ROADS SUB-COMMITTEE
SPECIAL MEETING AGENDA
WEDNESDAY, OCTOBER 2, 2019 - 1:30 P.M.
MEETING HELD IN THE COUNCIL CHAMBERS

1. Call to Order

2. Declaration of Pecuniary Interest or Conflict of Interest

3. Delegations

    1. 1:30 p.m. - Arunas Kalinauskas, R.J. Burnside and Associates - Presentation of the Draft Road Management Plan

    2. 2:30 p.m. or shortly thereafter - Chris Knechtel, R.J. Burnside and Associates - Presentation of the 2019 Municipal Bridge Inspection Report

4. Recommendations to Council

5. Confirmation Motion

6. Adjournment and Date of Next Meeting

BURNSIDE

Road Management Plan

Township of Melancthon

Road Management Plan

Township of Melancthon

157101 Highway 10
Melancthon, ON L9V 2E6

R.J. Burnside & Associates Limited
15 Townline
Orangeville ON L9W 3R4 CANADA

September 2019
300043927.0000

Distribution List

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0	Yes	Yes	Township of Melancthon

Record of Revisions

Revision	Date	Description
0	September 2019	Initial Submission to Township

R.J. Burnside & Associates Limited

Report Prepared By:

Cody Raposo, P.Eng.
Transportation Engineer
CR:

Henry Centen, P.Eng.
Senior Transportation Engineer
HC:

Report Reviewed By:

Arunas Kalinauskas
Business Manager – Asset Management & GIS
AK:

Executive Summary

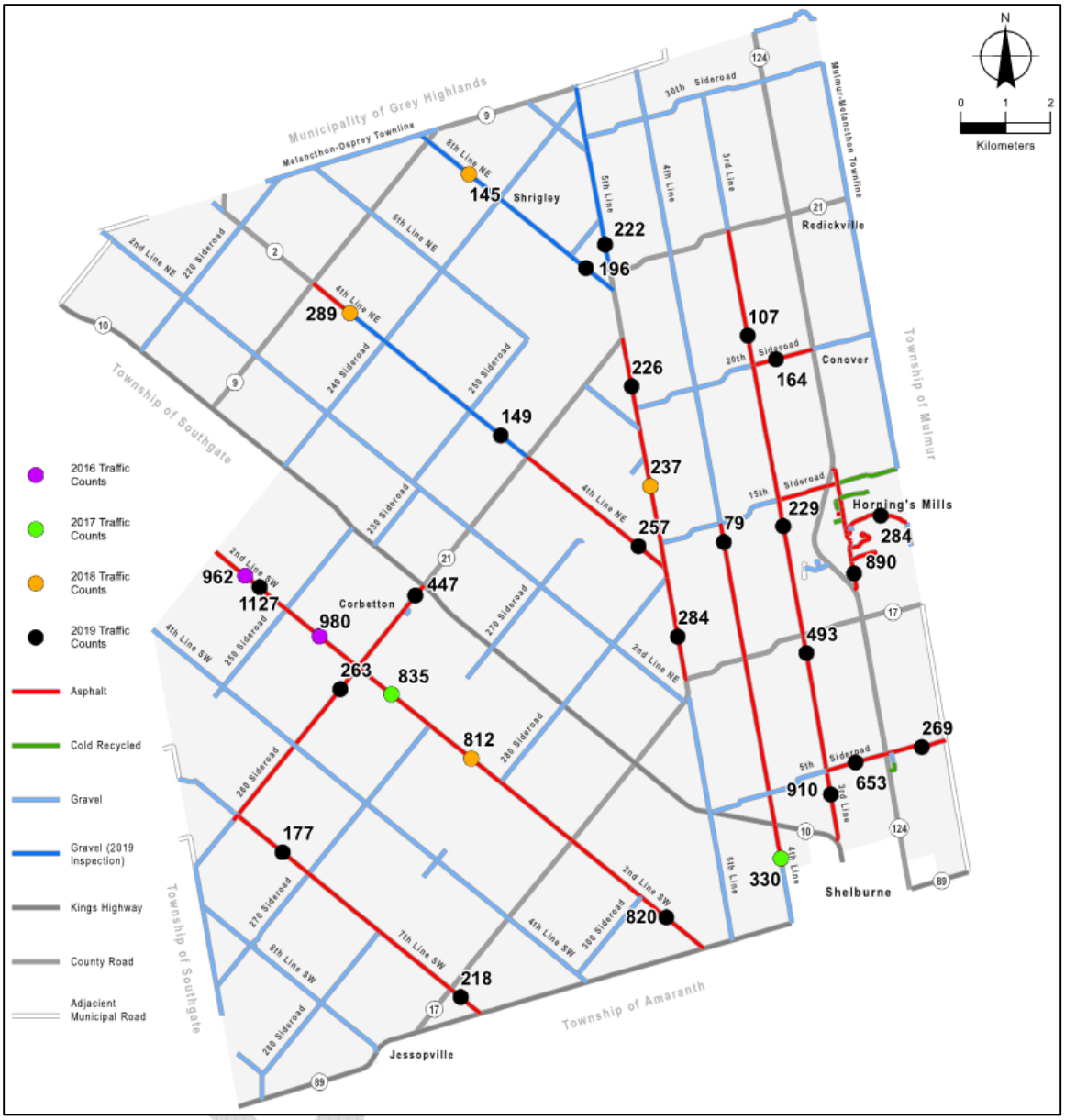
R.J. Burnside & Associates Limited (Burnside) was retained by the Corporation of the Township of Melancthon (Township) to conduct a Road Management Plan (RMP). This RMP has addressed various road improvement, maintenance and management issues in the Township, including a review of the following:

- all existing hardtop roads in the Township, in addition to Township-identified select gravel roads (via field data collection in Spring 2019);
- an analysis of the current road conditions;
- a review of potential surface type upgrades or downgrades for select roads;
- a ten-year road capital and maintenance improvement plan; and
- an analysis of long-term (20-year) capital and maintenance budget requirements.

A total of 91 km (centerline) of roads were inventoried and reviewed in this RMP, consisting of 74 km High Class Bituminous (HCB) asphalt, 2 km Cold Recycled Asphalt (CRA), and 15 km gravel surface.

Burnside's sub-consultant Ontario Traffic Inc. (OTI) conducted a total of 22 Automatic Traffic Recorder (ATR) counts on roadways throughout the Township in Spring 2019. All 22 ATR counts were collected over a 72-hour period (Thursday to Saturday) and were collected in 15-minute intervals. The raw traffic count data collected by OTI has been provided to the Township digitally (Excel and PDF formats). In addition, the Township provided Burnside with traffic volume and classification data from 2016, 2017 and 2018 on select roads. The traffic count volumes in vehicles per day (vpd), collected between 2016 and 2019, is summarized in Figure (i).

Figure (i): Traffic Count Volume Data



For each hardtop road section, Ride Comfort Rating (RCR), Distress Manifestation Index (DMI) and Pavement Condition Index (PCI) values were determined according to Ontario Good Roads Association (OGRA) criteria. In addition to PCI values, this RMP determined two more specific condition ratings for each hardtop road section: a Surface Condition Rating (SCR), which considers all surface-related deficiencies visible on a road section's surface, and a Base Condition Rating (BCR), which considers all base-related deficiencies visible on a road section's surface (i.e., surface deficiencies that infer the condition of the base, in the absence of boreholes or Falling Weight

Deflectometer (FWD) data). The PCI value is out of 100, the SCR value is out of 10 and BCR value is out of 10.

Various improvement types (capital and maintenance) were considered and assessed in this study. For the 20-year budget sensitivity analysis, SCR and BCR post-treatment values (i.e., conditions) were determined in order to assist in the analysis, through the application of the SCR and BCR values within road degradation formulae. A Priority Guide Number (PGN) was developed in order to prioritize improvement needs.

A financial comparison was made to compare overall construction and maintenance costs of hardtop versus gravel roads under various conversion scenarios and structural base conditions. The results of the cost assessment indicate that, in general, gravel surface roads have reduced costs over hardtop roads (i.e., capital and maintenance costs), assuming a 60-year lifecycle and Annual Average Daily Traffic (AADT) volumes below 400 vpd. However, several other factors were also identified that can influence the decision on which surface type is preferable.

A methodology for establishing the relative merit of upgrading or downgrading road surface types was developed and applied against select roads within the network.

Geometric Deficiencies on the Roads

No horizontal alignment deficiencies were noted on the roads reviewed in this RMP. However, vertical curve deficiencies have been identified on the following road sections:

- Section #1507: 3rd Line OS from Highway 10 to 5th Sideroad.
- Section #93: 3rd Line OS from 5th Sideroad to 2 km north of 5th Sideroad.
- Section #544: 3rd Line OS from 2 km north of 5th Sideroad to County Road 17.
- Section #96: 3rd Line OS from County Road 17 to 15th Sideroad.
- Section #1467: 3rd Line OS from 15th Sideroad to 1.5 km south of 20th Sideroad.
- Section #102: 3rd Line OS from 1.5 km south of 20th Sideroad to 20th Sideroad.

Appropriate warning signage should be provided at all vertical deficiency locations, and any future road improvement projects at these locations should consider improving/reducing the magnitude of the vertical deficiency. For projects requiring reconstruction, it is recommended that vertical curves be reviewed as part of any detailed design work, prior to implementation of such projects.

Minimum tolerable hardtop and gravel road widths (i.e., travel lanes) were assessed according to Transportation Association of Canada (TAC) and OGRA criteria. The road sections reviewed in this RMP which do not meet the minimum tolerable road widths are as follows:

- Section #185: High Street from William Street to Main Street.
- Section #200: Church Street from Main Street to end of road.

- Section #186: Addeson Street from George Street to Lloyd Street.
- Section #187: Lloyd Street from Addeson Street to Main Street.
- Section #188: George Street from Addeson Street to Main Street.
- Section #195: Mill Lane from Main Street to end of road.

In addition to providing adequate travel widths, it is important to maintain adequate shoulder widths along hardtop roads, to meet the requirements for pavement edge support and as a buffer between traffic and embankment slopes. Based on consultation with Township staff, it was noted that most of the hardtop roads provide acceptable shoulders, except for various segments of 3rd Line OS (which have limited shoulders).

It is recommended that when road sections which have deficient travel widths or deficient shoulder widths are rehabilitated or reconstructed, that the widths be upgraded to meet minimum acceptable standards.

Road Maintenance Considerations

The Township undertakes brushing as part of their regular maintenance practices. Where road works are proposed, it is recommended that additional investigations be completed to determine drainage improvement requirements. However, it is also recognized that the practicality of achieving sufficient drainage outlets may constrain the opportunities to improve roads in areas with drainage issues.

In general, gravel roads in the Township maintain an adequate condition after they are graded and dust suppressant is applied. Based on discussions with Township staff, the following road sections have above-average maintenance demands:

- Cold patching is required regularly on the following roads:
  - 5th Line OS between County Road 17 and County Road 21 (Sections #94, 101, 1492, 159, 1493, 160 and 161).
  - 3rd Line OS between Sideroad 15 and Sideroad 20 (Sections #1467 and 102).
- It is expected that a higher level of cold patch maintenance will be required on the following roads:
  - 260 Sideroad between Highway 10 and 7th Line SW (Sections #107, 26, 25, 24, 29,32 and 31).
  - 7th Line SW between Highway 89 and Sideroad 260 (Sections #143, 142, 111 and 1489).

Review of Gravel Road Upgrading Needs

Table (i) outlines the gravel road sections reviewed in this study, including each road section's estimated existing (2019) AADT volume and estimated Gravel Upgrading Priority Index (GUPI) value. The GUPI value considers factors such as traffic volumes, truck volumes, maintenance requirements and driveway densities. The gravel road

sections in Table (i) have been sorted according to their GUPI values, with the higher values having a higher perceived need for a hardtop surface (according to the aforementioned factors).

Table (i): Gravel Road Section Summary

Section ID	Road Name	From	To	Existing AADT Volume (vpd)	Traffic Count Year	GUPI
1452	5th Line OS	County Road 21	30th Sideroad	222	2019	40
1519	5th Line OS	30th Sideroad	Sideroad 240	222	Estimate	40
1520	5th Line OS	Sideroad 240	County Road 9	222	Estimate	40
1511	8th Line NE	Sideroad 240	County Road 9	145	2018	15
1603	8th Line NE	County Road 9	Townline	125	Estimate	15
1440	8th Line NE	5th Line OS	Sideroad 250	196	2019	10
1441	8th Line NE	Sideroad 250	Sideroad 240	125	Estimate	10
1596	4th Line NE	Sideroad 240	1 km N of Sideroad 240	150	Estimate*	10
1594	4th Line NE	Sideroad 250	Sideroad 240	150	Estimate	5
1595	4th Line NE	County Road 21	Sideroad 250	149	2019	0

* This road section had a traffic count completed in 2018, however this was before the asphalt road surface was reverted to gravel. Thus, a post-2018 (gravel road) AADT estimate has been applied.

The potential for the existing gravel roads reviewed in this RMP to be upgraded to a hardtop surface was analyzed. Based on this analysis, none of the existing gravel road sections are recommended for upgrading to a hardtop surface at this time.

Review of Hardtop Road Needs

It has been estimated that the total cost of current hardtop road improvement needs in the Township is approximately $8 million. Table (ii) summarizes the hardtop road needs by improvement types.

Table (ii): Township of Melancthon Hardtop Road Needs

Improvement Need Type	Amount of Hardtop Road Needs		
	Cost (in CAD Dollars)	Length (in kilometres)	Percentage of Total Length
Routine Maintenance	$81,781	16.3	21.4%
Preventive Maintenance	$280,053	11.2	14.7%
Resurface	$191,658	2.0	2.6%
Rehabilitation	$4,994,751	37.7	49.4%
Reconstruction	$2,502,444	9.1	11.9%
Total	**$8,050,867**	**76.3**	**100.0%**

Table (iii) provides a qualitative condition summary based on the PCI ranges of all hardtop roads in the Township.

Table (iii): Qualitative Description of Road Network

PCI Range	Condition	Length of Road (Centerline km)	Percentage of Total Length
90 to 100	Excellent	25.1	32.9%
75 to 89	Good	17.6	23.1%
65 to 74	Fairly Good	5.3	6.9%
50 to 64	Fair	20.6	27.0%
Below 50	Poor	7.7	10.1%
Total	**-**	**76.3**	**100.0%**

This RMP has reviewed low volume (i.e., less than 200 vpd) rural hardtop roads for possible reversion back to gravel. Table (iv) outlines these low volume rural road sections, including each road section's estimated existing (2019) AADT volume and estimated GUPI value. The hardtop road sections in Table (iv) have been sorted according to their GUPI values, with the higher values having a higher perceived need for maintaining these as hardtop surfaces (according to the aforementioned factors).

Table (iv): Hardtop Rural Road Sections with AADT Volumes Less Than 200 vpd

Section ID	Road Name	From	To	Existing AADT Volume (vpd)	Traffic Count Year	GUPI
1489	7th Line SW	Sideroad 270	200m S of Sideroad 260	177	2019	5
95B	4th Line OS	Strada Pit North Entrance	15th Sideroad	79	2019	20
194	15th Sideroad	County Road 124	Main Street	125	Estimate	20
1345	20th Sideroad	3rd Line	County Road 124	164	2019	20
1490	3rd Line OS	20th Sideroad	County Road 21	107	2019	25
95A	4th Line OS	County Road 17	Strada Pit North Entrance	125	Estimate	25
1491	15th Sideroad	Main Street	East End of Hardtop	125	Estimate	25
176	15th Sideroad	3rd Line	County Road 124	125	Estimate	25

The potential for existing hardtop roads reviewed in this RMP to be downgraded to a gravel surface was analyzed. Based on this analysis, it is recommended that the Township consider reverting the following existing hardtop road sections to gravel, once the existing hardtop surfaces deteriorate to a point where rehabilitation is required:

- 4th Line NE between 5th Line OS and Dufferin Road 21 (section ID #65).
- 4th Line NE between County Road 9 and 1 km north of Sideroad 240 (section ID #72).
- 7th Line SW between Highway 89 and 200 metres south of Sideroad 260 (section IDs #1489, 111, 142 and 143).
- 4th Line OS between the Strada Pit North Entrance and 15th Sideroad (section #95B).

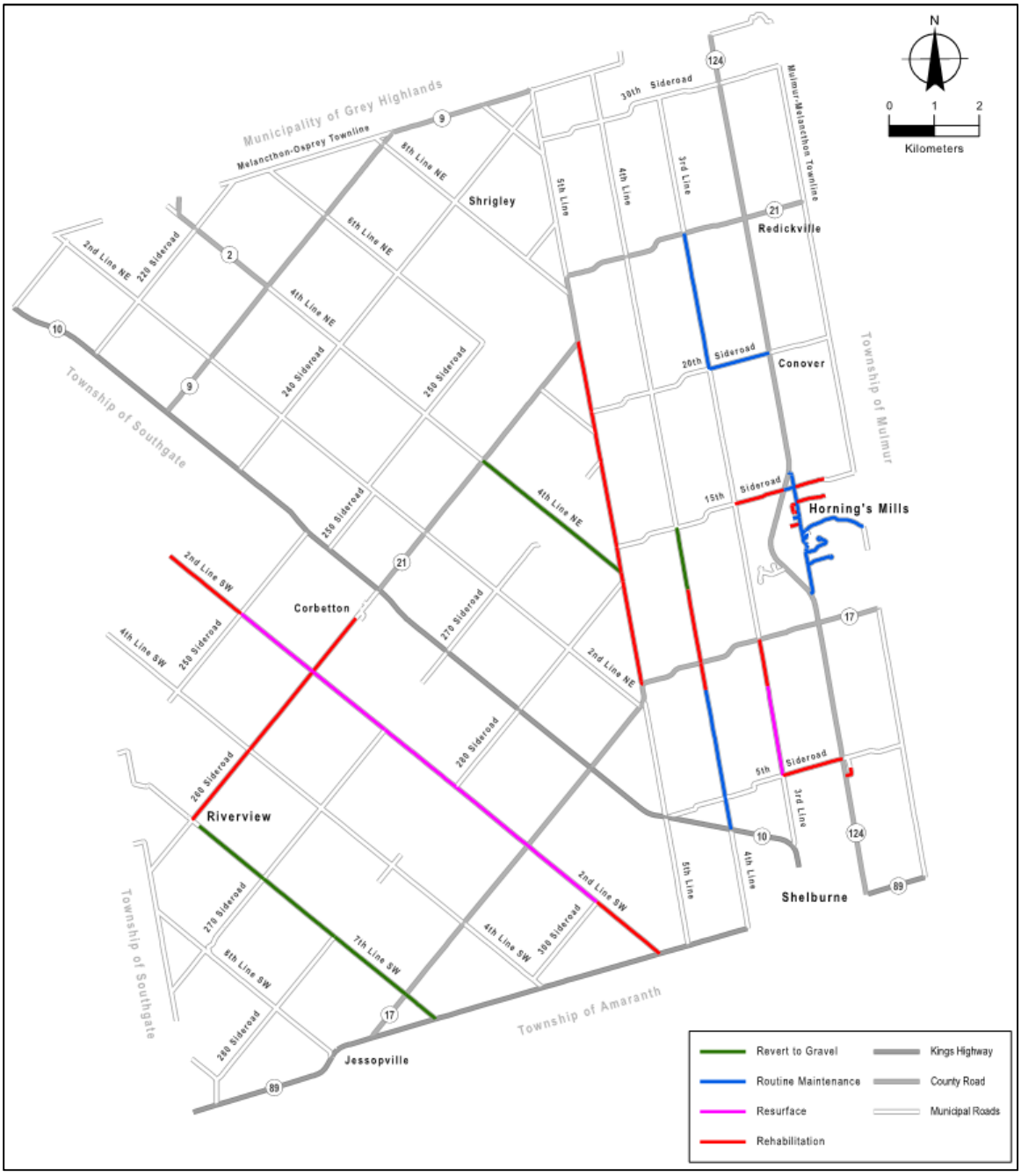
The existing hardtop road sections recommended for consideration to downgrade to gravel surfaces are highlighted on Figure (ii).

Figure (ii): Hardtop Surface Downgrade Recommendations

Development of Ten-Year Hardtop Road Improvement Plan

A comprehensive ten-year (2020 to 2029) road capital and maintenance improvement plan is recommended, based on an average cost of $530,000 per year. This budget amount is higher than what the Township currently spends, however a significant budget increase is required over the next decade in order to reduce the existing capital need backlog. As a result of implementing the recommended ten-year improvement plan, it is forecast that the Township's overall hardtop road network will improve significantly from an "average" (6.2 out of 10) to "good" (8.7 out of 10) condition state by 2029. Specific details regarding the ten-year improvement plan can be found in Appendix E. Figure (iii) summarizes the ten-year road improvement plan recommendations (capital and maintenance).

Figure (iii): Ten-Year Road Improvement Plan



Review of Long-Term (20-year) Hardtop Road Budget Requirements

A sensitivity analysis was completed to determine the funding level required to sustain the Township's forecast "good" overall hardtop road network condition over a 20-year period. The cost to maintain a "good" condition level over the next 20 years (i.e., an overall hardtop network condition at or above 8 out of 10 through year 2039) is forecast to be approximately $315,000 per year (i.e., average over the 20-year period). The 20-year analysis assumes the aforementioned ten-year plan as a subset of the 20-year period, thus it can be concluded that the annual budget required to maintain the "good" network condition (after spending more than usual over the first ten years to reduce the capital need backlog and achieve a "good" overall network condition) is significantly less between years 11 to 20, when compared to the first ten year period. This reflects the shifting of focus from primarily costly capital improvements to more cost-effective maintenance treatments after a "good" overall condition state is reached, so that this condition state is sustainable over the long-term.

It is recommended that the Township increase their annual investment on hardtop roads over the next decade to try to meet the target average $530,000 per year amount, and that the Township continue to actively pursue all available capital grants and other funding sources for such work. As noted in the *Township of Melancthon Asset Management Plan*: "while the annual funding requirement may fluctuate, it is important for the Township to implement a consistent, yet increasing, annual investment in capital so that the excess annual funds accrue in capital reserve funds" (Burnside, May 2017). As identified above, it is anticipated that the annual average capital and maintenance investment in the Township's hardtop road network will be significantly less after the first decade, resulting in a 20-year average amount of about $315,000 per year.

The Township does not currently have an annual budget specific to routine and preventive maintenance treatments for hardtop roads (e.g., crack sealing, micro-surfacing, slurry sealing etc.). However, both the ten-year plan that was developed (at an average of $530,000 per year) and the 20-year sensitivity analysis (at an average of $315,000 per year) consider and include maintenance treatments. Best practice indicates that maintenance treatments applied on roads with good bases can provide extended life and are cost-effective in reducing the overall lifecycle expenditures on such roads. Therefore, it is recommended that the Township begin incorporating maintenance treatments on hardtop roads (within the aforementioned recommended budgets). Such maintenance treatments may be implemented as demonstration (i.e., test) projects initially, with ongoing monitoring to gauge their effectiveness.

Burnside gratefully acknowledges the assistance and contributions of Township staff in the preparation of this study.

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Disclaimer

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In the preparation of the various instruments of service contained herein, R.J. Burnside & Associates Limited was required to use and rely upon various sources of information (including but not limited to: reports, data, drawings, observations) produced by parties other than R.J. Burnside & Associates Limited. For its part R.J. Burnside & Associates Limited has proceeded based on the belief that the third party/parties in question produced this documentation using accepted industry standards and best practices and that all information was therefore accurate, correct and free of errors at the time of consultation. As such, the comments, recommendations and materials presented in this instrument of service reflect our best judgment in light of the information available at the time of preparation. R.J. Burnside & Associates Limited, its employees, affiliates and subcontractors accept no liability for inaccuracies or errors in the instruments of service provided to the client, arising from deficiencies in the aforementioned third party materials and documents.

R.J. Burnside & Associates Limited makes no warranties, either express or implied, of merchantability and fitness of the documents and other instruments of service for any purpose other than that specified by the contract.

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by the Corporation of the Township of Melancthon (Township) to conduct a Road Management Plan (RMP). This RMP has addressed various road improvement, maintenance and management issues in the Township, including a review of the following:

- all existing hardtop roads in the Township, in addition to Township-identified select gravel roads (via field data collection in Spring 2019);
- an analysis of the current road conditions;
- a review of potential surface type upgrades or downgrades for select roads;
- a ten-year road capital and maintenance improvement plan; and
- an analysis of long-term (20-year) capital and maintenance budget requirements.

2.0 Asset Management Plan Considerations

2.1 Road Management Plans as Input to Asset Management Plans

As an asset management practice, it is recommended that detailed condition and inventory information be obtained and analyzed on the Township's tangible capital assets regularly. To paraphrase, Ontario Regulation 588/17 specifies that each municipality's asset management plan should base current levels of service being provided on data from at most the two calendar years prior to the year in which the Asset Management Plan (AMP) is completed. Where detailed condition information is not available, AMPs typically use the age of an asset as a general indicator of where an asset is within its lifecycle and in assessing the risk associated with the needed improvements or replacements to this infrastructure. Ontario Regulation 588/17 requires that the following considerations be made:

- Options must be compared on lifecycle cost, including the cost of constructing, maintaining, renewing and operating an infrastructure asset through its service life.
- Other indirect benefits and costs associated with each option should be considered (e.g. user costs, safety, environmental, etc.).
- Each option must be evaluated based on its potential risk, using an approach that allows for comparative analysis. Risks associated with each option can be scored based on quantitative measures when reasonable estimates can be made of the probability of the risk event happening and the cost associated with the risk event.

Ontario Regulation 588/17 also requires that municipal governments have an adopted AMP for its core assets (i.e., which includes roads) by July 1, 2021. The AMP is to discuss current levels of service and the cost of maintaining those services. For roads, the regulation sets out the following qualitative descriptions and technical metrics that are to be reported in the AMP as an indication of the current levels of service being provided by the municipality:

- A description, which may include maps, of the road network in the municipality and its level of connectivity. The number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the municipality;
- A description or images that illustrate the different levels of road class pavement condition. For paved roads in the municipality, the average pavement condition index value is to be provided. For unpaved roads in the municipality, the average surface condition (e.g., excellent, good, fair or poor) is to be provided.

The AMP is to provide an assessment of the lifecycle activities that would need to be undertaken to maintain the current levels of service, for each of the ten years following the year for which the current levels of service were established. By July 1, 2024, the AMP is to also include the establishment of the municipality's proposed levels of service,

the options for achieving these levels of service and the risks associated with those options to the long-term sustainability of the municipality.

The inventory and road needs assessment provided in this RMP are intended to provide a basis for the information requirements for the updating of the municipality's AMP, to meet the requirements of Ontario Regulation 588/17.

2.2 2017 Township of Melancthon Asset Management Plan

The *Township of Melancthon Asset Management Plan* (Burnside, May 2017) concluded that the Township's overall (i.e., weighted average) road surface and road base condition were both "average". It was also concluded that the overall risk of the Township's road surface and road base assets was "moderate".

The following specific recommendations were made in the Asset Management Plan with regards to the Township's roads:

- 2nd Line SW – change the posted speed limit from 80 km/h to 60 km/h.
- 2nd Line SW from 250 Sideroad to Melancthon/Southgate Boundary Line – grind the existing asphalt surface and add more gravel to stabilize the road base. Consider replacing the asphalt surface in a subsequent year, depending on traffic volume.
- 2nd Line SW from Highway 89 to 300 Sideroad – grind the existing asphalt surface and add more gravel to stabilize the road base. Consider replacing the asphalt surface in a subsequent year, depending on traffic volume.
- Road bases are not expected to be fully replaced, but rather improved in localized areas (i.e., by digging out and repacking). The following road sections may require additional road base support/stabilization:
  - 2nd Line SW from 250 Sideroad to Melancthon/Southgate Boundary Line;
  - 2nd Line SW from Highway 89 to 300 Sideroad; and
  - High Street in Horning's Mills (which has been completed at the time of this RMP).
- 4th Line NE from 240 Sideroad to County Road 9 – grind the existing asphalt surface and add more gravel to stabilize the road base. Consider replacing the asphalt surface in a subsequent year, depending on traffic volume. At the time of this RMP, part of this segment has been reverted to gravel.
- 5th Line OS (asphalt road segments) – indications of road base instability. Grind the existing asphalt surface and add more gravel to stabilize the road base. Consider replacing the asphalt surface in a subsequent year, depending on traffic volume.

The 2017 AMP estimated that the total 2016 replacement cost of road surfaces and bases in the Township were $6,460,483 and $105,612,196, respectively.

3.0 Inventory of Roads Considered in this RMP

All road section data contained in this RMP is based on a field review conducted in May 2019 by one Township staff member and one senior technical Burnside staff member. This RMP focuses primarily on the construction and maintenance needs of all hardtop roads in the Township, in addition to select gravel road sections (as confirmed via discussions between the Township and Burnside).

A total of 91 km (centerline) of roads were inventoried and reviewed in this RMP, consisting of 74 km High Class Bituminous (HCB) asphalt, 2 km cold recycled asphalt (CRA), and 15 km gravel surface (i.e., select gravel roads only, not the entire Township gravel road network). A map illustrating the existing surface type of roads in the Township is contained in Appendix A.

The road section inventory data collected in this RMP is summarized in Appendix B.

4.0 Traffic Counts and Annual Average Daily Traffic (AADT)

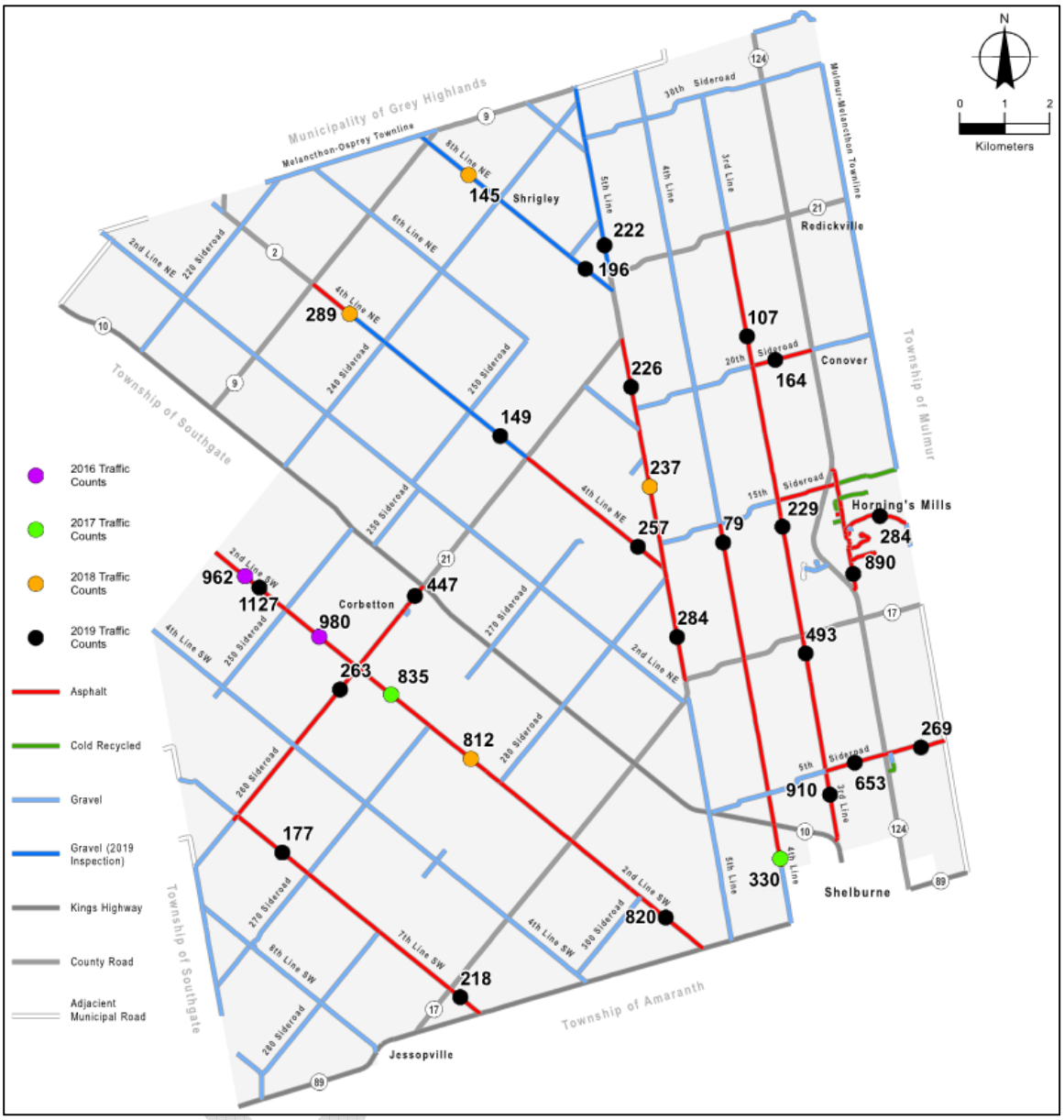
Burnside's sub-consultant, Ontario Traffic Inc. (OTI), completed a total of 22 Automatic Traffic Recorder (ATR) counts on roadways throughout the Township in the Spring of 2019. Factors that were considered in determining the optimal 22 ATR count locations included:

- gravel road sections that may be potential candidates for upgrading to hardtop surfaces;
- Hardtop road sections through the Township where it was deemed necessary to confirm the traffic and truck volumes to ensure that accurate data was incorporated into the road analysis work completed in this RMP.

All 22 ATR counts included both volume and vehicle classification data, collected over a 72-hour period between Thursday and Saturday, recorded in 15-minute intervals.

In addition to the above counts conducted by OTI, the Township provided Burnside with traffic volume/classification data from 2016, 2017 and 2018 on select roads. The traffic count data collected in 2016, 2017, 2018 and 2019 is summarized in Figure 1.

Figure 1: Traffic Count Volume Data



The traffic volume/classification data was utilized, in conjunction with a general assessment of the road network and origin/destination considerations, in order to estimate Annual Average Daily Traffic (AADT) volumes and truck volumes on all road sections considered in this RMP. AADT volumes are one of the factors used in establishing potential improvement/upgrading requirements, as well as the formulation of improvement benchmark costs and road improvement priorities. For road segments where no traffic counts were available, traffic volume approximations were assigned based on the general traffic volume range forecasted, for use in the road assessments.

The location of various urban areas and developments throughout and adjacent to the Township were reviewed in conjunction with planning-level studies in order to make 10-year AADT forecasts on roads considered in this RMP. In the *Township of Melancthon Official Plan* (August 2014), it is stated that the population in 2031 is forecast to be 3,410, which would represent a 0.84% per annum growth rate from the Township's 2016 population of 3,008 (Statistics Canada). Also, population growth in the municipalities adjacent to Melancthon will impact traffic on some of the Township's roads. Growth in the Town of Shelburne is estimated to be approximately 2.2% per annum over the next 20 years, according to the *Town of Shelburne Official Plan* (December 2017 Consolidation). Growth in Southgate Township is estimated to be 0.61% per annum over the next 20 years (about 370 residential units, much of which will be in Dundalk), according to Grey County's *Growth Management Strategy Update* (Hemson Consulting Ltd, December 2015).

Based on the above considerations, the following traffic volume (i.e., AADT) growth rates were applied on roadways in this RMP, for the purpose of estimating 10-year (i.e., 2029) traffic volumes:

- A 2.0% Compound Annual Growth Rate (CAGR) was applied to AADT volumes on the following roadways:
  - 3rd Line OS between Highway 10 and County Road 21;
  - 4th Line OS between Shelburne Boundary and 15th Sideroad;
  - 5th Line OS between County Road 17 and County Road 21;
  - 5th Sideroad between 3rd Line and Mulmur/Melancthon Townline; and
  - 2nd Line SW (entire length).
- A 1.0% CAGR was applied to AADT volumes on all other roads considered in this RMP.

The AADT volume and range estimates for all road sections considered in this RMP is contained in Appendix B. The raw traffic count data collected by OTI has been provided to the Township digitally (Excel and PDF formats).

5.0 Methodology

5.1 Hardtop Road Condition Ratings

The Township's hardtop roads were reviewed in the field by Burnside with Township staff in May 2019 to determine their condition ratings. Specific pavement distress ratings were assigned for 15 distress types for all hardtop road sections in the Township, based generally on the "Flexible Pavement Condition Evaluation Form" developed by the Ontario Good Roads Association (OGRA), as illustrated in Figure 2. Weighting factors are assigned to each distress type as well as to the severity and density of the distress, as shown in Figure 1. The summation of all the various distress weightings, severities and densities for each road section provide a Distress Manifestation Index (DMI) for that section.

In addition to surface distresses, a Ride Comfort Rating (RCR) was also estimated for each road section. The RCR is a subjective measure of ride smoothness, measured on a 1 to 10 rating scale, with 10 representing a very good RCR (i.e., very smooth ride) and 1 representing a very poor ride, as delineated on Figure 1.

Pavement Condition Index (PCI) values were calculated for all hardtop road sections in the Township, according to the formula identified in Figure 2. The PCI, which is based on the DMI and RCR values for each road section, provides a rating out of 100, with higher PCI ratings reflecting better road pavement conditions.

Figure 2: Flexible Pavement Condition Evaluation Form (Generally Following Ontario Good Roads Association Methodology)

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Survey Date: _____ Evaluated by: _____

Road (Street) Name: _____ Section Length _____ km

Location from: _____ to: _____

Class of Road (circle both mtce. class & functional class) 1 2 3 4 5 6 Freeway Arterial Collector Local

Section # (if applicable)

Ride Comfort Rating (at posted speed)

10	9	8	7	6	5	4	3	2	1
Very Good	Good			Fair			Poor		Very Poor

					Severity of Distress (Si)					Density of Distress (Di)				
					Very Slight	Slight	Moderate	Severe	Very Severe	Few	Intermittent	Frequent	Extensive	Throughout
										<10	10-20	20-40	40-80	>80
Pavement				Wi	0.25	0.5	1	1.5	2	0.25	0.5	1	1.5	2
Surface Defects		Ravelling & loss of surface aggregate	1	1.5										
		Flushing	2	0.5										
Surface Deformations		Rippling and Shoving	3	1.0										
		Wheel Track Rutting	4	3.0										
		Distortion	5	3.0										
Cracking	Longitudinal Wheel Track	Single and Multiple	6	1.0										
		Alligator	7	3.0										
	Centreline	Single and Multiple	8	0.5										
		Alligator	9	2.0										
	Pavement Edge	Single and Multiple	10	0.5										
		Alligator	11	1.5										
	Transverse	Half, full and multiple	12	1.0										
		Alligator	13	3.0										
	Longitudinal – meander or mid-lane		14	1.0										
	Potholes/Patching		15	3.0										

Σ Wi x (Si + Di) (for all 15 distresses) = _____DMI

PCI = 100 – (DMI + (10 – RCR)) = _____

The establishment of a PCI value for each road section provides valuable information to identify, compare and prioritize road maintenance and improvement needs for the various road segments within the network. However, the provision of a single PCI number does not fully capture the causative factors of the observed distresses, nor whether such factors are indications of a surface condition need or a base condition need. One of the key challenges in utilizing performance-based decision making to manage road assets is a recognition that the road and base elements will have different lifecycles. To address these factors Burnside has further used the collected condition data to establish condition ratings that are specific to the surface or base components. A Surface Condition Rating (SCR) is established from the surface-related distresses that are visible on the road sections' surface. A Based Condition Rating (BCR) is established from the base-related distresses that are inferred from some of the distress types that are visible on the road sections' surface (i.e. in the absence of boreholes being completed to directly view the base). The distresses that are considered in the establishment of the SCR and BCR ratings are summarized in Table 5.1.

Table 5.1: Individual Hardtop Deficiency Types Relating to SCR and BCR Values

Deficiency Type		Considered in SCR (Yes/No)	Considered in BCR (Yes/No)
Surface Defects	Ravelling & loss of surface aggregate	Yes	No
	Flushing	Yes	No
Surface Deformations	Rippling & Shoving	Yes	No
	Wheel Track Rutting	No	Yes
	Distortion	No	Yes
Longitudinal Wheel Track Cracking	Single & Multiple	Yes	No
	Alligator	No	Yes
Centerline Cracking	Single & Multiple	Yes	No
	Alligator	No	Yes
Pavement Edge Cracking	Single & Multiple	Yes	No
	Alligator	No	Yes
Transverse Cracking	Single & Multiple	Yes	No
	Alligator	No	Yes
Longitudinal Cracking – meander or mid-lane		Yes	No
Potholes/Patching		No	Yes

The SCR and BCR ratings have been applied in the study to get more representative and specific data relative to the condition of road surfaces and bases, as well as to more precisely assess treatment need types. Each of the SCR and BCR ratings are on a scale out of 10, with 10 representing a very good condition.

To convert the condition data collected in the field (i.e., based on the severity and density of the distresses noted on the surface of the road) into SCR and BCR values, the conversion matrix shown in Table 2 was applied.

Table 5.2: Individual Deficiency Rating Conversion Matrix (to SCR & BCR Values)

Severity	Density				
	Few	Intermittent	Frequent	Extensive	Throughout
Very Slight	9	9	9	9	9
Slight	9	9	8	8	8
Moderate	8	7	6	5	5
Severe	8	7	4	3	2
Very Severe	8	7	3	2	1

* If a specific distress is not present (for any given road section), then the SCR and BCR values are both 10.

In order to obtain the overall SCR and BCR rating for each hardtop road section, the minimum SCR and BCR rating for any specific deficiency on any given road section was applied. For example, for a given road section, if the individual surface-related deficiencies have SCR's ranging from 3-10 and individual base-related deficiencies ranging from 4-7, then the overall SCR and BCR ratings for this road section would be 3 and 4, respectively.

The SCR, BCR, and PCI condition ratings for each road section inventoried are included in Appendix B.

5.2 Improvement Types

The hardtop road improvement types considered in this study are the following:

- Routine Maintenance (RM) – crack sealing.
- Responsive Maintenance - spot improvements/patching (asphalt surfaces).
- Preventive Maintenance (PM) – micro-surfacing or slurry seals.
  - Routine/Preventive Maintenance can help to delay the need for more extensive rehabilitation or reconstruction. Routine/preventive maintenance is typically done when a road is in good condition. Crack sealing, slurry sealing, and microsurfacing can prevent water from infiltrating through cracks to the road base, which ultimately helps to prevent further deterioration of the road base and increases the length of time before more extensive treatments are required.
- Resurface (R) – Hot Mix Asphalt (HMA) overlay (semi-urban and rural environments) or mill and replace surface course asphalt (urban environment).
  - Resurfacing treatments are typically done when a road is in fair condition. Given that the road is in fair condition, resurfacing treatments generally consist of replacing the surface of roadways, but minimal (if any) work is done to the base of the road. Resurfacing treatments mentioned in this RMP are not to be confused with microsurfacing treatments, which are considered a form of preventative maintenance which is applied to roads still in good condition with only minor amounts of cracking.
- Rehabilitation (REH) – pulverize, partial culvert replacement, addition of Granular A and one or two lifts of HMA (semi-urban and rural environments) or full depth asphalt

removal, catch basin/manhole adjustments, spot curb replacement and two lifts HMA (urban environments).
  - More extensive rehabilitation treatments are applied to pavements in poor condition which have deteriorated to a point where partial or full depth replacement of the pavement is required to protect the integrity of the underlying granular base and to delay more extensive reconstruction being required. Pavement rehabilitation extends the service life of a pavement and its load carrying capacity by enhancing its pavement structure. This is achieved by eliminating the age-related deterioration of the pavement and/or increasing the thickness of pavement layers, which returns the structural adequacy of the overall pavement to a value that is able to meet the loading requirements that it is designed to service.
- Reconstruction (REC) – full depth removal, total base replacement, total curb replacement and catch basin/manhole adjustments (urban environment), partial culvert replacement (rural or semi-urban environments), and one or two lifts HMA.
  - Reconstructions are typically done when a road is in very poor condition, or if work is being done to infrastructure beneath a road which require that the road be reconstructed. If pavements are left to deteriorate, they become weak and lose their structural integrity. As its structural capacity is weakened, a pavement will begin to disintegrate, resulting in extensive cracking, rutting and potholes being developed. At this point maintenance, resurfacing, or rehabilitation treatments will not be able to restore its structural integrity. Once a minimum condition level is reached (i.e., approximately PCI 20), the pavement and road base may require full reconstruction in order to reestablish the proper base support for the pavement. Applying a lesser degree of rehabilitation may result in premature failure of any newly applied pavement surface. Once the pavement degrades below a minimum recommended condition, ongoing maintenance (e.g., filling of potholes) will typically increase significantly and/or safety or user complaints may become a concern. Reconstruction is also required when the pavement needs to be improved, to cater to significant increases in projected traffic volumes or increased truck volumes or to accommodate road widening.

To determine improvement types that are warranted for certain road sections, the SCR and BCR ratings, determined from the distresses collected in the field, were assigned to the distress trigger value ranges set for different improvement types. The trigger value ranges set for each improvement type are summarized in Table 5.3, in addition to the effect that is anticipated from the improvement on road conditions (i.e., the net benefit to the SCR and BCR values after a certain improvement type). Specific details on what each improvement entails are included in Table 5.3, based on the distress trigger ranges, surface type, roadside environment, and traffic volumes. Estimated treatment costs (approximate) are also provided in Table 5.3, with the basis of these estimated bench mark costs provided in Appendix C.

Table 5.3: Template for Lifecycle Road Improvements

Improvement	Urban or Semi-Urban - Hardtop (Any AADT)				Rural - Hardtop (HCB/CRA)					Semi-Urban or Rural - Gravel			
	Post-Treatment Condition	High Class Bituminous (HCB)	Cold Recycled Asphalt (CRA)	Distress Triggers	Post-Treatment Condition	AADT>=400	400>AADT >=200	AADT<200	Distress Triggers	Post-Treatment Condition	AADT>=200	AADT<200	Distress Triggers
Routine Maintenance (RM)[1]	SCR=10	Crack Sealing [$0.75 per m^2]	N/A (Responsive Maintenance)	8.5<=SCR<9.5 **AND** BCR>=7.5	SCR=10	HCB – Crack Sealing [$0.75 per m^2] CRA – N/A (Responsive Maintenance)			8.5<=SCR<9.5 **AND** BCR>=7.5	N/A	Maintenance Gravel + Calcium Chloride [$0.80 per m^2]	Maintenance Gravel + Calcium Chloride [$0.80 per m^2]	N/A
Preventive Maintenance (PM)	SCR=10	Micro-Surfacing [$4 per m^2]		7.5<=SCR<8.5 **AND** BCR>=7.5	SCR=10	Micro-Surfacing [$4 per m^2]		Slurry Seal [$3 per m^2]	7.5<=SCR<8.5 **AND** BCR>=7.5				
Resurface (R)[2]	SCR=10 BCR=8	*Urban* - Mill + 50mm HL4 [$13 per m^2] *Semi-Urban* – 50mm HL4 + Shouldering [$10 per m^2]		5.5<=SCR<7.5 **AND** BCR>=6.5	SCR=10 BCR=8	60mm HL4 + Shouldering [$14 per m^2]	50mm HL4 + Shouldering [$10 per m^2]		5.5<=SCR<7.5 **AND** BCR>=6.5				
Rehabilitation (REH)[5, 9]	SCR=10 BCR=9	*Urban* - Full depth asphalt removal + 50mm HL8 + 40mm HL3 + 10% Curb/Gutter Replacement + Catch Basin/Manhole Adjustments [$26 per m^2] *Semi-Urban* – Pulverize + 60mm HL4 + Shouldering [$15 per m^2]		2<=SCR<5.5 **OR** 2<=BCR<6.5	SCR=10 BCR=9	Pulverize + PAD + 100mm Granular A + 60mm HL4 + 40mm HL3 + Shouldering [$29 per m^2] [7]	Pulverize + PAD + 100mm Granular A + 60mm HL4 + Shouldering [$20 per m^2] [8]	Pulverize + 60mm HL4 + Shouldering [$15 per m^2]	2<=SCR<5.5 **OR** 2<=BCR<6.5				
Reconstruction (REC)[6]	SCR=10 BCR=10	*Urban* – Full depth asphalt removal + + Total base replacement + 50mm HL8 + 40mm HL3+ 100% Curb/Gutter Replacement + Catch Basin/Manhole Adjustments [$68 per m^2] *Semi-Urban* – Full depth asphalt removal + Total base replacement + 60mm HL4 + Shouldering [$42 per m^2]		SCR<2 **OR** BCR<2 **OR** Requires underground infrastructure improvements	SCR=10 BCR=10	Full depth asphalt removal + Total base replacement + 50mm HL8 + 40mm HL3 + Shouldering [$51 per m^2]	Full depth asphalt removal + Total base replacement + 60mm HL4 + Shouldering [$42 per m^2]		SCR<2 **OR** BCR<2 **OR** Requires underground infrastructure improvements	SCR=10 BCR=10	Total base replacement + 60mm HL4 [3] + Shouldering [$37 per m^2]		Considers Surface Upgrade Criteria[4]

1. For crack sealing, in addition to the SCR, single/multiple cracking must be present on the road section (i.e., some cracking, such as alligator or block cracking, is more typically related to the road base and typically are not able to practically benefit from crack sealing).
2. Cracks over 0.25 inches wide should be sealed prior to application of an HMA Overlay treatment, to reduce the potential for reflective cracking. Contingencies have been excluded from the resurface unit cost estimates.
3. Boreholes should be taken at the design stage to determine the condition of a gravel road's base, and to confirm if asphalt is preferred (over Double Surface Treatment, recycled asphalt, etc.). Improvements to the road section's base and drainage are required prior to hardtopping the road's surface.
4. Refer to the gravel road upgrading policy outlined in Section 5.8 for all criteria that should be considered when determining if a gravel road section warrants upgrading to a hardtop surface, as well as an upgrading prioritization methodology. Note that simply adding a hardtop surface to a previously gravel road section (without ensuring that the road's alignments, width, drainage, etc. meet hardtop road standards) does not constitute as a reconstruction project.
5. Either a REH or REC treatment is applied at the end of the road's life, depending on the condition of the road base. Rehabilitation unit costs shown do not consider culvert replacement costs. Contingencies have been excluded from the rehabilitation unit cost estimates.
6. The unit cost applied in this study to revert an existing hard-top road to a gravel surface is $5.76 per m^2, and consists of pulverizing the existing hard-top road and adding 100mm of Granular A. Either a REH or REC treatment is applied at the end of the road's life, depending on the condition of the road base. Reconstruction unit costs shown do not consider culvert replacement costs. Contingencies have been excluded from the reconstruction unit cost estimates.
7. Additionally, the cost for a potential rehabilitation treatment on any segment of 2nd Line SW or 3rd Line OS (from Shelburne to County Road 17) was estimated at $29 per m^2, to account for high traffic volumes and the function of each road.
8. Additionally, the cost for a potential rehabilitation treatment on any segment of 5th Line OS was estimated at $34 per m^2 (instead of $20 per m^2), since 5th Line OS is in a swamp area and, therefore, a rehabilitation on 5th Line OS would include a 9 metre wide geogrid as well as additional granular A. The estimated existing (2019) traffic volume on all asphalt segments of 5th Line OS are between 200 and 400 vehicles per day (vpd).
9. The following sections have both an existing rehabilitation treatment need and vertical deficencies: 3rd Line OS between County Road 17 and 2 km north of 5th Sideroad (section #544) and 3rd Line OS between County Road 17 and 15th Sideroad (section #96). To account for the correction of the vertical deficencies on these two sections, an additional $30,000 and $150,000 were added to the total improvement need cost for sections #544 and #96, respectively.
10. Unit costs for specific road section improvements may have been adjusted, where required, to account for local road characteristics. Refer to the Inventory Table in Appendix B for the specific unit costs applied for each road section improvement need.

5.3 Improvement Costs

General improvement benchmark unit costs are for budget planning purposes and have been based on theoretical costs per square metre of hardtop surface for a recommended improvement standard. Improvement projects are generally completed through a combination of day labor and equipment rental, where required, or through contract work. While these unit costs are considered sufficient for planning purposes, actual costs may vary according to the following factors:

- site-specific requirements/constraints;
- fluctuations in input costs (such as the price of oil impacting asphalt costs); and
- budget constraints requiring consideration of lesser standards (such as maintaining vertical profiles to tolerable conditions or reducing overall improvements).

Benchmark improvement costs (per square metre) are outlined in Table 5.3 above and are based on available unit cost data from similar lower-tier Ontario municipalities (in terms of location, population, and climate) as well as some recent unit cost data provided by the Township**.** The improvement types/costs consider surface types, traffic volumes, road conditions, and roadside environments. Since the improvement benchmark costs are estimated on a square metre of hardtop road basis, the improvement costs for any particular road section will also capture individual road widths.

Note that the unit costs (per square metre) identified above have been used in years 11 to 20 of this study's 20-year budget sensitivity analysis. However, unit costs applied in this study's detailed ten-year improvement plan differ slightly from the unit costs outlined in Table 5.3 to account for some of the factors listed above, such as the addition of geogrid in swampy areas, correcting vertical deficiencies and network continuity, among others. It is recommended that standards be reviewed on a project specific basis as budgets are established and additional design details become available.

The breakdown of the unit costs applied in this RMP's 20-year budget sensitivity analysis are provided in Appendix C.

5.4 Improvement Prioritization

The Ministry of Transportation Ontario (MTO) has developed a Priority Guide Number (PGN) formula that can be used to prioritize road improvements based on condition ratings, improvement costs, and traffic volumes. To prioritize recommended hardtop road improvements in this study, Burnside has adjusted MTO's PGN formula, to reflect the adjusted condition rating methodology that has been developed for this study.

The PGN has built-in factors which account for asset management best practices, to strive to recommend the right treatment to the right road at the right time based on

where the road section lies within its lifecycle. As described in further detail in Section 5.5 of this RMP, to be most cost-effective, timely expenditures should be made using routine and preventive maintenance treatments, rather than allowing further degradation requiring much more costly rehabilitation or reconstruction treatments.

The PGN formula used in this RMP is as follows:

$$PGN = \frac{(20 - \text{SCR} - \text{BCR}) * \text{TF} * \text{LCF}}{10000 * Road\ Width * (cost\ per\ square\ metre)}$$

where:

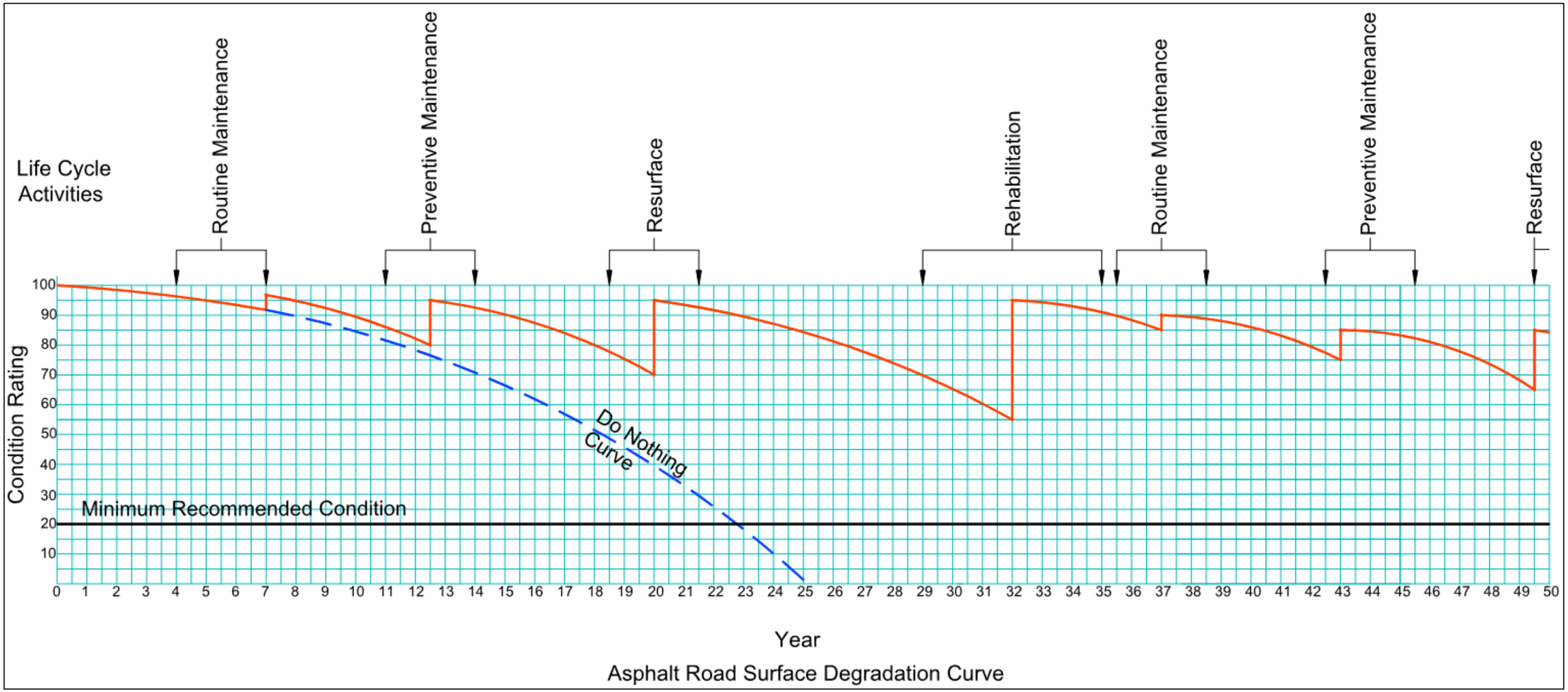
- SCR is the Surface Condition Rating (out of 10).
- BCR is the Base Condition Rating (out of 10).
- TF is the Traffic Factor, which is an estimate of the traffic served over the life cycle of the improvement, as follows:
  - routine maintenance TF = (Existing AADT + Yr. 10 AADT) x 0.38
  - preventive maintenance TF = (Existing AADT + Yr. 10 AADT) x 0.42
  - resurfacing TF = (Existing AADT + Yr. 10 AADT) x 0.50
  - rehabilitation or reconstruction TF = Yr. 10 AADT
- LCF is the Lifecycle Factor, which is the typical number of days that is assumed to be added to the pavement life as a result of the treatment, as follows:
  - 1095 for routine maintenance treatments;
  - 1825 for preventive maintenance treatments;
  - 3650 for or resurfacing treatments; and
  - 7300 for rehabilitation and reconstruction treatments.
- Road Width is the hardtop width of a given road section (in metres).

The higher the PGN value, the higher the priority of the section relative to its condition, the traffic it is serving and the cost of improving the section to provide the most service to traffic for the dollar expended. This provides one measure of comparison between improvement requirements of any particular road section relative to other road sections.

5.5 Road Condition Deterioration

Typically, roadways with poor condition ratings are considered maintenance intensive. It is recognized that budget constraints often require that road sections be allowed to deteriorate before rehabilitation is scheduled. However, if routine and/or preventive maintenance is applied to a road section prior to the road base being significantly impacted, then the overall life of the road section can be extended, beyond what is achievable through a reconstruction/rehabilitation strategy alone, thus optimizing the use of the Township's resources. Figure 3 below illustrates how preventative maintenance modifies the typical degradation curve of pavements, thus extending the road's useful life while at the same time providing a higher level of service to the public.

Figure 3: Benefit of Applying Preventive Maintenance – Asphalt Surface Life



To account for the ongoing deterioration of roads in the Township, Burnside has developed formulas to estimate the future condition of a road section in any given year. The road condition degradation equations are described below for hardtop roads (HCB and CRA roads).

This study assumes that the surface of all hardtop roads in the Township will have a useful life of 20-25 years, and that the base of all hardtop roads will have a useful life of 60 years. Based on these assumptions, degradation formulae have been developed for an asphalt road's surface condition (i.e., SCR) and base condition (i.e., BCR), as follows:

$$SCR\ in\ Year\ Y = \ Current\ SCR - (e^{0.092*(Y)} - 1)$$

$$BCR\ in\ Year\ Y = Current\ BCR - (e^{0.038*(Y)} - 1)$$

where:

- Current SCR is the current year SCR value. The minimum SCR value is 1.0 in any given year.
- Current BCR is the current year BCR value. The minimum BCR value is 1.0 in any given year.
- Y is the year at which a road section's SCR or BCR value is being estimated (for example, Y would be 20 if a road section's SCR and BCR were being estimated 20 years into the future).

5.6 Remaining Useful Life

In general, the remaining useful life of a physical asset is the length of time an asset is forecast to function/operate providing acceptable level of service (i.e., remain "useful") before it needs to be replaced. As noted previously, this study assumes that the surface of all hardtop roads in the Township will have a useful life of 25 years, and that the base of all hardtop roads will have a useful life of 60 years.

The remaining useful life of hardtop road surfaces and bases in the Township as of 2019 have been estimated using the following formulae, which account for each road section's current condition:

$$Road\ Surface\ Remaining\ Useful\ Life\ (in\ Years) = 25 - \frac{Ln(11 - Current\ SCR)}{0.092}$$

$$Road\ Base\ Remaining\ Useful\ Life\ (in\ Years) = 60 - \frac{Ln(11 - Current\ BCR)}{0.038}$$

where:

- Current SCR is the current year SCR value (maximum 10, minimum 1).
- Current BCR is the current year BCR value (maximum 10, minimum 1).

5.7 Replacement Costs

The replacement cost of a physical asset is the amount it would cost to replace the existing asset with the same (or a similar) asset.

The benchmark improvement costs for "Reconstruction" improvements, as outlined in Table 5.3 (Section 5.2), were used to estimate the replacement cost for all hardtop roads in the Township. For the purposes of estimating the replacement cost of gravel road sections reviewed in this study, it is assumed that these roads will retain their gravel surface (i.e., rather than be upgraded to a hardtop surface). Thus, the cost to reconstruct an existing gravel road (back to gravel, including building-up the road) was estimated using a benchmark cost of $21.78 per m^2 (refer to Appendix C for unit cost breakdowns).

The estimated road replacement cost for all roads reviewed in this study (i.e., approximately 91 centreline km) are contained in the inventory table in Appendix B. In summary, the total 2019 replacement cost for all roads inventoried in this study is estimated to be $25.1 million.

5.8 Gravel Road vs Hardtop Roads

The Township's *2017 Asset Management Plan* estimated that there were 167.3 km of gravel surface roads within the Municipality at that time. Maintaining the condition of gravel roads is typically dealt with as ongoing maintenance work (such as ongoing grading, maintenance gravel, dust control, etc.), unless upgrading the gravel road to a hardtop surface. Thus, this RMP reviews the potential for the select gravel roads considered in this study to be upgraded to a hardtop surface. Similarly, considering the limited budgets for maintaining and improving the roads, consideration has been given to the potential for some existing hardtop roads to revert to a gravel surface, once improvements are required to such roads. The purpose of the following sections of this report is to review the most appropriate surface management strategy.

5.8.1 Financial Comparison Between Gravel and Hardtop Roads

To compare the overall construction and maintenance costs of hardtop versus gravel roads, the following data has been obtained from the Township and used in this analysis:

- Gravel Roads (200 to 400 vpd)
  - The cost for the supply of maintenance gravel is approximately $5,200/every 2 years ($10.40/tonne).
  - Gravel roads are typically graded 7 times per year (at 1.5 hours per kilometer at $150/hour).
- Hardtop Roads (<400 vpd)

- The cost for grinding asphalt, supply and place 700 tonne of gravel, grading and compacting is approximately $13,575/km.
- The cost for supply and place 50 mm depth of asphalt is approximately $70,000/km.

The cost comparison of gravel versus hardtop surfaces assumes that the road is being rehabilitated or reconstructed in Year 1 to respond to condition deficiencies. Therefore, the work required in Year 1 will reflect the existing base condition (i.e., good or poor base) and the intended surface to be implemented (i.e., gravel or hardtop). It is assumed that the resulting Year 1 base will be sufficient to accommodate a 60-year lifecycle, assuming that typical maintenance and improvement work is completed to address the surface distresses throughout this period. The assumed works and costs expended during the lifecycle, depending on the surface strategy and the existing base conditions, are summarized as follows:

- Existing Gravel to Future Gravel – Good Base
  - Year 1 – Dust control + grading 7 times = $2,175/km
  - Year 2 – 500 tonne maintenance gravel + dust control + grading 7 times = $7,375/km
  - Years 3 through 59, repeat Year 1 and Year 2 sequence.

- Existing Gravel to Future Gravel – Poor Base
  - Year 1 – Base strengthening + dust control + grading 7 times = $33,800/km
  - Year 2 – Dust control + grading 7 times = $2,175/km
  - Year 3 – 500 tonne maintenance gravel + dust control + grading 7 times = $7,375/km
  - Years 4 through 59, repeat Year 2 and Year 3 sequence.

- Existing Gravel to Future Hardtop – Good Base
  - Year 1 – 700 tonne gravel + 50 mm asphalt = $79,575/km
  - Year 5 – Crack sealing = $1,500/km
  - Year 10 – Patch repair = $22,500/km
  - Year 20 – Pulverize = 700 tonne gravel + 50 mm asphalt = $83,575/km
  - Repeat the Year 5, 10, 20 sequence for the remainder of the lifecycle.

- Existing Gravel to Future Hardtop – Poor Base
  - Year 1 – Base strengthening + 50 mm asphalt = $101,625/km
  - Year 5 – Crack sealing = $1,500/km
  - Year 10 – Patch Repair = $22,500/km
  - Year 20 – Pulverize + 700 tonne gravel + 50 mm asphalt = $83,575/km
  - Repeat the Year 5, 10, 20 sequence for the remainder of the lifecycle.

- Existing Hardtop to Future Hardtop – Good Base
  - Year 1 – Pulverize + 700 tonne gravel + 50 mm asphalt = $83,575
  - Year 5 – Crack sealing = $1,500/km
  - Year 10 – Patch Repair = $22,500/km
  - Year 20 – Pulverize + 700 tonne gravel + 50 mm asphalt = $83,575/km
  - Repeat the Year 5, 10, 20 sequence for the remainder of the lifecycle.

- Existing Hardtop to Future Hardtop – Poor Base
  - Year 1 - Pulverize + base strengthening + 50 mm asphalt = $105,626/km
  - Year 5 – Crack sealing = $1,500/km
  - Year 10 – Patch Repair = $22,500/km
  - Year 20 – Pulverize + 700 tonne gravel + 50 mm asphalt = $83,575/km
  - Repeat the Year 5, 10, 20 sequence for the remainder of the lifecycle.

- Existing Hardtop to Future Gravel – Good Base
  - Year 1 - Pulverize + 700 tonne gravel + dust control + grading 7 times = $15,750/km
  - Year 2 – Dust control + grading 7 times = $2,175/km
  - Year 3 – 500 tonne maintenance gravel + dust control + grading 7 times = $7,375/km
  - Years 4 through 59, repeat Year 2 and Year 3 sequence.

- Existing Hardtop to Future Gravel – Poor Base
  - Year 1 – Pulverize + Base Strengthen + dust control + grading 7 times = $37,800/km
  - Year 2 – Dust control + grading 7 times = $2,175/km
  - Year 3 – 500 tonne maintenance gravel + dust control + grading 7 times = $7,375/km
  - Years 4 through 59, repeat Year 2 and Year 3 sequence.

The lifecycle costs for the various scenarios noted above are summarized in the following table:

Table 5.4: Lifecycle Costs for Gravel Versus Hardtop

Scenario	Existing Base Condition	Present Value Cost Per Km of 60 Year Maintenance / Improvement Lifecycle*
Retain Existing Gravel	Good	$169,953
Retain Existing Gravel to Future Gravel	Poor	$198,184
Conversion of Existing Gravel to	Good	$216,996
Conversion of Existing Gravel to	Poor	$239,046
Retain Existing Hardtop	Good	$220,996
Retain Existing Hardtop	Poor	$243,096
Conversion of Existing Hardtop to	Good	$180,134
Conversion of Existing Hardtop to	Poor	$202,184

* Present Value is based on assumed 2% inflation rate and 4% discount rate.

The results of the cost assessment indicate that gravel surface roads may have reduced costs over hardtop roads (i.e., capital and maintenance costs), assuming a 60-year lifecycle and traffic volumes below 400 vpd. However, there are several other considerations that may also be considered and may influence the decision on which surface type to apply. Many of these other considerations are difficult to associate a value to or may not provide a direct benefit to the Township. Additional considerations may include:

- Location of any particular road section within the continuity of the overall hardtop road networks (i.e., both internal to the Township and beyond the Township boundaries).
- Potential for a hardtop road to redistribute traffic away from other gravel roads as road users preferentially select paved roads, reducing maintenance requirements.
- Potential for the hardtop road to result in increased traffic volumes and higher travel speeds.
- Hardtop roads effectively waterproof the road base, which can reduce the potential for load related damage.
- Hardtop roads reduce dust emissions.

- Hardtop roads provide for improved vehicular operational characteristics (smoother ride, less noisy, higher skid resistance, reduce vehicular maintenance costs and fuel costs).
- Impact on road maintenance requirements.
- Possible impact on real estate values for properties along the road.

5.8.2 Pre-Screening Criteria for Potential Gravel Road Upgrading or Hardtop Road Downgrading

In addition to the general network-level considerations (i.e., both economic and non-economic) that have been outlined in the previous section, it is recommended that roads being considered for surface type modifications should also be pre-screened to identify specific road-related criteria that may further inform the decision. Some of the primary factors that should be considered when considering surface type requirements are the following:

- traffic volumes (i.e., AADT volumes);
- traffic types (e.g., percentage of trucks)
- functional classifications (e.g., local or collector, residential or industrial/commercial);
- driveway densities;
- road platform widths;
- road structures;
- drainage;
- road conditions;
- road geometry (alignments); and
- maintenance requirements/frequency.

Based on the factors listed above, the framework in Table 5.5 has been developed for the Township, for use as a pre-screening to assist in assessing surface type requirements and priorities. The criteria listed in Table 5.5 are intended as guidelines to identify areas that may need to be further addressed prior to assessing the impacts of modifying the road surface type. The prescreening list is intended to be a guide and is not an exhaustive list of all criteria. Modifications to surface type will also be subject to the budget and level of service limitations set by the Township.

Table 5.5: Site-Specific Considerations in the Determination of Surface Type Associated with Road Improvements (Pre-Screening)

Item No.	Description	Criteria
1	Traffic Volume	Rural road standards *(Inventory Manual for Municipal Roads, MTO, 1991)* recommend hardtop surfaces for roads with AADT of 200 vpd or more. However, hardtop surfaces may be considered for lesser volumes, if warranted by other factors.

		Similarly, gravel roads may continue to be considered for higher volumes, depending on other factors.
2	Network Continuity	Hardtop network continuity, emergency detour routes etc.
3	Land Use	The typical Level of Service for urban, semi-urban or commercial land uses is a har- top surface.
4	Road Alignment	Substandard vertical and/or horizonal curves should be tolerable, to support operating speeds that are anticipated to occur under hardtop road conditions.
5	Road Width	Hardtop road sections should have a platform width of at least 7.0 metres and tolerable encroachment of vegetation into the clear zone within the right-of-way.
6	Drainage	Adequacy of drainage (e.g., flooding, saturated granular base, inadequate ditching etc.).
7	Road Structure*	The road base and subbase materials should be adequate to support the anticipated loading and environmental conditions, considering the surface type specified (e.g., absence of frost boils or soft spots, etc.).

* To confirm that a road section will be able to support a hardtop surface, boreholes should be obtained on candidate road sections to assess the existing base and subbase materials and condition. Construction and lifecycle costs should be considered when deciding on which hardtop surface type to construct.

The criterion noted in Table 5.5 is recommended to be assessed as part of the detailed design for improvement projects, with the tolerable levels of these criteria established as part of such designs.

For the purposes of this RMP, the Township has identified several roads for which an assessment of surface type has been completed, as outlined in a subsequent section of this report.

5.8.3 Gravel Road Upgrading Prioritization

For gravel roads that are identified for potential surface upgrading, it is recommended that all such gravel roads be prioritized based on a Gravel Upgrade Prioritization Index (GUPI), which is based on the following numerical formula:

$$GUPI = TF + TVF + MF + DF$$

where the factors are described as follows:

- GUPI is the Gravel Upgrade Priority Index, out of 100 points. The higher the GUPI, the higher the priority. Table 5.6 indicates how each GUPI relates to a road section's upgrading priority.

Table 5.6: Gravel Upgrade Priority Index (GUPI) Ranges

Gravel Upgrade Priority Index (GUPI)	Priority to Upgrade from Gravel to Hardtop Surface	Priority to Downgrade from Hardtop to Gravel Surface
0-49	Low	High
50-74	Medium	Medium
75-100	High	Low

- TF is the Traffic Factor. The TF is based on a road section's AADT range in vehicles per day (vpd). Table 5.7 indicates how a given road section's TF corresponds to its AADT range.

Table 5.7: Traffic Factor (TF) Ranges

AADT Range (vpd)	Traffic Factor (TF)
0-199	0
200-399	30
400 and above	50

- TVF is the Truck Volume Factor. The TVF is based on the total average annual daily truck volume on a given road section. Based on the vehicle classification definitions contained in the *Verification, Refinement, and Applicability of Long-Term Pavement Performance Vehicle Classification Rules* (U.S. Department of Transportation Federal Highway Administration, November 2014), all vehicles in classification groups 4 to 13 are considered trucks (i.e., motorcycles, passenger cars, and other two-axle four-tire single-unit vehicles are not considered trucks). Table 5.8 indicates how a given road section's TVF corresponds to its truck volume range.

Table 5.8: Truck Volume Factor (TVF) Ranges

Truck Volume Range (vpd)*	Truck Volume Factor (TVF)
0-9	0
10-19	5
20-49	10
50 and above	20

* Includes the summation of all vehicles on a road section in classification groups 4 to 13 of the *Verification, Refinement, and Applicability of Long-Term Pavement Performance Vehicle Classification Rules* (U.S. Department of Transportation Federal Highway Administration, November 2014).

- MF is the Maintenance Factor, which accounts for a road's condition and maintenance needs, as well as the financial benefit that may be achieved as a result of eliminating the gravel road maintenance need. Based on input from Municipal staff, a gravel road section under consideration for upgrading should be classified as "high maintenance" if the road section's surface has historically higher maintenance needs than other gravel roads in the municipality. Note that this assessment should be based strictly on the maintenance of a gravel road surface, and that the base condition of any gravel road should be sufficient to accommodate a hardtop surface. Table 5.9 summarizes how a given road section's MF relates to its maintenance needs.

Table 5.9: Maintenance Factor (MF) Characteristics

Existing Surface Type	Maintenance Level	Characteristics	Maintenance Factor (MF)
Gravel	Normal	Road section has average maintenance needs.	0
	High	Road section has above average maintenance needs, as confirmed by Municipal staff (compared to other gravel roads in the municipality). Examples of high maintenance gravel roads include roads with above average maintenance gravel needs, above average grading needs, and/or above average dust suppressant needs.	15
Hardtop (HCB or CRA)	Normal	Road section has average maintenance needs.	15
	High	Road section has above average maintenance needs, as confirmed by Municipal staff (compared to other hardtop roads in the municipality). Examples of high maintenance hardtop roads include roads with above average cold patching and/or crack sealing needs.	0

- DF is the Driveway Factor, which accounts for the driveway access density on gravel road sections. Residential, commercial, institutional, and industrial driveways are included in this classification. Table 5.10 summarizes the DF that should be assigned to a given road section according to the driveway density per kilometre.

Table 5.10: Driveway Factor (DF) Ranges

Number of Driveways per Kilometre	Driveway Factor (DF)
0-3	0
4-6	5
7-9	10
10 and above	15

Potential gravel roads that may be considered for upgrading of their surface type can be sorted according to their GUPI values, so that such projects may be prioritized (i.e., higher GUPI values have higher priority for upgrading) and incorporated within the municipality's capital improvement programs, subject to budget availability.

The above methodology can also be used as an initial tool when assessing if an existing hardtop road may warrant reversion to a gravel surface. Potential hardtop roads that may be considered for downgrading of their surface type may be assessed according to their GUPI values (i.e., lower GUPI values have higher priority for a downgrade).

6.0 Consideration of Other Needs for Establishing Road Network Improvements

In addition to the condition of roads, this study has considered several other road-related needs that trigger certain improvement requirements for any particular road section. The other needs considered in this RMP include the following:

- Surface type needs – based on the criteria outlined in Section 5.6.
- Geometric needs – including deficiencies in horizontal/vertical alignments or surface/platform widths.
- Drainage needs – based on the frequency of flooding on the roadway or the adequacy of roadside drainage (such as ditching and brushing).
- Maintenance considerations.
- Coordination with other projects (e.g., infrastructure replacement, bridge works, Development Charge works).
- Road network connectivity considerations.

It is recommended that these road needs be considered independently, rather than collectively. The benefits of this approach include the following:

- Allows for a better integration into a pavement management system, where road condition will form the primary trigger for improvements.
- Clarity in establishing the time of needs, reason for improvement, and appropriate response.

The standards associated with the above road needs are based on the criteria outlined in the *Inventory Manual for Municipal Roads* (MTO, February 1991).

6.1 Geometrics

6.1.1 Alignments

Road alignments are reviewed to determine the number of substandard horizonal/vertical curves and/or substandard stopping sight distances resulting from such curves.

Deficient alignments are defined as curves which do not meet design speeds of 10 km/h over posted speeds. However, the *Inventory Manual for Municipal Roads* (MTO, 1991) defines curves as tolerable when they meet design speeds of 5 to 15 km/h below the posted speeds.

No horizontal alignment deficiencies were noted on the roads reviewed in this RMP. Therefore, all horizontal curves are considered adequate for resurfacing projects.

Vertical curve deficiencies have been identified on the following road sections:

- 3rd Line OS - from Highway 10 to 5th Sideroad (Section 1507).
- 3rd Line OS - from 5th Sideroad to 2 km north of 5th Sideroad (Section 93).
- 3rd Line OS - from 2 km north of 5th Sideroad to County Road 17 (Section 544).
- 3rd Line OS - from County Road 17 to 15th Sideroad (Section 96).
- 3rd Line OS - from 15th Sideroad to 1.5 km south of 20th Sideroad (Section 1467).
- 3rd Line OS - from 1.5 km south of 20th Sideroad to 20th Sideroad (Section 102).

Appropriate warning signage should be provided at all vertical deficiency locations, and any future road improvement projects at these locations should consider improving/reducing the magnitude of the vertical deficiency. For projects requiring reconstruction, it is recommended that vertical curves be reviewed as part of any detailed design work, prior to implementation of such projects.

6.1.2 Road Widths

Minimum tolerable and recommended minimum road widths for hardtop roads have been assessed according to criteria outlined in the *Geometric Design Guide for Canadian Roads* (Transportation Association of Canada [TAC], June 2017). The surface (i.e., travel lanes) width requirements for hardtop roads are outlined below in Table 6.1.

Table 6.1: Tolerable & Recommended Surface Widths for Hardtop Roads (Based on Criteria in the TAC *Geometric Design Guide for Canadian Roads*)

Roadside Environment	Design Speed (km/h)	Road Surface Width (Two-Lane Roadways)			
		Tolerable Lower Limit	Recommended Lower Limit	Recommended Upper Limit	Tolerable Upper Limit
Rural or Semi-Urban[1]	60 or less	5.4 m	6.0 m	7.4 m	8.0 m
	70 to 100	6.5 m[2]	7.0 m	7.4 m	8.0 m
Urban	60 or less	5.4 m	6.0 m	7.4 m	8.0 m
	70 to 100	6.0 m	6.6 m	7.4 m	8.0 m

1. It is assumed that the Design Hour Directional Volume is less than or equal to 450 vehicles per direction per hour (vpdph) on all rural and semi-urban road sections in the Township.
2. For rural or semi-urban roadways with a design speed of 70 to 100 km/h, a minimum tolerable surface width of 3.25 metres per lane was applied, which is consistent with minimum width criteria for secondary highways with an AADT less than 1,000 vpd outlined in the *Geometric Design Standards for Ontario Highways* (Ministry of Transportation Ontario, 1989).

The minimum gravel road surface widths (i.e., platform width, including shoulders) have been assessed according to criteria outlined in the *Geometric Guidelines for Municipal Roads* (Ontario Good Roads Association [OGRA], 1998). The recommended minimum platform width requirements for gravel roads are outlined below in Table 6.2

Table 6.2: Recommended Minimum Platform Widths for Gravel Roads (Based on Criteria in the OGRA *Geometric Guidelines for Municipal Roads*)

Design Speed (km/h)	Minimum Platform Width for Varying AADT Traffic Volume Ranges (Vehicles per Day) [1]				
	<50 vpd	50 – 249 vpd	250 – 399 vpd	400 – 999 vpd	1,000 – 2,000 vpd
80	5.5 m	6.0 m	6.5 m	7.5 m	7.5 m
70				7.0 m	7.0 m
60				6.5 m	6.5 m
50				6.0 m	6.5 m
40				6.0 m	6.0 m

1. Widths outlined in the table exclude road rounding.

The hardtop road sections reviewed in this RMP which do not meet the minimum tolerable road widths outlined above are the following:

- High Street - from William Street to Main Street (Section 185).
- Church Street - from Main Street to end of road (Section 200).
- Addeson Street - from George Street to Lloyd Street (Section 186).
- Lloyd Street - from Addeson Street to Main Street (Section 187).
- George Street - from Addeson Street to Main Street (Section 188).
- Mill Lane - from Main Street to end of road (Section 195).

All of the gravel roads that were reviewed in this RMP were found to have acceptable widths, both as gravel roads and to support the potential upgrading of these roads to asphalt.

For rural hardtop roads, the provision of sufficient shoulder widths is necessary to ensure proper support for the pavement surface and to ensure a sufficient buffer between traffic and embankment slopes to maintain safety. For higher traffic volumes, a wider shoulder may also be provided to allow for space for disabled vehicles. MTO's desirable design standards for various traffic volumes are as follows:

- Traffic volumes < 1000 vpd – 1.5 m shoulders.
- Traffic volumes 1000 to 3000 vpd – 2.5 m shoulders.
- Traffic volumes >3000 vpd – 3.0 m shoulders.

A minimum shoulder width of 0.5 metres is required to meet the requirements for pavement edge support.

Based on consultation with Township staff, it was identified that various segments of 3rd Line OS have limited shoulder widths. It is recommended that widths be considered for upgrading to meet tolerable standards for roads that are being rehabilitated or reconstructed, considering site-specific requirements.

6.2 Drainage

Historical and existing drainage issues (e.g., flooding, ponding) were identified based on discussions with Township staff. In general, the Township does not have a history of flooding on any of their roads. The Township undertakes brushing as part of their regular maintenance practices, which allows for roadside ditches to function and which promotes the drying of the roads and ditches.

Ditching was completed in 2018/2019 on the following road sections:

- 5th Line OS - from 20th Sideroad to County Road 21 (Section 161).
- 5th Line OS - from County Road 21 to Sideroad 250 (Section 1452).

Where road works are proposed, it is recommended that additional investigations be completed to determine the requirements for drainage improvements. It is recognized that the practicality of achieving sufficient drainage outlets may constrain the opportunities to improve roads in some areas with drainage issues. However, considering the importance of proper drainage in achieving the performance of the roads, effort should continue to be made to improving these outlets, possibly through mechanisms such as petitions under the Drainage Act.

6.3 Maintenance Considerations

Maintenance demands (e.g., low, average, high) is not a primary consideration in the prioritization of road sections for improvements, however is an additional item that may be considered by the Township when reviewing maintenance requirements.

In general, gravel roads in the Township maintain an adequate condition after they are graded and dust suppressant is applied.

Based on discussions with Township staff, the following road sections have above-average (i.e., high) maintenance demands, due to their current condition:

- Cold patching is required regularly on the following roads:
  - 5th Line OS between County Road 17 and County Road 21 (Sections 94, 101, 1492, 159, 1493, 160 and 161).
  - 3rd Line OS between Sideroad 15 and Sideroad 20 (Sections 1467 and 102).
- It is expected that a higher level of cold patch maintenance will be required on the following roads:
  - 260 Sideroad between Highway 10 and 7th Line SW (Sections 107, 26, 25, 24, 29,32 and 31).
  - 7th Line SW between Highway 89 and Sideroad 260 (Sections 143, 142, 111 and 1489).

7.0 Road Improvement Needs

7.1 Gravel Road Needs and Review of Potential Gravel Road Upgrades to Hardtop Surfaces

A total of approximately 15 km of gravel roads were reviewed in this study, consisting of segments of 4th Line NE, 5th Line OS and 8th Line NE, as shown on the map in Appendix A.

Table 7.1 outlines the gravel road sections reviewed in this study, including each road section's estimated existing AADT volume and estimated GUPI value (according to the criteria and methodology outlined in Section 5.8.3). In addition, each gravel road section outlined in Table 7.1 has been sorted according to its estimated GUPI value, in order to demonstrate which sections have higher priority for upgrading to a hardtop surface (i.e., road sections with higher relative GUPI values have a higher perceived need for a hardtop surface).

Table 7.1: Gravel Road Sections, Sorted by Gravel Upgrade Priority Index (GUPI) Values

Section ID	Road Name	From	To	Existing AADT Volume (vpd)	Traffic Count Year	GUPI
1452	5th Line OS	County Road 21	30th Sideroad	222	2019	40
1519	5th Line OS	30th Sideroad	Sideroad 240	222	Estimate	40
1520	5th Line OS	Sideroad 240	County Road 9	222	Estimate	40
1511	8th Line NE	Sideroad 240	County Road 9	145	2018	15
1603	8th Line NE	County Road 9	Townline	125	Estimate	15
1440	8th Line NE	5th Line OS	Sideroad 250	196	2019	10
1441	8th Line NE	Sideroad 250	Sideroad 240	125	Estimate	10
1596	4th Line NE	Sideroad 240	1 km N of Sideroad 240	150	Estimate*	10
1594	4th Line NE	Sideroad 250	Sideroad 240	150	Estimate	5
1595	4th Line NE	County Road 21	Sideroad 250	149	2019	0

* This road section had a traffic count completed in 2018, however this was before the asphalt road surface was reverted to gravel. Thus, a post-2018 (gravel road) AADT estimate has been applied.

As shown in Table 7.1, all gravel roads reviewed in this study have GUPI values that reflect low priority for conversion to a hardtop surface, based on their traffic volumes, truck volumes, maintenance requirements and driveway densities. In addition, maintaining these as gravel roads is expected to reduce capital and maintenance costs over the long term. For the most part these gravel roads have good PCI ratings, good road structure, acceptable road alignment, road widths and drainage, which could accommodate their upgrading to hardtop roads, if required.

Note that for all existing gravel road sections analyzed below, a primary consideration / factor is that it is expected that maintaining these as gravel roads will reduce capital and maintenance costs over the long term, compared to a hardtop road surface.

5th Line OS: From a network continuity perspective, the paving of the gravel road sections of 5th Line OS (i.e., ID numbers 1452, 1519 and 1520) completes a north-south hardtop connection running parallel to Dufferin Road 124 between Grey Road 9 and

Dufferin Road 21, as well as to Dufferin Road 17 (i.e., via the existing paved sections of 5th Line OS). These sections currently have traffic volumes that exceed 200 vpd. The potential for this road attracting additional traffic as a result of upgrading to a hardtop surface may be limited, considering origin-destination considerations and alternate county road routes in this area. Given the limited budgets for upgrading the level of service of roads within the Township, the upgrade of these sections of the 5th Line OS is not recommended at this time.

4th Line NE: From a network continuity perspective, alternate asphalt roads exist in the vicinity of 4th Line NE that could accommodate traffic in this area, including Dufferin Road 21, Highway 10 and 5th Line OS. The existing gravel surface sections of 4th Line NE are sections #1594, 1595 and 1596 (between Dufferin Road 21 and 1 km north of Sideroad 240). Based on 2019 traffic volume data, the AADT on the existing gravel road section of 4th Line NE between County Road 21 and Sideroad 250 is only 149 vpd, which is relatively low. Also, it is likely that upgrading these sections of 4th Line NE would result in an increase in traffic volumes, since greater volumes of drivers would re-route to these road sections as a result of a new hardtop surface. However, ideally external drivers (i.e., drivers who do no reside on 4th Line NE or roads intersecting 4th Line NE) will utilize the upper-tier road network (i.e., county and provincial roads) in order to travel through the Township, rather than local roads under the Township's jurisdiction. Therefore, for the above reasons, it is recommended that sections #1594, 1595 and 1596 of 4th Line NE (between County Road 21 and 1 km north of Sideroad 240) remain gravel.

8th Line NE: From a network continuity perspective, the paving of the gravel surface 8th Line NE sections (i.e., ID numbers 1511, 1603 and 1440) would provide an additional connection between Dufferin Road 21 and Dufferin Road 9. However, this road currently has relatively low traffic volumes (less than 200 vpd). As noted previously, external drivers should use upper-tier hardtop roads to travel through the Township, rather than use 8th Line NE as a "shortcut" between Grey Road 9 and Dufferin Road 21. Therefore, the upgrade of these sections of the 8th Line NE is not recommended at this time.

Although none of the above road sections are recommended to be upgraded to hardtop surfaces at this time, it is recommended that traffic volumes and maintenance costs continue to be monitored in the future to reassess the cost-benefit of potential upgrading, as conditions change and subject to budget availability.

The surface type recommendations for the gravel roads reviewed are shown on the map in Appendix D.

7.2 Hardtop Road Needs and Review of Potential Hardtop Road Downgrades to Gravel Surfaces

Based on the existing road condition data collected in the field in Spring 2019, the hardtop road improvement needs were determined according to the improvement trigger criteria outlined in Table 5.3 (Section 5.2).

It has been estimated that the existing cost of hardtop road needs in the Township is approximately $8 million. Table 7.2 below summarizes the hardtop road needs by improvement types.

Table 7.2: Township of Melancthon Hardtop Road Needs

Improvement Need Type	Amount of Hardtop Road Needs		
	Cost (in CAD Dollars)	Length (in kilometres)	Percentage of Total Length
Routine Maintenance	$81,781	16.3	21.4%
Preventive Maintenance	$280,053	11.2	14.7%
Resurface	$191,658	2.0	2.6%
Rehabilitation	$4,994,751	37.7	49.4%
Reconstruction	$2,502,444	9.1	11.9%
Total	**$8,050,867**	**76.3**	**100.0%**

Table 7.3 provides a qualitative condition summary based on the PCI ranges of all hardtop roads in the Township.

Table 7.3: Qualitative Description of Road Network

PCI Range	Condition	Length of Road (Centerline km)	Percentage of Total Length
90 to 100	Excellent	25.1	32.9%
75 to 89	Good	17.6	23.1%
65 to 74	Fairly Good	5.3	6.9%
50 to 64	Fair	20.6	27.0%
Below 50	Poor	7.7	10.1%
Total	**-**	**76.3**	**100.0%**

Based on the criteria outlined in Section 5.8.1, all existing hardtop road sections in the Township have been reviewed in the context of potential reversion to a gravel road surface. One of the primary considerations in deciding whether a hardtop or gravel road surface is more appropriate for any given road section is the daily traffic volume that a road receives. Therefore, all existing rural hardtop road sections with AADT volumes less than 200 vpd have been listed in Table 7.4 below, for the purpose of outlining hardtop road sections in the Township which may warrant reversion to a gravel road surface. However, note that analyzing traffic volumes alone is not enough to conclude whether or not any given section warrants a hardtop surface. Urban and semi-urban

road sections with AADT volumes less than 200 vpd have not been included in Table 7.4, since the recommended surface type for such roadside environments is hardtop.

The road sections outlined in Table 7.4 provide direction to the Township on which roads may warrant reversion based on traffic volumes, in conjunction with a review of other factors such as truck volumes, widths, alignments, drainage, and road structures. In addition, each hardtop road section outlined in Table 7.4 has been sorted according to its estimated GUPI value, in order to demonstrate which sections may have higher priority for reversion to gravel surfaces (i.e., road sections with lower relative GUPI values have a lower perceived need for a hardtop surface).

Table 7.4: Hardtop Road Sections with AADT Volumes Less Than 200 vpd, Sorted by Gravel Upgrade Priority Index (GUPI) Values

Section ID	Road Name	From	To	Existing AADT Volume (vpd)	Traffic Count Year	GUPI
1489	7th Line SW	Sideroad 270	200m S of Sideroad 260	177	2019	5
95B	4th Line OS	Strada Pit North Entrance	15th Sideroad	79	2019	20
194	15th Sideroad	County Road 124	Main Street	125	Estimate	20
1345	20th Sideroad	3rd Line	County Road 124	164	2019	20
1490	3rd Line OS	20th Sideroad	County Road 21	107	2019	25
95A	4th Line OS	County Road 17	Strada Pit North Entrance	125	Estimate	25
1491	15th Sideroad	Main Street	East End of Hardtop	125	Estimate	25
176	15th Sideroad	3rd Line	County Road 124	125	Estimate	25

Maintaining these as gravel roads is expected to reduce capital and maintenance costs over the long term. In addition, based on qualitative information provided by Township staff, it is understood that most of the hardtop roads are assumed to have relatively poor road structure, for which it may be more cost-effective to maintain as gravel road surfaces.

Discussed below are existing hardtop roads (with any AADT volume) that have been assessed in further detail with regards to potential reversion to gravel surfaces.

4th Line NE: From a network continuity perspective, alternate routes exist in the vicinity of section #65 (4th Line NE between County Road 21 and 5th Line OS) that could accommodate traffic in this area, including County Road 21 and 5th Line OS, which both

consist of asphalt surfaces. Based on a traffic count collected in 2019, the existing AADT on section #65 is 257 vpd, which is relatively low. Also, it is likely that reverting section #65 to gravel would result in a reduction in traffic volumes, since greater volumes of drivers would re-route to the existing hardtop roads in the area. This is considered to be particularly true for section #65, since it appears to provide drivers with an alternate connection between County Road 21 and County Road 9 / County Road 2. However, ideally external drivers (i.e., drivers who do no reside on 4th Line NE or roads intersecting 4th Line NE) will utilize the upper-tier road network (i.e., county and provincial roads) in order to travel through the Township, rather than local roads under the Township's jurisdiction. Therefore, for the above reasons, it is recommended that section #65 of 4th Line NE (between County Road 21 and 5th Line OS) be considered for reversion to gravel once the existing hardtop surface deteriorates to a condition level where a gravel surface would be preferred. The estimated cost to downgrade section #65 of 4th Line NE is approximately $147,000 (assuming the road base is good).

Alternate routes exist in the vicinity of section #72 (4th Line NE between County Road 9 and 1 km north of Sideroad 240) that could accommodate traffic in this area, such as Highway 10 and County Road 9. The existing AADT is relatively low at 289 vpd. Therefore, it is recommended that this section be reverted to gravel once the existing hardtop surface deteriorates to a condition level where a gravel surface would be preferred. Based on the road sections current condition, it is expected that this may occur in the 2040-2045 horizon, assuming that appropriate treatments are applied to the road section at the appropriate time in its lifecycle. The estimated cost to downgrade section #72 of 4th Line NE is approximately $60,000 (assuming the road base is good).

7th Line SW: The sections of 7th Line SW between Highway 89 and 200 metres south of Sideroad 260 (i.e., section IDs #1489, 111, 142 and 143) have traffic volumes that are less than 220 vpd, which is relatively low. If these sections of 7th Line SW were to revert to gravel, it is probable that traffic volumes would reduce to less than 200 vpd. Alternate hardtop road routes exist for existing residents to get to/from the community of Riverview (i.e., Sideroad 260 via 2nd Line SW or Highway 10). Based on consultation with Township staff, it is expected that future growth in the community of Riverview will be minimal. The costs required to maintain the hardtop road condition to a tolerable state may outweigh the benefits, when compared to gravel road surface. Therefore, for the above reasons, it is recommended that sections #1489, 111, 142 and 143 of 7th Line SW (between Highway 89 and 200 metres south of Sideroad 260) be considered for reversion to gravel once the existing hardtop surface deteriorates to a condition level where a gravel surface would be preferred (expected within the next five years, considering the existing condition of 7th Line SW). The estimated total cost to downgrade the aforementioned sections of 7th Line SW (between Highway 89 and 200 metres south of Sideroad 260) is approximately $261,000 (assuming the road base is good).

4th Line OS: The sections of 4th Line OS between County Road 17 and 15th Sideroad (i.e., ID #95A from County Road 17 to Strada Pit North Entrance, and ID #95B from Strada Pit North Entrance to 15th Sideroad) provide connections to the Strada Pit. The north section (i.e., ID #95B) has relatively low traffic volumes (79 vpd according to a 2019 traffic count), only provides network connectivity to existing gravel road sections (beyond the Strada Pit North Entrance) and is currently in poor condition. Therefore, it is recommended that section #95B of 4th Line OS (between the Strada Pit North Entrance and 15th Sideroad) be considered for reversion to gravel, at the time of any future condition improvements (expected within the next few years, considering the road section's existing condition). The south section (i.e., ID 95A) should continue to be hardtop, to serve heavy truck traffic generated by the Strada Pit.

15th Sideroad: The sections of 15th Sideroad between County Road 124 and the east limit (i.e., ID #194 from County Road 124 to Main Street, ID #176 from 3rd Line to County Road 124, and ID #1491 between Main Street and the east limit) provide network connectivity between Horning's Mills, County Road 124 and 3rd Line. There is also residential growth along this segment of 15th Sideroad. Therefore, it is recommended that these sections remain hardtop.

20th Sideroad: The section of 20th Sideroad between 3rd Line and County Road 124 (i.e., ID #1345) provides network connectivity between the hardtop sections of 3rd Line and Dufferin Road 124. Therefore, it is recommended that this section remain hardtop.

3rd Line OS: The 3rd Line OS between County Road 21 and Highway 10 provides a significant connectivity benefit throughout the Township. Also, the traffic volumes on 3rd Line OS are some of the highest in the Township, ranging from 107 vpd to 910 vpd, based on 2019 traffic count data. Section #1507, which is 3rd Line OS between Highway 10 and 5th Sideroad, is estimated to have the highest average traffic volume of all roads under the Township's jurisdiction (910 vpd). Therefore, it is recommended that these sections remain hardtop.

The surface type recommendations are shown on the map in Appendix D.

8.0 Ten-Year Capital Hardtop Road Improvement Plan

A ten-year hardtop road capital plan was developed based on the current road improvement needs in the Township, in addition to a strategy that strives to significantly improve the Township's overall hard-top road network condition by year 2029.

The Township's existing hardtop road budget was estimated based on information provided by the Township on their asphalt budget over the last five-year period (i.e., 2014-2018 inclusive). The specifics of the Township's asphalt budget from 2014 to 2018 are detailed in Table 8.1.

Table 8.1: Township of Melancthon Asphalt Budget – 2014 to 2018

Year	Budget Amount		Funding Allocated
	Hardtop Resurfacing	Patch Paving	
2014	$250,000	$180,000	$180,000 Gas Tax
2015	$250,000	$175,000	$100,000 Gas Tax
2016	$0	$200,000	$0
2017	$0	$200,000	$0
2018	$170,000*	$30,000	$60,000 Gas Tax
Total	**$670,000**	**$785,000**	**$340,000 Gas Tax**
Average	**$134,000**	**$157,000**	**$68,000 Gas Tax**

* includes $50,000 that was budgeted for paving of the shoulders on Main Street in Horning's Mills.

As shown in Table 8.1, the combined hardtop resurfacing and patch paving budget was $1.455M over the five-year period from 2014 to 2018, or an average of $291,000 per annum. The maximum combined asphalt budget during the 2014-2018 period was $430,000 in 2014, and the minimum amount was $200,000 in 2016, 2017, and 2018. The Township has indicated that they do not anticipate undertaking any road capital improvements in 2019, thus 2019 has been excluded from the above annual asphalt budget analysis to avoid skewing the annual averages (i.e., exclusion of the outlier).

The Township's existing overall hard-top road network condition was estimated to be 12.4 out of 20 (i.e., the weighted average SCR plus BCR value out of 20 was estimated to be 12.4 for the Township's hardtop road network, based on the existing condition data). The Township's existing hard-op road network condition of 12.4 out of 20 translates to a score of 6.2 out of 10. According to the *Township of Melancthon Asset Management Plan* (Burnside, May 2017), an infrastructure asset with a condition rating of 5 or 6 out of 10 represents an "average" condition. A condition score between 7 or 8 out of 10 is representative of a "good" road condition. Based on this criterion, it can be concluded that the Township's existing overall hardtop road network is in an "average" condition state.

In order to a improve the Township's overall hard-top road network condition to "good", a weighted average hardtop road network condition target of 16 out of 20 (i.e., 8 out of 10)

was set for horizon year 2029. To achieve this target, a ten-year plan was developed that consists of both capital and cost-effective maintenance improvement recommendations. A table and map summarizing the details of the recommended ten-year hardtop road improvement plan is contained in Appendix E.

By utilizing the improvements highlighted in the ten-year plan in addition to the ongoing degradation of other road assets (as described previously in this report), the overall weighted average hardtop road network condition was estimated to be 17.4 out of 20 (i.e., 8.7 out of 10) at year 2029. Note that the value of 17.4 out of 20 increased slightly due to the recommended reversion of some hardtop roads to gravel in the ten-year plan. By reverting existing hardtop roads to gravel, such roads are excluded from the overall hardtop road network, which alters the overall hardtop road network conditon. Therefore, it can be concluded that the ten-year plan developed by Burnside, as outlined in Appendix E, has been forecast to improve the Township's overall hardtop road network condition from "average" in 2019 to "good" by 2029.

It is estimated that the total cost to implement the 10-year plan will be approximately $5.29M, or an average of approximately $529,000 per year. This reflects an increase of approximately $238,000 per year above the existing annual budget amount of $291,000, or an increase of approximately 82%. It is understood that this budget is significantly higher than the Township's existing budget. However, a significant increase in budget is required in the next decade to reduce the existing capital need backlog.

The ten-year plan developed is forecast to significantly improve the hardtop road network condition by 2029. After the first decade, less capital will be required annually to maintain the Township's "good" overall hardtop road network condition, since the focus will shift towards incorporating more cost-effective maintenance treatments at the right times (in addition to some capital improvements) in order to sustain an overall "good" hardtop road network condition. Section 9.0 of this RMP includes a long-term (20-year) budget sensitivity analysis, which utilized the ten-year plan outlined above as a subset of the 20-year analysis to determine that an average annual budget of approximately $315,000 per year is required to maintain an overall "good" hardtop road network condition over the 20-year period.

8.1 Coordination with Bridge Projects

For budget allocation and phasing purposes, coordination with planned bridge and road improvement projects in the Township has been considered. Construction detours may also be a consideration in the scheduling / interface of road and bridge improvement projects. The preliminary recommendations for bridge rehabilitation or replacement, as set out in the Township's *2019 Municipal Bridge Inspection Report* (Burnside, 2019) is summarized in Table 8.2.

Table 8.2: Preliminary Bridge Improvement Plan

Structure No./Name	Road Name	Recommended Work	Estimated Construction Cost
2020			
004	5th Sideroad	Replace or Close Road	$714,500.00 (Replace) $0.00 (Close Road)
2013	30th Sideroad	Replace	$474,500.00
011	8th Line SW	Rehabilitate	$401,500.00
2021			
2023	4th Line NE	Rehabilitate	$187,000.00
013	260 Sideroad	Rehabilitate	$421,000.00
2022			
007	7th Line SW	Rehabilitate	$255,000.00
006	4th Line SW	Rehabilitate (Waterproof & Pave)	$57,000.00
2023			
018	2nd Line NE	Rehabilitate	$282,500.00
2021	2nd Line NE	Replace	$594,500.00
2024			
016	250 Sideroad	Rehabilitate	$339,000.00
		Total	**$3,726,500.00**

The following recommendations made in the ten-year road improvement plan were also made in the *2019 Municipal Bridge Inspection Report*:

- 4th Line NE – the section between 5th Line OS and Dufferin Road 21 is scheduled in year 2029 of the ten-year road improvement plan for reversion to gravel. The bridge on this road section is also recommended to be rehabilitated in 2021. There is significant time differential between these two improvement recommendations (i.e., eight years), and reverting the road to gravel is not anticipated to interfere with the bridge work, since the surface of the bridge will remain hardtop, and pulverizing the road section will terminate a certain distance from each of the bridge approaches. Therefore, coordination between the road and bridge improvements is not required.
- 260 Sideroad – the section between 4th Line SW and 7th Line SW is scheduled in year 2029 of the ten-year road improvement plan for a rehabilitation (hardtop surface). The bridge on this road section is also recommended to be rehabilitated in 2021. There is significant time differential between these two improvement recommendations (i.e., eight years), and given the location of the bridge in the community of Riverview, it is believed that separating the road and bridge improvements in separate years is preferred since this will reduce temporary

driveway access restrictions for residents of Riverview while the work is being undertaken. Therefore, coordination between the road and bridge improvements is not required.

- 7th Line SW – the section between Sideroad 270 and 200 metres south of Sideroad 260 is scheduled in year 2023 of the ten-year road improvement plan for reversion to gravel. The bridge improvement recommendation (in year 2022) on 7th Line SW is not made on this road section, since the bridge is located only approximately 100 metres south of Sideroad 260 (i.e., approximately 100 metres north of the end of the aforementioned road section). Given the location of the bridge in the community of Riverview, it is believed that separating the road and bridge improvements in separate years is preferred since this will reduce temporary driveway access restrictions for residents of Riverview while the work is being undertaken. Also, note that the hardtop road reversion (to gravel) is recommended to terminate approximately 200 metres south of Sideroad 260, thus a hardtop surface will remain for approximately 100 metres south of the bridge. Therefore, coordination between the road and bridge improvements is not required.

Based on the above conclusions, any coordination would be limited to budget allocation between road and bridge projects in any particular year.

9.0 Long-Term (20-Year) Hardtop Road Budget Requirements

As concluded in Section 8.0, as a result of following Burnside's recommended ten-year hardtop road capital and maintenance improvement plan, it has been forecast that the Township's overall hardtop road network condition will improve from 12.4 (out of 20) in 2019 to 17.4 (out of 20) in 2029. Thus, the Township's overall hardtop road network condition is forecast to change from an "average" to "good" state after implementation of the ten-year plan.

Burnside has conducted a sensitivity analysis to estimate the annual budget in horizon years 11 to 20 (i.e., 2030 to 2039) required to sustain the Township's "good" overall hardtop network condition over the long-term. To do this, the sensitivity analysis assessed the annual budget required to maintain a rating above 16 out of 20 (or 8 out of 10) until the end of the 20-year period. It is understood that the combined condition value by year 2029 was forecast to be 17.4 out of 20 (i.e., 8.7/10) after completion of the ten-year plan outlined in Section 8.0, however it is believed that a combined condition target of 16 out of 20 (i.e., 8/10) is a realistic, attainable and sustainable long-term condition target for the Township, considering budgets and the existing condition of hardtop roads.

To summarize, the following steps were employed in conducting the 20-year budget sensitivity analysis:

1. Starting in year 2020, the SCR and BCR values for every hardtop road section in the Township were degraded based on the degradation formula outlined in Section 5.5. The ongoing degradation of road sections was considered until horizon year 2039 (i.e., for each year analyzed). For any road sections that were modelled to receive improvements, degradation formulae were applied to the road section's newly improved SCR and BCR values in the following analysis years.

2. Based on the degraded SCR and BCR values, a weighted average combined SCR plus BCR value was determined in every analysis year, based on the degraded SCR and BCR values.

3. The PGN value, improvement type need, and improvement need cost were all updated for each road section in any given year based on the degraded SCR and BCR values.

4. Road sections were sorted by their PGN values from highest to lowest.

5. The road sections with the highest PGN values had their respective improvement type needs and costs applied in the model. This includes the application of cost-effective maintenance treatments, which oftentimes had higher PGN values than other road sections with resurfacing or rehabilitation needs. After each

improvement type was applied to a given road section, the SCR and BCR values were increased by the amounts outlined in Table 5.3 (Section 5.2).

6. Repeat step 5 until the weighted average combined SCR plus BCR value for all hardtop roads in the Township equated (i.e., balanced) to at or above 16 out of 20 in each consecutive year (i.e., in each analysis year between 2030 and 2039). This was done to ensure that the weighted average combined SCR plus BCR value equated to 16 out of 20 (or 8 out of 10) in year 2039.

7. The cost of all treatments applied between 2020 and 2039 were added in order to obtain the total dollar amount spent to balance the weighted combined SCR plus BCR value of 16.0 in year 2039. This total dollar amount was divided by 20 in order to obtain the annual average amount required to sustain the weighted combined SCR plus BCR value of 16.0 in year 2039.

As identified previously, the Township spent an average of $291,000 per year between 2014 and 2018 (inclusive) on hardtop (asphalt) capital improvement projects. This amount excluded any funding towards cost-effective routine and preventive maintenance treatments.

Based on the above methodology, it was estimated that a 20-year annual average of approximately $315,000 per year, or a 20-year total amount of $6.3M, is required to achieve and sustain an overall hardtop road condition score of 8 out of 10 by year 2039. This amount includes the improvements outlined in the comprehensive ten-year plan outlined in Section 8.0 as a subset and combines both capital and maintenance improvements in order to simulate the largest benefits at the lowest costs. This represents an increase of approximately $24,000 per year above current hardtop road budget amounts, or 8.2% over the 20-year period. Therefore, it is forecast that the Township's current funding amount on hardtop road improvements will not be enough to meet the required road needs or close the funding gap.

It is recommended that the Township increase their annual investment on hardtop roads over the next decade to try to meet the target average $530,000 per year amount, and that the Township continue to actively pursue all available capital grants and other funding sources for such work. The first ten years of the recommended Road Management Plan will require the Township to access other funding sources to cover the costs of the remaining hardtop road improvements. This will get the Township back on appropriate levels of service and develop a sustainable hardtop road network.

Once into the horizon second half of the 20-year plan, it will be important for the Township to continue to set aside funds in road capital reserves to ensure that a similar backlog of road improvements does not occur. As identified in the *Township of Melancthon Asset Management Plan*: "while the annual funding requirement may fluctuate, it is important for the Township to implement a consistent, yet increasing,

annual investment in capital so that the excess annual funds accrue in capital reserve funds" (Burnside, May 2017).

The Township does not currently have an annual budget specific to routine and preventive maintenance treatments for hardtop roads (e.g., crack sealing, micro-surfacing, slurry sealing etc.). However, both the ten-year plan that was developed (at an average of $530,000 per year) and the 20-year sensitivity analysis (at an average of $315,000 per year) consider and include maintenance treatments. Best practice indicates that such treatments applied on roads with good bases can provide extended life and are cost-effective in reducing the overall lifecycle expenditures on such roads. Therefore, it is recommended that the Township begin incorporating maintenance treatments on hardtop roads (within the aforementioned recommended budgets). Such maintenance treatments may be implemented as demonstration (i.e., test) projects initially, with ongoing monitoring to gauge their effectiveness. Other Dufferin County municipalities are testing various maintenance treatments and can be contacted to pool resultant information.

10.0 Summary, Conclusions and Recommendations

The following primary conclusions and recommendations of this RMP are as follows:

- The updated inventory and road needs assessment in this RMP provides a basis for the updating of the Township's Asset Management Plan, as required by Ontario Regulation 588/17.
- Approximately 91 centreline kilometres of road were reviewed (approximately 76 km of hardtop roads and 15 km of gravel roads).
- Annual Average Daily Traffic (AADT) volumes and traffic growth estimates were updated for the roads reviewed.
- A field evaluation was completed on the condition of the roads, based on methodologies provided by the Ontario Good Roads Association (OGRA) and the Ministry of Transportation for Ontario (MTO). The following parameters were established for each road section: Pavement Condition Index (PCI), Ride Comfort Rating (RCR), Surface Condition Rating (SCR) and Based Condition Rating (BCR).
- Lifecycle improvement needs and costs were identified for each road section, based on their condition needs, traffic volumes, roadside environment and surface type.
- Priority Guide Numbers (PGN) were calculated for each road section, based on their condition, traffic volumes and improvement costs, to establish their relative priority for improvement (i.e., the strategy for applying the most cost-effective improvements, considering best practices for lifecycle improvements and budget limitations).
- Road degradation formulae was developed to assess the impacts on road conditions and long-term budget implications.
- For roads with less than 400 vpd, it was concluded that gravel roads may have present worth cost reductions in the order of $40,000 to $50,000 per km over hardtop roads (i.e., capital and maintenance costs), assuming a 60-year lifecycle. However, other factors such as network connectivity, dust control, and traffic diversion should also be considered when assessing potential surface type conversions.
- A Gravel Upgrade Priority Index (GUPI) was calculated to compare the relative priority of gravel roads to be upgraded to hardtop surfaces, or priority of hardtop roads to be downgraded to gravel surfaces, based on traffic volumes, truck volumes, maintenance requirements, and driveway densities.
- Vertical curve deficiencies have been identified on the following road sections:
  - 3rd Line OS - from Highway 10 to 5th Sideroad (Section 1507).
  - 3rd Line OS - from 5th Sideroad to 2 km north of 5th Sideroad (Section 93).
  - 3rd Line OS - from 2 km north of 5th Sideroad to County Road 17 (Section 544).
  - 3rd Line OS - from County Road 17 to 15th Sideroad (Section 96).
  - 3rd Line OS - from 15th Sideroad to 1.5 km south of 20th Sideroad (Section 1467).
  - 3rd Line OS - from 1.5 km south of 20th Sideroad to 20th Sideroad (Section 102).
- Appropriate warning signage should be applied at all vertical deficiency locations, and any future road improvement projects at these locations should consider reducing the magnitude of the vertical deficiency.

- The following road sections reviewed in this RMP do not meet minimum tolerable road widths:
  - High Street - from William Street to Main Street (Section 185).
  - Church Street - from Main Street to end of road (Section 200).
  - Addeson Street - from George Street to Lloyd Street (Section 186).
  - Lloyd Street - from Addeson Street to Main Street (Section 187).
  - George Street - from Addeson Street to Main Street (Section 188).
  - Mill Lane - from Main Street to end of road (Section 195).

  It is recommended that when road sections which have deficient widths are rehabilitated or reconstructed, that widths be upgraded to meet minimum acceptable standards.
- In general, the Township does not have flooding issues on their roads. However, as part of the design for any future improvements, it is recommended that detailed investigations be completed to determine drainage requirements.
- A number of roads were identified to have high maintenance demands (i.e., cold patching requirements), including part of 5th Line OS, 3rd Line OS, Sideroad 260 and 7th Line SW.
- None of the existing gravel road sections that were reviewed in this RMP are recommended for upgrading from gravel surface to hardtop at this time.
- It is recommended that the Township consider reverting the following existing hardtop road sections to gravel, once the existing hardtop surfaces deteriorate to a point where rehabilitation is required:
  - 4th Line NE between 5th Line OS and Dufferin Road 21 (section ID #65).
  - 4th Line NE between County Road 9 and 1 km north of Sideroad 240 (section ID #72).
  - 7th Line SW between Highway 89 and 200 metres south of Sideroad 260 (section IDs #1489, 111, 142 and 143).
  - 4th Line OS between the Strada Pit North Entrance and 15th Sideroad (section #95B).
- Approximately 65% of the Township's hardtop roads were found to be in fairly good to excellent condition, 25% in fair condition and 10% in poor condition. The existing cost of hardtop road needs, based on condition, is estimated to be $8.05M.
- A comprehensive ten-year (2020 to 2029) road capital and maintenance improvement plan was recommended, using an average cost of $529,000 per year. A significant budget increase is required over the next decade in order to reduce the existing capital need backlog. As a result of implementing the recommended ten-year improvement plan, it is forecast that the Township's overall hardtop road network will improve significantly from an "average" (6.2 out of 10) to "good" (8.7 out of 10) condition state by 2029. Details regarding the ten-year improvement plan can be found in Appendix E.
- A sensitivity analysis was completed to determine the funding level required to sustain the Township's forecast "good" overall hardtop road network condition over a

20-year period. The cost to maintain a “good” condition level over the next 20 years (i.e., an overall hardtop network condition at or above 8 out of 10 through year 2039) is forecast to be approximately $315,000 per year. The 20-year analysis assumes the aforementioned ten-year plan as a subset of the 20-year period, thus it can be concluded that the annual budget required to maintain the “good” network condition (after spending more than usual over the first ten years to reduce the capital need backlog and achieve a “good” overall network condition) is significantly less between years 11 to 20, when compared to the first ten year period. This reflects the shifting of focus from primarily costly capital improvements to more cost-effective maintenance treatments after a “good” overall condition state is reached, so that this condition state is sustainable over the long-term.

- The Township does not currently have an annual budget specific to routine and preventive maintenance treatments for hardtop roads (e.g., crack sealing, micro-surfacing, slurry sealing etc.). However, both the ten-year plan that was developed (at an average of $530,000 per year) and the 20-year sensitivity analysis (at an average of $315,000 per year) consider and include maintenance treatments. Best practice indicates that maintenance treatments applied on roads with good bases can provide extended life and are cost-effective in reducing the overall lifecycle expenditures on such roads. Therefore, it is recommended that the Township begin incorporating maintenance treatments on hardtop roads (within the aforementioned recommended budgets). Such maintenance treatments may be implemented as demonstration (i.e., test) projects initially, with ongoing monitoring to gauge their effectiveness.

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Appendix A

Existing Road Surface Types Map

BURNSIDE

Map Title

ROAD MANAGEMENT PLAN

EXISTING SURFACE TYPE

Client

TOWNSHIP OF MELANCTHON

Drawn	Checked	Date	Figure No.
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Appendix B

Road Inventory Table

Township of Melancthon Road Management Plan
Road Inventory Table
All Hardtop Roads and Select Gravel Roads

Line No.	Asset ID	Road Name	Road From	Road To	Length of Road (m)	Road Width (m)	Road Material	Road Environment	Road Surface Remaining Useful Life	Estimated Road Replacement Costs	Existing AADT Volume (vpd)	Existing AADT Range (vpd)	Count Year	Percent Trucks	10-Year Percent Traffic Growth	Year 10 AADT Volume (vpd)	Ride Comfort Rating (RCR)	Pavemenet Condition Index (PCI)	Surface Condition Rating (SCR)	Base Condition Rating (BCR)	Existing (2019) Improvement Need (Based on Treatment Matrix Criterion)	Total Improvement Cost	Priority Guide Number (PGN)	Vertical Deficiencies?	Deficient Width?	Field Notes	Construction History - Treatment(s)
1	176	15th Sideroad	3rd Line	County Rd. 124	1142	6.5	Asphalt	Rural	3	$314,216	125	50-199	Estimate	Unknown	10.46%	138	7	80.3	5	5	Rehabilitation	$113,052	10.2				
2	194	15th Sideroad	County Rd. 124	Main St.	227	6.5	Asphalt	Rural	24	$62,458	125	50-199	Estimate	Unknown	10.46%	138	9	98.5	9	10	Routine Maintenance	$1,107	2.2				
3	1491	15th Sideroad	Main St.	East	691	6.5	Cold Recycled	Rural	3	$190,125	125	50-199	Estimate	Unknown	10.46%	138	3	56.8	10	2	Rehabilitation	$68,406	8.1			Significant patching	
4	1345	20th Sideroad	3rd Line	County Rd. 124	1378	6.5	Asphalt	Rural	24	$379,150	164	50-199	2019	8.20%	10.46%	181	10	99.0	9	10	Routine Maintenance	$6,718	2.9				Chip Seal (1991), Asphalt Resurfacing (1997)
5	32	260 (Main St.)	2nd Line SW	4th Line SW	2228	6.5	Asphalt	Rural	6	$613,023	263	200-399	2019	4.70%	10.46%	291	5	63.0	5	2	Rehabilitation	$291,812	21.1				Asphalt Resurfacing (1999)
6	31	260 (Main St.)	4th Line SW	7th Line SW	2013	6.5	Asphalt	Rural	6	$553,867	250	200-399	Estimate	Unknown	10.46%	276	5	63.0	5	2	Rehabilitation	$263,653	20.0				Asphalt Resurfacing (1999)
7	25	260 (Main St.)	Poulton	Manitoba	74	8	Asphalt	Urban	11	$40,061	450	400-999	Estimate	Unknown	10.46%	497	6	90.8	9	8	Routine Maintenance	$444	19.7				Asphalt Resurfacing (1999)
8	29	260 (Main St.)	Geirson	2nd Line SW	1526	6.5	Asphalt	Rural	5	$508,349	450	400-999	Estimate	Unknown	10.46%	497	5	63.0	5	2	Rehabilitation	$289,932	24.8				Asphalt Resurfacing (1999)
9	107	260 (Main St.)	Hwy. 10	Shook	418	8	Asphalt	Semi-Urban	11	$171,380	447	400-999	2019	5.50%	10.46%	494	6	90.8	9	8	Routine Maintenance	$2,508	19.6				Asphalt Resurfacing (1999)
10	24	260 (Main St.)	Manitoba	Geirson	159	8	Asphalt	Urban	11	$86,076	450	400-999	Estimate	Unknown	10.46%	497	6	90.8	9	8	Routine Maintenance	$954	19.7				Asphalt Resurfacing (1999)
11	26	260 (Main St.)	Shook	Poulton	153	8	Asphalt	Urban	11	$82,828	450	400-999	Estimate	Unknown	10.46%	497	6	90.8	9	8	Routine Maintenance	$918	19.7				Asphalt Resurfacing (1999)
12	82	2nd Line SW	250	North Limit	2350	6.5	Asphalt	Rural	2	$646,591	1127	1000-1999	2019	4.97%	21.90%	1374	2	57.5	6	2	Rehabilitation	$307,791	91.9			Average 0.5m shoulder	
13	81	2nd Line SW	260	250	2054	6.6	Asphalt	Rural	15	$573,842	980	400-999	2016	3.82%	21.90%	1195	7	95.0	9	10	Routine Maintenance	$10,167	18.3				
14	1509	2nd Line SW	270	260	2045	6.6	Asphalt	Rural	15	$691,721	835	400-999	2017	2.03%	21.90%	1018	7	95.0	9	10	Routine Maintenance	$10,123	15.6				
15	117	2nd Line SW	280	270	2028	6.5	Asphalt	Rural	15	$675,578	812	400-999	2018	7.74%	21.90%	990	8	96.9	9	10	Routine Maintenance	$9,887	15.4				Repave (Asphalt, 2006)
16	1351	2nd Line SW	300	County Rd. 17	1981	6.7	Asphalt	Rural	12	$680,226	812	400-999	Estimate	Unknown	21.90%	990	9	98.3	7	10	Resurface	$191,658	10.2			0.5m shoulder	
17	1278	2nd Line SW	County Rd. 17	280	2051	6.5	Asphalt	Rural	15	$683,239	812	400-999	Estimate	Unknown	21.90%	990	6	87.8	5	9	Rehabilitation	$389,680	22.8				Repave (Asphalt, 2009)
18	147	2nd Line SW	Hwy. 89	300	1799	6.8	Asphalt	Rural	2	$626,952	820	400-999	2019	2.50%	21.90%	1000	5	61.3	3	3	Rehabilitation	$357,576	51.4			1m shoulder	
19	102	3rd Line OS	1.5 km S of 20th Sideroad	20th Sideroad	1522	6.5	Asphalt	Rural	7	$418,771	200	200-399	Estimate	Unknown	21.90%	244	6	79.3	5	8	Rehabilitation	$199,344	9.5	Yes			Asphalt (1999)
20	1467	3rd Line OS	15th Sideroad	1.5 km S of 20th Sideroad	1523	6.5	Asphalt	Rural	7	$419,046	200	200-399	Estimate	Unknown	21.90%	244	6	79.3	5	8	Rehabilitation	$199,475	9.5	Yes			Asphalt (1999)
21	1490	3rd Line OS	20th Sideroad	County Rd. 21	3055	6.5	Asphalt	Rural	23	$840,568	107	50-199	2019	8.40%	21.90%	130	9	97.0	8	10	Preventive Maintenance	$59,573	1.9				Chip Seal (1991), Asphalt Resurfacing (2000)
22	93	3rd Line OS	5th Sideroad	2 km N of 5th Sideroad	2011	6.5	Asphalt	Rural	12	$669,914	493	400-999	2019	3.50%	21.90%	601	8	89.3	8	9	Preventive Maintenance	$52,286	9.7	Yes			Chip Seal (1996), Asphalt Resurfacing (1998), Repaved (2007)
23	1507	3rd Line OS	5th Sideroad	Hwy. 10	1650	6.5	Asphalt	Rural	15	$549,656	910	1000-1999	2019	3.30%	21.90%	1109	8	96.5	8	10	Preventive Maintenance	$42,900	11.9	Yes			Chip Seal (1988), Asphalt Resurfacing (1999)
24	96	3rd Line OS	County Rd. 17	15th Sideroad	3052	6.5	Asphalt	Rural	8	$839,743	229	200-399	2019	4.60%	21.90%	279	6	79.3	5	8	Rehabilitation	$399,736	10.9	Yes			Asphalt (1999)
25	544	3rd Line OS	County Rd. 17	2 km N of 5th Sideroad	1048	6.5	Asphalt	Rural	8	$349,115	493	400-999	2019	3.50%	21.90%	601	8	89.3	8	9	Preventive Maintenance	$27,248	9.7	Yes			Chip Seal (1996), Asphalt Resurfacing (1998), Repaved (2008)
26	72	4th Line NE	1 km N of Sideroad 240	County Rd 9/2	1300	8	Asphalt	Rural	23	$440,232	289	200-399	2018	6.29%	10.46%	319	9	95.3	8	10	Preventive Maintenance (Reversion to Gravel Recommended Once Road is in Rehabilitation Need)	$41,600	2.9				Asphalt (1994), Repaved (2002)
27	65	4th Line NE	5th Line OS	County Rd. 21	3937	6.5	Asphalt	Rural	15	$1,083,246	257	200-399	2019	5.50%	10.46%	284	7	68.8	6	5	Rehabilitation	$515,649	14.2				Repaved (Asphalt, 2007)
28	1595	4th Line NE	County Rd. 21	Sideroad 250	1634	8	Gravel	Rural	N/A	$284,708	149	50-199	2019	5.80%	10.46%	165	N/A	N/A	N/A	N/A							
29	1596	4th Line NE	Sideroad 240	1 km N of Sideroad 240	1000	8	Gravel	Rural	N/A	$174,240	289	200-399	2018	6.29%	10.46%	319	N/A	N/A	N/A	N/A							Asphalt (1994), Repaved (2002)
30	1594	4th Line NE	Sideroad 250	Sideroad 240	2443	8	Gravel	Rural	N/A	$425,668	150	50-199	Estimate	Unknown	10.46%	166	N/A	N/A	N/A	N/A							Asphalt (1995), Repaved (2002)
31	1494A	4th Line OS	5th Sideroad	Lot 9/10	2438	6.5	Asphalt	Rural	24	$670,804	300	200-399	Estimate	Unknown	21.90%	366	9	98.3	9	10	Routine Maintenance	$11,885	5.7				Asphalt (1997)
32	1274	4th Line OS	Abandon Rail	Hwy. 10	956	6.5	Asphalt	Rural	17	$263,039	330	400-999	2017	10.51%	21.90%	402	7	88.3	5	9	Rehabilitation	$125,212	13.4				Chip Seal (1995), Asphalt Resurfacing (1998), Repaved (2009)
33	95A	4th Line OS	County Rd. 17	Strada Pit North Entrance	1651	6.5	Asphalt	Rural	3	$454,264	125	50-199	Estimate	Unknown	21.90%	152	6	80.5	8	5	Rehabilitation	$163,441	7.8			Strada pit responsible for paving	Asphalt (1997)
34	1495	4th Line OS	Hwy. 10	5th Sideroad	713	6.5	Asphalt	Rural	24	$196,178	300	200-399	Estimate	Unknown	21.90%	366	9	98.3	9	10	Routine Maintenance	$3,476	5.7				Asphalt (1997)
35	1494B	4th Line OS	Lot 9/10	County Rd. 17	750	6.5	Asphalt	Rural	3	$206,359	300	200-399	Estimate	Unknown	21.90%	366	5	69.5	3	2	Rehabilitation	$98,231	30.6				Asphalt (1997)
36	95B	4th Line OS	Strada Pit North Entrance	15th Sideroad	1400	6.5	Asphalt	Rural	3	$385,203	79	50-199	2019	6.60%	21.90%	96	6	54.3	1	1	Reconstruction	$385,203	4.6				Asphalt (2000)
37	159	5th Line OS	15th Sideroad	Sideroad 270	1930	6.5	Asphalt	Rural	1	$531,030	237	200-399	2018	26.54%	21.90%	289	4	41.0	2	1	Reconstruction	$531,030	13.0				Chip Seal (1992), Asphalt Resurfacing (2000)
38	161	5th Line OS	20th Sideroad	County Rd. 21	1577	6.5	Asphalt	Rural	3	$433,904	226	200-399	2019	9.10%	21.90%	275	4	41.0	2	1	Reconstruction	$433,904	12.4				Chip Seal (1992), Asphalt Resurfacing (2000)
39	1519	5th Line OS	30th Sideroad	Sideroad 240	816	8	Gravel	Rural	N/A	$142,180	222	200-399	Estimate	Unknown	10.46%	245	N/A	N/A	N/A	N/A							
40	1492	5th Line OS	4th Line NE	15th Sideroad	570	6.5	Asphalt	Rural	1	$156,833	250	200-399	Estimate	Unknown	21.90%	305	4	41.0	2	1	Reconstruction	$156,833	13.8				Chip Seal (1992), Asphalt Resurfacing (1998)
41	160	5th Line OS	6th Line NE	20th Sideroad	466	6.5	Asphalt	Rural	1	$128,218	230	200-399	Estimate	Unknown	21.90%	280	4	41.0	2	1	Reconstruction	$128,218	12.6				Chip Seal (1992), Asphalt Resurfacing (2000)
42	94	5th Line OS	County Rd. 17	Sideroad 280	2293	6.5	Asphalt	Rural	1	$630,907	284	200-399	2019	9.20%	21.90%	346	4	41.0	2	1	Reconstruction	$630,907	15.6				Chip Seal (1992), Asphalt Resurfacing (1998)
43	1452	5th Line OS	County Rd. 21	30th Sideroad	3102	8	Gravel	Rural	N/A	$540,492	222	200-399	2019	8.70%	10.46%	245	0	90.0	10	10							
44	1520	5th Line OS	Sideroad 240	County Rd. 9	351	8	Gravel	Rural	N/A	$61,158	222	200-399	Estimate	Unknown	10.46%	245	0	90.0	10	10							
45	1493	5th Line OS	Sideroad 270	6th Line NE	654	6.5	Asphalt	Rural	1	$179,945	230	200-399	Estimate	Unknown	21.90%	280	4	41.0	2	1	Reconstruction	$179,945	12.6				Chip Seal (1992), Asphalt Resurfacing (2000)
46	101	5th Line OS	Sideroad 280	4th Line NE	205	6.5	Asphalt	Rural	1	$56,405	284	200-399	Estimate	Unknown	21.90%	346	4	41.0	2	1	Reconstruction	$56,405	15.6				Chip Seal (1992), Asphalt Resurfacing (1998)
47	207	5th Sideroad	3rd Line	County Rd. 124	1371	6.5	Asphalt	Rural	8	$456,714	653	400-999	2019	3.40%	21.90%	796	6	86.8	8	8	Preventive Maintenance	$35,646	17.1				Chip Seal (1990)
48	206	5th Sideroad	County Rd. 124	Townline	1367	6.5	Asphalt	Rural	7	$376,123	269	200-399	2019	3.90%	21.90%	328	4	64.8	5	5	Rehabilitation	$179,043	18.3				Asphalt (2000)
49	142	7th Line SW	County Rd. 17	Sideroad 280	2040	6.5	Asphalt	Rural	5	$561,296	200	200-399	Estimate	Unknown	10.46%	221	6	63.5	5	3	Rehabilitation	$267,189	14.8				Chip Seal (1992), Chip Seal Resurface (1996), Asphalt Resurfacing (2000)
50	143	7th Line SW	Hwy. 89	County Rd. 17	853	6.5	Asphalt	Rural	5	$234,699	218	200-399	2019	6.80%	10.46%	241	6	63.5	5	3	Rehabilitation	$111,722	16.1				Chip Seal (1992), Chip Seal Resurface (1996), Asphalt Resurfacing (2000)
51	1489	7th Line SW	Sideroad 270	200 m S Sideroad 260	2048	6.5	Asphalt	Rural	5	$563,497	177	50-199	2019	5.90%	10.46%	196	6	63.5	5	3	Rehabilitation	$202,742	17.3				Chip Seal (1992), Chip Seal Resurface (1996), Asphalt Resurfacing (2000)
52	111	7th Line SW	Sideroad 280	Sideroad 270	2033	6.5	Asphalt	Rural	5	$559,370	200	200-399	Estimate	Unknown	10.46%	221	6	63.5	5	3	Rehabilitation	$266,272	14.8				Chip Seal (1992), Chip Seal Resurface (1996), Asphalt Resurfacing (2000)

Township of Melancthon Road Management Plan
Road Inventory Table
All Hardtop Roads and Select Gravel Roads

Line No.	Asset ID	Road Name	Road From	Road To	Length of Road (m)	Road Width (m)	Road Material	Road Environment	Road Surface Remaining Useful Life	Estimated Road Replacement Costs	Existing AADT Volume (vpd)	Existing AADT Range (vpd)	Count Year	Percent Trucks	10-Year Percent Traffic Growth	Year 10 AADT Volume (vpd)	Ride Comfort Rating (RCR)	Pavemenet Condition Index (PCI)	Surface Condition Rating (SCR)	Base Condition Rating (BCR)	Existing (2019) Improvement Need (Based on Treatment Matrix Criterion)	Total Improvement Cost	Priority Guide Number (PGN)	Vertical Deficiencies?	Deficient Width?	Field Notes	Construction History - Treatment(s)
53	1440	8th Line NE	5th Line OS	Sideroad 250	1219	8	Gravel	Rural	N/A	$212,399	196	200-399	2019	11.70%	10.46%	217	N/A	N/A	N/A	N/A							
54	1603	8th Line NE	County Rd. 9	Townline	228	8	Gravel	Rural	N/A	$39,727	125	50-199	Estimate	Unknown	10.46%	138	N/A	N/A	N/A	N/A							
55	1511	8th Line NE	Sideroad 240	County Rd. 9	2040	8	Gravel	Rural	N/A	$355,450	145	50-199	2018	15.70%	10.46%	160	N/A	N/A	N/A	N/A							
56	1441	8th Line NE	Sideroad 250	Sideroad 240	2033	8	Gravel	Rural	N/A	$354,230	125	50-199	Estimate	Unknown	10.46%	138	N/A	N/A	N/A	N/A							
57	186	Addeson St.	George St.	Lloyd St.	155	4.5	Cold Recycled	Semi-Urban	4	$29,525	50	50-199	Estimate	Unknown	10.46%	55	3	76.3	10	5	Rehabilitation	$10,623	2.9		Yes		
58	201	Charles St. W	Main St.	End of Road	141	7	Asphalt	Semi-Urban	21	$41,780	30	0-49	Estimate	Unknown	10.46%	33	8	96.5	10	9							
59	200	Church St.	Main St.	North Limit	242	4	Cold Recycled	Semi-Urban	1	$40,975	60	50-199	Estimate	Unknown	10.46%	66	2	54.3	10	2	Rehabilitation	$14,743	6.3		Yes		
60	182	Fieldway Ct.	Main St.	End of Road	800	6.5	Asphalt	Semi-Urban	19	$220,116	120	50-199	Estimate	Unknown	10.46%	133	6	92.8	8	10	Preventive Maintenance	$20,800	1.5				
61	188	George St.	Addeson St.	Main St.	114	5.5	Cold Recycled	Semi-Urban	4	$26,541	50	50-199	Estimate	Unknown	10.46%	55	3	76.3	10	5	Rehabilitation	$9,549	2.4		Yes		
62	185	High St.	William St.	Main St.	170	5.3	Asphalt	Semi-Urban	24	$38,139	70	50-199	Estimate	Unknown	10.46%	77	9	98.8	9	10	Routine Maintenance	$676	1.5		Yes		
63	205	Hunter Pkwy.	County Rd. 124	Apartment Building	291	6.5	Cold Recycled	Semi-Urban	7	$80,067	100	50-199	Estimate	Unknown	10.46%	110	5	76.0	10	5	Rehabilitation	$28,808	4.1			Cold recycled south half	
64	187	Lloyd St.	Addeson St.	Main St.	110	4.5	Cold Recycled	Semi-Urban	4	$20,953	50	50-199	Estimate	Unknown	10.46%	55	3	76.3	10	5	Rehabilitation	$7,539	2.9		Yes		
65	183	Main St.	15th Sideroad	County Rd. 124	366	6.5	Asphalt	Rural	24	$121,924	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,784	16.2				
66	1313	Main St.	Charles St.	George St.	126	6.5	Asphalt	Urban	24	$55,422	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$614	16.2				
67	1312	Main St.	Church St.	Charles St.	153	6.5	Asphalt	Urban	24	$67,298	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$746	16.2				
68	1347	Main St.	County Rd. 124	Oldfield Ct.	692	6.5	Asphalt	Rural	24	$230,523	890	400-999	2019	2.10%	10.46%	983	9	98.8	9	10	Routine Maintenance	$3,374	16.0				
69	1315	Main St.	Fieldway Ct.	High St.	323	6.5	Asphalt	Semi-Urban	24	$107,599	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,575	16.2				
70	1314	Main St.	George St.	Mill Ln.	212	6.5	Asphalt	Urban	24	$93,249	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,034	16.2				
71	1311	Main St.	High St.	Mill St.	120	6.5	Asphalt	Urban	24	$52,783	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$585	16.2				
72	193	Main St.	Mill Ln.	15th Sideroad	355	6.5	Asphalt	Semi-Urban	24	$118,259	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,731	16.2				
73	1310	Main St.	Mill St.	Church St.	214	6.5	Asphalt	Urban	24	$94,129	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,043	16.2				
74	1346	Main St.	Oldfield Ct.	Fieldway Ct.	277	6.5	Asphalt	Semi-Urban	24	$92,276	900	400-999	Estimate	Unknown	10.46%	994	9	98.8	9	10	Routine Maintenance	$1,350	16.2				
75	195	Mill Ln.	Main St.	End of Road	655	5	Cold Recycled	Semi-Urban	4	$138,631	150	50-199	Estimate	Unknown	10.46%	166	3	66.3	10	4	Rehabilitation	$49,878	9.5		Yes		
76	196	Mill St.	Main St.	William St.	95	6.5	Asphalt	Semi-Urban	24	$26,139	300	200-399	Estimate	Unknown	10.46%	331	9	98.3	9	10	Routine Maintenance	$463	5.4				
77	184	Old Field Ct.	Main St.	End of Road	643	6.5	Asphalt	Semi-Urban	17	$176,918	150	50-199	Estimate	Unknown	10.46%	166	5	75.6	5	8	Rehabilitation	$63,654	8.6				
78	189	River Rd.	William St.	Townline	1401	7.5	Asphalt	Semi-Urban	24	$444,782	284	200-399	2019	3.90%	10.46%	314	9	98.3	9	10	Routine Maintenance	$7,881	4.4				
									Total:	$25,143,038												$8,049,945					

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Appendix C

Benchmark Cost Breakdown Tables

Item	Unit	Unit Cost
Granular A - 150mm	m2	$7.00
Granular B - 300mm	m2	$9.00
Granular B - 450mm	m2	$13.00
Earth Excavation	m3	$15.00
Milling	m2	$4.00
Pulverizing	m2	$2.00
Asphalt Removal	m	$32.00
Crack Sealing	m2	$0.75
Maintenance Gravel + Calcium Chloride*	m2	$0.80
Curb and Gutter Replacement	m	$120.00
Catch Basin/Manhole Adjustments	m	$14.85
Driveway Culvert Replacement	m	$375.00
Cross Culvert Replacement	m	$500.00
Tack Coat	m	$3.00
Shouldering (50mm Depth)	m	$5.00
PAD with 100mm Granular A	m	$32.00
50mm HL8	m	$80.00
50mm HL4	m	$67.00
60mm HL4	m	$80.00
40mm HL3	m2	$8.00
Geogrid (9m wide)	m	$45.00

* Maintenance gravel and calcium chloride are material costs only. Road preparation and grading are assumed to be by Township forces.

Urban Hardtop Resurfacing								
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**
Milling		8			m2		$4.00	$4.00
Tack Coat		8			m		$3.00	$0.38
50mm HL4		8			m		$67.00	$8.38
Shouldering (50mm Depth)		8			m		$5.00	$0.63
							Total =	$13.38
Rural or Semi-Urban (AADT>=400) Hardtop Resurfacing								
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**
Crack Sealing		6.5			m2		$0.75	$0.75
Tack Coat		6.5			m		$3.00	$0.46
60mm HL4		6.5			m		$80.00	$12.31
Shouldering (50mm Depth)	120%	6.5			m		$5.00	$0.92
							Total =	$14.44
Rural or Semi-Urban (AADT<400) Hardtop Resurfacing								
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**
Crack Sealing		6.5			m2		$0.75	$0.75
Tack Coat		6.5			m		$3.00	$0.46
50mm HL4		6.5			m		$67.00	$8.38
Shouldering (50mm Depth)		6.5			m		$5.00	$0.63
							Total =	$10.21

60mm depth

Urban Hardtop Rehabilitation									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Asphalt Removal		8			m		$32.00	$4.00	
50mm HL8		8			m		$80.00	$10.00	
Tack Coat		8			m		$3.00	$0.38	
40mm HL3		8			m2		$8.00	$8.00	
Curb and Gutter Replacement	10%	8			m		$120.00	$1.50	
Catch Basin/Manhole Adjustments	100%	8			m		$14.85	$1.86	33 structures per km at $450 each
							Total =	$25.73	
Semi-Urban Hardtop Rehabilitation									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Pulverizing		6.5			m2		$2.00	$2.00	
60mm HL4		6.5			m		$80.00	$12.31	
Shouldering (50mm Depth)	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$15.23	
Rural (AADT>=400) Hardtop Rehabilitation									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Pulverizing		6.5			m2		$2.00	$2.00	
PAD with 100mm Granular A		6.5			m		$32.00	$4.92	
60mm HL4		6.5			m		$80.00	$12.31	
Tack Coat		6.5			m		$3.00	$0.46	
40mm HL3		6.5			m2		$8.00	$8.00	
Shouldering (50mm Depth)	200%	6.5			m		$5.00	$1.54	100mm depth
							Total =	$29.23	
Rural (400>AADT>=200) Hardtop Rehabilitation									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Pulverizing		6.5			m2		$2.00	$2.00	
PAD with 100mm Granular A		6.5			m		$32.00	$4.92	
60mm HL4		6.5			m		$80.00	$12.31	
Shouldering (50mm Depth)	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$20.15	
Rural (400>AADT>=200) AND Swamp Area (e.g., 5th Line OS) Hardtop Rehabilitation									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Pulverizing		6.5			m2		$2.00	$2.00	
PAD with 100mm Granular A	250%	6.5			m		$32.00	$12.31	
60mm HL4		6.5			m		$80.00	$12.31	
Geogrid (9m wide)		6.5			m		$45.00	$6.92	
Shouldering (50mm Depth)	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$34.46	

Rural (AADT<200) Hardtop Rehabilitation									
Item	Amount	Width (m)	Depth (mm)	Conversion Factor	Unit	Quantity	Unit Cost	Cost/m2	
Pulverizing		6.5			m2		$2.00	$2.00	
60mm HL4		6.5			m		$80.00	$12.31	
Shouldering (50mm Depth)	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$15.23	
Urban Hardtop Reconstruction									
Item	Amount	Width (m)	Depth (mm)	Conversion Factor	Unit	Quantity	Unit Cost	Cost/m2	
Asphalt Removal		8			m		$32.00	$4.00	
Earth Excavation	100%	10	450		m3	4500	$15.00	$8.44	
Granular A - 150mm	100%	10			m2		$7.00	$8.75	
Granular B - 300mm	100%	10			m2		$9.00	$11.25	
50mm HL8		8			m		$80.00	$10.00	
Tack Coat		8			m		$3.00	$0.38	
40mm HL3		8			m2		$8.00	$8.00	
Curb and Gutter Replacement	100%	8			m		$120.00	$15.00	
Catch Basin/Manhole Adjustments	100%	8			m		$14.85	$1.86	33 structures per km at $450 each
							Total =	$67.67	
Rural or Semi-Urban (AADT>=400) Hardtop Reconstruction									
Item	Amount	Width (m)	Depth (mm)	Conversion Factor	Unit	Quantity	Unit Cost	Cost/m2	
Asphalt Removal		6.5			m		$32.00	$4.92	
Earth Excavation	100%	8.5	450		m3	3825	$15.00	$7.17	
Granular A - 150mm	100%	8.5			m2		$7.00	$7.44	
Granular B - 300mm	100%	8.5			m2		$9.00	$9.56	
50mm HL8		6.5			m		$80.00	$12.31	
Tack Coat		6.5			m		$3.00	$0.46	
40mm HL3		6.5			m2		$8.00	$8.00	
Shouldering (50mm Depth)	180%	6.5			m		$5.00	$1.38	90mm depth
							Total =	$51.25	
Rural of Semi-Urban (AADT<400) Hardtop Reconstruction									
Item	Amount	Width (m)	Depth (mm)	Conversion Factor	Unit	Quantity	Unit Cost	Cost/m2	
Asphalt Removal		6.5			m		$32.00	$4.92	
Earth Excavation	100%	8.5	450		m3	4500	$15.00	$7.17	
Granular A - 150mm	100%	8.5			m2		$7.00	$7.44	
Granular B - 300mm	100%	8.5			m2		$9.00	$9.56	
60mm HL4		6.5			m		$80.00	$12.31	
Shouldering	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$42.33	

Gravel Road Reconstruction - To HCB Surface (ASSUMING ROAD SECTION MEETS UPGRADING CRITERIA)									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Earth Excavation	100%	8.5	450		m3	3825	$15.00	$7.17	
Granular A - 150mm	100%	8.5			m2		$7.00	$7.44	
Granular B - 300mm	100%	8.5			m2		$9.00	$9.56	
60mm HL4		6.5			m		$80.00	$12.31	
Shouldering	120%	6.5			m		$5.00	$0.92	60mm depth
							Total =	$37.40	
Gravel Road Reconstruction - To Gravel Surface									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Earth Excavation	100%	8.5	300		m3	2550	$15.00	$4.78	
Granular A - 150mm	100%	8.5			m2		$7.00	$7.44	
Granular B - 300mm	100%	8.5			m2		$9.00	$9.56	
							Total =	$21.78	
Existing Hardtop Road Reconstruction - To Gravel Surface									
Item	**Amount**	**Width (m)**	**Depth (mm)**	**Conversion Factor**	**Unit**	**Quantity**	**Unit Cost**	**Cost/m2**	
Pulverizing		8.5			m2		$2.00	$2.00	
PAD with 100mm Granular A		8.5			m		$32.00	$3.76	
							Total =	$5.76	

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Appendix D

Map of Surface Upgrade or Downgrade Recommendations

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Map Title

ROAD MANAGEMENT PLAN

SURFACE TYPE DOWNGRADE RECOMMENDATIONS

Client

TOWNSHIP OF MELANCTHON

Drawn	Checked	Date	Figure No.
PS	CR	2019/09/19	D
Scale		Project No.	
H 1:120,000		300043927	

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BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix E

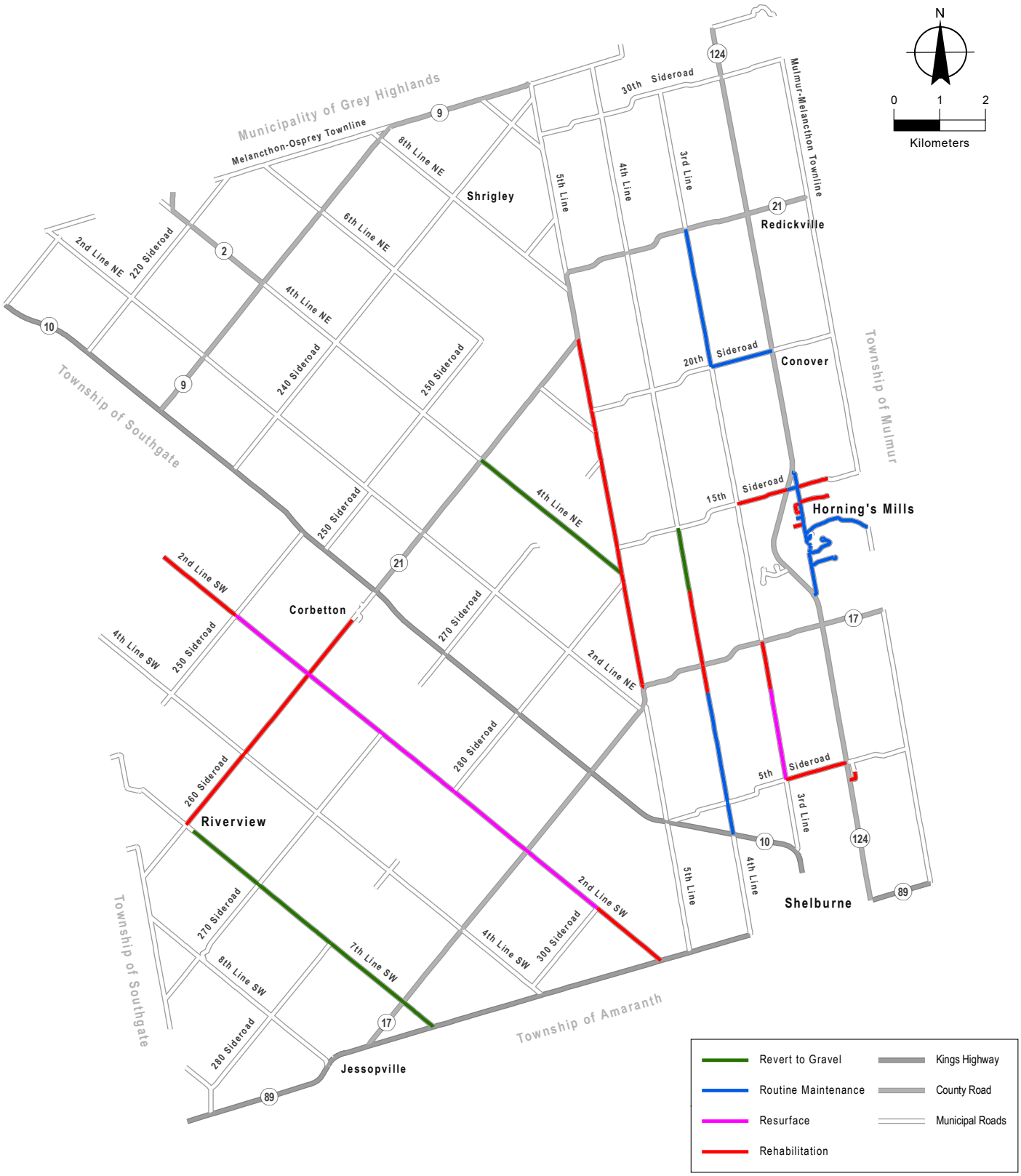
Table and Map of Ten-Year Road Improvement Plan

2019 Township of Melancthon Road Management Plan
Ten-Year Improvement Plan (2020 to 2029)

Line No.	Asset ID	Road Name	From	To	Road Length (m)	Road Width (m)	Road Material	Road Environment	Existing AADT Volume (vpd)	Existing AADT Range (vpd)	Count Year	Year 10 (2029) AADT Estimate (vpd)	Road Surface Remaining Useful Life	Pavement Condition Index (PCI)	Priority Guide Number (PGN)	Existing (2019) SCR	Existing (2019) BCR	Improvement Type	Improvement Benchmark Cost ($/m2) *	Total Improvement Cost	Proposed Improvement Year	Notes	Annual Cost Subtotal
1	194	15th Sideroad	County Rd. 124	Main St.	227	6.5	Asphalt	Rural	125	50-199	Estimate	138	24	98.5	2.2	9	10	**Routine Maintenance**	$0.75	$1,107	**2020**		
2	1345	20th Sideroad	3rd Line	County Rd. 124	1,378	6.5	Asphalt	Rural	164	50-199	2019	181	24	99.0	2.9	9	10	**Routine Maintenance**	$0.75	$6,718	**2020**		
3	82	2nd Line SW	250	North Limit	2,350	6.5	Asphalt	Rural	1,127	1000-1999	2019	1,374	2	57.5	91.9	6	2	**Rehabilitation (Apply Base Asphalt Only)**	$20.08	$306,756	**2020**		**$561,192**
4	147	2nd Line SW	Hwy. 89	300	1,799	6.8	Asphalt	Rural	820	400-999	2019	1,000	2	61.3	51.4	3	3	**Rehabilitation (Apply Base Asphalt Only)**	$20.08	$246,611	**2020**		
5	1490	3rd Line OS	20th Sideroad	County Rd. 21	3,055	6.5	Asphalt	Rural	107	50-199	2019	130	23	97.0	1.9	8	10	**Routine Maintenance**	$0.75	$14,893	**2021**		
6	95B	4th Line OS	Strada Pit North Entrance	15th Sideroad	1,400	6.5	Asphalt	Rural	79	50-199	2019	96	3	54.3	4.6	1	1	**Revert to Gravel**	$5.76	$52,416	**2021**		
7	95A	4th Line OS	County Road 17	Strada Pit North Entrance	1,651	6.5	Asphalt	Rural	125	50-199	Estimate	152	3	80.5	7.8	8	5	**Rehabilitation**	$20.00	$214,630	**2021**	Since the Strada Pit owner is responsible for paying for improvements to this section, the cost has been excluded from the "Annual Cost Subtotal".	**$534,939**
8	1492	5th Line OS	4th Line NE	15th Sideroad	570	6.5	Asphalt	Rural	250	200-399	Estimate	305	1	41.0	13.8	2	1	**Rehabilitation**	$20.00	$74,100	**2021**		
9	94	5th Line OS	County Rd. 17	Sideroad 280	2,293	6.5	Asphalt	Rural	284	200-399	2019	346	1	41.0	15.6	2	1	**Rehabilitation**	$24.62	$366,880	**2021**	Includes geogrid and additional gravel (swamp area).	
10	101	5th Line OS	Sideroad 280	4th Line NE	205	6.5	Asphalt	Rural	284	200-399	Estimate	346	1	41.0	15.6	2	1	**Rehabilitation**	$20.00	$26,650	**2021**		
11	1494A	4th Line OS	5th Sideroad	Lot 9/10	2,438	6.5	Asphalt	Rural	300	200-399	Estimate	366	24	98.3	5.7	9	10	**Routine Maintenance**	$0.75	$11,885	**2022**		
12	82	2nd Line SW	250	North Limit	2,350	6.5	Asphalt	Rural	256	200-399	2019	312	2	57.5	20.9	6	2	**Resurface (Top Asphalt Only)**	$9.15	$139,744	**2022**		
13	147	2nd Line SW	Hwy. 89	300	1,799	6.8	Asphalt	Rural	820	400-999	2019	1,000	2	61.3	51.4	3	3	**Resurface (Top Asphalt Only)**	$9.15	$110,975	**2022**		
14	159	5th Line OS	15th Sideroad	Sideroad 270	1,930	6.5	Asphalt	Rural	237	200-399	2018	289	1	41.0	13	2	1	**Rehabilitation**	$20.00	$250,900	**2022**		**$644,304**
15	1493	5th Line OS	Sideroad 270	6th Line NE	654	6.5	Asphalt	Rural	230	200-399	Estimate	280	1	41.0	12.6	2	1	**Rehabilitation**	$30.77	$130,800	**2022**	Includes geogrid and additional gravel (swamp area).	
16	1495	4th Line OS	Hwy. 10	5th Sideroad	713	6.5	Asphalt	Rural	300	200-399	Estimate	366	24	98.3	5.7	9	10	**Routine Maintenance**	$0.75	$3,476	**2023**		
17	201	Charles St. W	Main St.	End of Road	141	7	Asphalt	Semi-Urban	30	0-49	Estimate	33	21	96.5	0.5	10	9	**Routine Maintenance**	$0.75	$740	**2023**		
18	185	High St.	William St.	Main St.	170	5.3	Asphalt	Semi-Urban	70	50-199	Estimate	77	24	98.8	1.5	9	10	**Routine Maintenance**	$0.75	$676	**2023**		
19	142	7th Line SW	County Rd. 17	Sideroad 280	2,040	6.5	Asphalt	Rural	200	200-399	Estimate	221	5	63.5	14.8	5	3	**Revert to Gravel**	$5.76	$76,378	**2023**		
20	143	7th Line SW	Hwy. 89	County Rd. 17	853	6.5	Asphalt	Rural	218	200-399	2019	241	5	63.5	16.1	5	3	**Revert to Gravel**	$5.76	$31,936	**2023**		
21	1489	7th Line SW	Sideroad 270	200 m S Sideroad 260	2,048	6.5	Asphalt	Rural	177	50-199	2019	196	5	63.5	17.3	5	3	**Revert to Gravel**	$5.76	$76,677	**2023**		**$611,519**
22	111	7th Line SW	Sideroad 280	Sideroad 270	2,033	6.5	Asphalt	Rural	200	200-399	Estimate	221	5	63.5	14.8	3	3	**Revert to Gravel**	$5.76	$76,116	**2023**		
23	161	5th Line OS	20th Sideroad	County Rd. 21	1,577	6.5	Asphalt	Rural	226	200-399	2019	275	3	41.0	12.4	2	1	**Rehabilitation**	$24.62	$252,320	**2023**	Includes geogrid and additional gravel (swamp area).	
24	160	5th Line OS	6th Line NE	20th Sideroad	466	6.5	Asphalt	Rural	230	200-399	Estimate	280	1	41.0	12.6	2	1	**Rehabilitation**	$30.77	$93,200	**2023**	Includes geogrid and additional gravel (swamp area).	
25	182	Fieldway Ct.	Main St.	End of Road	800	6.5	Asphalt	Semi-Urban	120	50-199	Estimate	133	19	92.8	1.5	8	10	**Routine Maintenance**	$0.75	$3,900	**2024**		
26	200	Church St.	Main St.	North Limit	242	4	Cold Recycled	Semi-Urban	60	50-199	Estimate	66	1	54.3	6.3	10	2	**Rehabilitation**	$32.50	$31,460	**2024**		
27	196	Mill St.	Main St.	William St.	95	6.5	Asphalt	Semi-Urban	300	200-399	Estimate	331	24	98.3	5.4	9	10	**Routine Maintenance**	$0.75	$463	**2024**		
28	184	Old Field Ct.	Main St.	End of Road	643	6.5	Asphalt	Semi-Urban	150	50-199	Estimate	166	17	75.6	8.6	5	8	**Routine Maintenance**	$0.75	$3,135	**2024**		
29	189	River Rd.	William St.	Townline	1,401	7.5	Asphalt	Semi-Urban	284	200-399	2019	314	24	98.3	4.4	9	10	**Routine Maintenance**	$0.75	$7,881	**2024**		
30	195	Mill Ln.	Main St.	End of Road	655	5	Cold Recycled	Semi-Urban	150	50-199	Estimate	166	4	66.3	9.5	10	4	**Rehabilitation**	$20.00	$65,500	**2024**		
31	205	Hunter Pkwy.	County Rd. 124	Apartment Building	291	6.5	Cold Recycled	Semi-Urban	100	50-199	Estimate	110	7	76.0	4.1	10	5	**Rehabilitation**	$15.38	$29,100	**2024**		**$480,869**
32	187	Lloyd St.	Addeson St.	Main St.	110	4.5	Cold Recycled	Semi-Urban	50	50-199	Estimate	55	4	76.3	2.9	10	5	**Rehabilitation**	$22.22	$11,000	**2024**		
33	188	George St.	Addeson St.	Main St.	114	5.5	Cold Recycled	Semi-Urban	50	50-199	Estimate	55	4	76.3	2.4	10	5	**Rehabilitation**	$18.18	$11,400	**2024**		
34	186	Addeson St.	George St.	Lloyd St.	155	4.5	Cold Recycled	Semi-Urban	50	50-199	Estimate	55	4	76.3	2.9	10	5	**Rehabilitation**	$22.22	$15,500	**2024**		
35	1494B	4th Line OS	Lot 9/10	County Rd. 17	750	6.5	Asphalt	Rural	300	200-399	Estimate	366	3	69.5	30.6	3	2	**Rehabilitation**	$20.00	$97,500	**2024**		
36	1491	15th Sideroad	Main St.	East	691	6.5	Cold Recycled	Rural	125	50-199	Estimate	138	3	56.8	8.1	10	2	**Rehabilitation**	$20.00	$89,830	**2024**		
37	176	15th Sideroad	3rd Line	County Rd. 124	1,142	6.5	Asphalt	Rural	125	50-199	Estimate	128	3	80.3	10.2	5	5	**Rehabilitation**	$15.38	$114,200	**2024**		
38	183	Main St.	15th Sideroad	County Rd. 124	366	6.5	Asphalt	Rural	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,784	**2025**		
39	1313	Main St.	Charles St.	George St.	126	6.5	Asphalt	Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$614	**2025**		
40	1312	Main St.	Church St.	Charles St.	153	6.5	Asphalt	Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$746	**2025**		
41	1347	Main St.	County Rd. 124	Oldfield Ct.	692	6.5	Asphalt	Rural	890	400-999	2019	983	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$3,374	**2025**		
42	1315	Main St.	Fieldway Ct.	High St.	323	6.5	Asphalt	Semi-Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,575	**2025**		
43	1314	Main St.	George St.	Mill Ln.	212	6.5	Asphalt	Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,034	**2025**		
44	1311	Main St.	High St.	Mill St.	120	6.5	Asphalt	Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$585	**2025**		
45	193	Main St.	Mill Ln.	15th Sideroad	355	6.5	Asphalt	Semi-Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,731	**2025**		
46	1310	Main St.	Mill St.	Church St.	214	6.5	Asphalt	Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,043	**2025**		
47	1346	Main St.	Oldfield Ct.	Fieldway Ct.	277	6.5	Asphalt	Semi-Urban	900	400-999	Estimate	994	24	98.8	16.2	9	10	**Routine Maintenance**	$0.75	$1,350	**2025**		
48	207	5th Sideroad	3rd Line	County Rd. 124	1,371	6.5	Asphalt	Rural	653	400-999	2019	796	8	86.8	17.1	8	8	**Rehabilitation (Apply Base Asphalt Only)**	$13.91	$123,986	**2025**		
49	544	3rd Line OS	County Rd. 17	2 km N of 5th Sideroad	1,048	6.5	Asphalt	Rural	493	400-999	2019	601	8	89.3	9.7	8	9	**Rehabilitation**	$31.54	$214,840	**2025**	Includes vertical deficiency correction of $30,000.	
50	93	3rd Line OS	5th Sideroad	2 km N of 5th Sideroad	2,011	6.5	Asphalt	Rural	493	400-999	2019	601	12	89.3	9.7	8	9	**Resurface**	$14.44	$188,752	**2025**		**$541,413**
51	117	2nd Line SW	280	270	2,028	6.5	Asphalt	Rural	812	400-999	2018	990	15	96.9	15.4	9	10	**Resurface**	$14.44	$190,348	**2026**		
52	1351	2nd Line SW	300	County Rd. 17	1,981	6.7	Asphalt	Rural	812	400-999	Estimate	990	12	98.3	10.2	7	10	**Resurface**	$14.44	$191,658	**2026**		**$574,513**
53	1278	2nd Line SW	County Rd. 17	280	2,051	6.5	Asphalt	Rural	812	400-999	Estimate	990	15	87.8	22.8	5	9	**Resurface**	$14.44	$192,507	**2026**		
54	207	5th Sideroad	3rd Line	County Rd. 124	1,371	6.5	Asphalt	Rural	653	400-999	2019	796	8	86.8	17.1	8	8	**Resurface (Top Asphalt Only)**	$6.09	$54,244	**2027**		
55	81	2nd Line SW	260	250	2,054	6.6	Asphalt	Rural	980	400-999	2016	1,195	15	95.0	18.3	9	10	**Resurface**	$14.44	$195,754	**2027**		**$444,895**
56	1509	2nd Line SW	270	260	2,045	6.6	Asphalt	Rural	835	400-999	2017	1,018	15	95.0	15.6	9	10	**Resurface**	$14.44	$194,897	**2027**		
57	32	260 (Main St.)	2nd Line SW	4th Line SW	2,228	6.5	Asphalt	Rural	263	200-399	2019	291	6	63.0	21.1	5	2	**Rehabilitation**	$20.00	$289,640	**2028**		
58	29	260 (Main St.)	Geirson	2nd Line SW	1,526	6.5	Asphalt	Rural	450	400-999	Estimate	497	5	63.0	24.8	5	2	**Rehabilitation**	$20.00	$198,380	**2028**		**$488,020**
59	65	4th Line NE	5th Line OS	County Rd. 21	3,937	6.5	Asphalt	Rural	257	200-399	2019	284	15	68.8	14.2	6	5	**Revert to Gravel**	$5.76	$147,401	**2029**		
60	31	260 (Main St.)	4th Line SW	7th Line SW	2,013	6.5	Asphalt	Rural	250	200-399	Estimate	276	6	63.0	20	5	2	**Rehabilitation**	$20.00	$261,690	**2029**		**$409,091**
																				$5,290,755			**$5,290,755**

* Benchmark costs in this Table may differ from the benchmark costs shown in the Treatment Matrix. This is to reflect road-section-specific unit cost estimates in the detailed ten-year plan. See the "Notes" field for any specific adjustments.

** Section #72 (4th Line NE between County Road 9 and 1 km north of Sideroad 240) is not recommended for reversion to gravel in the next ten-year period, however is anticipated to warrant reversion to gravel in the 2040-2045 time horizon.



BURNSIDE

Map Title

ROAD MANAGEMENT PLAN

TEN YEAR ROAD CAPITAL & MAINTENANCE IMPROVEMENT PLAN

Client

TOWNSHIP OF MELANCTHON

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R.J. Burnside & Associates Limited

2019 Municipal Bridge Inspection Report

Township of Melancthon
157101 Highway 10
Melancthon ON L9V 2E6

R.J. Burnside & Associates Limited
15 Townline,
Orangeville, ON L9W 3R4 CANADA

September 2019
300050184.0000

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Record of Revisions

Revision	Date	Description
-	September 2019	Final Report to Township of Melancthon

R.J. Burnside & Associates Limited

Report Prepared By:

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Executive Summary

R.J. Burnside & Associates Limited (Burnside) was engaged by the Township of Melancthon (Township) to undertake the inspection of 51 municipal bridge and culvert structures. It should be noted that Structure No. 004 on 5th Sideroad was inspected but has since been closed by the Township to through traffic. The visual inspections were carried out on an element by element basis in accordance with the Ministry of Transportation – Ontario Structure Inspection Manual (OSIM). The inspections were completed under the direction of a Professional Engineer to assess their condition and identify any material defects, performance deficiencies, maintenance needs, additional studies and/or repairs/rehabilitation work required on a structure by structure basis.

Following the field inspections, recommendations were made based on the data collected and the review of the previous inspection reports. Depending on the condition of each structure, the remedial needs have been provided in three classifications; routine maintenance, additional investigations and repairs and rehabilitations (Capital Works).

The routine maintenance work often requires a minimal scope of work, and in most cases can be carried out by Township staff. It is anticipated that all maintenance needs identified can be addressed within the Township's routine maintenance program and will be completed within the calendar year of receiving this report. The total estimated value of the work to be completed by the Township is **$109,000.00**. We recommend that a general allowance to complete the works described above be included in the Township's annual road budget.

Additional studies, investigations and monitoring programs, as summarized in

Table 2, are recommended to structures currently demonstrating severe material defects or performance deficiencies which may necessitate an inspector to require more detailed information. These investigations have been identified based on a "normal" or "urgent" priority.

The capital works needs include any repair, rehabilitation or replacement work which would typically be completed by a Township hired Contractor, to assist in extending the service life of a structure and increasing the Bridge Condition Index (BCI). In accordance with the OSIM, the capital works required are based on a priority of six to ten years, one to five years, within one year, and urgent and have been estimated as follows:

Capital Works Costs and Timeframes

Time Frame	Capital Cost
< 1 year	$1,393,720.00
1 – 5 years	$2,537,500.00
6 – 10 years	$2,722,000.00
TOTAL	**$6,653,220.00**

It should be noted that these costs include recommended replacement costs for structures in need.

The roadside safety needs include a general allowance for guide rail and/or end treatments at all bridge locations as required. The total estimated cost for roadside safety is **$1,384,000.00**.

Taking into consideration the structures calculated BCI's, several structures have been identified for replacement or rehabilitation. Within the next year, one (1) structure has been identified as requiring rehabilitation and two (2) structures have been identified for replacement. Within the next 1 to 5 years, seven (7) structures have been identified as requiring rehabilitation and one (1) structures have been identified for replacement. Within the next 6 to 10 years, four (4) structures have been identified as requiring rehabilitation and three (3) structures have been identified for replacement.

It should be noted that all of the aforementioned estimated costs throughout this summary and the report do not include Engineering fees, property acquisition costs, road work beyond the wingwalls, and HST.

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Appendices

Disclaimer

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been engaged by the Township of Melancthon (Township) to undertake the inspection of 51 municipal road bridge and culvert structures over the span of 3.0 m. It should be noted that Structure No. 004 on 5th Sideroad was inspected but has since been closed by the Township to through traffic. The inspections have been completed in accordance with the Ministry of Transportation - Ontario Structure Inspection Manual (OSIM). Inspection of the Township's bridges and culverts are required every two years as per Ontario Regulation 104/97 which states "*The structural integrity, safety and condition of every bridge shall be determined through the performance of at least one inspection in every second calendar year under the direction of a professional engineer and in accordance with the Ontario Structure Inspection Manual*". A map showing the location of all structures has been provided in Appendix C.

Burnside staff conducted a detailed element by element visual assessment of each bridge/culvert in order to identify any material defects, performance deficiencies and maintenance needs on a structure by structure basis. All data collected has been documented on the OSIM forms and provided in digital format in Appendix D. In addition, a brief written overview has been provided to clarify the OSIM data.

2.0 Inspection Observations and Recommendations

The following observations and recommendations were made during our recent inspection of the Township's structures. These inspections, along with a review of the previous reports have contributed to the recommendations provided.

The Township of Melancthon has an inventory of 51 structures, which is comprised of a variety of structure types. Figure 1 below summarizes the number and types of structures within the inventory.

Figure 1: Types of Structures

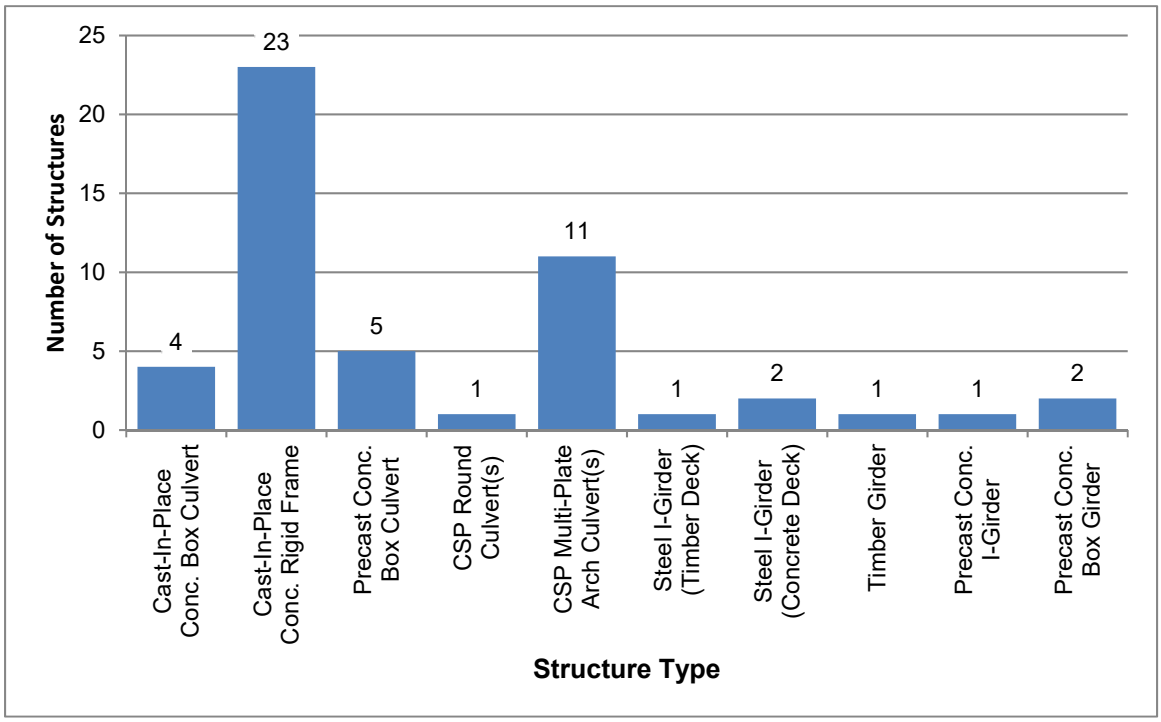


Table 1: Structures with Existing Load Limits

Structure No./Name	Structure Type	Road Name	Load Limit (Tonnes)
004	CIP Conc. Rigid Frame	5th Sideroad	5

Taking into consideration the condition, vintage and design loads at the time of construction, using engineering judgement it is recommended the Township place a 15 tonne load limit over Structure No. 2013 (30th Sideroad, 500 m east of 3rd Line) until the structure is replaced.

Depending on the condition of each structure, some level of remedial action is usually required. The recommendations for remedial work are provided in three classifications, routine maintenance, additional investigations, and repair, rehabilitation or replacement.

2.1 Routine Maintenance

Routine maintenance needs often require minimal effort to extend the service life of the structure. In most cases, routine maintenance can be undertaken by Township staff or locally contracted out. It is desirable to ensure that all maintenance needs identified at each structure be completed within the calendar year of receiving this Report.

Common structure defects were noted, to varying degrees, at most of the structures inspected. These common defects include:

- Minor erosion of slopes on culvert embankments and adjacent to bridge wingwalls;
- Excessive sand/granular material on deck surface due to winter maintenance or vehicle tracking;
- Clogged deck drains or lack of drainage;
- Erosion of stream banks at the water level;
- Debris collection and heavy vegetation at culvert and bridge openings;
- Lack of, damaged or non code-conforming guide rail;
- Minor asphalt defects (potholes, cracking); and
- Lack of or missing hazard warning signs.

These general defects can be addressed within the Township's routine maintenance program and these issues can be added to the Township's in-house road and structure inspection routine.

Routine bridge sweeping, washing of decks, drains, joints, bearing seat areas and girders will improve a structures service life. Removal or trimming of vegetation and addressing minor erosion concerns regularly will pre-empt more serious issues.

The total estimated value of the work to be completed by the Township is approximately **$109,000.00**. We recommend that a general allowance to complete the works described above be included in the Township's annual road maintenance budget.

A summary of maintenance needs is provided in Appendix B, along with estimated costs to complete the work.

2.2 Additional Studies/Investigations

As per the OSIM, additional investigations or surveys may be required to further assess the condition of certain elements that may not be fully determined by a visual inspection. In many cases, where a major rehabilitation of a structure is required or planned, the completion of additional studies or investigations will assist in developing appropriate rehabilitation programs. Studies or investigations may also be required where performance deficiencies are suspected. Typical investigations that may be required include:

- Deck condition surveys;
- Structure evaluations (Load Capacity);
- Monitoring of deformations, settlements and movement; and
- Monitoring crack widths.

It should be noted that a cost has not been provided if the monitoring can be completed as part of the Township's biennial bridge inspections. A summary of the additional investigations recommended for the Town are summarized in Table 2 below:

Table 2: Additional Investigations

Structure No./Name	Additional Investigation	Reasoning	Estimated Cost
011	Detailed Deck Condition Survey	Determine extent of repairs prior to rehabilitation.	$10,000.00
013	Detailed Deck Condition Survey	Determine extent of repairs prior to rehabilitation.	$8,100.00
004	Monitor Movements	Monitor structure to ensure structure is stable until replacement.	$5,000.00
2013	Monitor Movements & Cracks	Monitor movements in timber deck & headwall, and wide crack in timber abutment until replacement is an option.	$5,000.00
2021	Monitor Cracks	Monitor bolt hole cracking until structure can be replaced or repaired.	$5,000.00
2029	Monitor Movements	Monitor movement and rotation observed in the substructure.	$5,000.00
		Total	**$38,100.00**

Table 3 Future Biennial Inspections and Additional Investigations

Structure No./Name	Additional Investigation	Reasoning	Estimated Cost
001	Monitor Severe Erosion	Monitor erosion of abutments & footings to determine if actively progressing.	$0.00
2002	Monitoring Deformation	Monitor slight sag in culvert barrel to determine if it is actively progressing.	$0.00
2012	Monitor Movements & Cracks	Monitor the cracks and movement in the wingwalls to determine if it is actively progressing.	$0.00
2026	Monitor Deformation	Monitor deformations and cusping to ensure they are not actively progressing.	$0.00
2031	Monitor Deformation	Monitor localized deformation in culvert barrel to ensure its not actively progressing.	$0.00
2032	Monitor Deformation	Monitor local deformations in South culvert barrel to ensure they are not actively progressing.	$0.00
		Total	**$0.00**

A summary of recommended studies and costs is also included in Appendix B. The estimated costs are based on completing each investigation individually and can likely be reduced by grouping together studies.

2.3 Roadside Safety

During our inspections, Burnside makes note of the condition and effectiveness of roadside safety measures on the approaches to the structures. Where no roadside safety systems are present, Burnside has a responsibility to identify that there should be consideration given to installing roadside safety systems, i.e., guide rail and end treatments.

Roadside safety system requirements are set out in the MTO - Roadside Safety Manual which is a guideline provided to be used as a risk assessment tool in establishing the need, type and extent of roadside safety measures.

As is discussed in more detail in the Manual, risk management is critical in assessing the need for roadside safety installations. At some structures, and on some roadways, the installation of guide rail systems may be seen as more of a hazard than not having a system. This may be a result of a reduction in road platform width, the ability to remove snow effectively, and the space available to place and anchor end treatments. In addition, local use of a roadway by farm equipment and the location of driveway and field entrances around structures should also be considered in determining the need and effectiveness of guide rail systems.

For the purpose of this Report, where a high level review indicated that guide rail or guiderail components would be required (apparent substandard length of need, substandard end treatments, rigid barriers on the structure, small clear zone between the edge of road and edge of structure, etc.) a general allowance for a typical guide rail system installation has been provided, however, site specific and detailed assessments of need at each structure is not included in this Report. Where the need for a guiderail system was not evident based on high level review, an allowance for an investigation into the need for guiderail was provided. The total estimated cost relating to guide rail installation or investigation is **$1,384,000.00**.

Where recommendations have been made for installation or corrective measures, Burnside has identified that the work is to be completed within one to five years. However, as each site has unique characteristics relating to the requirements of guiderail, Burnside also recommends that a further investigation and risk analysis of each of the identified sites be completed by the Township within one year to classify the structures as high, medium, or low priority for guide rail installation or improvements. The study may also outline a timeline for guide rail upgrades based on annual guide rail budget.

2.4 Repair, Rehabilitation or Replacement

Recommended repair, rehabilitation or replacement work is provided on the OSIM form for each bridge and culvert. The recommended work is indicated for each element and outlines the priority and estimated construction cost. The priorities for the specified rehabilitation or replacement plans are typically identified on the OSIM forms as six to ten years, one to five years, within one year, and urgent.

The costs associated with the recommended work are based on the measured quantities of fair and poor element conditions and unit costs for similar and recent works. In many instances, where only minor works are required, the costs for mobilization, site access and or waterway control items (as required) are difficult to assess and may skew the costs of small-scale works. This work is often best completed by grouping similar efforts together.

For repair programs that require a number of prolonged on-site activities, we have assigned a variable general cost that may range from $20,000.00 to $100,000.00, to address some of the mobilization, insurance, bonding and related costs of being on-site.

Where the recommended work is the replacement of the structure, these general costs are assumed to be included in the overall replacement cost.

Construction cost estimates do not include engineering, property acquisition, or utilities relocation or support as may be required.

The total estimated cost for the capital works for all 51 structures within the Township, (including rehabilitation/repair and replacement costs) has been estimated as follows:

Table 4 Capital Works Costs and Timeframes

Time Frame	Capital Cost
< 1 year	$1,393,720.00
1 – 5 years	$2,537,500.00
6 – 10 years	$2,722,000.00
TOTAL	**$6,653,220.00**

The total, ten year estimated capital costs, which includes the above as well as all other associated costs including maintenance, additional investigations, and roadside protection costs, is **$8,184,320.00**. It should be noted that all costs are based on 2019 prices and do not account for inflation. A summary of the capital works needs can be found in Appendix B.

3.0 Bridge Condition Index

The Bridge Condition Index (BCI) for each structure has been determined based on the Ministry of Transportation Ontario (MTO) methodology followed in the MTO Document, MTO Bridge Condition index and Overall Measure of Bridge Condition, July 2009.

A new structure would have a BCI value of 100 and the value will decline over time. Monitoring the rate of decline in the BCI and comparing this with an anticipated rate of decline will provide the Township with valuable, long-term planning and asset management information. The reduction in BCI, in theory, is a function of many factors, including traffic volume, truck use, use of de-icing chemicals, exposure to the elements and the type of structure. Each bridge will decline at its own rate, but it is reasonable to expect that the decline begins slowly and accelerates as the structure gets older.

In addition, determining an individual BCI value at any point in time will allow the Township to make estimates of expected remaining service life and or establish target BCI criteria for major rehabilitations or replacements.

The Canadian Highway Bridge Design Code has a target service life of approximately 75 years, but it is recognized that maintenance, repair, and rehabilitations will be required along the way to reach or exceed this target.

As indicated, the BCI for a structure can range from 0 to 100 and a municipal bridge and culvert infrastructure can be organized into several ranges.

Good – BCI Range 70 to 100

A bridge with a BCI greater than 70 is generally considered to be in good to excellent condition, and repair or rehabilitation work is not usually required within the next five years. Routine maintenance, such as sweeping, cleaning and washing are still recommended.

Fair – BCI Range 50 to 70

A bridge with a BCI between 50 and 70 is generally considered to be in good to fair condition. Repair or rehabilitation work recommended is ideally scheduled to be completed within the next five years. This is the ideal time to schedule major bridge repairs for larger and/or critical structures from an economic perspective. The most effective improvement in a structure's service life can be achieved by completing repairs while in this range.

Poor – BCI Less than 50

A bridge with a BCI rating of less than 50 is generally considered poor with lower numbers representing structures nearing the end of their service life. The repair or rehabilitation of these structures is ideally best scheduled to be completed within approximately one year. However, if it is determined that the replacement of the structure would be a more viable, practical or economical solution than repairing the structure, the structure can be identified for continued monitoring and scheduled for replacement within a one to ten year range. The lower the BCI the more of a priority, within the one to ten year range, the replacement becomes.

4.0 Structure Inventory Trends

Based on the biennial inspection of each structure, the Bridge Condition Index (BCI) is calculated for each structure. The Bridge Condition Index Distribution graph, shown in Figure 2 below, provides a summary of the current state of the Township's structures, and Figure 3 shows the historical trend of the state of the structures over past inspections where BCI information was available.

Figure 2: Bridge Condition Index Distribution (2019)

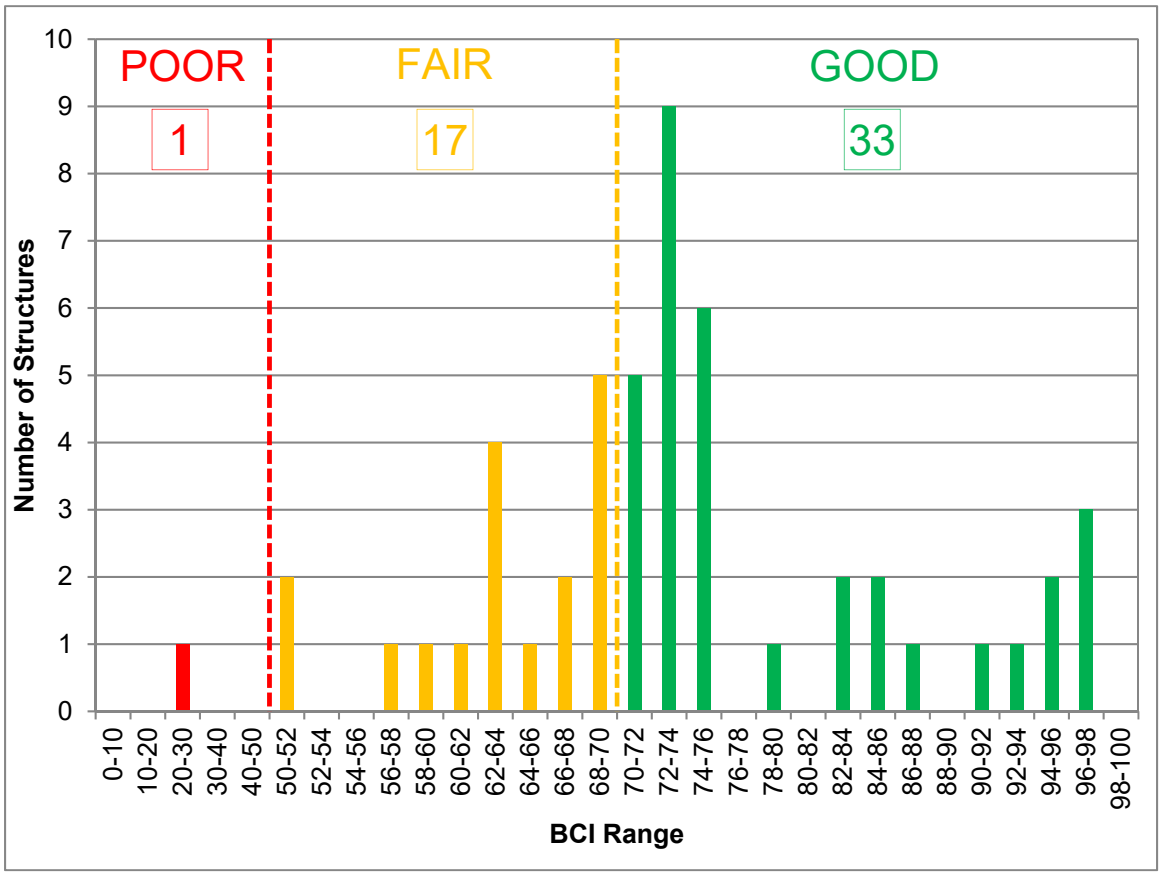
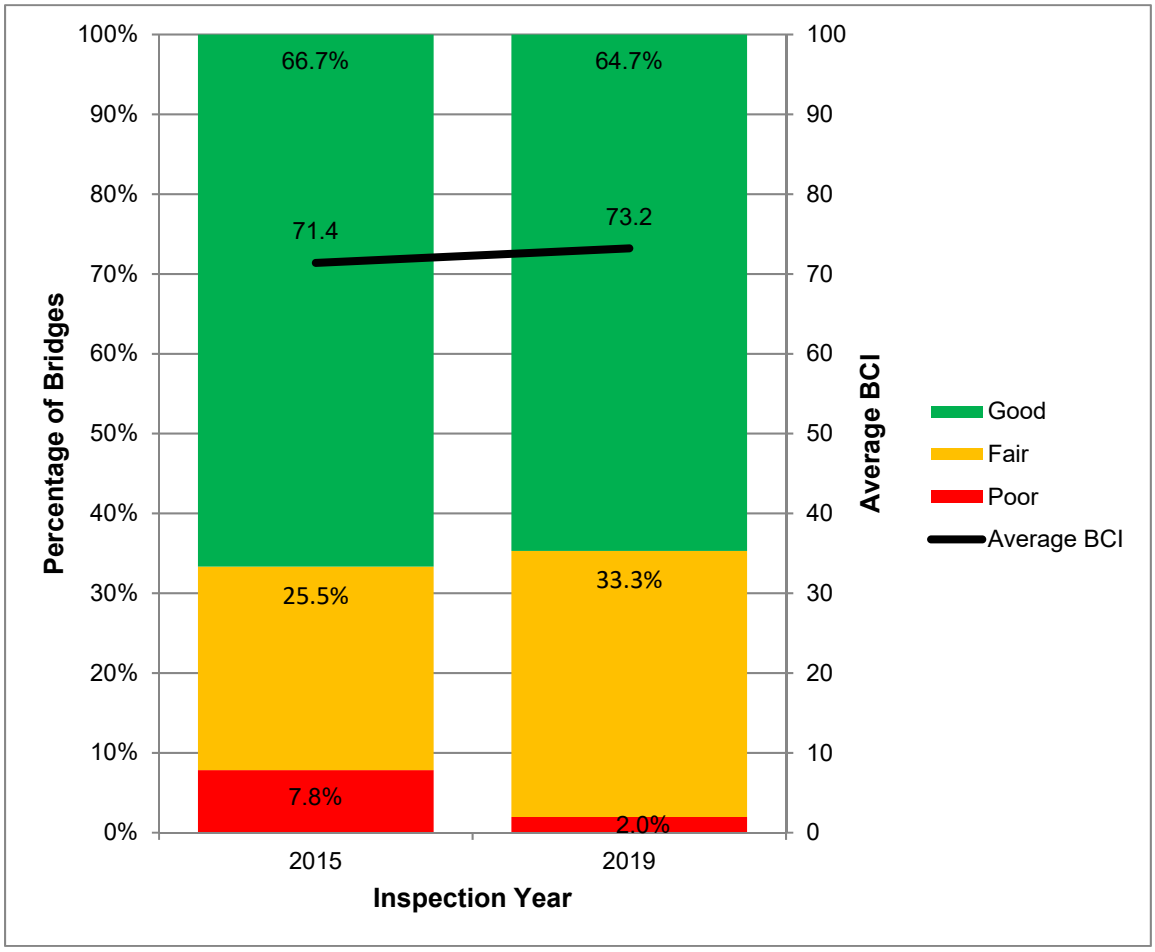


Figure 3: Bridge Condition Index Historical Trend



Currently, approximately 64.7% of the Township's structures are within the "good" range, with 33.3% of the structures classified as "fair" and 2% classified as "poor", as illustrated in Figure 3 above. Of interest, the MTO has established a goal to have 85% of their structures in "good" condition (BCI ≥ 70) by the year 2021, and to maintain that condition moving forward by addressing rehabilitations and replacements as necessary. Burnside recognizes that the above goal was not established by the Township, but it is noted that, based on the current state of the inspected structures, the Township is underperforming on the management of their bridge assets when compared to the MTO's established goal.

However, the trend in Figure 3 identifies an increase in the overall average BCI of the Township's inventory due to recently completed capital works projects since the 2015 inspections, which include the following:

- Structure No. 2027 – 15 Sideroad Replacement (2014);
- Structure No. 2028 – Main Street Replacement (2015);
- Structure No. 2010, 2020 & 2024 – Replacement (2016);

- Structure No. 15 – 2nd Line SW Rehabilitation (2017);
- Structure No. 10 – 280 Sideroad Rehabilitation (2018); and
- Structure No. 2003 – 3rd Line Rehabilitation (2019) – rehabilitation to be included on 2021 OSIM inspections.

Continued maintenance and completion of rehabilitative or replacement works as recommended in this report will help to continue this trend of overall improvement of the Township's bridge assets.

The MTO has also developed theoretical deterioration curves which can be used as a backdrop to estimate the remaining service life of a structure before replacement, or to establish a time frame for future rehabilitations.

For the purposes of this report, culverts and bridges less than 4.5 m in span are assumed not to have a rehabilitation cycle. These structures will be monitored and planned for replacement when their BCI drops below a lower limit of 40. However, even though our recommendation is to replace a structure, the costs to repair identified defects are included on the OSIM forms should the Township wish to repair these structures.

For structures with spans greater than 4.5 m, it has been assumed that a structure will be rehabilitated once during its lifetime. The rehabilitations are scheduled when the structures reach a target BCI of 60. However, for certain larger, more significant bridges, rehabilitation options may still be viable for BCI's lower than 60, but these will be considered on a site by site basis.

The estimated time until replacement or rehabilitation is required has been provided and the costs for all works required in the next ten years are identified.

5.0 Prioritization and Recommended Work

As an initial measure for prioritizing any required work, the structures have been ranked using their BCI values. A summary of the structures, in ascending order of BCI, along with their associated preliminary construction costs has been included in Appendix B. Two separate summary tables have been created to identify replacement and rehabilitation priority structures.

It should be noted that although the BCI is a good measure of the overall condition of the bridge, and therefore relative construction need, other factors are often considered when programming and prioritizing bridge work. Other factors that may be considered include:

- Traffic volume and number of trucks that regularly use the road;
- Load capacity restrictions at the site;
- Geometric restrictions (alignment or width);

- Pedestrian or cycling requirements;
- History of accidents or traffic conflicts;
- History of flooding or ice problems;
- Area growth and development; and
- In conjunction with already planned road improvements.

The prioritized capital works plan, and associated construction costs can be used for estimating future capital budgets. The budgets and rehabilitation work plans have been provided for the Township's highest priority structures.

The 5-Year Capital Plan below in Table 5, has been identified for rehabilitation or replacement based on their condition during the latest completed inspection, but also take into account additional factors through recent discussions with the Township such as low traffic volume roads, scheduled reconstruction projects, close proximately of priority structures, etc. Taking into consideration the recommended work in the next 5 years, it is recommended that the Township allocates approximately **$450,000.00** in their annual capital works budget for bridges and culverts. It should be noted the costs below are all inclusive estimates (include contingencies for construction and engineering).

Table 5: 5-Year Capital Plan

Structure No./Name	Road Name	Recommended Work	Estimated Construction Cost
2019			
2003	3rd Line	Rehabilitate (Culvert Invert Paving)	$204,720.00
2021	2nd Line NE	Repair (welded steel reinforcing)	$8,700.00
013	260 Sideroad	Detailed Deck Condition Survey	$8,100.00
2020			
2013	30th Sideroad	Replace	$474,500.00
2021			
013	260 Sideroad	Rehabilitate	$421,000.00
2022			
2023	4th Line NE	Rehabilitate	$187,000.00
007	7th Line SW	Rehabilitate	$255,000.00
006	4th Line SW	Rehabilitate (Waterproof & Pave)	$57,000.00
2023			

Structure No./Name	Road Name	Recommended Work	Estimated Construction Cost
011	8th Line SW	Rehabilitate	$401,500.00
2024			
016	250 Sideroad	Rehabilitate	$339,000.00
		Total	**$2,151,800.00**

It should be noted the 2019 work above are the quoted prices scheduled by the Township. It is our understanding that the Township may consider replacing Structure No. 2017 & 2032 using a local Contractor and their own forces, therefore these structures have not been included in the 5-year capital plan for the time being.

6.0 Summary

The 2019 OSIM inspections were carried out by Burnside on behalf of the Township of Melancthon to identify the current condition of all the structures within the Township's inventory. The Summary Reports provided in Appendix A summarize the maintenance needs, additional investigations and capital works requirements for each structure. The capital works for each structure has been given a priority of six to ten years, one to five years, within one year and urgent, based on the current BCI.

We trust the summary report provides all the information that you require at this time. If you have any questions or comments, please do not hesitate to contact us.

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix A

Summary Reports

1.1 Structure No. 1

2019 BCI: 72.1

Structure Name:	Structure 001		
Road Name:	4th Line SW		
Location:	1 km North of Highway 89 (Lot 4, CON. 4 & 5 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3.7 m
Overall Structure Width:	7.45 m	Roadway Width:	6.8 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 001 is generally in good condition but is demonstrating signs of concrete deterioration and erosion specifically on the abutments, wingwalls and exposed portion of the foundation. The Township should consider installing rock protection along the abutments and wingwalls to prevent further concrete deterioration and help extend the service life of the structure. It is also recommended that erosion of the abutments and footings be monitored during future biennial inspections. The repairs listed above may be considered to help extend the lifespan of the structure; however, based on the current BCI, span, and low clearance a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 16 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove overgrown vegetation along curbs and wingwalls.	$1,500.00
Erosion Control	Install rock protection along abutments.	$5,000.00
	Maintenance Needs Total	**$6,500.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of Deformations, Settlements and Movements	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	N/A	$2,500.00
Type B concrete repairs to soffit.	N/A	$4,000.00
Type C concrete repairs to abutment walls and wingwalls.	N/A	$5,000.00
Remove fill, Waterproof and Pave.	N/A	$25,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$106,500.00**

Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Utilities - Utility relocation	N/A	$5,000.00
Total Associated Work Cost		**$20,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$126,500.00	$420,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$13,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$42,000.00
Total Capital Work Cost			**$206,500.00**	**$558,500.00**

1.2 Structure No. 3

2019 BCI: 67.1

Structure Name:	Structure 003		
Road Name:	5th Sideroad		
Location:	100 m West of 4th Line (Lot 5/6, Con. 4 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3.7 (skew = 4.25) m
Overall Structure Width:	8 m	Roadway Width:	3.9 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years

Justification:

Structure 003 is generally in good to fair condition but is demonstrating signs of concrete deterioration, and moisture penetration through the deck based on delaminations noted on the soffit. Based on the current BCI, span, narrow driving platform and low clearance, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 14 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove overgrown vegetation along curbs.	$500.00
Erosion Control	Repair washouts on NE & SE embankments. Install rock protection along abutments.	$5,000.00
	Maintenance Needs Total	**$5,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	N/A	$5,000.00
Type B concrete repairs to soffit.	N/A	$15,000.00
Type C concrete repairs to abutment walls, wingwalls.	N/A	$8,000.00
Remove fill, waterproof and pave.	N/A	$25,000.00
Add slope stabilization.	N/A	$10,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$133,000.00**

Estimate Value of Replacement Structure	
Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$148,000.00	$415,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$15,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$42,000.00
	Total Capital Work Cost		**$230,000.00**	**$553,500.00**

1.3 Structure No. 4

2019 BCI: 29

Structure Name:	Structure 004		
Road Name:	5th Sideroad		
Location:	Lot 5/6, CON. 4 O.S		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	6.1 m
Overall Structure Width:	5.5 m	Roadway Width:	4.6 m
Year of Construction:	1930	Current Load Limit:	5 tonnes

Recommendation: Structure replacement is recommended as soon as possible

Justification:

Structure 004 is generally in poor condition and is demonstrating signs of severe concrete deterioration, moisture penetration, movement/rotation and instability. The barrier over the structure has fully deteriorated resulting in a severe hazard for errant vehicles and the wingwalls have significantly rotated and displaced. Further rotation/displacement of the wingwalls may result in failure of the retainment system and supported roadway corridor. The structure has surpassed the point of being economically repaired and as such should be replaced within the next year. Burnside understands the Township plans to close this structure to through traffic in 2019, leaving the existing structure in place. It is recommended a monitoring program be established to ensure the structure remains stable until replacement. Consideration should also be given to installing a temporary barrier system until replacement can occur.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Repair Washouts on South Embankments.	$1,500.00
Hazard Signs	Install "narrow bridge" signs at structure.	$500.00
Other	Install a temporary barrier/delineation system.	$5,000.00
	Maintenance Needs Total	**$7,000.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of Deformations, Settlements and Movements.	Normal	$5,000.00

Estimate Value of Replacement Structure	$550,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$550,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$55,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$55,000.00
	Total Capital Work Cost		**N/A**	**$714,500.00**

1.4 Structure No. 5

2019 BCI: 72.9

Structure Name:	Structure 005		
Road Name:	2nd Line SW		
Location:	1.4 km North of County Road 17 (Lot 283, CON. 2 & 3 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	7.8 m
Overall Structure Width:	8.7 m	Roadway Width:	7.9 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 6 years

Justification:

Structure 005 is generally in good condition but is beginning to demonstrate signs of concrete deterioration, and moisture penetration on the soffit indicating that water is likely penetrating through the existing wearing course and waterproofing system (if waterproofing was completed during original structure) and requires replacement. Based on the current BCI, minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, and barrier replacement should be included in the rehabilitation project within approximately 6 years. Consideration should also be given to installing a steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Sweep deck wearing surface, remove vegetation along curbs.	$1,000.00
Hazard Signs	Raise hazard warning signs at structure.	$500.00
	Maintenance Needs Total	**$1,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type B concrete repairs to soffit.	6 to 10 years	$10,000.00
Type C concrete repairs to abutment walls, wingwalls.	6 to 10 years	$1,500.00
Replace barrier system.	6 to 10 years	$30,000.00
Waterproof and repave.	6 to 10 years	$25,000.00
General Items - Insurance, Mobilization, Access etc.	6 to 10 years	$70,000.00
	Rehabilitation Cost Subtotal	**$136,500.00**

Estimate Value of Replacement Structure	$650,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 Years	$15,000.00
	Total Associated Work Cost	**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$151,500.00	$665,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$16,000.00	$67,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$67,000.00
		Total Capital Work Cost	**$234,500.00**	**$853,500.00**

1.5 Structure No. 6

2019 BCI: **78.4**

Structure Name:	Structure 006		
Road Name:	4th Line SW		
Location:	1.7 km North of County Road 17 (Lot 281 & 11, Con. 4 & 5 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	10 m
Overall Structure Width:	7.9 m	Roadway Width:	6.7 m
Year of Construction:	2003	Current Load Limit:	N/A

Recommendation: No Capital Works estimated to be required within 10 years. Future structure rehabilitation should be considered.

Justification:

Structure 006 is generally in good condition with only minor maintenance recommended at this time. The Township should consider waterproofing and paving the deck top of this structure to help maximize the lifespan of the structure. Consideration should also be given to extending the steel beam guide rail system and installing current code conforming end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Sweep Deck Top.	$1,000.00
Erosion Control	Install rock protection along abutments & wingwalls.	$8,000.00
	Maintenance Needs Total	**$9,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Extend Guide Rail, install end treatments.	1 to 5 Years	$20,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Waterproof and pave.	1 to 5 years	$20,000.00
	Rehabilitation Cost Subtotal	**$20,000.00**

Estimate Value of Replacement Structure	$800,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$20,000.00	$800,000.00
Roadside Protection:			$20,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$2,000.00	$80,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$80,000.00
	Total Capital Work Cost		**$57,000.00**	**$1,014,500.00**

1.6 Structure No. 7

2019 BCI: 68.9

Structure Name:	Structure 007		
Road Name:	7th Line SW		
Location:	1.5 km South of 270 Sideroad (Lot 13, Con. 6 & 7 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	9.4 m
Overall Structure Width:	8.6 m	Roadway Width:	7.4 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 4 years

Justification:

Structure 007 is generally in good to fair condition but is demonstrating signs of concrete deterioration throughout, and moisture penetration on the soffit. A minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, and barrier replacement should be included in the rehabilitation project within approximately 4 years. However, given the narrow, sub-standard driving platform width, consideration may be given to forgoing the rehabilitation and scheduling the replacement of the structure within 14 years. Consideration should also be given to installing a steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove vegetation along curbs.	$1,000.00
Hazard Signs	Replace hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$2,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	1 to 5 years	$5,000.00
Type B concrete repairs to soffit.	1 to 5 years	$10,000.00
Type C concrete repairs to abutment walls and wingwalls.	1 to 5 years	$15,000.00
Replace barrier system.	1 to 5 years	$30,000.00
Waterproof and pave.	1 to 5 years	$25,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$70,000.00
Rehabilitation Cost Subtotal		**$155,000.00**

Estimate Value of Replacement Structure	$800,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$170,000.00	$815,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$17,000.00	$82,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$16,000.00	$82,000.00
	Total Capital Work Cost		**$255,000.00**	**$1,033,500.00**

1.7 Structure No. 8

2019 BCI: 70.5

Structure Name:	Structure 008		
Road Name:	7th Line SW		
Location:	1.5 km South of 270 Sideroad (Lot 15, Con. 6 & 7 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	6.1 m
Overall Structure Width:	18.2 m	Roadway Width:	6.9 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 008 is generally in good to fair condition. Wet cracks were noted on the soffit which indicate a potential of moisture penetration through the deck but may also be due to the humid environment within the barrel. These cracks should be monitored during future inspections and consideration may be given to removing the fill from over the culvert to waterproof the deck top surface and help extend the service life of the structure. If the Township wishes to complete this work and associated paving/concrete repairs, the work is recommended to be completed within 5 years. Otherwise, the Township may wish to forgo rehabilitation due to the narrow driving platform width and schedule to replace the structure in approximately 15 years. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove fill over exposed deck top ends.	$1,000.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$2,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail	1 to 5 Years	$1,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	1 to 5 years	$10,000.00
Type C concrete repairs to barrels.	1 to 5 years	$10,000.00
Waterproof and pave.	1 to 5 years	$20,000.00
Add slope stabilization.	1 to 5 years	$8,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$70,000.00
Rehabilitation Cost Subtotal		**$118,000.00**

Estimate Value of Replacement Structure	$550,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$133,000.00	$565,000.00
Roadside Protection:			$1,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$14,000.00	$57,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$57,000.00
Total Capital Work Cost			**$163,000.00**	**$733,500.00**

1.8 Structure No. 9

2019 BCI: 72.9

Structure Name:	Structure 009		
Road Name:	8th Line SW		
Location:	2.5 km North of HWY 89 (Lot 14, Con. 8 & 9 SW)		
Structure Type:	Precast Concrete Box Girder		
Number of Spans:	1	Span Lengths:	10.4 m
Overall Structure Width:	8.8 m	Roadway Width:	7.8 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 6 years.

Justification:

Structure 009 is generally in good condition but is demonstrating signs of concrete deterioration caused by the salt laden water leaking through the expansion joints. Based on the current BCI, minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, and expansion joint replacement should be included in the rehabilitation project within approximately 6 years. Consideration may be given to converting the bridge to a semi-integral configuration during future rehabilitation to eliminate future maintenance and durability concerns related to the expansion joint. Consideration should also be given to installing a steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Clean deck top and seals / sealants.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to barrier/parapet walls interior, deck top and concrete end dams.	6 to 10 years	$5,000.00
Type B concrete repairs to girders and soffit,	6 to 10 years	$5,000.00
Replace expansion joint, seals and sealant/convert to semi-integral.	6 to 10 years	$105,000.00
Waterproof and pave.	6 to 10 years	$25,000.00
General Items - Insurance, Mobilization, Access etc.	6 to 10 years	$70,000.00
Rehabilitation Cost Subtotal		**$210,000.00**

Estimate Value of Replacement Structure	$750,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$225,000.00	$765,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$23,000.00	$77,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$21,000.00	$77,000.00
Total Capital Work Cost			**$321,000.00**	**$973,500.00**

1.9 Structure No. 10

2019 BCI: **90.4**

Structure Name:	Structure 010		
Road Name:	280 Sideroad		
Location:	LOT 11 & 12, CON 10 SW		
Structure Type:	Steel I-Girder (Timber Deck)		
Number of Spans:	1	Span Lengths:	10.38 m
Overall Structure Width:	5.5 m	Roadway Width:	4.9 m
Year of Construction:	2000	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 010 was rehabilitated in 2018 and is generally in excellent condition with only minor maintenance recommended at this time.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Sweep deck top.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Estimate Value of Replacement Structure	$700,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$700,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$70,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$70,000.00
	Total Capital Work Cost		**N/A**	**$894,500.00**

1.10 Structure No. 11 **2019 BCI: 69.6**

Structure Name:	Structure 011		
Road Name:	8th Line SW		
Location:	3.4 km North of HWY 89 (Lot 16, Con. 8 & 9 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	16.2 (skew = 19.8) m
Overall Structure Width:	8.5 m	Roadway Width:	7.3 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 5 years

Justification:

Structure 011 is generally in good to fair condition but is demonstrating signs of concrete deterioration on the deck top, and moisture penetration primarily through the deck construction joint. Based on the current BCI, a minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, barrier replacement, and deck drain replacement should be included in the rehabilitation project within 5 years to help extend the service life of the structure. It is also recommended that a Detailed Deck Condition Survey, be completed prior to rehabilitation to determine the extent of deck repairs. Consideration should also be given to installing a steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic. Based on the presence of swallow nests noted during the inspection, it is recommended that bird netting be installed on the structure in the season ahead of the scheduled rehabilitation work.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning sign at SW quadrant.	$250.00
	Maintenance Needs Total	**$250.00**

Additional Investigations	Priority	Estimated Cost
Detailed Deck Condition Survey.	Normal	$10,000.00

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	1 to 5 Years	$60,000.00
Type B concrete repairs to soffit.	1 to 5 Years	$30,000.00
Type C concrete repairs to abutment walls.	1 to 5 Years	$5,000.00
Replace barrier system.	1 to 5 Years	$65,000.00
Replace deck drains.	1 to 5 Years	$5,000.00
Waterproof and pave.	1 to 5 Years	$35,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 Years	$70,000.00
	Rehabilitation Cost Subtotal	**$270,000.00**

Estimate Value of Replacement Structure	$1,300,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Environmental - Install bird netting	1 to 5 Years	$7,500.00
	Total Associated Work Cost	**$22,500.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$292,500.00	$1,322,500.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$30,000.00	$133,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$27,000.00	$117,000.00
	Total Capital Work Cost		**$401,500.00**	**$1,627,000.00**

1.11 Structure No. 12

2019 BCI: **86.3**

Structure Name:	Structure 012		
Road Name:	7th Line SW		
Location:	Lot 21, Conc. 6 & SW		
Structure Type:	Steel I-Girder (Concrete Deck)		
Number of Spans:	1	Span Lengths:	Clear=17.1 Skew=18 m
Overall Structure Width:	8.7 m	Roadway Width:	7 m
Year of Construction:	2007	Current Load Limit:	N/A

Recommendation: No Capital Works estimated to be required within 10 years. Future structure rehabilitation should be considered.

Justification:

Structure 012 which was erected in 2007, is generally in excellent to good condition with only minor maintenance recommended at this time.

Maintenance Need	Element and Comments	Estimated Cost
Rout and Seal	Repairs required to approach wearing surface and deck wearing surface.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Estimate Value of Replacement Structure	$1,300,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$1,300,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$130,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$115,000.00
	Total Capital Work Cost		**N/A**	**$1,599,500.00**

1.12 Structure No. 13

2019 BCI: 63.7

Structure Name:	Structure 013		
Road Name:	260 Sideroad		
Location:	200 m East of 7th Line SW (Lot 21 & 22, Con. 6 & 7 SW)		
Structure Type:	Precast Concrete I-Girder		
Number of Spans:	1	Span Lengths:	17.8 m
Overall Structure Width:	10.7 m	Roadway Width:	8.6 m
Year of Construction:	1968	Current Load Limit:	N/A

Recommendation: Major Rehabilitation is recommended within 2 years.

Justification:

Structure 013 is generally in fair condition and is demonstrating signs of concrete deterioration, moisture penetration and bottom-up defects in the deck wearing surface indicating a potential poor condition of the underlying deck top. Based on the bottom-up defects observed in the deck wearing surface, a detailed deck condition survey is recommended to determine if the superstructure can be repaired as the extent of the deck repairs are unknown at this point in time. Pending the findings of the detailed deck condition survey, it is recommended that a major rehabilitation consisting of concrete repairs, waterproofing, paving, joint sealant and bearing replacement be planned within the next 2 years.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Sweep Sidewalk/Curbs.	$500.00
Deck Drains	Flush deck drains.	$250.00
Parapet Walls	Replace deteriorated joint sealant, powerwash barriers.	$1,250.00
	Maintenance Needs Total	**$2,000.00**

Additional Investigations	Priority	Estimated Cost
Detailed Deck Condition Survey.	Normal	$8,100.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to barrier/parapet walls interior, deck top, and curbs.	1 to 5 years	$100,000.00
Type B concrete repairs to barrier/parapet walls exterior and soffit.	1 to 5 years	$15,000.00
Type C concrete repairs to abutment walls and wingwalls.	1 to 5 years	$6,000.00
Waterproof and pave.	1 to 5 years	$40,000.00
Replace seals and sealant.	1 to 5 years	$20,000.00
Replace bearings.	1 to 5 years	$65,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$90,000.00
Rehabilitation Cost Subtotal		**$336,000.00**

Estimate Value of Replacement Structure	$1,300,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$351,000.00	$1,315,000.00
Roadside Protection:			$0.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$36,000.00	$132,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$34,000.00	$116,000.00
Total Capital Work Cost			**$421,000.00**	**$1,617,500.00**

1.13 Structure No. 14

2019 BCI: 71.1

Structure Name:	Structure 014		
Road Name:	4th Line SW		
Location:	500m North of 250 Sideroad (Lot 28, Con. 4 & 5 SW)		
Structure Type:	Precast Concrete Box Girder		
Number of Spans:	1	Span Lengths:	16.35 m
Overall Structure Width:	8.6 m	Roadway Width:	7.7 m
Year of Construction:	1977	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 6 years

Justification:

Structure 014 is generally in good condition but is demonstrating signs of concrete deterioration on the deck top and seized expansion joints. The majority of defects were noted to be in areas adjacent to leaking or unsealed joints in the barrier or deck. As such, a minor rehabilitation to seal the joints, waterproof and pave, and complete concrete repairs to help slow the rate of deterioration is recommended within the next 6 years. Consideration may be given to converting the structure to a semi-integral configuration at the time of rehab to eliminate future maintenance and durability concerns of the expansion joint. Consideration should also be given to replacing the steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Clean Deck Top and Flush expansion joints.	$1,500.00
Joint Sealant	Replace deteriorated barrier joint sealant.	$1,500.00
	Maintenance Needs Total	**$3,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Replace Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to barrier/parapet walls interior, deck top and concrete end dams.	6 to 10 years	$20,000.00
Type B concrete repairs to girders.	6 to 10 years	$5,000.00
Waterproof and pave.	6 to 10 years	$30,000.00
Replace expansion joints.	6 to 10 years	$120,000.00
Install abutment rock protection.	6 to 10 years	$10,000.00
General Items - Insurance, Mobilization, Access etc.	6 to 10 years	$70,000.00
	Rehabilitation Cost Subtotal	**$255,000.00**

Estimate Value of Replacement Structure	$1,200,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 Years	$15,000.00
	Total Associated Work Cost	**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$270,000.00	$1,215,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$27,000.00	$122,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$26,000.00	$111,000.00
	Total Capital Work Cost		**$375,000.00**	**$1,502,500.00**

1.14 Structure No. 15 **2019 BCI: 74.4**

Structure Name:	Structure 015		
Road Name:	2nd Line SW		
Location:	70m North of 250 Sideroad (Lot 249, Con. 2 & 3 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	15.3 m
Overall Structure Width:	7.45 m	Roadway Width:	6.2 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 015, which was rehabilitated in 2017, is generally in good condition with no capital works required at this time. Routine maintenance should be ongoing to help maximize the lifespan of the structure.

Estimate Value of Replacement Structure	$1,100,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$1,100,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$110,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$105,000.00
	Total Capital Work Cost		**N/A**	**$1,369,500.00**

1.15 Structure No. 16 **2019 BCI: 70.4**

Structure Name:	Structure 016		
Road Name:	250 Sideroad		
Location:	2 km West of Hwy 10 (Lot 250/251, Con. 1 SW)		
Structure Type:	Steel I-Girder (Concrete Deck)		
Number of Spans:	1	Span Lengths:	13.4 m
Overall Structure Width:	6.3 m	Roadway Width:	5.3 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 5 years.

Justification:

Structure 016 which was rehabilitated in 1990, is generally in good condition but is demonstrating signs of concrete deterioration, and peeling/flaking of structural steel coating. Based on the current BCI, and the size of the structure, an additional minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, re-painting structural steel, and erosion protection should be included in the rehabilitation project within approximately 5 years. However, given the narrow, sub-standard driving platform width, consideration may be given to forgoing the rehabilitation and scheduling the replacement of the structure within 15 years. Consideration should also be given to replacing the steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Clean deck top.	$1,000.00
Handrail Maintenance	Repair hand railings.	$1,000.00
Hazard Signs	Raise hazard warning signs and install narrow structure signs.	$1,000.00
Guide Rail	Replace missing bolts on NE and replace damaged posts.	$1,500.00
	Maintenance Needs Total	**$4,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Replace Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	1 to 5 years	$10,000.00
Type C concrete repairs to abutment walls and wingwalls.	1 to 5 years	$10,000.00
Painting required to structural steel (Full length).	1 to 5 years	$85,000.00
Repairs to barrier system and hand railings.	1 to 5 years	$15,000.00
Waterproof and pave.	1 to 5 years	$25,000.00
Install rock protection along abutments.	1 to 5 years	$10,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$70,000.00
	Rehabilitation Cost Subtotal	**$225,000.00**

Estimate Value of Replacement Structure	$900,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
	Total Associated Work Cost	**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$240,000.00	$915,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$24,000.00	$92,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$23,000.00	$92,000.00
		Total Capital Work Cost	**$339,000.00**	**$1,153,500.00**

1.16 Structure No. 17

2019 BCI: 74.7

Structure Name:	Structure 017		
Road Name:	250 Sideroad		
Location:	370m West of Hwy 10 (Lot 250/251, Con. 1 SW)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	2	Span Lengths:	5.89, 5.89 m
Overall Structure Width:	12.8 m	Roadway Width:	7.3 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 7 years.

Justification:

Structure 017 is generally in good condition with only roadside safety upgrades recommended at this time. Routine maintenance is recommended to be ongoing to help maximize the lifespan of the structure.

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and replace damaged sections.	1 to 5 Years	$20,000.00

Estimate Value of Replacement Structure	$900,000.00

Total Capital Works Costs			
Cost		**Rehabilitation**	**Replacement**
Subtotal:		N/A	$900,000.00
Roadside Protection:		N/A	$52,000.00
Staging:		N/A	$0.00
Environmental Assessment:		N/A	$2,500.00
Contingencies:	10%	N/A	$90,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M	N/A	$90,000.00
Total Capital Work Cost		**N/A**	**$1,134,500.00**

1.17 Structure No. 18

2019 BCI: 69

Structure Name:	Structure 018		
Road Name:	2nd Line NE		
Location:	750m South of County Road 21 (Lot 15, Con. 2 & 3 NE)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	7.4 m
Overall Structure Width:	8.65 m	Roadway Width:	7.45 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 4 years.

Justification:

Structure 018 is generally in good to fair condition but is demonstrating signs concrete deterioration, and moisture penetration. Based on the current BCI, a minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, barrier replacement, and erosion protection should be included in the rehabilitation project within approximately 4 years. However, given the narrow, sub-standard driving platform width, consideration may be given to forgoing the rehabilitation and scheduling the replacement of the structure within 14 years. Consideration should also be given to installing a steel beam guide rail system, end treatments and structure connections to help protect oncoming traffic.

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments and structure connections.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	1 to 5 years	$2,500.00
Type B concrete repairs to soffit.	1 to 5 years	$5,000.00
Type C concrete repairs to abutment walls and wingwalls.	1 to 5 years	$15,000.00
Install thrie beam barrier system.	1 to 5 years	$45,000.00
Waterproof and pave.	1 to 5 years	$25,000.00
Install slope protection.	1 to 5 years	$10,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$70,000.00
Rehabilitation Cost Subtotal		**$172,500.00**

Estimate Value of Replacement Structure	$600,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Utilities - Utility relocation	1 to 5 Years	$5,000.00
Total Associated Work Cost		**$20,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$192,500.00	$620,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$20,000.00	$62,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$18,000.00	$62,000.00
Total Capital Work Cost			**$282,500.00**	**$798,500.00**

1.18 Structure No. 2001 **2019 BCI: 70.7**

Structure Name:	Structure 2001		
Road Name:	3rd Line		
Location:	2.5 km South of County Road 17 (Lot 6 Con. 2 & 3 O.S.)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.5 m
Overall Structure Width:	15.8 m	Roadway Width:	7.9 m
Year of Construction:	1989	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2001 is generally in good condition but is demonstrating signs of light to moderate surface corrosion along the waterline. Based on the structure type and span a rehabilitation is not recommended and replacement of the structure is recommended once the BCI reaches 40, in approximately 15 years. Consideration should also be given to repairing the 3-cable guide rail system to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Repair Guide Rail (Replace rotten posts, Raise 3-cable).	1 to 5 Years	$6,000.00

Estimate Value of Replacement Structure	$400,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$400,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$40,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$40,000.00
	Total Capital Work Cost		**N/A**	**$534,500.00**

1.19 Structure No. 2002 **2019 BCI: 75**

Structure Name:	Structure 2002		
Road Name:	5th Sideroad		
Location:	200m East of 4th Line (Lot 5 & 6 Con. 3 O.S.)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.4 m
Overall Structure Width:	22.5 m	Roadway Width:	6.5 m
Year of Construction:	1988	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2002 is generally in good condition with only minor maintenance recommended at this time. It is also recommended that the slight sag in the culvert barrel be monitored during future biennial inspections. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Remove tree growing close to inlet.	$1,000.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
Other	Tighten loose nuts in barrel.	$250.00
	Maintenance Needs Total	**$2,250.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of Deformations, Settlements and Movements.	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$450,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$450,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$45,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$45,000.00
	Total Capital Work Cost		**N/A**	**$594,500.00**

1.20 Structure No. 2003 **2019 BCI: 56.2**

Structure Name:	Structure 2003		
Road Name:	3rd Line		
Location:	1 km South of 5th Sideroad (Lot 4 Con. 2 & 3 O.S.)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.8 m
Overall Structure Width:	26 m	Roadway Width:	7 m
Year of Construction:	1970	Current Load Limit:	N/A

Recommendation: Complete invert paving rehabilitation within 1 year, otherwise replace structure within 8 years

Justification:

Structure 2003 is generally in fair to poor condition and is demonstrating signs of severe corrosion, section loss and perforations along the culvert floor. We understand the Township has scheduled culvert rehabilitation works in the form of steel reinforced invert paving to be completed in 2019. Consideration may also be given to repairing the 3-cable guide rail system to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Install rock protection on SE and SW embankments.	$2,500.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$3,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Repair Guide Rail.	Within 1 year	$6,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Install welded wire fabric.	Within 1 year	$7,000.00
Culvert invert paving.	Within 1 year	$121,000.00
General Items - Insurance, Mobilization, Access etc.	Within 1 year	$36,720.00
Rehabilitation Cost Subtotal		**$164,720.00**

Estimate Value of Replacement Structure	$550,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	Within 1 year	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$164,720.00	$565,000.00
Roadside Protection:			$6,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$17,000.00	$57,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$17,000.00	$57,000.00
	Total Capital Work Cost		**$204,720.00**	**$733,500.00**

1.21 Structure No. 2004 **2019 BCI: 73.9**

Structure Name:	Structure 2004		
Road Name:	5th Sideroad		
Location:	300m West of county Road 124 (Lots 5 & 6, Con. 2 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	6.1 m
Overall Structure Width:	8 m	Roadway Width:	7.4 m
Year of Construction:	1990	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 7 years.

Justification:

Structure 2004 is generally in good condition but is demonstrating signs of moisture penetration on the soffit. Based on the current BCI, a minor rehabilitation should be considered as the BCI approaches 60 to ensure the structure does not deteriorate beyond repair. Concrete repairs, waterproofing and paving, and erosion protection should be included in the rehabilitation project within approximately 7 years. However, given the narrow, sub-standard driving platform width, consideration may be given to forgoing the rehabilitation and scheduling the replacement of the structure within 17 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Streams and Waterways	Remove blockage at inlet, remove silt and vegetation build-up.	$2,500.00
	Maintenance Needs Total	**$2,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	6 to 10 years	$1,000.00
Type B concrete repairs to soffit.	6 to 10 years	$5,000.00
Type C concrete repairs to abutment walls and wingwalls.	6 to 10 years	$1,000.00
Waterproof and pave.	6 to 10 years	$25,000.00
Add slope stabilization.	6 to 10 years	$8,000.00
General Items - Insurance, Mobilization, Access etc.	6 to 10 years	$70,000.00
Rehabilitation Cost Subtotal		**$110,000.00**

Estimate Value of Replacement Structure	$550,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$125,000.00	$565,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$13,000.00	$57,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$57,000.00
	Total Capital Work Cost		**$205,000.00**	**$733,500.00**

1.22 Structure No. 2005 **2019 BCI: 94.7**

Structure Name:	Structure 2005		
Road Name:	3rd Line		
Location:	1.1 km South of County Road 17 (Lot 8, Con. 2 & 3 O.S.)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	2.3 m
Overall Structure Width:	17 m	Roadway Width:	8.4 m
Year of Construction:	2014	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2005 is generally in excellent condition with only minor maintenance recommended at this time. The Township may consider removing this structure from future biennial inspection lists since the span is less than 3 metres (2.3 metres).

Maintenance Need	Element and Comments	Estimated Cost
Guide Rail	Tighten loose end treatment cables.	$500.00
	Maintenance Needs Total	**$500.00**

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.23 Structure No. 2006 **2019 BCI: 73.9**

Structure Name:	Structure 2006		
Road Name:	3rd Line		
Location:	70m South of 15th Sideroad (Lot 15, Con. 2 & 3 O.S)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3 m
Overall Structure Width:	8 m	Roadway Width:	7.4 m
Year of Construction:	1990	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2006 is generally in good condition with only minor maintenance recommended at this time. Based on the current BCI, span of 3 m (less than 4.5 m), and low clearance a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 17 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Rout and Seal	Repairs required to approach wearing surface.	$500.00
Hazard Signs	Reinstate hazard warning signs at structure.	$500.00
Other	Remove excess silt and vegetation build-up in stream.	$2,000.00
	Maintenance Needs Total	**$3,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs			
Cost		**Rehabilitation**	**Replacement**
Subtotal:		N/A	$350,000.00
Roadside Protection:		N/A	$52,000.00
Staging:		N/A	$0.00
Environmental Assessment:		N/A	$2,500.00
Contingencies:	10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M	N/A	$35,000.00
	Total Capital Work Cost	**N/A**	**$474,500.00**

1.24 Structure No. 2007 **2019 BCI: 69.7**

Structure Name:	Structure 2007		
Road Name:	15th Sideroad		
Location:	50m West of 3rd Line (Lot 15 & 16, Con. 3 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3 m
Overall Structure Width:	8 m	Roadway Width:	7 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2007 is generally in good to fair condition but is demonstrating signs of moisture penetration through the cracks in the soffit. Based on the span and low clearance, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 15 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure but would not be considered economical as a standalone contract.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Repair washout on SE embankment.	$1,000.00
Hazard Signs	Straighten hazard warning signs at structure and raise SE hazard warning sign.	$250.00
	Maintenance Needs Total	**$1,250.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	N/A	$5,000.00
Type B concrete repairs to soffit.	N/A	$5,000.00
Waterproof and pave.	N/A	$20,000.00
Add slope stabilization.	N/A	$8,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$108,000.00**

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$123,000.00	$365,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$13,000.00	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$37,000.00
	Total Capital Work Cost		**$203,000.00**	**$493,500.00**

1.25 Structure No. 2008 **2019 BCI: 73.4**

Structure Name:	Structure 2008		
Road Name:	15th Sideroad		
Location:	600m East of County Road 124 (Lots 15 & 16, Con. 1 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3.7 m
Overall Structure Width:	9.25 m	Roadway Width:	6.2 m
Year of Construction:	1970	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2008 is generally in good condition with only minor maintenance recommended at this time. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 17 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure but would not be considered economical as a standalone contract.

Maintenance Need	Element and Comments	Estimated Cost
Streams and Waterways	Remove fallen trees blocking inlet,	$500.00
	Maintenance Needs Total	**$500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type B concrete repairs to soffit.	N/A	$1,000.00
Type C concrete repairs to wingwalls.	N/A	$3,500.00
Remove fill, waterproof and pave.	N/A	$20,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$94,500.00**

Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$109,500.00	$415,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$11,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$42,000.00
Total Capital Work Cost			**$187,500.00**	**$553,500.00**

1.26 Structure No. 2009 **2019 BCI: 85.7**

Structure Name:	Structure 2009		
Road Name:	15th Sideroad		
Location:	1 km East of County Road 124 (Lot 16, Con. 1, O.S.)		
Structure Type:	Cast-In-Place Conc. Box Culvert		
Number of Spans:	1	Span Lengths:	5.5 m
Overall Structure Width:	9.11 m	Roadway Width:	8 m
Year of Construction:	2008	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years

Justification:

Structure 2009 is generally in excellent to good condition with only minor maintenance recommended at this time. Consideration should also be given to replacing the approach steel beam guide rail system, and end treatments to help protect oncoming traffic as well as installing a drip detail edge detail in the concrete soffit to help prevent future water damage.

Maintenance Need	Element and Comments	Estimated Cost
Rout and Seal	Rout and seal cracks in deck wearing surface.	$1,000.00
Other	Consider installing drip edge detail in soffit.	$2,500.00
	Maintenance Needs Total	**$3,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Replace Guide Rail, end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$400,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$400,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$40,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$40,000.00
	Total Capital Work Cost		**N/A**	**$534,500.00**

1.27 Structure No. 2010 **2019 BCI: 96.9**

Structure Name:	Structure 2010		
Road Name:	3rd Line		
Location:	850m South of 20th Sideroad (Lot 19, Con 2 & 3, OS)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.89 m
Overall Structure Width:	19.6 m	Roadway Width:	6.7 m
Year of Construction:	2016	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2010 was replaced in 2016 and is generally in excellent condition. Consideration should be given to investigating the need for steel beam guide rail, end treatments to help protect oncoming traffic. No water was flowing through the structure at time of inspection.

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$400,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$400,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$40,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$40,000.00
	Total Capital Work Cost		**N/A**	**$534,500.00**

1.28 Structure No. 2011 **2019 BCI: 63.9**

Structure Name:	Structure 2011		
Road Name:	20th Sideroad		
Location:	2 km East of 5th Line (Lots 20 & 21, Con. 3 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3.65 m
Overall Structure Width:	12.7 m	Roadway Width:	6.5 m
Year of Construction:	1985	Current Load Limit:	N/A

Recommendation: Structure replacement is recommended within 8 years.

Justification:

Structure 2011 is generally in fair condition and is demonstrating signs of severe concrete deterioration, and moisture penetration. The overgrown vegetation and excess fill overtop of the wingwalls and fascia appear to be contributing to the concrete defects and should be removed to prevent further deterioration. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 8 years. The repairs listed above may be completed to help extend the lifespan of the structure but are not considered economical as a standalone contract.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove overgrown vegetation above wingwalls and fascia.	$4,000.00
Hazard Signs	Install hazard warning signs at structure.	$250.00
Guide Rail (End Treatments)	Tighten guide rail end treatment cables.	$500.00
Guide Rail	Consider raising SBGR to adequate height.	$6,000.00
	Maintenance Needs Total	**$10,750.00**

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	N/A	$2,500.00
Type B concrete repairs to soffit.	N/A	$8,000.00
Type C concrete repairs to abutment walls and wingwalls.	N/A	$25,000.00
Remove fill and waterproof.	N/A	$45,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$150,500.00**

Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 years	$15,000.00
Utilities - Utility relocation	6 to 10 years	$5,000.00
Total Associated Work Cost		**$20,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$170,500.00	$420,000.00
Roadside Protection:			$0.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$18,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$16,000.00	$42,000.00
	Total Capital Work Cost		**$204,500.00**	**$558,500.00**

1.29 Structure No. 2012 **2019 BCI: 73.2**

Structure Name:	Structure 2012		
Road Name:	30th Sideroad		
Location:	250m East of County Road 124 (Lots 30 & 31, Con. 1 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	3.65 m
Overall Structure Width:	7.45 m	Roadway Width:	5.6 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: Structure replacement is recommended within 10 years

Justification:

Structure 2012 is generally in good condition with the exception of wide cracks and movement noted in the wingwalls. It is recommended that the cracks and movement in the wingwalls be monitored during future biennial inspections. Based on the current BCI, span, and low clearance, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 10 years. The repairs listed above may be completed to help extend the lifespan of the structure but are not considered economical as a standalone contract. Consideration should also be given to installing a steel beam guide rail system, end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove vegetation along curbs, remove excess vegetation and fill above wingwalls.	$1,500.00
Hazard Signs	Replace damaged hazard warning signs at structure and install narrow bridge signs.	$1,000.00
	Maintenance Needs Total	**$2,500.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of Deformations, Settlements and Movements, and Monitoring Crack Widths.	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	N/A	$3,500.00
Type B concrete repairs to soffit.	N/A	$1,500.00
Type C concrete repairs to wingwalls.	N/A	$4,000.00
Install wingwall reinforcement.	N/A	$8,000.00
Install barrier system.	N/A	$15,000.00
Remove fill, waterproof and pave.	N/A	$20,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$122,000.00**

Estimate Value of Replacement Structure	$400,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$122,000.00	$400,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$13,000.00	$40,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$40,000.00
	Total Capital Work Cost		**$202,000.00**	**$534,500.00**

1.30 Structure No. 2013 **2019 BCI: 51.9**

Structure Name:	Structure 2013		
Road Name:	30th Sideroad		
Location:	500m East of 3rd Line (Lots 30 & 31, Con. 3 O.S.)		
Structure Type:	Timber Girder		
Number of Spans:	1	Span Lengths:	3 m
Overall Structure Width:	7.1 m	Roadway Width:	5 m
Year of Construction:	1950	Current Load Limit:	N/A

Recommendation: Structure replacement is recommended within 1 years.

Justification:

Structure 2013 is generally in fair to poor condition and is demonstrating signs of moderate to severe deterioration of the timber members throughout. Furthermore, it appears there is bow in the timber decking which may be caused by the excess of granular material placed over the deck. It is recommended that the movements in timber deck, stability of timber headwall, and wide crack in timber abutment be monitored until replacement is an option. Based on the current BCI, span, age, and condition of the abutment walls (BCI < 40), a rehabilitation is not recommended, and replacement is recommended to be completed within 1 year despite the overall condition of the structure. Taking into consideration the condition, vintage and design loads at the time of construction, using engineering judgement it is recommended the Township place a 15 tonne load limit over the structure until the structure is replaced. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove tree at SE quadrant.	$1,000.00
Hazard Signs	Reinstate NE hazard warning sign at structure.	$250.00
	Maintenance Needs Total	**$1,250.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of Deformations, Settlements and Movements and Monitoring Crack Widths.	Normal	$5,000.00

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.31 Structure No. 2014

2019 BCI: 73.6

Structure Name:	Structure 2014		
Road Name:	4th Line		
Location:	900m South of Melancthon-Osprey Townline (Lot 31, Con. 3 & 4 O.S.)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	4.85 m
Overall Structure Width:	8 m	Roadway Width:	5 m
Year of Construction:	1950	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2014 is generally in good condition with only minor maintenance recommended at this time. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove vegetation along curbs.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$450,000.00

Associated Work	Priority	Estimated Cost
Utilities - Utility relocation	N/A	$5,000.00
Total Associated Work Cost		**$5,000.00**

Total Capital Works Costs			
Cost		**Rehabilitation**	**Replacement**
Subtotal:		N/A	$455,000.00
Roadside Protection:		N/A	$52,000.00
Staging:		N/A	$0.00
Environmental Assessment:		N/A	$2,500.00
Contingencies:	10%	N/A	$46,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M	N/A	$46,000.00
Total Capital Work Cost		**N/A**	**$601,500.00**

1.32 Structure No. 2015 **2019 BCI: 82.9**

Structure Name:	Structure 2015		
Road Name:	10th Line Northeast		
Location:	300m Northeast of 5th Line (Lot 25, Con. 10 & 11)		
Structure Type:	Precast Concrete Box Culvert		
Number of Spans:	1	Span Lengths:	4 m
Overall Structure Width:	9.5 m	Roadway Width:	6 m
Year of Construction:	2008	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2015, which was constructed in 2008, is generally in excellent to good condition with only minor maintenance recommended at this time. Consideration should be given to extending the steel beam guide rail system and installing end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove vegetation along SBGR.	$500.00
Concrete Repair	Patch large spall on interior precast unit.	$1,500.00
Erosion Control	Place rock protection along abutments.	$2,000.00
Other	Install missing nuts/bolts in barrier posts.	$250.00
	Maintenance Needs Total	**$4,250.00**

Roadside Protection Repairs	Priority	Estimated Cost
Extend Guide Rail and install end treatments.	1 to 5 Years	$20,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
		Total Capital Work Cost	**N/A**	**$474,500.00**

1.33 Structure No. 2016 **2019 BCI: 71.1**

Structure Name:	Structure 2016		
Road Name:	4th Line NE		
Location:	600m South of County Road 9 (Lot 30, Con. 4 & 5 NE)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	2.4 m
Overall Structure Width:	14.85 m	Roadway Width:	6.6 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2016, which has been previously rehabbed, is generally in good condition but is demonstrating signs of concrete deterioration, and moisture penetration. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 16 years. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic. The Township may consider removing this structure from their biennial bridge inspection list since the span is less than 3 m.

Maintenance Need	Element and Comments	Estimated Cost
Rout and Seal	Repairs required to approach wearing surface.	$500.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
		Total Capital Work Cost	**N/A**	**$474,500.00**

1.34 Structure No. 2017 **2019 BCI: 58.9**

Structure Name:	Structure 2017		
Road Name:	2nd Line NE		
Location:	1.4 km South of County Road 9 (Lot 28, Con. 2 & 3 NE)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	2.5 m
Overall Structure Width:	17.2 m	Roadway Width:	6.3 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: Structure replacement is recommended within 9 years.

Justification:

Structure 2017 is generally in fair to poor condition and is demonstrating signs of severe section loss > 10% along the waterline. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 9 years. Alternatively, the repairs listed above may be completed to help extend the lifespan of the structure. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Repair washouts on east embankments.	$1,500.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$2,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail	1 to 5 Years	$1,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Culvert paving with shotcrete.	N/A	$100,000.00
Welded wire fabric.	N/A	$5,000.00
Add slope stabilization.	N/A	$8,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$183,000.00**

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	6 to 10 years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$198,000.00	$365,000.00
Roadside Protection:			$1,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$20,000.00	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$19,000.00	$37,000.00
Total Capital Work Cost			**$238,000.00**	**$493,500.00**

1.35 Structure No. 2018 **2019 BCI: 69.2**

Structure Name:	Structure 2018		
Road Name:	2nd Line NE		
Location:	250m South of Sideroad 240 (Lot 26, Con. 2 & 3 NE)		
Structure Type:	Cast-In-Place Conc. Box Culvert		
Number of Spans:	1	Span Lengths:	2.44 m
Overall Structure Width:	12.25 m	Roadway Width:	6.3 m
Year of Construction:	1960	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2018 is generally in good to fair condition but is demonstrating signs of severe concrete deterioration on the culvert inlet. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 15 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure but would not be considered economical as a standalone contract. The Township may consider removing this structure from their biennial inspection list since the span is less than 3 m.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Reinstate NW hazard warning sign at structure.	$250.00
	Maintenance Needs Total	**$250.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	N/A	$5,000.00
Type C concrete repairs to barrels, inlet and outlet.	N/A	$15,000.00
Remove fill, waterproof and pave.	N/A	$20,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$110,000.00**

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$125,000.00	$365,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$13,000.00	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$37,000.00
Total Capital Work Cost			**$205,000.00**	**$493,500.00**

1.36 Structure No. 2019 **2019 BCI: 74.9**

Structure Name:	Structure 2019		
Road Name:	4th Line NE		
Location:	2.4 km North of County Road 21 (Lot 23, Con. 4 & 5 NE)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	5 m
Overall Structure Width:	18.4 m	Roadway Width:	6.5 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2019 is generally in good condition with only minor maintenance recommended at this time. Consideration should be given to installing steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	N/A	$5,000.00
Type C concrete repairs to barrels and inlet.	N/A	$1,000.00
Remove fill, waterproof and pave.	N/A	$20,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$96,000.00**

Estimate Value of Replacement Structure	$450,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$96,000.00	$450,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$10,000.00	$45,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$45,000.00
	Total Capital Work Cost		**$173,000.00**	**$594,500.00**

1.37 Structure No. 2020 **2019 BCI: 96.6**

Structure Name:	Structure 2020		
Road Name:	4th Line NE		
Location:	2.5 km North of County Road 21 (Lot 22, Con 4 & 5 NE)		
Structure Type:	Precast Concrete Box Culvert		
Number of Spans:	1	Span Lengths:	3 m
Overall Structure Width:	16.8 m	Roadway Width:	6.5 m
Year of Construction:	2016	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2020 is generally in excellent condition with only minor maintenance recommended at this time. Consideration should be given to investigating the need for steel beam guide rail to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.38 Structure No. 2021 **2019 BCI: 50.5**

Structure Name:	Structure 2021		
Road Name:	2nd Line NE		
Location:	2 km North of Country Road 21 (Lot 21 Con. 2 & 3 NE)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	5.2 m
Overall Structure Width:	19.8 m	Roadway Width:	6.3 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: Structure replacement is recommended within 5 years.

Justification:

Structure 2021 is generally in poor condition with bolt hole cracking throughout the culvert barrel. Based on the structure type a rehabilitation is not recommended and replacement of the structure is recommended once the BCI reaches 40, in approximately 5 years. However, the Township should establish a monitoring program for the bolt hole cracking until the structure can be replaced. Burnside understands the Township has scheduled temporary culvert repairs in 2019 to place welded steel reinforcement over the bolt hole cracking. Consideration should be given to investigating the need for steel beam guide rail, end treatments to help protect oncoming traffic.

Additional Investigations	Priority	Estimated Cost
Monitoring Crack Widths.	Normal	$5,000.00

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$450,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$450,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$45,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$45,000.00
	Total Capital Work Cost		**N/A**	**$594,500.00**

1.39 Structure No. 2022 **2019 BCI: 74.4**

Structure Name:	Structure 2022		
Road Name:	4th Line NE		
Location:	150m North of county Road 21 (Lot 17, Con. 4 & 5 NE)		
Structure Type:	Cast-In-Place Conc. Box Culvert		
Number of Spans:	1	Span Lengths:	3.1 m
Overall Structure Width:	18.5 m	Roadway Width:	6.5 m
Year of Construction:	1980	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2022 is generally in good condition with only minor maintenance recommended at this time. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.40 Structure No. 2023 **2019 BCI: 62.8**

Structure Name:	Structure 2023		
Road Name:	4th Line NE		
Location:	400 m South of County Road 21 (Lot16, Con. 4 & 5 NE)		
Structure Type:	Cast-In-Place Conc. Box Culvert		
Number of Spans:	1	Span Lengths:	3.6 m
Overall Structure Width:	14.1 m	Roadway Width:	6.5 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: Minor Rehabilitation is recommended within 1 years.

Justification:

Structure 2023 is generally in fair condition and is demonstrating signs of severe concrete deterioration specifically at the culvert ends. The vegetation and fill overtop of the culvert ends appear to be contributing to the concrete deterioration and should be removed as soon as possible. Given the relatively small span, the Township may wish to continue monitoring the structure's BCI during future biennial inspections and consider replacement as the BCI reaches 40, which is estimated to occur in approximately 11 years. However, given that the culvert interior is generally in good condition, reconstructing the culvert ends, exposing the deck to repair and apply waterproofing, backfilling and paving would help extend the service life and is the recommended action. With the current BCI approaching 60, rehabilitation should be scheduled within 1 to 2 years. Consideration should also be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove fill and overgrown vegetation over culvert ends.	$2,000.00
	Maintenance Needs Total	**$2,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	1 to 5 years	$5,000.00
Type C concrete repairs to barrels and reconstruct culvert ends.	1 to 5 years	$40,000.00
Remove fill, waterproof, backfill and pave.	1 to 5 years	$25,000.00
General Items - Insurance, Mobilization, Access etc.	1 to 5 years	$70,000.00
Rehabilitation Cost Subtotal		**$140,000.00**

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	1 to 5 Years	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$155,000.00	$365,000.00
Roadside Protection:			$1,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$16,000.00	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$37,000.00
	Total Capital Work Cost		**$187,000.00**	**$493,500.00**

1.41 Structure No. 2024 **2019 BCI: 96.5**

Structure Name:	Structure 2024		
Road Name:	2nd Line NE		
Location:	800 m South of Sideroad 240 (Lot 25, Con 2 & 3)		
Structure Type:	Precast Concrete Box Culvert		
Number of Spans:	1	Span Lengths:	3 m
Overall Structure Width:	17 m	Roadway Width:	6.3 m
Year of Construction:	2016	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2024 was recently replaced in 2016 and is generally in excellent condition. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to help protect oncoming traffic.

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.42 Structure No. 2025 **2019 BCI: 67.7**

Structure Name:	Structure 2025		
Road Name:	Sideroad 260		
Location:	3.2 km West of Highway 10 (Lot 260-261 Con.3 SW)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.1 m
Overall Structure Width:	19.1 m	Roadway Width:	8.5 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2025 is generally in good to fair condition but is demonstrating signs of moderate to severe surface corrosion and section loss throughout the culvert barrel. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 14 years. Consideration should be given to investigating the need for steel beam guide rail, and end treatments to protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$400,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$400,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$40,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$40,000.00
	Total Capital Work Cost		**N/A**	**$534,500.00**

1.43 Structure No. 2026 **2019 BCI: 83.3**

Structure Name:	Structure 2026		
Road Name:	8th Line SW		
Location:	1 km North of Highway 89 (Lot 11 Con.8 & 9 SW)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.4 m
Overall Structure Width:	17 m	Roadway Width:	8 m
Year of Construction:	2008	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2026 is generally in excellent to good condition. However, several areas of minor localized deformations and cusping were noted but may be from original construction. The deformations and cusping should be monitored during future biennial inspections to ensure they are not actively progressing. Consideration should also be given to replacing the steel beam guide rail system, end treatments to help protect oncoming traffic.

Additional Investigations	Priority	Estimated Cost
Monitoring of deformations, settlements and movements.	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Replace Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$365,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$37,000.00
Total Capital Work Cost			**N/A**	**$493,500.00**

1.44 Structure No. 2027 **2019 BCI: 95**

Structure Name:	Structure 2027		
Road Name:	15 Sideroad		
Location:	2 km West of County Road 124 (Lot 15 & 16, Conc. 2 OS)		
Structure Type:	Precast Concrete Box Culvert		
Number of Spans:	1	Span Lengths:	3.6 m
Overall Structure Width:	10 m	Roadway Width:	8.5 m
Year of Construction:	2015	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2027 is generally in excellent condition with only minor maintenance recommended at this time.

Maintenance Need	Element and Comments	Estimated Cost
Guide Rail	Bury channel ends, tighten loose end treatment cables.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.45 Structure No. 2028 **2019 BCI: 92.5**

Structure Name:	Structure 2028		
Road Name:	Main Street (County Road 14)		
Location:	0.5 km South of Sideroad 15 (Lot 15, Conc. 1 & 2 OS)		
Structure Type:	Precast Concrete Box Culvert		
Number of Spans:	1	Span Lengths:	2.44 m
Overall Structure Width:	16.8 m	Roadway Width:	6.5 m
Year of Construction:	2014	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2028 is generally in excellent condition with only minor maintenance recommended at this time. The Township may wish to consider removing the culvert from the future bridge inspection list as the span of the new structure is less than 3 m.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Install additional rock protection at inlet.	$1,000.00
Other	Trim exposed filter fabric on east retaining wall.	$250.00
	Maintenance Needs Total	**$1,250.00**

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.46 Structure No. 2029 **2019 BCI: 74.1**

Structure Name:	Structure 2029		
Road Name:	220 Sideroad		
Location:	0.5 km East of County Road 2 (Lots 36 & 37, Con. 5 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	2.42 m
Overall Structure Width:	8.04 m	Roadway Width:	4.7 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2029 is generally in good condition but is demonstrating signs of potential movement/rotation of the south abutment and SE wingwall. Based on the span, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 17 years. However, if the movements/rotations in the substructure progress then the replacement timeline should be expedited. It is also recommended that a monitoring program be established to monitor the movement/rotation observed in the substructure. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure but would not be considered economical as a standalone contract.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Reinstate SE hazard warning sign at structure	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of deformations, settlements and movements.	Normal	$5,000.00

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	N/A	$1,500.00
Type B concrete repairs to soffit.	N/A	$1,000.00
Type C concrete repairs to abutment walls.	N/A	$500.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$73,000.00**

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$73,000.00	$350,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$8,000.00	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$35,000.00
	Total Capital Work Cost		**$148,000.00**	**$474,500.00**

1.47 Structure No. 2030 **2019 BCI: 63.8**

Structure Name:	Structure 2030		
Road Name:	240 Sideroad		
Location:	1.3 km East of 4th Line NE (Lots 26 & 27, Con. 5 SW)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	1.5 (2.5m skew span) m
Overall Structure Width:	8.2 m	Roadway Width:	4.55 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2030 is generally in fair condition and is demonstrating signs of concrete deterioration and moisture penetration throughout. Based on the span, and sub-standard driving platform width, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 12 years. Consideration should also be given to installing a steel beam guide rail system, end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Install rock protection along abutments.	$2,500.00
Hazard Signs	Install narrow bridge sign on approach.	$250.00
	Maintenance Needs Total	**$2,750.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top and curbs.	N/A	$8,000.00
Type B concrete repairs to soffit.	N/A	$5,000.00
Type C concrete repairs to abutment walls and wingwalls.	N/A	$15,000.00
Remove fill, waterproof and pave.	N/A	$20,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$118,000.00**

Estimate Value of Replacement Structure	$350,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$133,000.00	$365,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$14,000.00	$37,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$37,000.00
Total Capital Work Cost			**$214,000.00**	**$493,500.00**

1.48 Structure No. 2031 **2019 BCI: 85.2**

Structure Name:	Structure 2031		
Road Name:	240 Sideroad		
Location:	0.5 km East of Highway 10 (Lot 240 & 241, Conc. 1 NE)		
Structure Type:	CSP Multi-Plate Arch Culvert(s)		
Number of Spans:	1	Span Lengths:	3.73 m
Overall Structure Width:	16 m	Roadway Width:	6.7 m
Year of Construction:	2005	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2031 is generally in excellent to good condition. It is recommended that the localized deformation in the culvert barrel be monitored during future biennial inspections to ensure it is not actively progressing. Consideration should also be given to replacing the steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$1,000.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of deformations, settlements and movements.	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Replace Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs			
Cost		**Rehabilitation**	**Replacement**
Subtotal:		N/A	$350,000.00
Roadside Protection:		N/A	$52,000.00
Staging:		N/A	$0.00
Environmental Assessment:		N/A	$2,500.00
Contingencies:	10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M	N/A	$35,000.00
Total Capital Work Cost		**N/A**	**$474,500.00**

1.49 Structure No. 2032 **2019 BCI: 61.7**

Structure Name:	Structure 2032		
Road Name:	2nd Line Northeast		
Location:	0.7 km North of Sideroad 280		
Structure Type:	CSP Round Culvert(s)		
Number of Spans:	2	Span Lengths:	1.8 m
Overall Structure Width:	14.6 m	Roadway Width:	6 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2032 is generally in fair condition but is demonstrating signs of moderate to severe surface corrosion with section loss greater than 15% in localized areas. Based on the structure type, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 11 years. It is recommended that the deformations noted in the south culvert barrel be monitored during future biennial inspections to ensure they are not actively progressing. Consideration should also be given to investigating the need for a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Erosion Control	Repair erosion on NE embankment.	$1,000.00
Hazard Signs	Install hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$2,000.00**

Additional Investigations	Priority	Estimated Cost
Monitoring of deformations, settlements and movements.	Normal	$0.00

Roadside Protection Repairs	Priority	Estimated Cost
Investigate need for Guide Rail.	1 to 5 Years	$1,000.00

Estimate Value of Replacement Structure	$350,000.00

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			N/A	$350,000.00
Roadside Protection:			N/A	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	N/A	$35,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		N/A	$35,000.00
	Total Capital Work Cost		**N/A**	**$474,500.00**

1.50 Structure No. 2033 **2019 BCI: 72.8**

Structure Name:	Structure 2033		
Road Name:	7th Line SW		
Location:	0.25km South of 260 Sideroad		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:		Span Lengths:	3.65m (4.0m skew)
Overall Structure Width:	12.2 m	Roadway Width:	6 m
Year of Construction:	Unknown	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2033 is generally in good condition however, the existing embankments are eroded, very steep and appear unstable. Based on the span, and low clearance, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 18 years. However, it is recommended that the Township consider constructing headwalls, retaining walls, and placing slope protection within 1 year to avoid potential failure of the embankments and loss of road material. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove tree growing over inlet.	$1,000.00
Hazard Signs	Raise hazard warning signs on west side of structure.	$250.00
	Maintenance Needs Total	**$1,250.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail and end treatments.	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type C concrete repairs to barrels, inlet and outlet.	N/A	$5,000.00
Install headwalls and retaining walls.	Within 1 year	$50,000.00
Add slope stabilization.	Within 1 year	$12,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$137,000.00**

Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	Within 1 year	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$152,000.00	$415,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$16,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$42,000.00
Total Capital Work Cost			**$235,000.00**	**$553,500.00**

1.51 Structure No. 2034 **2019 BCI: 65.9**

Structure Name:	Structure 2034		
Road Name:	Mulmur-Melancthon Townline		
Location:	North of 15th Sideroad (Lot 18, Conc. I/III)		
Structure Type:	Cast-In-Place Conc. Rigid Frame		
Number of Spans:	1	Span Lengths:	4.25 m
Overall Structure Width:	9.6 m	Roadway Width:	5.5 m
Year of Construction:	1950	Current Load Limit:	N/A

Recommendation: No Capital Works is estimated to be required within the next 10 years.

Justification:

Structure 2034 is generally in good to fair condition but is demonstrating signs of concrete deterioration specifically on the original portion of the structure. Based on the span and low clearance, a rehabilitation is not recommended, and replacement of the structure is recommended once the BCI reaches 40, in approximately 13 years. Consideration should also be given to installing a steel beam guide rail system, and end treatments to help protect oncoming traffic. The repairs listed above may be completed to help extend the lifespan of the structure.

Maintenance Need	Element and Comments	Estimated Cost
Bridge Cleaning	Remove excess vegetation blocking waterway.	$2,500.00
Erosion Control	Repairs erosion on SE embankment.	$1,000.00
Hazard Signs	Install additional hazard warning signs at structure.	$1,000.00
	Maintenance Needs Total	**$4,500.00**

Roadside Protection Repairs	Priority	Estimated Cost
Install Guide Rail, end treatments	1 to 5 Years	$52,000.00

Rehabilitation/Repair Required	Priority	Estimated Cost
Type A concrete repairs to deck top.	N/A	$5,000.00
Type B concrete repairs to soffit.	N/A	$15,000.00
Type C concrete repairs to abutment walls.	N/A	$15,000.00
Remove fill, waterproof and pave.	N/A	$25,000.00
Add slope stabilization.	N/A	$12,000.00
General Items - Insurance, Mobilization, Access etc.	N/A	$70,000.00
Rehabilitation Cost Subtotal		**$142,000.00**

Estimate Value of Replacement Structure	$400,000.00

Associated Work	Priority	Estimated Cost
Traffic Control	N/A	$15,000.00
Total Associated Work Cost		**$15,000.00**

Total Capital Works Costs				
Cost			**Rehabilitation**	**Replacement**
Subtotal:			$157,000.00	$415,000.00
Roadside Protection:			$52,000.00	$52,000.00
Staging:			N/A	$0.00
Environmental Assessment:			N/A	$2,500.00
Contingencies:		10%	$16,000.00	$42,000.00
Engineering Design:	10% of first $1M + 5% of cost above $1M		$15,000.00	$42,000.00
Total Capital Work Cost			**$240,000.00**	**$553,500.00**

BURNSIDE

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Appendix B

Structure Inventory and Cost Summaries

TOWNSHIP OF MELANCTHON - STRUCTURE INVENTORY

Structure No.	Year of Construction	Road Name	Location	Structure Type	Span(s) (m)	Width (m)	Deck Area (m2)	Deterioration Curve	BCI
001	1960	4th Line SW	1 km North of Highway 89 (Lot 4, CON. 4 & 5 SW)	Cast-In-Place Conc. Rigid Frame	3.7	7.45	33.525	BR	72.07
003	Unknown	5th Sideroad	100 m West of 4th Line (Lot 5/6, Con. 4 O.S.)	Cast-In-Place Conc. Rigid Frame	3.7 (skew = 4.25)	8	46.4	BR	67.07
004	1930	5th Sideroad	Lot 5/6, CON. 4 O.S	Cast-In-Place Conc. Rigid Frame	6.1	5.5	36.85	BR-1	28.96
005	1960	2nd Line SW	1.4 km North of County Road 17 (Lot 283 , CON. 2 & 3 SW)	Cast-In-Place Conc. Rigid Frame	7.8	8.7	80.04	BR-1	72.87
006	2003	4th Line SW	1.7 km North of County Road 17 (Lot 281 & 11, Con. 4 & 5 SW)	Cast-In-Place Conc. Rigid Frame	10	7.9	90.85	BR-1	78.38
007	1960	7th Line SW	1.5 km South of 270 Sideroad (Lot 13, Con. 6 & 7 SW)	Cast-In-Place Conc. Rigid Frame	9.4	8.6	92.45	BR-1	68.94
008	1980	7th Line SW	1.5 km South of 270 Sideroad (Lot 15, Con. 6 & 7 SW)	Cast-In-Place Conc. Rigid Frame	6.1	18.2	127.4	CC	70.47
009	1980	8th Line SW	2.5 km North of HWY 89 (Lot 14, Con. 8 & 9 SW)	Precast Concrete Box Girder	10.4	8.8	96.8	BR-1	72.94
010	2000	280 Sideroad	LOT 11 & 12, CON 10 SW	Steel I-Girder (Timber Deck)	10.38	5.5	61.88	BR	90.43
011	1960	8th Line SW	3.4 km North of HWY 89 (Lot 16, Con. 8 & 9 SW)	Cast-In-Place Conc. Rigid Frame	16.2 (skew = 19.8)	8.5	187	BR-1	69.55
012	2007	7th Line SW	Lot 21, Conc. 6 & SW	Steel I-Girder (Concrete Deck)	Clear=17.1 Skew=18	8.7	189.66	BR-1	86.27
013	1968	260 Sideroad	200 m East of 7th Line SW (Lot 21 & 22, Con. 6 & 7 SW)	Precast Concrete I-Girder	17.8	10.7	203.3	BR-1	63.67
014	1977	4th Line SW	500m North of 250 Sideroad (Lot 28, Con. 4 & 5 SW)	Precast Concrete Box Girder	16.35	8.6	143.62	BR-1	71.13
015	1960	2nd Line SW	70m North of 250 Sideroad (Lot 249, Con. 2 & 3 SW)	Cast-In-Place Conc. Rigid Frame	15.3	7.45	129.63	BR-1	74.41
016	Unknown	250 Sideroad	2 km West of Hwy 10 (Lot 250/251, Con. 1 SW)	Steel I-Girder (Concrete Deck)	13.4	6.3	93.87	BR-1	70.44
017	Unknown	250 Sideroad	370m West of Hwy 10 (Lot 250/251, Con. 1 SW)	CSP Multi-Plate Arch Culvert(s)	5.89, 5.89	12.8	169.344	BR-1	74.75
018	1960	2nd Line NE	750m South of County Road 21 (Lot 15, Con. 2 & 3 NE)	Cast-In-Place Conc. Rigid Frame	7.4	8.65	69.2	BR-1	68.97
2001	1989	3rd Line	2.5 km South of County Road 17 (Lot 6 Con. 2 & 3 O.S.)	CSP Multi-Plate Arch Culvert(s)	3.5	15.8	55.3	CS	70.68
2002	1988	5th Sideroad	200m East of 4th Line (Lot 5 & 6 Con. 3 O.S.)	CSP Multi-Plate Arch Culvert(s)	3.4	22.5	76.5	CS	74.96
2003	1970	3rd Line	1 km South of 5th Sideroad (Lot 4 Con. 2 & 3 O.S.)	CSP Multi-Plate Arch Culvert(s)	3.8	26	98.8	CS	56.23
2004	1990	5th Sideroad	300m West of county Road 124 (Lots 5 & 6, Con. 2 O.S.)	Cast-In-Place Conc. Rigid Frame	6.1	8	54.4	BR-1	73.92
2005	2014	3rd Line	1.1 km South of County Road 17 (Lot 8, Con. 2 & 3 O.S.)	CSP Multi-Plate Arch Culvert(s)	2.3	17	39.1	CS	94.66
2006	1990	3rd Line	70m South of 15th Sideroad (Lot 15, Con. 2 & 3 O.S)	Cast-In-Place Conc. Rigid Frame	3	8	28.8	BR	73.92
2007	1980	15th Sideroad	50m West of 3rd Line (Lot 15 & 16, Con. 3 O.S.)	Cast-In-Place Conc. Rigid Frame	3	8	28.8	BR	69.66
2008	1970	15th Sideroad	600m East of County Road 124 (Lots 15 & 16, Con. 1 O.S.)	Cast-In-Place Conc. Rigid Frame	3.7	9.25	40.7	BR	73.36
2009	2008	15th Sideroad	1 km East of County Road 124 (Lot 16, Con. 1, O.S.)	Cast-In-Place Conc. Box Culvert	5.5	9.11	56.2998	BR	85.74
2010	2016	3rd Line	850m South of 20th Sideroad (Lot 19, Con 2 & 3, OS)	CSP Multi-Plate Arch Culvert(s)	3.89	19.6	76.3	CS	96.94
2011	1985	20th Sideroad	2 km East of 5th Line (Lots 20 & 21, Con. 3 O.S.)	Cast-In-Place Conc. Rigid Frame	3.65	12.7	57.15	CC	63.90
2012	1960	30th Sideroad	250m East of County Road 124 (Lots 30 & 31, Con. 1 O.S.)	Cast-In-Place Conc. Rigid Frame	3.65	7.45	32.035	BR	73.18
2013	1950	30th Sideroad	500m East of 3rd Line (Lots 30 & 31, Con. 3 O.S.)	Timber Girder	3	7.1	23.785	BR	51.90
2014	1950	4th Line	900m South of Melancthon-Osprey Townline (Lot 31, Con. 3 & 4 O.S.)	Cast-In-Place Conc. Rigid Frame	4.85	8	44	BR	73.62
2015	2008	10th Line Northeast	300m Northeast of 5th Line (Lot 25, Con. 10 & 11)	Precast Concrete Box Culvert	4	9.5	44.65	BR	82.89
2016	1980	4th Line NE	600m South of County Road 9 (Lot 30, Con. 4 & 5 NE)	Cast-In-Place Conc. Rigid Frame	2.4	14.85	47.52	CC	71.06
2017	1980	2nd Line NE	1.4 km South of County Road 9 (Lot 28, Con. 2 & 3 NE)	CSP Multi-Plate Arch Culvert(s)	2.5	17.2	43	CS	58.92
2018	1960	2nd Line NE	250m South of Sideroad 240 (Lot 26, Con. 2 & 3 NE)	Cast-In-Place Conc. Box Culvert	2.44	12.25	36.75	CC	69.23
2019	1980	4th Line NE	2.4 km North of County Road 21 (Lot 23, Con. 4 & 5 NE)	Cast-In-Place Conc. Rigid Frame	5	18.4	106.72	BR	74.86
2020	2016	4th Line NE	2.5 km North of County Road 21 (Lot 22, Con 4 & 5 NE)	Precast Concrete Box Culvert	3	16.8	58.8	CC	96.62
2021	1980	2nd Line NE	2 km North of Country Road 21 (Lot 21 Con. 2 & 3 NE)	CSP Multi-Plate Arch Culvert(s)	5.2	19.8	102.96	CS	50.50
2022	1980	4th Line NE	150m North of county Road 21 (Lot 17, Con. 4 & 5 NE)	Cast-In-Place Conc. Box Culvert	3.1	18.5	68.45	CC	74.38
2023	Unknown	4th Line NE	400 m South of County Road 21 (Lot16, Con. 4 & 5 NE)	Cast-In-Place Conc. Box Culvert	3.6	14.1	63.45	BR-1	62.81
2024	2016	2nd Line NE	800 m South of Sideroad 240 (Lot 25, Con 2 & 3)	Precast Concrete Box Culvert	3	17	59.5	CC	96.54
2025	Unknown	Sideroad 260	3.2 km West of Highway 10 (Lot 260-261 Con.3 SW)	CSP Multi-Plate Arch Culvert(s)	3.1	19.1	59.21	CS	67.67
2026	2008	8th Line SW	1 km North of Highway 89 (Lot 11 Con.8 & 9 SW)	CSP Multi-Plate Arch Culvert(s)	3.4	17	57.8	CS	83.26
2027	2015	15 Sideroad	2 km West of County Road 124 (Lot 15 & 16, Conc. 2 OS)	Precast Concrete Box Culvert	3.6	10	42	CC	94.99
2028	2014	Main Street (County Road 14)	0.5 km South of Sideroad 15 (Lot 15, Conc. 1 & 2 OS)	Precast Concrete Box Culvert	2.44	16.8	47.712	CC	92.51

TOWNSHIP OF MELANCTHON - STRUCTURE INVENTORY

Structure No.	Year of Construction	Road Name	Location	Structure Type	Span(s) (m)	Width (m)	Deck Area (m2)	Deterioration Curve	BCI
2029	Unknown	220 Sideroad	0.5 km East of County Road 2 (Lots 36 & 37, Con. 5 SW)	Cast-In-Place Conc. Rigid Frame	2.42	8.04	24.12	BR	74.07
2030	Unknown	240 Sideroad	1.3 km East of 4th Line NE (Lots 26 & 27, Con. 5 SW)	Cast-In-Place Conc. Rigid Frame	1.5 (2.5m skew span)	8.2	52.07	BR	63.81
2031	2005	240 Sideroad	0.5 km East of Highway 10 (Lot 240 & 241, Conc. 1 NE)	CSP Multi-Plate Arch Culvert(s)	3.73	16	59.68	CS	85.22
2032	Unknown	2nd Line Northeast	0.7 km North of Sideroad 280	CSP Round Culvert(s)	1.8	14.6	68.62	CS	61.73
2033	Unknown	7th Line SW	0.25km South of 260 Sideroad	Cast-In-Place Conc. Rigid Frame	3.65 (4.0m skew span)	12.2	48.8	CC	72.77
2034	1950	Mulmur-Melancthon Townline	North of 15th Sideroad (Lot 18, Conc. I/III)	Cast-In-Place Conc. Rigid Frame	4.25	9.6	48	BR	65.87

TOWNSHIP OF MELANCTHON - CAPITAL WORKS BY BCI

Structure No.	Road Name	Deterioration Curve	BCI	Years to Rehab	Years to Replace	Total Cost of Rehabilitation	Total Cost of Replacement	Recommended Work	Maintenance Needs	Additional Investigations	Roadside Protection	Structure Repair/ Replacement	Associated Work	Staging	Environmental Assessment	Contingency	Engineering Design	Capital Works Within 1 year	Capital Works 1 - 5 Years	Capital Works 6 - 10 Years	10-Year Capital Works Cost
004	5th Sideroad	BR-1	28.96	0.00	0.00	N/A	$ 714,500.00	Replace	$ 7,000.00	$ 5,000.00	$ -	$ 550,000.00	$ -	$ -	$ 2,500.00	$ 55,000.00	$ 55,000.00	$ 714,500.00	$ -	$ -	$ 714,500.00
2021	2nd Line NE	CS	50.50	N/A	5.25	N/A	$ 594,500.00	Replace	$ -	$ 5,000.00	$ 1,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ 594,500.00	$ -	$ 594,500.00
2013	30th Sideroad	BR	51.90	N/A	1.00	N/A	$ 474,500.00	Replace	$ 1,250.00	$ 5,000.00	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ 474,500.00	$ -	$ -	$ 474,500.00
2003	3rd Line	CS	56.23	0.00	8.11	$ 204,720.00	$ 733,500.00	Rehabilitate	$ 3,500.00	$ -	$ 6,000.00	$ 164,720.00	$ -	N/A	$ -	$ 17,000.00	$ 17,000.00	$ 204,720.00	$ -	$ -	$ 204,720.00
2017	2nd Line NE	CS	58.92	N/A	9.46	$ 238,000.00	$ 493,500.00	Replace	$ 2,500.00	$ -	$ 1,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ 493,500.00	$ 493,500.00
2032	2nd Line Northeast	CS	61.73	N/A	10.87	N/A	$ 474,500.00	Replace	$ 2,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2023	4th Line NE	BR-1	62.81	1.41	11.41	$ 187,000.00	$ 493,500.00	Rehabilitate	$ 2,000.00	$ -	$ 1,000.00	$ 140,000.00	$ 15,000.00	N/A	$ -	$ 16,000.00	$ 15,000.00	$ -	$ 187,000.00	$ -	$ 187,000.00
013	260 Sideroad	BR-1	63.67	1.83	11.83	$ 421,000.00	$ 1,617,500.00	Rehabilitate	$ 2,000.00	$ 8,100.00	$ -	$ 336,000.00	$ 15,000.00	N/A	$ -	$ 36,000.00	$ 34,000.00	$ -	$ 421,000.00	$ -	$ 421,000.00
2030	240 Sideroad	BR	63.81	N/A	11.91	$ 214,000.00	$ 493,500.00	Replace	$ 2,750.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
2011	20th Sideroad	CC	63.90	N/A	7.50	$ 204,500.00	$ 558,500.00	Replace	$ 10,750.00	$ -	$ -	$ 400,000.00	$ 20,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ 558,500.00	$ 558,500.00
2034	Mulmur-Melancthon Townline	BR	65.87	N/A	12.94	$ 240,000.00	$ 553,500.00	Replace	$ 4,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
003	5th Sideroad	BR	67.07	N/A	13.53	$ 230,000.00	$ 553,500.00	Replace	$ 5,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2025	Sideroad 260	CS	67.67	N/A	13.84	N/A	$ 534,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
007	7th Line SW	BR-1	68.94	4.47	14.47	$ 255,000.00	$ 1,033,500.00	Rehabilitate	$ 2,000.00	$ -	$ 52,000.00	$ 155,000.00	$ 15,000.00	N/A	$ -	$ 17,000.00	$ 16,000.00	$ -	$ 255,000.00	$ -	$ 255,000.00
018	2nd Line NE	BR-1	68.97	4.49	14.49	$ 282,500.00	$ 798,500.00	Rehabilitate	$ -	$ -	$ 52,000.00	$ 172,500.00	$ 20,000.00	N/A	$ -	$ 20,000.00	$ 18,000.00	$ -	$ 282,500.00	$ -	$ 282,500.00
2018	2nd Line NE	CC	69.23	N/A	14.61	$ 205,000.00	$ 493,500.00	Replace	$ 250.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
011	8th Line SW	BR-1	69.55	4.80	14.78	$ 401,500.00	$ 1,627,000.00	Rehabilitate	$ 250.00	$ 10,000.00	$ 52,000.00	$ 270,000.00	$ 22,500.00	N/A	$ -	$ 30,000.00	$ 27,000.00	$ -	$ 401,500.00	$ -	$ 401,500.00
2007	15th Sideroad	BR	69.66	N/A	14.83	$ 203,000.00	$ 493,500.00	Replace	$ 1,250.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
016	250 Sideroad	BR-1	70.44	5.40	15.42	$ 339,000.00	$ 1,153,500.00	Rehabilitate	$ 4,500.00	$ -	$ 52,000.00	$ 225,000.00	$ 15,000.00	N/A	$ -	$ 24,000.00	$ 23,000.00	$ -	$ 339,000.00	$ -	$ 339,000.00
008	7th Line SW	CC	70.47	N/A	15.47	$ 163,000.00	$ 733,500.00	Replace	$ 2,000.00	$ -	$ 1,000.00	$ 550,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 57,000.00	$ 57,000.00	$ -	$ -	$ -	$ -
2001	3rd Line	CS	70.68	N/A	15.38	N/A	$ 534,500.00	Replace	$ 1,000.00	$ -	$ 6,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
2016	4th Line NE	CC	71.06	N/A	16.06	N/A	$ 474,500.00	Replace	$ 1,500.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
014	4th Line SW	BR-1	71.13	5.57	15.57	$ 375,000.00	$ 1,502,500.00	Rehabilitate	$ 3,000.00	$ -	$ 52,000.00	$ 255,000.00	$ 15,000.00	N/A	$ -	$ 27,000.00	$ 26,000.00	$ -	$ -	$ 375,000.00	$ 375,000.00
001	4th Line SW	BR	72.07	N/A	16.04	$ 206,500.00	$ 558,500.00	Replace	$ 6,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 20,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2033	7th Line SW	CC	72.77	N/A	17.77	$ 235,000.00	$ 553,500.00	Replace	$ 1,250.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
005	2nd Line SW	BR-1	72.87	6.43	16.43	$ 234,500.00	$ 853,500.00	Rehabilitate	$ 1,500.00	$ -	$ 52,000.00	$ 136,500.00	$ 15,000.00	N/A	$ -	$ 16,000.00	$ 15,000.00	$ -	$ -	$ 234,500.00	$ 234,500.00
009	8th Line SW	BR-1	72.94	6.47	16.47	$ 321,000.00	$ 973,500.00	Rehabilitate	$ 1,000.00	$ -	$ 52,000.00	$ 210,000.00	$ 15,000.00	N/A	$ -	$ 23,000.00	$ 21,000.00	$ -	$ -	$ 321,000.00	$ 321,000.00
2012	30th Sideroad	BR	73.18	N/A	10.00	$ 202,000.00	$ 534,500.00	Replace	$ 2,500.00	$ -	$ 52,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ 534,500.00	$ 534,500.00
2008	15th Sideroad	BR	73.36	N/A	16.68	$ 187,500.00	$ 553,500.00	Replace	$ 500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2014	4th Line	BR	73.62	N/A	16.81	N/A	$ 601,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 450,000.00	$ 5,000.00	$ -	$ 2,500.00	$ 46,000.00	$ 46,000.00	$ -	$ -	$ -	$ -
2006	3rd Line	BR	73.92	N/A	17.46	N/A	$ 474,500.00	Replace	$ 3,000.00	$ -	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2004	5th Sideroad	BR-1	73.92	7.46	17.46	$ 205,000.00	$ 733,500.00	Rehabilitate	$ 2,500.00	$ -	$ 52,000.00	$ 110,000.00	$ 15,000.00	N/A	$ -	$ 13,000.00	$ 15,000.00	$ -	$ -	$ 205,000.00	$ 205,000.00
2029	220 Sideroad	BR	74.07	N/A	17.04	$ 148,000.00	$ 474,500.00	Replace	$ 1,000.00	$ 5,000.00	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2022	4th Line NE	CC	74.38	N/A	19.38	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
015	2nd Line SW	BR-1	74.41	N/A	32.01	N/A	$ 1,369,500.00	Replace	$ -	$ -	$ -	$ 1,100,000.00	$ -	$ -	$ 2,500.00	$ 110,000.00	$ 105,000.00	$ -	$ -	$ -	$ -
017	250 Sideroad	BR-1	74.75	7.37	17.37	N/A	$ 1,134,500.00	Rehabilitate	$ -	$ -	$ 20,000.00	$ -	$ -	N/A	$ -	N/A	N/A	$ -	$ -	$ -	$ -
2019	4th Line NE	BR	74.86	N/A	17.43	$ 173,000.00	$ 594,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ -	$ -	$ -
2002	5th Sideroad	CS	74.96	N/A	17.76	N/A	$ 594,500.00	Replace	$ 2,250.00	$ -	$ 1,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ -	$ -	$ -
006	4th Line SW	BR-1	78.38	15.19	25.19	$ 57,000.00	$ 1,014,500.00	Rehabilitate	$ 9,000.00	$ -	$ 20,000.00	$ 20,000.00	$ -	N/A	$ -	$ 2,000.00	$ 15,000.00	$ -	$ 57,000.00	$ -	$ 57,000.00
2015	10th Line Northeast	BR	82.89	N/A	28.69	N/A	$ 474,500.00	Replace	$ 4,250.00	$ -	$ 20,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2026	8th Line SW	CS	83.26	N/A	22.37	N/A	$ 493,500.00	Replace	$ -	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
2031	240 Sideroad	CS	85.22	N/A	23.46	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2009	15th Sideroad	BR	85.74	N/A	30.12	N/A	$ 534,500.00	Replace	$ 3,500.00	$ -	$ 52,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
012	7th Line SW	BR-1	86.27	20.13	30.13	N/A	$ 1,599,500.00	Rehabilitate	$ 1,000.00	$ -	$ -	$ -	$ -	N/A	$ -	N/A	N/A	$ -	$ -	$ -	$ -
010	280 Sideroad	BR	90.43	N/A	40.87	N/A	$ 894,500.00	Replace	$ 1,000.00	$ -	$ -	$ 700,000.00	$ -	$ -	$ 2,500.00	$ 70,000.00	$ 70,000.00	$ -	$ -	$ -	$ -
2028	Main Street (County Road 14)	CC	92.51	N/A	37.51	N/A	$ 474,500.00	Replace	$ 1,250.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2005	3rd Line	CS	94.66	N/A	28.70	N/A	$ 474,500.00	Replace	$ 500.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2027	15 Sideroad	CC	94.99	N/A	39.99	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2024	2nd Line NE	CC	96.54	N/A	41.54	N/A	$ 474,500.00	Replace	$ -	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2020	4th Line NE	CC	96.62	N/A	41.62	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2010	3rd Line	CS	96.94	N/A	29.97	N/A	$ 534,500.00	Replace	$ -	$ -	$ 1,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
Sub Totals									**$ 109,000.00**	**$ 38,100.00**	**$ 1,384,000.00**	**$ 17,594,720.00**	**$ 357,500.00**	**$ -**	**$ 92,500.00**	**$ 1,806,000.00**	**$ 1,802,000.00**	**$ 1,393,720.00**	**$ 2,537,500.00**	**$ 2,722,000.00**	**$ 6,653,220.00**

Note: Structure No. 004 to be closed to through traffic in 2019.
Structure No. 2021 to be repaired in 2019.
Structure No. 2003 rehabilitated in 2019.

TOWNSHIP OF MELANCTHON - REHABILITATION CAPITAL WORKS

Structure No.	Road Name	Deterioration Curve	BCI	Years to Rehab	Years to Replace	Total Cost of Rehabilitation	Total Cost of Replacement	Recommended Work	Maintenance Needs	Additional Investigations	Roadside Protection	Structure Repair/ Replacement	Associated Work	Staging	Environmental Assessment	Contingency	Engineering Design	Capital Works Within 1 year	Capital Works 1 - 5 Years	Capital Works 6 - 10 Years	10-Year Capital Works Cost
2003	3rd Line	CS	56.23	0.00	8.11	$ 204,720.00	$ 733,500.00	Rehabilitate	$ 3,500.00	$ -	$ 6,000.00	$ 164,720.00	$ -	N/A	$ -	$ 17,000.00	$ 17,000.00	$ 204,720.00	$ -	$ -	$ 204,720.00
2023	4th Line NE	BR-1	62.81	1.41	11.41	$ 187,000.00	$ 493,500.00	Rehabilitate	$ 2,000.00	$ -	$ 1,000.00	$ 140,000.00	$ 15,000.00	N/A	$ -	$ 16,000.00	$ 15,000.00	$ -	$ 187,000.00	$ -	$ 187,000.00
013	260 Sideroad	BR-1	63.67	1.83	11.83	$ 421,000.00	$ 1,617,500.00	Rehabilitate	$ 2,000.00	$ 8,100.00	$ -	$ 336,000.00	$ 15,000.00	N/A	$ -	$ 36,000.00	$ 34,000.00	$ -	$ 421,000.00	$ -	$ 421,000.00
007	7th Line SW	BR-1	68.94	4.47	14.47	$ 255,000.00	$ 1,033,500.00	Rehabilitate	$ 2,000.00	$ -	$ 52,000.00	$ 155,000.00	$ 15,000.00	N/A	$ -	$ 17,000.00	$ 16,000.00	$ -	$ 255,000.00	$ -	$ 255,000.00
018	2nd Line NE	BR-1	68.97	4.49	14.49	$ 282,500.00	$ 798,500.00	Rehabilitate	$ -	$ -	$ 52,000.00	$ 172,500.00	$ 20,000.00	N/A	$ -	$ 20,000.00	$ 18,000.00	$ -	$ 282,500.00	$ -	$ 282,500.00
011	8th Line SW	BR-1	69.55	4.80	14.78	$ 401,500.00	$ 1,627,000.00	Rehabilitate	$ 250.00	$ 10,000.00	$ 52,000.00	$ 270,000.00	$ 22,500.00	N/A	$ -	$ 30,000.00	$ 27,000.00	$ -	$ 401,500.00	$ -	$ 401,500.00
016	250 Sideroad	BR-1	70.44	5.40	15.42	$ 339,000.00	$ 1,153,500.00	Rehabilitate	$ 4,500.00	$ -	$ 52,000.00	$ 225,000.00	$ 15,000.00	N/A	$ -	$ 24,000.00	$ 23,000.00	$ -	$ 339,000.00	$ -	$ 339,000.00
014	4th Line SW	BR-1	71.13	5.57	15.57	$ 375,000.00	$ 1,502,500.00	Rehabilitate	$ 3,000.00	$ -	$ 52,000.00	$ 255,000.00	$ 15,000.00	N/A	$ -	$ 27,000.00	$ 26,000.00	$ -	$ -	$ 375,000.00	$ 375,000.00
005	2nd Line SW	BR-1	72.87	6.43	16.43	$ 234,500.00	$ 853,500.00	Rehabilitate	$ 1,500.00	$ -	$ 52,000.00	$ 136,500.00	$ 15,000.00	N/A	$ -	$ 16,000.00	$ 15,000.00	$ -	$ -	$ 234,500.00	$ 234,500.00
009	8th Line SW	BR-1	72.94	6.47	16.47	$ 321,000.00	$ 973,500.00	Rehabilitate	$ 1,000.00	$ -	$ 52,000.00	$ 210,000.00	$ 15,000.00	N/A	$ -	$ 23,000.00	$ 21,000.00	$ -	$ -	$ 321,000.00	$ 321,000.00
2004	5th Sideroad	BR-1	73.92	7.46	17.46	$ 205,000.00	$ 733,500.00	Rehabilitate	$ 2,500.00	$ -	$ 52,000.00	$ 110,000.00	$ 15,000.00	N/A	$ -	$ 13,000.00	$ 15,000.00	$ -	$ -	$ 205,000.00	$ 205,000.00
017	250 Sideroad	BR-1	74.75	7.37	17.37	N/A	$ 1,134,500.00	Rehabilitate	$ -	$ -	$ 20,000.00	$ -	$ -	N/A	$ -	N/A	N/A	$ -	$ -	$ -	$ -
006	4th Line SW	BR-1	78.38	15.19	25.19	$ 57,000.00	$ 1,014,500.00	Rehabilitate	$ 9,000.00	$ -	$ 20,000.00	$ 20,000.00	$ -	N/A	$ -	$ 2,000.00	$ 15,000.00	$ -	$ 57,000.00	$ -	$ 57,000.00
012	7th Line SW	BR-1	86.27	20.13	30.13	N/A	$ 1,599,500.00	Rehabilitate	$ 1,000.00	$ -	$ -	$ -	$ -	N/A	$ -	N/A	N/A	$ -	$ -	$ -	$ -
Sub Totals									**$ 32,250.00**	**$ 18,100.00**	**$ 463,000.00**	**$ 2,194,720.00**	**$ 162,500.00**	**$ -**	**$ -**	**$ 241,000.00**	**$ 242,000.00**	**$ 204,720.00**	**$ 1,943,000.00**	**$ 1,135,500.00**	**$ 3,283,220.00**

TOWNSHIP OF MELANCTHON - REPLACEMENT CAPITAL WORKS

Structure No.	Road Name	Deterioration Curve	BCI	Years to Rehab	Years to Replace	Total Cost of Rehabilitation	Total Cost of Replacement	Recommended Work	Maintenance Needs	Additional Investigations	Roadside Protection	Structure Repair/ Replacement	Associated Work	Staging	Environmental Assessment	Contingency	Engineering Design	Capital Works Within 1 year	Capital Works 1 - 5 Years	Capital Works 6 - 10 Years	10-Year Capital Works Cost
004	5th Sideroad	BR-1	28.96	0.00	0.00	N/A	$ 714,500.00	Replace	$ 7,000.00	$ 5,000.00	$ -	$ 550,000.00	$ -	$ -	$ 2,500.00	$ 55,000.00	$ 55,000.00	$ 714,500.00	$ -	$ -	$ 714,500.00
2021	2nd Line NE	CS	50.50	N/A	5.25	N/A	$ 594,500.00	Replace	$ -	$ 5,000.00	$ 1,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ 594,500.00	$ -	$ 594,500.00
2013	30th Sideroad	BR	51.90	N/A	1.00	N/A	$ 474,500.00	Replace	$ 1,250.00	$ 5,000.00	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ 474,500.00	$ -	$ -	$ 474,500.00
2017	2nd Line NE	CS	58.92	N/A	9.46	$ 238,000.00	$ 493,500.00	Replace	$ 2,500.00	$ -	$ 1,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ 493,500.00	$ 493,500.00
2032	2nd Line Northeast	CS	61.73	N/A	10.87	N/A	$ 474,500.00	Replace	$ 2,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2030	240 Sideroad	BR	63.81	N/A	11.91	$ 214,000.00	$ 493,500.00	Replace	$ 2,750.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
2011	20th Sideroad	CC	63.90	N/A	7.50	$ 204,500.00	$ 558,500.00	Replace	$ 10,750.00	$ -	$ -	$ 400,000.00	$ 20,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ 558,500.00	$ 558,500.00
2034	Mulmur-Melancthon Townline	BR	65.87	N/A	12.94	$ 240,000.00	$ 553,500.00	Replace	$ 4,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
003	5th Sideroad	BR	67.07	N/A	13.53	$ 230,000.00	$ 553,500.00	Replace	$ 5,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2025	Sideroad 260	CS	67.67	N/A	13.84	N/A	$ 534,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
2018	2nd Line NE	CC	69.23	N/A	14.61	$ 205,000.00	$ 493,500.00	Replace	$ 250.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
2007	15th Sideroad	BR	69.66	N/A	14.83	$ 203,000.00	$ 493,500.00	Replace	$ 1,250.00	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
008	7th Line SW	CC	70.47	N/A	15.47	$ 163,000.00	$ 733,500.00	Replace	$ 2,000.00	$ -	$ 1,000.00	$ 550,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 57,000.00	$ 57,000.00	$ -	$ -	$ -	$ -
2001	3rd Line	CS	70.68	N/A	15.38	N/A	$ 534,500.00	Replace	$ 1,000.00	$ -	$ 6,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
2016	4th Line NE	CC	71.06	N/A	16.06	N/A	$ 474,500.00	Replace	$ 1,500.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
001	4th Line SW	BR	72.07	N/A	16.04	$ 206,500.00	$ 558,500.00	Replace	$ 6,500.00	$ -	$ 52,000.00	$ 400,000.00	$ 20,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2033	7th Line SW	CC	72.77	N/A	17.77	$ 235,000.00	$ 553,500.00	Replace	$ 1,250.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2012	30th Sideroad	BR	73.18	N/A	10.00	$ 202,000.00	$ 534,500.00	Replace	$ 2,500.00	$ -	$ 52,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ 534,500.00	$ 534,500.00
2008	15th Sideroad	BR	73.36	N/A	16.68	$ 187,500.00	$ 553,500.00	Replace	$ 500.00	$ -	$ 52,000.00	$ 400,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 42,000.00	$ 42,000.00	$ -	$ -	$ -	$ -
2014	4th Line	BR	73.62	N/A	16.81	N/A	$ 601,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 450,000.00	$ 5,000.00	$ -	$ 2,500.00	$ 46,000.00	$ 46,000.00	$ -	$ -	$ -	$ -
2006	3rd Line	BR	73.92	N/A	17.46	N/A	$ 474,500.00	Replace	$ 3,000.00	$ -	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2029	220 Sideroad	BR	74.07	N/A	17.04	$ 148,000.00	$ 474,500.00	Replace	$ 1,000.00	$ 5,000.00	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2022	4th Line NE	CC	74.38	N/A	19.38	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
015	2nd Line SW	BR-1	74.41	N/A	32.01	N/A	$ 1,369,500.00	Replace	$ -	$ -	$ -	$ 1,100,000.00	$ -	$ -	$ 2,500.00	$ 110,000.00	$ 105,000.00	$ -	$ -	$ -	$ -
2019	4th Line NE	BR	74.86	N/A	17.43	$ 173,000.00	$ 594,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ -	$ -	$ -
2002	5th Sideroad	CS	74.96	N/A	17.76	N/A	$ 594,500.00	Replace	$ 2,250.00	$ -	$ 1,000.00	$ 450,000.00	$ -	$ -	$ 2,500.00	$ 45,000.00	$ 45,000.00	$ -	$ -	$ -	$ -
2015	10th Line Northeast	BR	82.89	N/A	28.69	N/A	$ 474,500.00	Replace	$ 4,250.00	$ -	$ 20,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2026	8th Line SW	CS	83.26	N/A	22.37	N/A	$ 493,500.00	Replace	$ -	$ -	$ 52,000.00	$ 350,000.00	$ 15,000.00	$ -	$ 2,500.00	$ 37,000.00	$ 37,000.00	$ -	$ -	$ -	$ -
2031	240 Sideroad	CS	85.22	N/A	23.46	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 52,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2009	15th Sideroad	BR	85.74	N/A	30.12	N/A	$ 534,500.00	Replace	$ 3,500.00	$ -	$ 52,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
010	280 Sideroad	BR	90.43	N/A	40.87	N/A	$ 894,500.00	Replace	$ 1,000.00	$ -	$ -	$ 700,000.00	$ -	$ -	$ 2,500.00	$ 70,000.00	$ 70,000.00	$ -	$ -	$ -	$ -
2028	Main Street (County Road 14)	CC	92.51	N/A	37.51	N/A	$ 474,500.00	Replace	$ 1,250.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2005	3rd Line	CS	94.66	N/A	28.70	N/A	$ 474,500.00	Replace	$ 500.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2027	15 Sideroad	CC	94.99	N/A	39.99	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ -	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2024	2nd Line NE	CC	96.54	N/A	41.54	N/A	$ 474,500.00	Replace	$ -	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2020	4th Line NE	CC	96.62	N/A	41.62	N/A	$ 474,500.00	Replace	$ 1,000.00	$ -	$ 1,000.00	$ 350,000.00	$ -	$ -	$ 2,500.00	$ 35,000.00	$ 35,000.00	$ -	$ -	$ -	$ -
2010	3rd Line	CS	96.94	N/A	29.97	N/A	$ 534,500.00	Replace	$ -	$ -	$ 1,000.00	$ 400,000.00	$ -	$ -	$ 2,500.00	$ 40,000.00	$ 40,000.00	$ -	$ -	$ -	$ -
Sub Totals									**$ 76,750.00**	**$ 20,000.00**	**$ 921,000.00**	**$ 15,400,000.00**	**$ 195,000.00**	**$ -**	**$ 92,500.00**	**$ 1,565,000.00**	**$ 1,560,000.00**	**$ 1,189,000.00**	**$ 594,500.00**	**$ 1,586,500.00**	**$ 3,370,000.00**

TOWNSHIP OF MELANCTHON - MAINTENANCE NEEDS

Structure Name	Road Name	Maintenance Need	Estimated Maintenance Costs
001	4th Line SW	Remove overgrown vegetation along curbs and wingwalls, Install rock protection along abutments	$6,500.00
003	5th Sideroad	Remove overgrown vegetation along curbs, Repair washouts on NE and SE embankments, Install rock protection along abutments	$5,500.00
004	5th Sideroad	Repair washouts on South embankments, Install "narrow bridge" signs at structure, Install a temporary barrier/delineation system	$7,000.00
005	2nd Line SW	Sweep deck wearing surface, Remove vegetation along curbs, Raise hazard warning signs at structure	$1,500.00
006	4th Line SW	Sweep deck top, Install rock protection along abutments and wingwalls	$9,000.00
007	7th Line SW	Remove vegetation along curbs, Replace hazard warning signs at structure	$2,000.00
008	7th Line SW	Remove fill over exposed deck top ends, Install hazard warning signs at structure	$2,000.00
009	8th Line SW	Clean deck top and seals/sealants	$1,000.00
010	280 Sideroad	Sweep deck top	$1,000.00
011	8th Line SW	Install hazard warning sign at SW quadrant	$250.00
012	7th Line SW	Repairs required to approach wearing surface and deck wearing surface	$1,000.00
013	260 Sideroad	Sweep sidewalk/curbs, Flush deck drains, Replace deteriorated joint sealant, powerwash barriers	$2,000.00
014	4th Line SW	Clean deck top, Flush expansion joints, Replace deteriorated barrier joint sealant	$3,000.00
016	250 Sideroad	Clean deck top, Repair hand railings, Raise hazard warning signs, Install narrow structure signs, Replace missing bolts on NE, Replace damaged posts.	$4,500.00
2001	3rd Line	Install hazard warning signs at structure	$1,000.00
2002	5th Sideroad	Remove tree growing close to inlet, Install hazard warning signs at structure, Tighten loose bolts in barrel	$2,250.00
2003	3rd Line	Install rock protection on SE and SW embankments, Install hazard warning signs at structure	$3,500.00
2004	5th Sideroad	Remove blockage at inlet, Remove silt and vegetation buildup	$2,500.00
2005	3rd Line	Tighten loose end treatment cables	$500.00
2006	3rd Line	Repairs required to approach wearing surface, Reinstate hazard warning signs at structure, Remove excess silt and vegetation buildup in stream	$3,000.00
2007	15th Sideroad	Repair washout on SE embankment, Straighten hazard warning signs at structure, Raise SE hazard warning sign	$1,250.00
2008	15th Sideroad	Remove fallen trees blocking inlet	$500.00
2009	15th Sideroad	Rout and seal cracks in deck wearing surface, Consider installing drip edge detail in soffit	$3,500.00
2011	20th Sideroad	Remove overgrown vegetation above wingwalls and fascia, Install hazard warning signs at structure, Tighten loose end treatment cables, Consider raising SBGR to adequate height	$10,750.00
2012	30th Sideroad	Remove vegetation along curbs, Remove excess vegetation and fill above wingwalls, Replace damaged hazard warning signs at structure, Install narrow bridge signs	$2,500.00
2013	30th Sideroad	Remove tree at SE quadrant, Reinstate NE hazard warning sign at structure	$1,250.00
2014	4th Line	Remove vegetation along curbs	$1,000.00
2015	10th Line Northeast	Remove vegetation along SBGR, Patch large spall on interior precast unit, Place rock protection along abutments, Install missing nuts/bolts in barrier posts	$4,250.00
2016	4th Line NE	Repairs required to approach wearing surface, Install hazard warning signs at structure	$1,500.00
2017	2nd Line NE	Repair washouts on East embankments, Install hazard warning signs at structure	$2,500.00
2018	2nd Line NE	Reinstate NW hazard warning sign at structure	$250.00
2019	4th Line NE	Install hazard warning signs at structure	$1,000.00
2020	4th Line NE	Install hazard warning signs at structure	$1,000.00
2022	4th Line NE	Install hazard warning signs at structure	$1,000.00
2023	4th Line NE	Remove fill and overgrown vegetation over culvert ends	$2,000.00
2025	Sideroad 260	Install hazard warning signs at structure	$1,000.00
2027	15 Sideroad	Bury channel ends, Tighten loose end treatment cables	$1,000.00
2028	Main Street (County Road 14)	Install additional rock protection at inlet, trim exposed filter fabric on East retaining wall	$1,250.00

TOWNSHIP OF MELANCTHON - MAINTENANCE NEEDS

Structure Name	Road Name	Maintenance Need	Estimated Maintenance Costs
2029	220 Sideroad	Reinstate SE hazard warning sign at structure	$1,000.00
2030	240 Sideroad	Install rock protection along abutments, Install narrow bridge sign on approach	$2,750.00
2031	240 Sideroad	Install hazard warning signs at structure	$1,000.00
2032	2nd Line Northeast	Repair erosion on NE embankment, Install hazard warning signs at structure	$2,000.00
2033	7th Line SW	Remove tree growing over inlet, Raise hazard warning signs on west side of structure	$1,250.00
2034	Mulmur-Melancthon Townline	Remove excess vegetation blocking waterway, Repair erosion on SE embankment, Install hazard warning signs at structure	$4,500.00

Total	**$109,000.00**

TOWNSHIP OF MELANCTHON - ADDITIONAL INVESTIGATIONS REQUIRED

Priority	Structure Name	Road Name	Additional Investigations Required	Estimated Cost
Normal	001	4th Line SW	Monitoring of Deformations, Settlements and Movements,	$0
Normal	004	5th Sideroad	Monitoring of Deformations, Settlements and Movements,	$5,000
Normal	011	8th Line SW	Detailed Deck Condition Survey,	$10,000
Normal	013	260 Sideroad	Detailed Deck Condition Survey,	$8,100
Normal	2002	5th Sideroad	Monitoring of Deformations, Settlements and Movements,	$0
Normal	2012	30th Sideroad	Monitoring of Deformations, Settlements and Movements, Monitoring Crack Widths,	$0
Normal	2013	30th Sideroad	Monitoring of Deformations, Settlements and Movements, Monitoring Crack Widths,	$5,000
Normal	2021	2nd Line NE	Monitoring Crack Widths,	$5,000
Normal	2026	8th Line SW	Monitoring of Deformations, Settlements and Movements,	$0
Normal	2029	220 Sideroad	Monitoring of Deformations, Settlements and Movements,	$5,000
Normal	2031	240 Sideroad	Monitoring of Deformations, Settlements and Movements,	$0
Normal	2032	2nd Line Northeast	Monitoring of Deformations, Settlements and Movements,	$0

Total	**$38,100.00**

BURNSIDE

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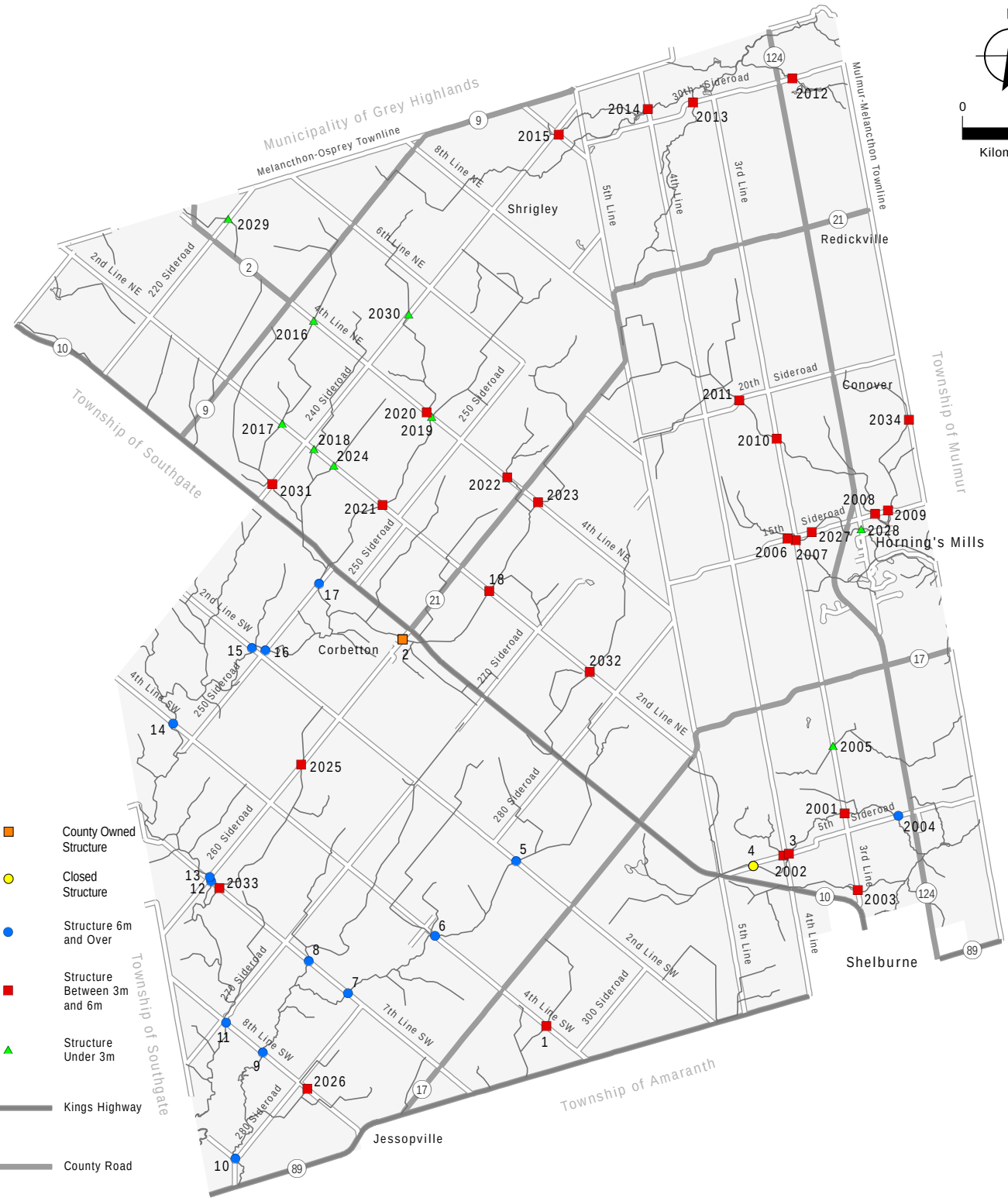
Appendix C

Structure Location Map



BURNSIDE

Map Title

2019 BRIDGE INSPECTIONS

BRIDGE AND CULVERT LOCATIONS

Client

TOWNSHIP OF MELANCTHON

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BURNSIDE

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Appendix D

OSIM Forms and Photos

Provided on USB