	Ontario St.	0.40	399	*RMP1 - Mill & Pave, 1 Lift*	*$111*	6 - 10	ADEQ	ADEQ
66	Cowie Rd.	Dingman Rd.	County Rd. 21	2.90	199	*G - Gravel (75mm)*	*$40*	ADEQ	ADEQ	ADEQ
154	Earl St.	Division St.	Victoria St.	0.20	199	*ST2 - Double Surface Treatment*	*$8*	6 - 10	ADEQ	ADEQ
149	North St.	Victoria St.	Division St.	0.20	99	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
178	Telephone Rd.	Haldimand/Cramahe Boundary	Brighton/Cramahe Boundary	10.50	429	*ST2 - Double Surface Treatment*	*$415*	6 - 10	NOW	ADEQ
140	Jane's Ct.	HWY 2	Dead End	0.20	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
134	Scott St.	Durham St.	Parliament St.	0.30	199	*ST2 - Double Surface Treatment*	*$12*	6 - 10	ADEQ	ADEQ
157	Cortland Crescent	Arthur St.	Arthur St.	0.30	99	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
25	Morganston Rd.	Mount Pleasant Rd.	Tait Rd.	2.80	123	*ST2 - Double Surface Treatment*	*$111*	ADEQ	ADEQ	ADEQ
137	Parliament St.	HWY 2	Scott St.	0.50	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
26	Morganston Rd.	Mount Pleasant Rd.	County Rd. 25	3.10	199	*ST2 - Double Surface Treatment*	*$123*	6 - 10	ADEQ	ADEQ
84	Jakobi Rd.	County Rd. 22	Dunbar Rd.	3.60	399	*ST2 - Double Surface Treatment*	*$142*	ADEQ	ADEQ	ADEQ
11	Campbell Rd.	Mitchell Rd.	Clarke Rd.	0.30	99	*ST2 - Double Surface Treatment*	*$12*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
170	Industrial Park Rd.	Purdy Rd.	Elgin St.	0.80	399	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
67	Cowie Rd.	Dingman Rd.	Barlow Rd.	1.30	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
82	Honey Rd.	Telephone Rd.	Herley Rd.	2.60	199	*ST2 - Double Surface Treatment*	*$103*	ADEQ	ADEQ	ADEQ
27	Mount Pleasant Rd.	County Rd. 22	County Rd. 25	5.50	199	*ST2 - Double Surface Treatment*	*$218*	ADEQ	ADEQ	ADEQ
175	Little Lake Rd.	Lake Rd.	Purdy Rd.	1.00	999	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
60	Shelter Valley Rd.	Old Shelter Valley Rd.	Neil McGregor Rd.	0.50	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
32	Tobacco Rd.	County Rd. 25	Dingman Rd.	3.90	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
99	Trenear Rd.	Little Lake Rd.	HWY 2	2.70	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
171	Industrial Park Rd.	Purdy Rd.	Dead End	0.10	199	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
183	Purdy Rd.	Herley Rd.	County Rd. 25	1.70	1799	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
108	Arthur's Lane	Purdy Rd.	Dead End	0.70	49	*G - Gravel (75mm)*	*$10*	ADEQ	ADEQ	ADEQ
189	Barlow Rd.	Jones Rd.	Dead End West of Cowie Rd.	0.60	49	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
18	Begg Rd.	County Rd. 27	Unmaintained	1.10	49	*GW - Gravel Road Widening*	*$26*	ADEQ	ADEQ	NOW
118	Bellamy Rd.	HWY 2	Dead End	1.30	49	*GW - Gravel Road Widening*	*$31*	ADEQ	ADEQ	NOW
123	Blythe Park Rd.	Simpson Rd.	Dead End	1.00	49	*G - Gravel (75mm)*	*$14*	ADEQ	ADEQ	ADEQ
98	Branscombe Rd.	HWY 2	Dead End	0.90	49	*G - Gravel (75mm)*	*$12*	ADEQ	ADEQ	ADEQ
88	Burbridge Rd.	Telephone Rd.	Dead End	1.30	49	*G - Gravel (75mm)*	*$18*	ADEQ	ADEQ	ADEQ
120	C.N. Crossing Rd.	Peters Rd.	Blythe Park Rd.	0.40	49	*G - Gravel (75mm)*	*$6*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
7	Carr Rd.	County Rd. 27	Dead End	1.60	49	*G - Gravel (75mm)*	*$22*	ADEQ	ADEQ	ADEQ
103	Cedar Lane	Little Lake Rd.	Dead End	0.20	49	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ
95	Cochrane Rd.	Little Lake Rd.	Dead End	1.50	49	*G - Gravel (75mm)*	*$21*	ADEQ	ADEQ	ADEQ
31	Comb View Rd.	Stoney Lonesome Rd.	Dead End	0.60	49	*G - Gravel (75mm)*	*$8*	ADEQ	ADEQ	ADEQ
191	Dean Rd.	Crandall Rd.	Dead End	0.20	49	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ
76	Deele Rd.	Telephone Rd.	Dead End	0.80	49	*G - Gravel (75mm)*	*$11*	ADEQ	ADEQ	ADEQ
187	DePaepe Rd.	Gould Rd.	Dead End	0.20	49	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
29	Dingwall Rd.	Mount Pleasant Rd.	Dead End	0.80	49	*GW - Gravel Road Widening*	*$19*	ADEQ	ADEQ	NOW
192	Dunk Rd.	Crandall Rd.	Dead End	0.20	49	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ
73	Feeney Rd.	Dingman Rd.	Dead End	0.10	49	*GW - Gravel Road Widening*	*$2*	ADEQ	ADEQ	NOW
71	Gillespie Rd.	Penryn Rd.	Dead End	1.00	49	*G - Gravel (75mm)*	*$14*	ADEQ	ADEQ	ADEQ
54	Hagarty Rd.	Clarkson Rd.	Dead End	0.20	49	*GW - Gravel Road Widening*	*$5*	ADEQ	ADEQ	NOW
6	Hardy Lane	Phillips Rd	Dead End	0.10	49	*GW - Gravel Road Widening*	*$2*	ADEQ	ADEQ	NOW
78	Ibbotson Rd.	Telephone Rd.	Dead End	0.30	49	*GW - Gravel Road Widening*	*$7*	ADEQ	ADEQ	NOW
185	Kelly Dr.	Morganston Dr.	Dead End	0.60	49	*GW - Gravel Road Widening*	*$14*	ADEQ	ADEQ	NOW
111	Kelwood Lane	House # 105 (start of new HCB)	Dead End	0.40	49	*G - Gravel (75mm)*	*$6*	ADEQ	ADEQ	ADEQ
190	Lee Lane	Telephone Rd.	Dead End	0.30	49	*GW - Gravel Road Widening*	*$7*	ADEQ	ADEQ	NOW
8	Massey Lane	County Rd. 27	Dead End	0.50	49	*GW - Gravel Road Widening*	*$12*	ADEQ	ADEQ	NOW

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
14	Mitchell Rd.	Stonehaven Rd.	Dead End	0.80	49	*GW - Gravel Road Widening*	*$19*	ADEQ	ADEQ	NOW
17	Mitchell Rd.	1st Concession Rd.	Unmaintained	1.50	49	*GW - Gravel Road Widening*	*$36*	ADEQ	ADEQ	NOW
62	Neil McGregor Rd.	Shelter Valley Rd.	Dead End	0.90	49	*G - Gravel (75mm)*	*$12*	ADEQ	ADEQ	ADEQ
97	Old Rail Rd.	Fiddick Rd.	Dead End	0.40	49	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
57	Old Shelter Valley Rd.	Pipeline Rd.	Dead End	0.30	49	*GW - Gravel Road Widening*	*$7*	ADEQ	ADEQ	NOW
112	Old Wharf Rd.	County Rd. 30	Dead End	0.50	49	*G - Gravel (75mm)*	*$7*	ADEQ	ADEQ	ADEQ
186	Park Rd.	County Rd. 22	Dead End	0.50	49	*G - Gravel (75mm)*	*$7*	ADEQ	ADEQ	ADEQ
37	Parsons Rd.	Pinewood School Rd.	Dead End	0.70	49	*GW - Gravel Road Widening*	*$17*	ADEQ	ADEQ	NOW
106	Peacock Lane	HWY 2	HWY 2	0.40	49	*G - Gravel (75mm)*	*$6*	ADEQ	ADEQ	ADEQ
193	Penny Lane	Honey Rd.	Dead End	0.20	49	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ
119	Peters Rd.	C.N. Crossing Rd.	Dead End	0.80	49	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
5	Phillips Rd.	County Rd. 27	Dead End	0.50	49	*GW - Gravel Road Widening*	*$12*	ADEQ	ADEQ	NOW
92	Pine Tree Lane	Lake Rd.	Dead End	0.40	49	*G - Gravel (75mm)*	*$6*	ADEQ	ADEQ	ADEQ
69	Pogue Rd.	County Rd. 21	Dead End	1.70	49	*G - Gravel (75mm)*	*$24*	ADEQ	ADEQ	ADEQ
188	Shepherd Lane	Haynes Rd.	Dead End	0.20	49	*ST2 - Double Surface Treatment*	*$8*	ADEQ	ADEQ	NOW
20	Smith Rd.	Red Cloud School Rd.	Cramahe Township Boundary	0.70	49	*G - Gravel (75mm)*	*$10*	ADEQ	ADEQ	ADEQ
15	Stonehaven Rd.	1st Concession Rd.	Mitchell Rd.	1.20	49	*GW - Gravel Road Widening*	*$28*	ADEQ	ADEQ	NOW
28	Sunnyhill Rd.	Mount Pleasant Rd.	Dead End	0.40	49	*GW - Gravel Road Widening*	*$9*	ADEQ	ADEQ	NOW

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
22	Tait Rd.	Morganston Rd.	Dead End	0.20	49	*GW - Gravel Road Widening*	*$5*	ADEQ	ADEQ	NOW
94	Trenear Rd.	Little Lake Rd.	Dead End	0.80	49	*G - Gravel (75mm)*	*$11*	ADEQ	ADEQ	ADEQ
101	Trent Valley Rd.	Little Lake Rd.	Dead End	2.90	49	*G - Gravel (75mm)*	*$40*	ADEQ	ADEQ	ADEQ
104	Van Wicklin Lane	Little Lake Rd.	Little Lake Rd.	0.20	49	*GW - Gravel Road Widening*	*$5*	ADEQ	ADEQ	NOW
195	Water Tower Access Rd.	Herley Rd.	Dead End	1.00	49	*GW - Gravel Road Widening*	*$24*	ADEQ	ADEQ	NOW
65	Wilce Rd.	Dingman Rd.	Dead End	0.50	49	*GW - Gravel Road Widening*	*$12*	ADEQ	ADEQ	NOW

Notes:

1. *Priorities in descending order. The higher the priority rating the greater the need.*
2. *Rehabilitation strategy to be confirmed by geotechnical investigations at detail design.*
3. *Costing is zero for roads within the network but maintained by others (i.e. boundary roads).*

6.3 Preservation Management

Preservation techniques seal the surface as to prevent water infiltration into the granular base. Route and Seal is used on HCB pavements to seal individual cracks. Slurry Seal / Microsurfacing is used on LCB and HCB pavements to seal large areas, although wide / active cracks will reflect through the treatment. An annual preservation management budget has been estimated as follows:

Route and Seal

- 23.8 km of paved roads (HCB).
- Assume that route and seal will be applied, on average, once per resurfacing cycle.
- 1.2 km of road to route and seal each year
- **Annual budget $9,600** (1.2 km x $4,000 / km In **Route and Seal** x 2 lanes).

Given the Township's short total length of HCB roads, it may not be practical to fund a Route and Seal program.

Slurry Seal / Microsurfacing

- 23.8 km of paved roads (HCB).
- 111.8 km of surface treated roads (LCB).
- Assume that slurry seal / microsurfacing will be applied, on average, once per resurfacing cycle.
- 17.2 km of road to preserve per year (1.2 km HCB and 26.1 km of LCB).
- **Annual budget $344,000** (17.2 km x $20,000 / km **Slurry Sealing / Microsurfacing**).

6.4 Road Maintenance

Preventative road and roadside maintenance is critical to prolonging the useful service life of a road and maximizing the capital investment. A continuous road and roadside maintenance program is recommended to reduce the road degradation rates. Ditch cleanout and clearing of vegetation from the right-of-way should be carried out on a regular basis. This can either be accomplished through dedicated internal Township forces or sub-contracting to private contractors. Consideration may be given to a dedicated capital program of ditch cleanout and clearing, to ensure resources are dedicated to these important activities.

7.0 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 7 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 Township's road infrastructure is approximately $ 28.1 M.

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.

8.0 Summary

D.M. Wills Associates (Wills) undertook a review of the Township of Cramahe's (Township) 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 August of 2017. A visual assessment of each road within the Township 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 Roads (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 2017 Road Needs Assessment is 81%, considering roads with greater than 50 AADT, per the Inventory Manual methodology.

It should be noted that a significant portion of the roads identified as deficient are such due to inadequate surface widths or surface types; their overall structural adequacy generally being good. These road(s) sections are identified in the document.

The overall system adequacy, excluding roads with inadequate surface widths or surface types, is 95%.

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 calculations as per the inventory manual methodology.

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" or 1-5 year need have been included in the capital improvement plan for reconstruction.

A total length of approximately 31.6 km of roads were identified as having surface type or structural needs in the "NOW," or 1 – 5 year periods. The estimated cost to improve these roads is approximately $ 6.6 M. An additional length of approximately 15.3 km of road is identified as having inadequate surface widths or surface type. Generally, provided no operational or safety concerns are identified, roads with surface width and/or type deficiencies are typically addressed / considered at the next full reconstruction cycle.

Resurfacing

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $1,132,600 per year.

Implementation / continuation of a road and roadside preventative maintenance program are strongly recommended. In addition, an annual budget of $344,000 is recommended for Preservation Management activities such as Slurry Seal / Microsurfacing. Due to the short length of the HCB network, a Route and Sealing program may be infeasible. 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 August 2017, by which time the township 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 Township and appreciate the opportunity to assist the Township in developing its road improvement plan.

Respectfully submitted,

Michael Lang, P. Eng.
Manager, Transportation Engineering

ML/TK/ms

Statement of Limitations

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

The report is intended to document the 2017 Roads Needs Study Report findings and assist the Township 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 2017 Road Needs Study Report findings.

Appendix A

Unit Price Form