THE CORPORATION OF THE TOWNSHIP OF PUSLINCH
July 16, 2019 SPECIAL COUNCIL MEETING

A G E N D A

DATE: Tuesday, July 16, 2019
OPEN MEETING: 9:00 A.M.

≠ Denotes resolution prepared

1. Call the Meeting to Order

2. Disclosure of Pecuniary Interest & the General Nature Thereof.

4. DELEGATIONS

1. Mike Kelso with respect to the condition of the road surface of Concession 11.

5. COMMUNICATIONS

The below preliminary reports are provided for discussion purposes only. The purpose of this meeting is to review the reports and to confirm direction and scope and to solicit input. Recommendations and costing analyses will be completed following detailed review with by Council.

1. 2019 Bridge and Culvert Inspection Summary Report prepared by GM BluePlan, June 2019.

2. Planning Considerations for Hard-Surfacing Township Roads prepared by GM BluePlan, July 9, 2019.

6. CONFIRMING BY-LAW ≠

(a) By-law to confirm the proceedings of Council for the Corporation of the Township of Puslinch.

7. ADJOURNMENT ≠

TOWNSHIP OF PUSLINCH

PROGRESSING TOGETHER

RECEIVED

JUL 0 2 2019

Township of Puslinch

Township of Puslinch
7404 Wellington Road 34
Puslinch, ON, N0B 2J0
T: (519) 763 – 1226
F: (519) 763 – 5846
www.puslinch.ca

Delegate Request

Meeting Date: _____

Applicant Information

Applicant Name: MIKE KELSO

Mailing Address: [redacted]

Email Address:

Telephone Number:

Purpose of delegation (state position taken on issue, if applicable):

TO DISCUSS AND SHARE RESIDENTS CONCERNS OF CONDITION AND SAFETY ISSUES OF CONCESSION 11 FROM HUME RD TO COUNTY ROAD 34.

TO DISCUSS HARDTOP SURFACING OF SAID RD.

TO PRESENT LETTERS FROM RESIDENTS AND SIGNED PETITION TO HAVE ROAD HARDSURFACED AS SOON AS POSSIBLE TO AVOID MORE SAFETY CONCERNS AND MAINTENANCE COSTS.

I am submitting a formal presentation to accompany my delegation:

Yes: ___ No: ✓

I will require the following audio-visual equipment: NO

PowerPoint: ___

Note: delegations are permitted to speak for 10 minutes. Your form or letter must be received 24 hours before the preparation of the Council agenda. This usually means at least one week prior to the Council meeting.

Personal Information collected on this form is collected under the authority of the Municipal Act and will be used only for the purposes of sending correspondence relating to matters before Council and for creating a record that is available to the general public in a hard copy format and on the internet in an electronic format in accordance with the Municipal Freedom of Information and Protection of Privacy Act. Questions regarding the collection of this information may be directed to the Township Clerk's office.

The Township of Puslinch is committed to providing accessible formats and communication supports for people with a disability. If another format would work better for you, please contact the Township Clerk's office for assistance.

Prepared By:

GM BluePlan ENGINEERING

Township of Puslinch

2019 Bridge and Culvert Inspection Summary Report

GMBP File: 119050

June 2019

TOWNSHIP OF PUSLINCH EST. 1850

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

EXECUTIVE SUMMARY

GM BluePlan Engineering Limited was retained to by the Township of Puslinch to complete bridge and culvert inspections as part of their Biennial Bridges and Culverts Inspection Program. Visual inspections were completed on an element-by-element basis for each structure, with the results recorded on Ontario Structure Inspection Manual (OSIM) inspection forms. Inspections were completed by technical staff under the direction of a Professional Engineer. The scope of work included the inspection of 23 structures, as well as the prioritization of rehabilitation and replacement projects.

Following data collection in the field to determine the current condition of the selected bridges and culverts, the structures were further evaluated to determine any potential for remedial repair or replacement needs. The remedial repair needs were divided into three categories as per the OSIM format: maintenance needs, additional studies and capital works. Maintenance needs are considered as small repair tasks or routine maintenance to keep the structure in proper working order, whereas additional studies and capital works are often larger and more costly procedures. Maintenance needs can normally be completed by Township staff, while additional studies and capital works would likely need to be completed by an outside party.

Maintenance needs identified for each structure may all be considered tasks that can be undertaken immediately. Due to the minimal scope of work, recommended maintenance can often be completed by Township staff. It is suggested that maintenance items be addressed as soon as possible, as the completion of these items will result in an immediate improvement to the condition of the structure.

Additional studies are prioritized as either normal or urgent. Recommended capital works have been prioritized as 6 to 10 year, 1 to 5 year, less than 1 year and urgent.

Recommended capital works for each structure were evaluated in a manner that would provide the Township with the greatest present worth cost benefit or long-term investment in the structure when comparing rehabilitation or replacement (where applicable). The results of the Bridge and Culvert Inspections, using criteria set out in OSIM, are as follows:

	Total Estimated Capital Works			
Structure Group	**Urgent**	**Less Than 1 Year**	**1-5 Years**	**6-10 Years**
Road Bridges and Culverts	-	$55,000	$1,940,000	$550,000

All of the costs presented above and in this report have been estimated based on data obtained from the OSIM inspections, our experience with projects of similar size and scope as well as discussions with suppliers and contractors. Costs do not include allowances for property acquisitions, road works beyond the structure extents, construction administration fees, agency approval fees, utility relocations or HST, unless specifically noted otherwise.

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APPENDICES

2019 BRIDGE AND CULVERT INSPECTION SUMMARY REPORT

TOWNSHIP OF PUSLINCH

GMBP FILE: 119050

JUNE 2019

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the Township of Puslinch (Township) to complete the inspection of bridges and culverts within the Township in accordance with Ontario Regulation 104/97. A total of 23 structures were inspected in 2019. A figure showing the locations of bridges and culverts inspected is provided in **Appendix A**. Each inspection consisted of an element-by-element evaluation with the information recorded on the Ontario Structure Inspection Manual (OSIM) inspection forms. The OSIM inspection forms have been provided in hardcopy and electronic format under separate cover.

Provincial legislation under Ontario Regulation 104/97 and OSIM requirements dictate that structures greater than 3.0 m in span are to be inspected under the direction of a Professional Engineer biennially. Our scope of work included structures under Regulation 104/97 and other smaller span structures within the Township that are not covered under legislation.

2. BRIDGE CONDITION INDEX (BCI)

The BCI value for each structure was calculated based on the Ministry of Transportation's "Bridge Condition Index (BCI) – An Overall Measure of Bridge Condition" (July 30, 2009), updated as required for new element types and materials.

A BCI value of 100 represents a new structure with no deficiencies immediately following construction. This value will decline over the useful life of a structure, depending on traffic volumes, maintenance, exposure to elements and chemicals (chlorides), and construction materials. For the purposes of this assignment, the useful life of road bridges and concrete culverts has been estimated at 75 years, while the useful life of pedestrian bridges and CSP culverts has been estimated at 50 years. Exceptions to these assumptions may be required, and are noted as such throughout the report.

Typically, road bridges and large concrete culverts (greater than 6.0 m span, per cell) are assumed to undergo at least one rehabilitation cycle once the structure's BCI reaches 60. Small concrete culverts, corrugated steel pipe (CSP) culverts, and pedestrian bridges may not undergo a rehabilitation cycle. All structures are assumed to be scheduled for replacement once their BCI reaches 40.

Larger structures requiring more substantial capital investments may be structurally suitable at a BCI of less than 40, and may be able to undergo multiple rehabilitation cycles. These structures would need to be addressed on a case-by-case basis.

3. INSPECTION RESULTS

Condition data collected during the visual inspections was analyzed to determine whether remedial action may be required. Remedial works were categorized as per the OSIM format: maintenance needs, additional investigations and

capital works. Maintenance needs are often small repairs or routine procedures to keep the structure in good working condition and can normally be completed by Township forces. Additional investigations and capitals works are larger tasks that will normally be completed by outside parties. A summary report for each individual structure, with recommended maintenance, investigation and capital works needs, is provided in **Appendix B**.

3.1 Maintenance Needs

Maintenance needs identified for each structure may all be considered tasks that can be undertaken immediately. Due to the minimal scope of work, recommended maintenance can often be completed by Township staff. A schedule has not been tied to maintenance needs, as each task is required currently and will result in an immediate improvement to the structure. Estimated costs for maintenance needs have not been included, as these costs will likely not result in significant capital expenditures to the Township. Maintenance tasks commonly include:

- Removing in-water debris build-up
- Installing hazard markers
- Stabilizing embankments and adding rip-rap protection
- Routing and sealing asphalt cracks
- Clearing debris from drains, bearing seats and joints
- Re-grading shoulders and gravel roads

A summary of the maintenance needs is attached in **Appendix C**.

We suggest that the Township considers a general maintenance program for all structures, which should include an annual washing in the spring or summer months of expansion joint seals, bearings and bridge decks to remove debris and accumulated road salt from winter maintenance. This proactive cleaning will assist in extending the service life of each structure, and should be completed in addition to the works identified in the recommended maintenance needs summary.

3.2 Additional Investigations

Additional investigations may be recommended following the visual OSIM inspections to establish a more accurate condition of the structure, as elements may not be accessible or condition states may not be apparent during visual OSIM inspections, or to complete site specific assessments and testing not typically covered in an OSIM inspection. Some investigations, such as monitoring investigations, may be completed at no additional cost to the Township as part of regular biennial inspections. The additional investigations may be organized based on “normal” or “urgent” priorities. Typical additional investigations can include:

- Enhanced OSIM Inspection
- Detailed Deck Condition Survey
- Concrete Substructure Condition Survey
- Monitoring of Deformations, Settlements and Movements
- Monitoring of Crack Widths
- Structure Evaluations (e.g., Load Limit Analysis, Site Specific Review for Guide Rail Warrant)

A complete list of the recommended additional investigations (without inclusion of required capital works) is attached in **Appendix C**. The priority of these investigations has been listed as normal; however, they should be carried out within the next 1-5 years as capital works budgets and schedules will be affected by their results.

3.3 Capital Works

3.3.1 Cost Estimate Assumptions for Capital Works

The capital works identified on the OSIM forms include all repair and replacement costs recommended for the identified structure. Structures that are recommended for replacement are anticipated to require a Municipal Class Environmental Assessment (EA). The EA process is dependent on a number of factors that will affect both duration and cost. The EA cost, for the purpose of budgeting in this report, has been generally estimated at $40,000 for structures that are recommended for replacement. Although various regulatory authorities may require an increase in structure size for hydraulic, traffic or other requirements, it has been assumed that all structures will be replaced with a structure of similar type and size (like for like).

Additionally, the rehabilitation cost estimates contained in this report should be considered preliminary as no pre-design work has been completed to determine a specific scope of work that could include (but not limited to) changes identified through the EA process, site specific geometric changes due to current design criteria, site specific environmental mitigation and any requirements that relate to the Canadian Environmental Assessment Act (CEAA). The engineering cost estimates have been based on a percentage of the construction cost estimate and can also change accordingly following pre-design.

Associated costs have also been included in the estimated costs for capital works (mobilization, insurance, dewatering, traffic control, contingencies, etc.). In instances where the scope of work is limited, these costs become difficult to estimate and may inflate the actual costs to complete small-scale projects. The Township may wish to group projects of similar scope together under a bundled design and tender approach to realize cost savings; however, the cost estimates provided assume that each project will be completed as a stand-alone assignment.

3.3.2 Prioritization of Work

The priorities for the specified capital works were identified on the OSIM forms in the time frames of urgent, within 1 year, 1 to 5 year, and 6 to 10 year. A complete list of structures recommended for capital works within each time frame as well as a summary list of anticipated capital works for each structure has been included in **Appendix C**.

Structures requiring work have been prioritized based on the inspected visual condition and review of the background information provided; however, this order may change depending on the outcome of additional investigations and other factors determined by the Township. The priority rankings do not necessarily reflect the order in which capital works must be carried out. In addition to the observed condition of the structure, our rankings are based on such factors as:

- Traffic Volumes
- Pedestrian or Cyclists Hazards or Requirements
- Load Rating Requirements

We note that, although the BCI value is a good tool for estimating the condition of a structure, it should not be relied upon solely for prioritization of capital works. BCI values can be skewed by non-critical elements, and do not take into account factors such as those listed above.

3.3.3 Recommended Capital Works

Recommended capital works for each structure were evaluated in a manner that would provide the Township with the greatest present worth cost benefit or long-term investment in the structure when comparing rehabilitation or replacement (where applicable). The results of the Bridge and Culvert Inspections, using criteria set out in OSIM, are as follows:

	Total Estimated Capital Works			
Structure Group	**Urgent**	**Less Than 1 Year**	**1-5 Years**	**6-10 Years**
Road Bridges and Culverts	-	$55,000	$1,940,000	$550,000

All of the costs presented above and in this report have been estimated based on data obtained from the OSIM inspections, our experience with projects of similar size and scope as well as discussions with suppliers and contractors. Costs do not include allowances for property acquisitions, road works beyond the structure extents, construction administration fees, agency approval fees, utility relocations or HST, unless specifically noted otherwise.

4. STRUCTURE DESCRIPTIONS

Provided below are brief narratives of structures that we believe require further detail or clarification.

4.1 Structure 0003 (Little's Bridge)

Structure 0003 (Little's Bridge) is located on Sideroad 25 North, 200 m south of Concession Road 7. The structure is a concrete rigid frame bridge with concrete parapet barriers. The barriers of the bridge are in very poor condition, and sagging is apparent in the deck slab. This bridge has a very low AADT, and services only one property (Slovenski Park).

Previous recommendations for this structure have included rehabilitation of poor concrete areas and barrier replacement in the 1 to 5 year time frame, and consideration of structure replacement. Upon review of this structure and the surrounding area, it was noted that there exists the possibility of abandoning the existing bridge and constructing a new driveway access to Slovenski Park south of Mill Creek. This would require property acquisitions by the Township, but would alleviate the need for a costly structure rehabilitation and ultimately replacement. It is estimated that the construction of a gravel driveway entrance to Slovenski Park south of Mill Creek would cost $200,000+HST. This cost does not include property acquisitions.

This structure is subject to a 10 tonne load limit. The scope of the rehabilitation provided on the OSIM report does not account for works to remove the load limit. It is unlikely that a rehabilitation to remove the load limit would be economically practical as compared to replacement. Replacement of the structure is estimated to cost approximately $500,000+HST.

4.2 Structure 0004 (Moyer's Bridge)

Structure 0004 (Moyer's Bridge) is located on Concession Road 7, 1.0 km south of Wellington Road 34. The original structure is a concrete T-beam bridge which has since been extended with cast-in-place concrete extensions (date of construction unknown). Overhead concrete repairs to the original T-beam structure, waterproofing and resurfacing works were completed in 2012.

Although the newer concrete extensions are in good condition, the original T-beam structure is in poor condition. Several delaminated areas are still present, even in the areas repaired in 2012. We believe that this is likely due to a high chloride concentration in the concrete from years of road salting causing corrosion of the steel reinforcement. It is also noted that this structure carries a large amount of heavy truck traffic. Our experience is that shallow overhead concrete patch work can be expected to last anywhere from 5 to 15 years.

If additional concrete repairs were to be completed to the existing T-beam structure, they would not be anticipated to appreciably extend the useful life of the structure. Therefore, replacement of the entire structure has been recommended

in 1 to 5 years. Alternatives to replace the existing structure while keeping the extensions could be explored to reduce capital costs.

4.3 Structure 0008

Structure 0008 is located on Gore Road, 200 m east of Shellard Side Road. The structure is a two-span concrete rigid frame structure. The ends of the structure are in poor condition with areas of severe disintegration, erosion and spalling; however, the interior of the structure appears to be in fair to good condition. Deterioration of the structure will continue to progress to the interior barrels of the structure as repairs are delayed.

Concrete repairs, waterproofing and resurfacing are recommended to the structure in 1 to 5 years in order to extend its useful life. Due to the lack of cover on the structure, the Township may also wish to consider concrete curbs and asphalt spillways to limit the chloride exposure of the exposed ends. This concrete curb and asphalt spillway work has not been included in the scope of work detailed on the OSIM form.

It is our understanding that this structure is a boundary road structure with the Township of North Dumfries, and that a cost sharing agreement with the Townships of Puslinch and North Dumfries may be in effect for this structure.

4.4 Structure 2009 (Culvert over Aberfoyle Creek)

Structure 2009 (Culvert over Aberfoyle Creek) is located in Gilmour Road. The structure is a concrete open-footing culvert with CSP extensions on the north and south ends.

Survey work and prep work for structure replacement was completed in 2014 by GMBP; however, upon completion of a legal survey, it was determined that the existing structure extends onto private property and that extensive soil retaining structures may be required to complete replacement works. As such, the Township has delayed the replacement of this structure.

Replacement has been recommended for this structure in the 1 to 5 year time frame. If replacement is expected to be significantly delayed, rehabilitation of the concrete barrel and CSP extensions should be completed in 1 to 5 years at an approximate cost of $100,000+HST.

4.5 Structure 2010 (Ellis Road Culvert over Irish Creek)

Structure 2010 (Ellis Road Culvert over Irish Creek) is located on Ellis Road, 800 m west of Wellington Road 32.The original structure is a concrete open-footing bridge, and there is a newer concrete open-footing culvert extension on the north end. The original structure was built in approximately 1920, and exhibits severe delamination, spalling and erosion with exposed corroded rebar. The extension to the north is in good condition.

In May 2017, the top of the culvert on the original structure was exposed and found to be good condition. The surface was chain dragged and hammer sounded, with no areas of delaminated concrete noted. One small area of spalled concrete was noted on the southeast corner of the bridge deck, and one full width longitudinal crack running from the east to west was noted. The defects did not appear to be of immediate concern. Given the size of the original culvert, repairs may not be a cost-effective way to extend the life of the structure. Therefore, the original structure has been recommended for replacement in the next 6 to 10 years.

We note that this work may be able to be delayed beyond the next 10 years, pending future biennial inspections. We measured approximately 0.45 m of cover at the centreline of the road, and approximately 0.60 m at the south edge of the structure. This may allow for the construction of a new reinforced concrete slab over the existing culvert should its condition deteriorate before the Township can fund a replacement of this section.

5. IMPROVEMENTS TO ROADSIDE SAFETY

Roadside safety guidelines are provided in the MTO's "Roadside Design Manual" (2017) and TACC's "Geometric Highway Design Guide for Canadian Roads" (2017). These documents can serve as reference points to be used for risk assessments in establishing the required measures to enhance roadside safety.

In most instances, the blunt end of a railing or concrete end wall on a bridge would be considered the hazard requiring protection. At culverts, the installation of guide rail to increase safety needs to be weighed against the hazard it would be protecting (e.g., sides of culvert protruding from embankment, waterways, etc.) as guide rail itself can be construed as a hazard as well. Guide rail needs and configuration should be addressed on a site-specific basis to account for factors such as road geometry, private entrances, and/or other hazards.

Due to capital costs and the quantity of structures requiring work, many municipalities leave guide rail upgrades until such time that the structure is repaired or replaced; however, the guidelines of the Roadside Design Manual and Geometric Design Guide for Canadian Roads apply to all public roads. If not currently in place, we have recommended that the Township consider implementing a guide rail program where guide rail is added to structures on an annual basis following a site-specific assessment.

In accordance with the Township's Asset Management Plan, costs associated with guide rail improvements have been included in the recommended capital works. Additional investigations have been recommended in the form of site-specific assessments to determine the warrant for guide rail at identified structures. For the purposes of budgeting, we have accounted for an allowance of $40,000 + HST at each of these sites until the assessment can be completed and the need and extent of guide rail can be determined. These costs are included in the summary tables provided in the previous sections. Timing for this work has been scheduled as 1 to 5 years, unless other rehabilitation works are recommended. In these instances, the review of guide rail should be completed as part of the rehabilitation design process and occur at the same time as the rehabilitation works.

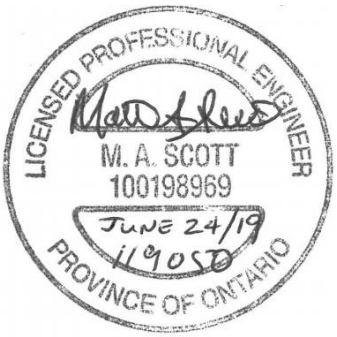
In the case of structures that are recommended for replacement, an additional investigation has not been identified as the detailed design process should include for a review of guide rail warrants at the site when considering the geometry of the replacement structure.

6. SUMMARY

OSIM Inspections of municipal bridges and culverts were completed in 2019 for the Township of Puslinch in conformance with Ontario Regulation 104/97. This information was utilized to establish remedial actions to maintain or improve the conditions of each structure, as required, and has been collected on an element-by-element basis on OSIM-style forms. Maintenance works were recommended for specified structures, which involve actions that can typically be carried out by Township staff. Additional investigations and capital works identified on these forms have been categorized based on the time frame to complete each task, and are typically completed by external companies.

We trust our report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

All of which is respectfully submitted.

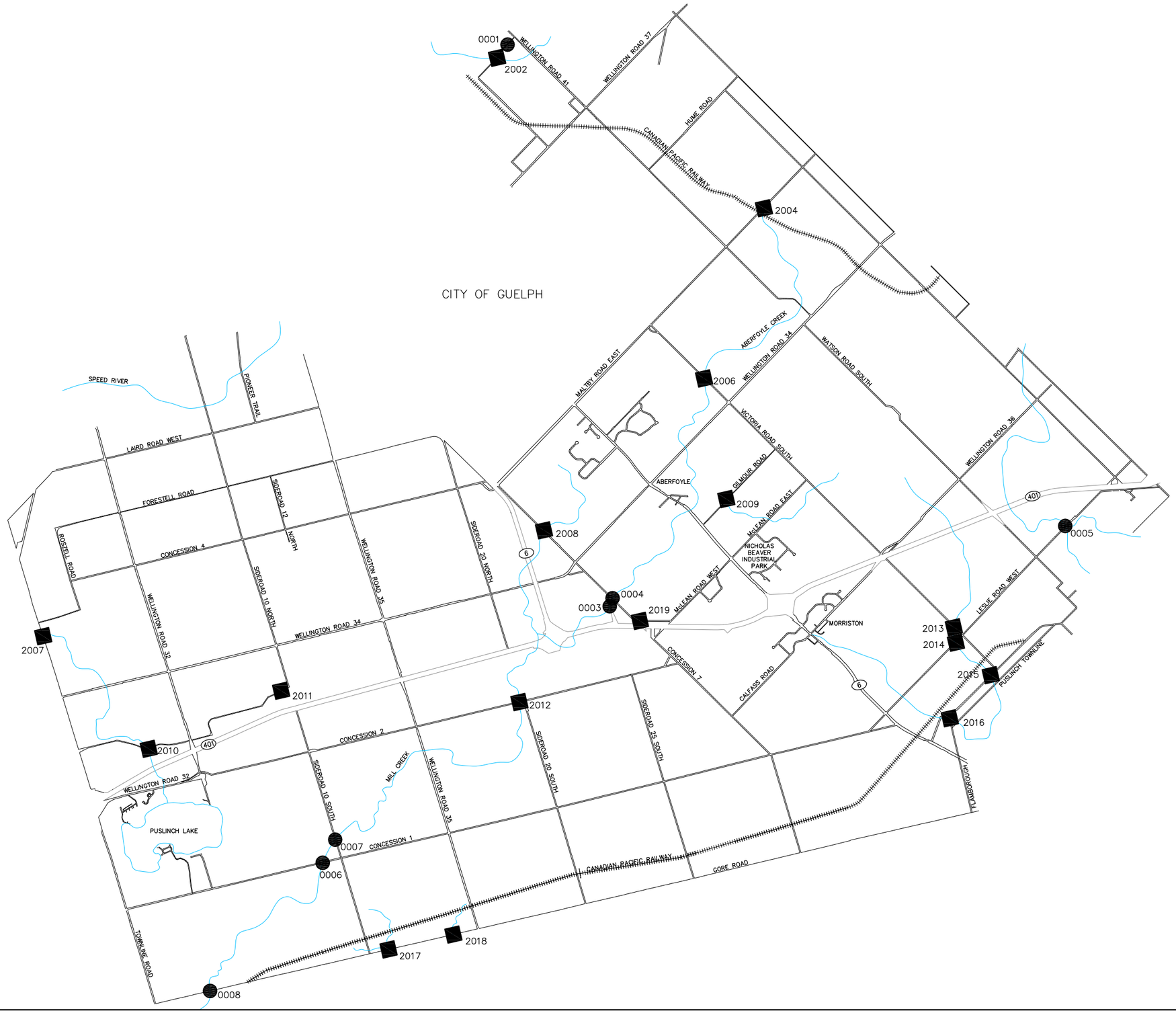


GM BLUEPLAN ENGINEERING LIMITED
Per:

Matt Scott, P.Eng.
Project Engineer

APPENDIX A:
BRIDGE AND CULVERT LOCATION MAP

TOWNSHIP OF PUSLINCH
DETAILED BRIDGE AND CULVERT INSPECTIONS



LEGEND

- 401 — PROVINCIAL HIGHWAY
- LOCAL ROAD
- 0005 — STRUCTURE NUMBER (BRIDGES)
- 2015 — STRUCTURE NUMBER (CULVERTS)

SCALE = 1:75000

JUN. 2019

APPENDIX A

BluePlan ENGINEERING

APPENDIX B:
BRIDGE AND CULVERT INSPECTION SUMMARY SHEETS

Cook's Mill Bridge

Structure: 0001

Bridge Condition Index (BCI): 69

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☐	☑	☐	$500
Monitoring of Crack Widths	☐	☑	☐	$500
Total Additional Investigations Cost				**$1,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Decks - Deck Top	Bridge Cleaning		Clean off deck annually.
Joints - Seals/Sealants			Clean debris from joints annually.

BluePlan ENGINEERING

Little's Bridge

Structure: 0003

Bridge Condition Index (BCI): 22

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☐	☑	☐	$10,000
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$10,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Abutments - Abutment Walls	Repair poor concrete on abutment walls	1-5 Years	$10,000
Abutments - Wingwalls	Repair poor concrete on wingwalls	1-5 Years	
Barriers - Barrier/Parapet Walls	Remove barrier and install thrie beam	1-5 Years	$35,000
Decks - Deck Top	Repair poor concrete on deck top	1-5 Years	$15,000
Decks - Soffit - Thick Slab	Repair poor concrete in soffit (interior and exterior)	1-5 Years	$30,000
Sidewalks/Curbs - Curbs	Remove and replace curb	1-5 Years	$15,000
	Sub-Total Recommended Work Cost		**$115,000**
	Sub-Total Associated Work Cost		**$80,000**
	Contingencies	13.50%	$26,000
	Engineering	20.00%	$39,000
	Total Recommended & Associated Work Cost		**$260,000**

Mainenance Needs

Element	Need	Priority	Description
Embankments & Streams - Streams and Waterways	Bridge Cleaning		Trim/remove excess vegetation. Remove fallen tree. Remove pieces of concrete barrier (both sides).

Moyer's Bridge

Structure: 0004

Bridge Condition Index (BCI): 59

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Decks - Soffit - Thin Slab	Replace structure	1-5 Years	$400,000
	Sub-Total Recommended Work Cost		**$400,000**
	Sub-Total Associated Work Cost		**$40,000**
	Contingencies	10.00%	$44,000
	Engineering	15.00%	$66,000
	Total Recommended & Associated Work Cost		**$550,000**

Mainenance Needs

Element	Need	Priority	Description
Approaches - Wearing Surface	Bridge Surface Repair		Repair pothole.

Structure 0005

Structure: 0005

Bridge Condition Index (BCI): 74

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☐	☑	☐	$2,000
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$2,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Barriers - Posts	Allowance for guide rail	1-5 Years	$40,000
	Sub-Total Recommended Work Cost		**$40,000**
	Sub-Total Associated Work Cost		**$0**
	Contingencies	10.00%	$4,000
	Engineering	15.00%	$6,000
	Total Recommended & Associated Work Cost		**$50,000**

Mainenance Needs

Element	Need	Priority	Description
Decks - Wearing Surface	Rout and Seal		Route and seal cracks. Clean sand from wearing surface.
Embankments & Streams - Embankments	Erosion Control at Bridges		Provide erosion control at SE and NW embankments.
Embankments & Streams - Streams and Waterways	Other		Remove tree upstream.

Structure 0006

Structure: 0006

Bridge Condition Index (BCI): 61

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Approaches - Wearing Surface	Bridge Cleaning		Clean debris off wearing surface
Decks - Drainage			Clean drains.

French's Bridge

Structure: 0007

Bridge Condition Index (BCI): 68

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Abutments - Bearings	Bridge Cleaning		Clean debris from bearing seats.
Accessories - Utilities	Other		Properly anchor cable to bridge.
Approaches - Wearing Surface			Re-grade gravel approaches.
Barriers - Railing Systems			Fix damaged southwest post connection.
Decks - Deck Top	Bridge Cleaning		Clean gravel from deck top.
Embankments & Streams - Streams and Waterways	Other		Clear debris build-up.

BluePlan ENGINEERING

Structure 0008

Structure: 0008

Bridge Condition Index (BCI): 60

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Culverts - Barrels	Repair poor concrete in barrel	1-5 Years	$20,000
Culverts - Inlet Components	Repair poor concrete on inlet face	1-5 Years	
Culverts - Outlet Components	Repair poor concrete on outlet	1-5 Years	
Decks - Wearing Surface	Allowance for guide rail	1-5 Years	$40,000
Embankments & Streams - Streams and Waterways	Place rock protection (barrel/inlet/outlet)	1-5 Years	$10,000
	Sub-Total Recommended Work Cost		**$110,000**
	Sub-Total Associated Work Cost		**$40,000**
	Contingencies	16.00%	$24,000
	Engineering	17.00%	$26,000
	Total Recommended & Associated Work Cost		**$200,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Install hazard markers.
Embankments & Streams - Embankments	Erosion Control at Bridges		Install erosion control at embankments.

Mill Race Culvert

Structure: 2002

Bridge Condition Index (BCI): 74

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☐	☑	☐	$1,000
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$1,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Install concrete curb wall	<1 Year	$30,000
Culverts - Barrels	Grout gap in CSPA joints	<1 Year	$1,000
	Sub-Total Recommended Work Cost		**$31,000**
	Sub-Total Associated Work Cost		**$12,000**
	Contingencies	10.00%	$4,000
	Engineering	19.00%	$8,000
	Total Recommended & Associated Work Cost		**$55,000**

Mainenance Needs

McFarlane's Culvert

Structure: 2004

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☐	☑	☐	$2,000
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$2,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Allowance for guide rail	1-5 Years	$40,000
	Sub-Total Recommended Work Cost		**$40,000**
	Sub-Total Associated Work Cost		**$0**
	Contingencies	10.00%	$4,000
	Engineering	15.00%	$6,000
	Total Recommended & Associated Work Cost		**$50,000**

Mainenance Needs

Culvert over Galt Creek

Structure: 2006

Bridge Condition Index (BCI): 72

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Allowance for guide rail	6-10 Years	$40,000
Culverts - Barrels	Repair poor concrete in barrel.	6-10 Years	$20,000
	Sub-Total Recommended Work Cost		**$60,000**
	Sub-Total Associated Work Cost		**$30,000**
	Contingencies	13.00%	$12,000
	Engineering	20.00%	$18,000
	Total Recommended & Associated Work Cost		**$120,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Install hazard marker at structure.

Structure 2007

Structure: 2007

Bridge Condition Index (BCI): 58

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Barriers	Repair guide rail	1-5 Years	$10,000
Approaches - Wearing Surface	Asphalt patch repair	1-5 Years	$5,000
Culverts - Barrels	Repair poor barrel concrete	1-5 Years	$25,000
Culverts - Inlet Components	Repair poor concrete on barrel inlet and wingwalls	1-5 Years	
Culverts - Outlet Components	Repair poor concrete on barrel outlet	1-5 Years	$5,000
Embankments & Streams - Embankments	Install rock protection	1-5 Years	$15,000
	Sub-Total Recommended Work Cost		**$85,000**
	Sub-Total Associated Work Cost		**$56,000**
	Contingencies	14.00%	$20,000
	Engineering	20.50%	$29,000
	Total Recommended & Associated Work Cost		**$190,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Utilities	Other		Remove/replace conduit
Embankments & Streams - Streams and Waterways	Erosion Control at Bridges		Remove debris from stream.

7th Concession Culvert

Structure: 2008

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Culvert over Aberfoyle Creek

Structure: 2009

Bridge Condition Index (BCI): 50

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Culverts - Barrels	Replace structure and install retaining walls	1-5 Years	$450,000
		Sub-Total Recommended Work Cost	**$450,000**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$45,000
		Engineering 10.00%	$45,000
		Total Recommended & Associated Work Cost	**$540,000**

Mainenance Needs

Element	Need	Priority	Description
Approaches - Barriers	Other		Tighten loose cables; install snow plow markers.
Embankments & Streams - Embankments			Stabilize slopes, remove large rocks and trees.
Embankments & Streams - Streams and Waterways			Remove rocks blocking channel flow.

Ellis Road Culvert over Irish Creek

Structure: 2010

Bridge Condition Index (BCI): 43

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Culverts - Barrels	Replace original structure	6-10 Years	$200,000
	Sub-Total Recommended Work Cost		**$200,000**
	Sub-Total Associated Work Cost		**$40,000**
	Contingencies	10.00%	$24,000
	Engineering	19.00%	$46,000
	Total Recommended & Associated Work Cost		**$310,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Three (3) additional markers required.

Ellis Road Culvert

Structure: 2011

Bridge Condition Index (BCI): 74

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Structure 2012

Structure: 2012

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Install hazard markers at structure.
Approaches - Barriers			Replace damaged sections of guide rail.
Embankments & Streams - Embankments	Erosion Control at Bridges		Stabilize embankments.

Structure 2013

Structure: 2013

Bridge Condition Index (BCI): 64

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Allowance for guide rail	6-10 Years	$40,000
Culverts - Barrels	Repair poor concrete in barrel	6-10 Years	$20,000
	Sub-Total Recommended Work Cost		**$60,000**
	Sub-Total Associated Work Cost		**$30,000**
	Contingencies	13.00%	$12,000
	Engineering	20.00%	$18,000
	Total Recommended & Associated Work Cost		**$120,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other	1 Year	Install hazard markers at structure.
Embankments & Streams - Streams and Waterways			Clear debris.

Structure 2014

Structure: 2014

Bridge Condition Index (BCI): 58

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☐	☑	☐	$2,000
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$2,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Allowance for guide rail	1-5 Years	$40,000
	Sub-Total Recommended Work Cost		**$40,000**
	Sub-Total Associated Work Cost		**$0**
	Contingencies	10.00%	$4,000
	Engineering	15.00%	$6,000
	Total Recommended & Associated Work Cost		**$50,000**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Install hazard markers at structure.

Structure 2015

Structure: 2015

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Approaches - Barriers	Other		Attach guide rail post to guard rail.

Structure 2016

Structure: 2016

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Abutments - Abutment Walls	Other		Remove plywood forms.

Structure 2017

Structure: 2017

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Structure 2018

Structure: 2018

Bridge Condition Index (BCI): 75

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☑	☐	☐	$0
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$0**

Recommended Work

Element	Repair / Rehab	Status	Cost
-			$0
		Sub-Total Recommended Work Cost	**$0**
		Sub-Total Associated Work Cost	**$0**
		Contingencies 10.00%	$0
		Engineering 20.00%	$0
		Total Recommended & Associated Work Cost	**$0**

Mainenance Needs

Element	Need	Priority	Description
Accessories - Signs	Other		Replace missing signs.

Structure 2019

Structure: 2019

Bridge Condition Index (BCI): 68

Additional Investigations

	Priority			Estimated Cost
	None	Normal	Urgent	
Detailed Deck Condition Survey	☑	☐	☐	$0
Non-Destructive Delamination Survey of Ashpalt Covered Deck	☑	☐	☐	$0
Substructure Condition Survey	☑	☐	☐	$0
Detailed Coating Survey	☑	☐	☐	$0
Detailed Timber Investigation	☑	☐	☐	$0
Post-Tension Strand Investigation	☑	☐	☐	$0
Underwater Survey	☑	☐	☐	$0
Fatigue Investigation	☑	☐	☐	$0
Seismic Investigation	☑	☐	☐	$0
Structure Evaluation	☐	☑	☐	$2,000
Monitoring of Deformations, Settlements & Movements	☑	☐	☐	$0
Monitoring of Crack Widths	☑	☐	☐	$0
Total Additional Investigations Cost				**$2,000**

Recommended Work

Element	Repair / Rehab	Status	Cost
Approaches - Wearing Surface	Allowance for guide rail	1-5 Years	$40,000
	Sub-Total Recommended Work Cost		**$40,000**
	Sub-Total Associated Work Cost		**$0**
	Contingencies	10.00%	$4,000
	Engineering	15.00%	$6,000
	Total Recommended & Associated Work Cost		**$50,000**

Mainenance Needs

Element	Need	Priority	Description
Embankments & Streams - Streams and Waterways	Other		Clear debris from inside of channel.

APPENDIX C:
RECOMMENDED MAINTENANCE, ADDITIONAL INVESTIGATION AND CAPITAL WORKS NEEDS

TOWNSHIP OF PUSLINCH
RECOMMENDED CAPITAL WORKS

Structure Number	Structure Name	Road Name	Description	Schedule	Priority (1)	Capital Cost Estimate (2)
0001	Cook's Bridge	Cook's Mill Road	none	none	-	-
0003	Little's Bridge	Sideroad 25 North	Major Rehab	1 to 5	3	$260,000
0004	Moyer's Bridge	Concession 7	Replace	1 to 5	1	$550,000
0005	Structure 0005	Leslie Road West	Minor Rehab	1 to 5	3	$50,000
0006	Structure 0006	Concession 1	none	none	-	-
0007	French's Bridge	Sideroad 10 South	none	none	-	-
0008	Structure 0008	Gore Road	Minor Rehab	1 to 5	2	$200,000
2002	Mill Race Culvert	Cook's Mill Road	Minor Rehab	Within 1 Year	1	$55,000
2004	McFarlane's Culvert	Maltby Road	Minor Rehab	1 to 5	3	$50,000
2006	Culvert over Galt Creek	Victoria Road South	Minor Rehab	6 to 10	4	$120,000
2007	Structure 2007	Townline Road	Major Rehab	1 to 5	1	$190,000
2008	7th Concession Culvert	Concession 7	none	none	-	-
2009	Culvert over Aberfoyle Creek	Gilmour Road	Replace	1 to 5	1	$540,000
2010	Ellis Road Culvert over Irish Creek	Ellis Road	Replace	6 to 10	4	$310,000
2011	Ellis Road Culvert	Ellis Road	none	none	-	-
2012	Structure 2012	Concession 2	none	none	-	-
2013	Structure 2013	Victoria Road South	Minor Rehab	6 to 10	4	$120,000
2014	Structure 2014	Leslie Road West	Minor Rehab	1 to 5	3	$50,000
2015	Structure 2015	Puslinch-Flamborough Townline	none	none	-	-
2016	Structure 2016	Puslinch-Flamborough Townline	none	none	-	-
2017	Structure 2017	Gore Road	none	none	-	-
2018	Structure 2018	Gore Road	none	none	-	-
2019	Structure 2019	McLean Road East	Minor Rehab	1 to 5	3	$50,000

Capital Works Cost Estimate Totals:

Urgent =	$0
Within 1 Year =	$55,000
1 to 5 Years =	$1,940,000
6 to 10 Years =	$550,000

NOTES:

1. Priority number should be used to reflect the urgency in which the work is to be completed. This is based on our opinion of the priority in which projects should occur. Priorities may change based on other constraints and preliminary design work. Lower numbers represent a higher priority ranking.
2. Costs include engineering, contingencies and other associated costs, but do not include property acquisitions, road works beyond structure extents, contract admin, agency approval fees, utility relocations or HST.

TOWNSHIP OF PUSLINCH
MAINTENANCE NEEDS

Structure Number	Structure Name	Road Name	Description of Maintenance Needs
0001	Cook's Bridge	Cook's Mill Road	- Clean gravel off deck annually - Clean debris from joints annually
0003	Little's Bridge	Sideroad 25 North	- Trim\remove excessive vegetation. Remove fallen tree. Remove pieces of concrete barrier (both sides)
0004	Moyer's Bridge	Concession 7	- Repair pothole
0005	Structure 0005	Leslie Road West	- Rout and seal cracks. Clean sand from wearing surface - Provide erosion control at SE and NW embankments - Remove fallen tree upstream
0006	Structure 0006	Concession 1	- Clean drains - Clean sand and gravel from deck
0007	French's Bridge	Sideroad 10 South	- Properly anchor utility cable to bridge - Re-grade gravel approaches - Fix damaged SW post connection - Clean gravel off deck annually - Clean debris from bearing seats - Clear debris build-up upstream
0008	Structure 0008	Gore Road	- Place hazard markers at structure - Install erosion control at embankments
2002	Mill Race Culvert	Cook's Mill Road	-
2004	McFarlane's Culvert	Maltby Road	-
2006	Culvert over Galt Creek	Victoria Road South	- Place hazard markers at structure
2007	Structure 2007	Townline Road	- Clean debris from stream - Remove/replace utility conduit
2008	7th Concession Culvert	Concession 7	-
2009	Culvert over Aberfoyle Creek	Gilmour Road	- Tighten loose cables, install snow plow markers - Stabilize embankments, remove large rocks and trees - Clean debris from stream
2010	Ellis Road Culvert over Irish Creek	Ellis Road	- Place hazard markers at structure
2011	Ellis Road Culvert	Ellis Road	-
2012	Structure 2012	Concession 2	- Place hazard markers at structure - Replace damaged sections of guide rail - Stabilize embankments
2013	Structure 2013	Victoria Road South	- Place hazard markers at structure - Debris cleanup at west end beyond structure
2014	Structure 2014	Leslie Road West	- Place hazard markers at structure
2015	Structure 2015	Puslinch-Flamborough Townline	- Attach disconnected post to guide rail
2016	Structure 2016	Puslinch-Flamborough Townline	- Remove plywood forms
2017	Structure 2017	Gore Road	-
2018	Structure 2018	Gore Road	- Replace missing signs
2019	Structure 2019	McLean Road East	- Clear debris from inside of channel

TOWNSHIP OF PUSLINCH
ADDITIONAL INVESTIGATIONS

Structure Number	Structure Name	Road Name	Estimated Cost	Investigation Description	Description of Additional Investigation
0001	Cook's Bridge	Cook's Mill Road	$1,000	- Monitoring of Deformations, Settlements and Movements - Monitoring of Crack Widths	- Monitor vertical crack on west abutment as part of regular OSIM Inspections - Monitoring rotation of NW gabion
0003	Little's Bridge	Sideroad 25 North	$10,000	- Detailed Deck Condition Survey	- Take cores from bridge deck in advance of rehabilitation
0004	Moyer's Bridge	Concession 7			-
0005	Structure 0005	Leslie Road West	$2,000	- Structure Evaluation	- Site assessment for guide rail
0006	Structure 0006	Concession 1			-
0007	French's Bridge	Sideroad 10 South			-
0008	Structure 0008	Gore Road			-
2002	Mill Race Culvert	Cook's Mill Road	$1,000	- Monitoring of Deformations, Settlements and Movements	- Monitor separation of midspan barrel joints with next inspection
2004	McFarlane's Culvert	Maltby Road	$2,000	- Structure Evaluation	- Site assessment for guide rail
2006	Culvert over Galt Creek	Victoria Road South			-
2007	Structure 2007	Townline Road			-
2008	7th Concession Culvert	Concession 7			-
2009	Culvert over Aberfoyle Creek	Gilmour Road			-
2010	Ellis Road Culvert over Irish Creek	Ellis Road			-
2011	Ellis Road Culvert	Ellis Road			-
2012	Structure 2012	Concession 2			-
2013	Structure 2013	Victoria Road South			-
2014	Structure 2014	Leslie Road West	$2,000	- Structure Evaluation	- Site assessment for guide rail
2015	Structure 2015	Puslinch-Flamborough Townline			-
2016	Structure 2016	Puslinch-Flamborough Townline			-
2017	Structure 2017	Gore Road			-
2018	Structure 2018	Gore Road			-
2019	Structure 2019	McLean Road East	$2,000	- Structure Evaluation	- Site assessment for guide rail

July 9, 2019
Our File: 119006-4

Township of Puslinch
RR 3, 7404 Wellington Road 34
Puslinch, ON N0B 2J0

Attention: Ms. Nina Lecic

Re: Hard-surfacing of Gravel Roads

Dear Ms. Lecic:

Enclosed please find a working version of the report GM BluePlan is preparing related to the study for the hard-surfacing of gravel roads and maintenance of hard-surfaced roads within the Township.

This study was initiated in response to the resolution by Council dated January 16, 2019 which requested that a report be initiated to:

1. Identify an appropriate and cost effective method of extending the life of paved roads;
2. Develop criteria to prioritize the paving of unpaved roads;
3. Identifying an appropriate and cost effective pavements (such as tar and chip) to be used for unpaved roads;
4. Developing a listing and schedule for the paving of unpaved roads.

This preliminary version of the report is provided for discussion purposes only. At this point, we wish to review with the Township to confirm direction and scope and to solicit input. Recommendations and costing analysis will be completed following detailed review with the Township.

If you have any questions or require additional information, please do not hesitate to contact us.

Yours truly,

GM BLUEPLAN ENGINEERING
Per:

Amanda Pepping, P. Eng.

Prepared By:

BluePlan ENGINEERING

Township of Puslinch

Planning Considerations for Hard-Surfacing Township Roads

GMBP File: 119006-4

DRAFT

TOWNSHIP OF PUSLINCH EST. 1850

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
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PLANNING CONSIDERATIONS FOR HARD-SURFACING TOWNSHIP ROADS

TOWNSHIP OF PUSLINCH

GMBP FILE: 119006-4

DRAFT

1. INTRODUCTION

The Township of Puslinch (Township) is located in the southern area of Wellington County around the intersection of Highway 6 and Highway 401. It is bordered by the City of Cambridge, City of Guelph, Township of Guelph/Eramosa, Town of Milton, Township of North Dumfries and City of Hamilton. Currently, the Township maintains approximately 193 km of roadways, of which approximately 55 km are gravel and 138 km are hard-surfaced. Hard-surfaced roads can be further categorized as follows: approximately 24 km are surfaced with two lifts of asphalt, approximately 7 km are surfaced with surface treatment ("tar and chip"), and the remaining 107 km are surfaced with a single lift of asphalt. A map of roads maintained by the Township can be found in **Appendix A.** In general, roads that experience high traffic volumes (commuter roads) and/or heavy truck traffic (gravel pit haul routes), as well as new roads in residential subdivision developments, are surfaced with two lifts of asphalt. Once residential roads are scheduled for resurfacing, they are generally resurfaced with a single lift of asphalt (even where two lifts had previously been constructed).

GM BluePlan Engineering Limited (GMBP) has been retained by the Township to provide engineering services related to the review for the hard-surfacing of gravel roads and maintenance of hard-surfaced roads within the Township. The objective of this report is to outline planning considerations that Township staff and Council can use when reviewing the level of service that the Township's road network provides. 'Levels of service' are high-level indicators that establish defined quality thresholds at which municipal services should be offered. They support the Township's strategic goals and are based on customer expectations, statutory requirements, standards, and the financial capacity of the Township to deliver those levels of service.

2. BACKGROUND INFORMATION ON ROAD CONSTRUCTION

2.1 Road Structure

All roads owned and maintained by the Township are constructed on a road base structure, meaning that there are no "earth" roads within the Township (i.e. roads where the native material is the road structure). Provided below in Figure 1 is a typical cross section of a road structure.

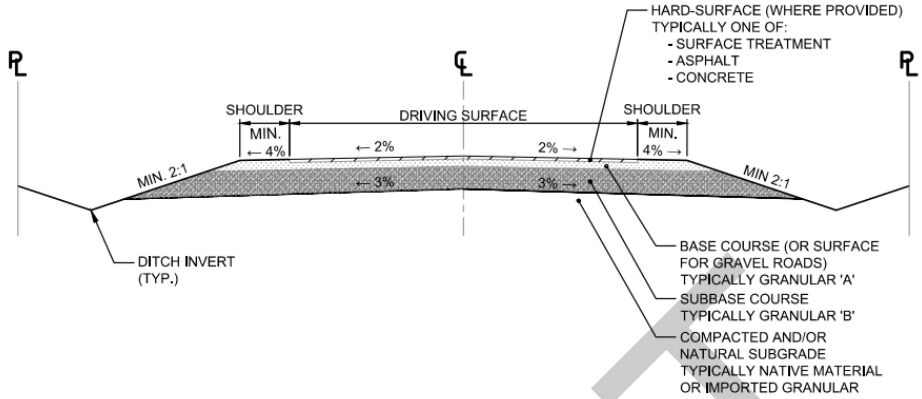

Figure 1: Typical Road Structure Cross Section

Parts of the typical road structure cross section are further defined below:

Subgrade: Native material or naturally occurring material on which the road is constructed. In the cases of unsuitable native material, or in the cases where the grade of the road must be raised well above the native grade, imported gravel fill can be used to form the subbase. The top layer of subgrade is graded and proof-rolled prior to placing road base material. The strength of subgrade is considered as part of the design of the road structure.

Subbase: Usually a layer of imported gravel (typically Granular 'B') that is graded and compacted on top of the subgrade. This layer is intended to be free-draining (e.g., a well graded granular material) and prevents subgrade material and water from migrating upwards into higher levels of the road base. This is the first layer of the road section that is intended to be frost-resistant, meaning that it conducts water away from the road surface into ditches and alleviates frost heave.

Base: A top layer of finely graded granular material (typically Granular 'A') that is graded and compacted to form the working platform for hard-surfacing, or in the case of a gravel road, the final road surface. While some drainage does occur through the base course, it also functions to direct water towards the edges of the road surface. This layer is subject to severe loading, and serves to spread loading from the wearing surface over a larger area in combination with the subbase course, thus reducing pressure on the subgrade.

Wearing Surface: Where present, this is the top layer of the road cross section that is in direct contact with surface loading. It can either be flexible (e.g., asphalt or surface treatment) or rigid (e.g., concrete). Design of base and subbase courses will differ for flexible and rigid wearing surfaces. The wearing surface functions to direct the majority of surface water to the shoulders and ditches of the road, provide a smooth and consistent riding surface that is resistant to skidding and reduce dust from the base and subbase.

For asphalt roads, general "rules of thumb" for road construction within the engineering industry reference a granular base equivalency (GBE) for road sections. The GBE is generally described as follows for strength of material:

1 mm Surface Asphalt ≈ 2 mm Base Granular ≈ 3 mm Subbase Granular

Recently, asphalt resurfacing programs in the Township have used 60 mm of surface asphalt, an increase from 50mm prior to 2016. Applying the GBE to the Township's typical surface asphalt thickness results in the following strength equivalencies:

60 mm Surface Asphalt ≈ 120 mm Base Granular ≈ 180 mm Subbase Granular*

*Note: the above is not the composition of the Township's standard road section design, rather represents the thickness of each material required to provide an equivalent strength.

Flexible pavements are classified as roads where subgrade deficiencies will deform the layers above and be reflected in the road surface. The design of flexible pavements, including gravel, asphalt and surface treated roads, is dependent on the strength of the subgrade. The road base and surface (if structural) must be thick enough to ensure no load great enough to deform the subgrade is passed through. Bituminous materials can be added over an aggregate base to smooth the driving surface and protect the base from moisture but since they are flexible they will deflect to reflect the quality of the base below. In a thin layer, bituminous material is known as a surface treatment and adds no additional strength unlike thicker asphalt layers that help to bear the load [1].

Concrete is the most commonly used rigid pavement material. Rigid pavement is characterized by having enough beam strength to bridge over localized subgrade failures. For this reason, the strength of the subgrade is less important in the design of concrete roads and the surface of the concrete is not affected by small deficiencies in the base. We are not aware of any concrete roads within the Township.

2.2 Proprietary Products used in Road Construction

Proprietary products that enhance the performance of road systems have been developed. While there are several different types of products, as well as a variety of applications, we are aware of two types of proprietary products that have been used on Township roads in construction of the road structure: biaxial geogrid and cellular confinement. Both of these products are described below.

Our corporate experience with these products is that they work to enhance the performance of a particular road design by either increasing the design volume of traffic, or reducing the magnitude of road base and subbase material required for a given volume of traffic. These products are most applicable in locations where the existing subgrade is a poor material that is not suitable for supporting traffic loading such as muck, peat or marle. They are not intended to extend the useful life of a road surface beyond what would typically be expected of a road with proper subgrade, subbase and base construction with adequate ditching and drainage.

2.2.1 Biaxial Geogrid

Biaxial geogrids are generally polypropylene strands that are bound together in a lattice configuration. They are often used in road construction between the subbase and subgrade layers. The function of biaxial geogrid is to improve the distribution of loading from traffic so that the subgrade is exposed to a reduced pressure. As this is also the function of the base and subbase courses of the road section, biaxial geogrid can also be used to reduce the thickness of these courses that is required for the pavement design.

Refer to Figure 2 below for a photo of biaxial geogrid installed on a Township road in 2018. In this instance, the biaxial geogrid was used to reduce the required thickness of granular subbase over a poor native subgrade material.

Figure 2: Installation of Biaxial Geogrid between Subgrade and Subbase

2.2.2 Cellular Confinement

Cellular confinement products are generally polyethylene webs that have annular space that can be filled with granular material. The polyethylene web acts to confine the granular material from laterally displacing under vertical loading, which allow the loading to spread across a larger area. This significantly reduces the pressure applied to the subgrade.

Refer to Figure 3 below for a picture of a cellular confinement system installed on a Township road (original date of construction unknown). In this instance, the cellular confinement system was used overtop of a poor subgrade material.

Figure 3: Installation of Cellular Confinement System overtop of Poor Subgrade

3. CURRENT TOWNSHIP MAINTENANCE PRACTICES

Preventative maintenance is work that is completed at regular intervals to prolong the service life of an asset. It does not include work that is completed in response to a specific defect or deficiency. An example would be annual grading of gravel roads in the spring. Corrective maintenance is work that is performed in response to a specific defect or deficiency, and is performed on an as-need basis. An example would include filling potholes. Currently, we understand that the Township's maintenance approach is more focused on corrective maintenance for hard-surfaced roads until the end of a road's service life (e.g., 15-20 years for asphalt roads) and annual preventative maintenance of its gravel roads.

Based on discussions with Township staff, the Township's current practice for maintaining the gravel road system is a rotating two-year cycle based on the north-south dividing line of Brock Road (Wellington County Road 46) and Highway 6. In year one, half of the gravel road system receives a fresh application of gravel averaging 25mm to 50mm in depth, while grading is conducted on the other half of the gravel road system. The process is reversed in year two of the cycle. Therefore, at a minimum each gravel road receives a fresh application of gravel every two years. Dust control is completed on an as-needed basis. Additional cycles of grading may also be completed on an as-needed basis in response to heavy rains, heavy-than-normal traffic or recurring problem areas.

The method primarily used by the Township for resurfacing single lift asphalt roads is to pulverize the existing asphalt into the road base and apply a new lift of asphalt. This process is generally thought to improve the quality of the road base through the addition of recycled asphalt pavement (RAP). This method creates a finished road surface that is slightly higher in elevation than the previous surface due to the addition of RAP. For double lift asphalt roads, the Township typically removes both layers of asphalt and applies two lifts of asphalt in order to approximately maintain the existing road elevation. For both single and double lift resurfacing, upgrades to culverts and addition of minor quantities of granular material to improve the road base are completed prior to paving.

4. METHODS FOR EXTENDING LIFE OF PAVED ROADS

As per the 2019 Asset Management Plan, the Township will strive to maintain all hard-surfaced roads in a good to fair condition, which approximately corresponds to a Pavement Condition Index (PCI) value of 60-65 [2]. Refer to the Ontario Ministry of Transportation's "Manual for the Condition Rating of Flexible Pavements SP-024" (2016) for more information on the PCI.

Road maintenance and rehabilitation account for a substantial portion of the Township's capital and operating expenses. Hard-surfaced road sections have an approximate replacement value of $53,864,495, constituting the Township's largest asset in value [2]. For this reason, the Township is committed to effectively managing the road network and investigating maintenance strategies that will increase the service life and performance of its roads. Various methods for maintaining hard-surfaced roads to increase service life and performance are described in further detail as part of this Section.

4.1 Crack Treatments

4.1.1 Crack Sealing

Crack sealing is the injection of a flexible rubberized material into a crack in the surface of asphalt that prevents further water seepage. Crack sealing improves protection of the road base and, thus, condition of the road surface.

Crack sealing is suitable for "working" cracks, which are defined as cracks with horizontal or vertical movement exceeding 3 mm per year and typically applies to transverse cracks [3]. Crack cutting, or routing, can provide better sealant flexibility for temperature variations, but is provided at a higher equipment and labour cost. It is recommended that routing be performed for transverse cracks greater than 75 mm in apart from adjacent

cracking [4]. Prior to sealing, the crack should be cleaned with a hot compressed air lance to remove debris and moisture, and should be dusted with limestone after the sealant dries to prevent tracking [4].

4.1.2 Crack Filling

Crack filling is a similar process to crack sealing and is used to treat "non-working" cracks, which are cracks that move less than 3 mm per year [3]. Due to the reduced amount of movement, crack filling material is not required to be as flexible as crack sealing and aims to offer greater structural support to the surrounding pavement. Non-working cracks include longitudinal and transverse cracks and often display more edge deterioration. Materials used to fill cracks is typically less expensive and can include asphalt emulsion and rubber asphalt [3].

4.2 Drainage System Maintenance

The drainage of road systems relies on proper grading of the road and shoulder surfaces to facilitate moving water off the driving surface off the road, as well as proper grading of the subgrade (i.e. cross fall) to direct water absorbed by the road base, into ditches or storm sewers. In areas where insufficient ditching is available, the installation of subdrain may be used to drain water from the road base and outlet to an appropriate discharge point. Drainage problems can be identified by Township staff through field reviews, evaluation of crash data or through police and resident notification.

The following sections outline considerations for proper maintenance of a rural road drainage system.

4.2.1 Shoulder Regrading

Water will pond on the edge of the roadway if the shoulder is raised from debris buildup or vegetation growth. Ponding on the edge of the road specifically deteriorates the edge of the wearing surface and ruts the supporting soil, which can lead to edge drop-offs and shoulder scour. Well graded shoulders are important for safety of cars that exit the roadway. Ontario Regulations for Minimum Maintenance Standards for Municipal Highways prescribe allowable shoulder drop-offs and shoulder potholes, as well as response times for remediation.

4.2.2 Maintaining Ditches and Culverts

Ditches and culverts must be cleaned out regularly to remove vegetation, silt and other debris that interferes with drainage. Culverts create a connected drainage system that reduces water ponding at intersections and driveways. It is suggested that drainage features are reviewed annually and after severe weather events. We note that regular inspection of Township roads is completed in accordance with the Minimum Maintenance Standards, which would identify any concerns with drainage features.

At a minimum the invert of the ditch should be below the elevation of the granular subbase to allow for water within the road section to drain. In areas adjacent to wetlands or areas where ditches normally contain water, it is ideal to have the normal water level below the elevation of the granular subbase.

4.2.3 Subdrains

In areas where ditching cannot be attained to the desired depth, installation of subdrain is often recommended. Subdrain is a perforated polyethylene pipe that can collect water from saturated soils to discharge at a suitable location. Subdrain is often wrapped in a geotextile to prevent granular material from migrating into the subdrain. Subdrains should be installed at or below the elevation of the granular subbase. The Township standard urban road cross section includes subdrains.

4.2.4 Storm Sewers with Curb and Gutter

Areas where ditching is not feasible, have a substantial paved road width to drain or where an urban roadway is desired, concrete or asphalt curbs with catchbasins and storm sewers is required to adequately drain the road. This is combined with the use of subdrains to drain the base and subbase courses of the road, which outlet to the catchbasins. The Township standard urban road cross section includes storm sewers with curb and gutter.

4.3 Surface Maintenance

4.3.1 Asphalt Recycling

Asphalt recycling refers to the process of reusing material from the existing asphalt surface to form part of a new asphalt surface. There are many types of asphalt recycling, distinguished by the milling depth, the process used to rejuvenate the asphalt and the materials used to reconstruct the road.

Full depth reclamation (FDR), also known as pulverizing, is the process of uniformly pulverizing the full thickness of asphalt and a specified thickness of the upper portion of the granular road base. This process blends the pulverized asphalt aggregate with the granular road base to improve the strength and consistency. This is the process that the Township currently uses for rehabilitation of its paved roads as it is typically more cost effective than removing the asphalt. FDR is not suitable for roads which cannot accommodate an increase in road profile.

Cold In-Place Recycling (CIR) is the process of cold milling the existing asphalt surface to a specified depth, screening the material to a desired aggregate distribution, mixing the aggregate with an asphalt binder and re-laying the mixture in one continuous operation. Roads that have a well drained and structurally adequate road base and subbase are ideal candidates for this process. Since the process is completed in the absence of heating, it reduces the energy required as compared to the process for hot mix asphalt. Asphalt laid as part of the CIR process is overlain by one or more lifts of hot mix asphalt or surface treatment

Hot In-Place Recycling (HIR) is a similar process to CIR but involves heating the milled asphalt along with adding material to regain workability. HIR involves the milling, heating, scarify, stripping, mixing and repaving of the existing asphalt to remediate of the road surface. Asphalt additives such as binders and fine aggregate as well a surface layer may need to be incorporated to create a good quality driving surface.

4.3.2 Leveling Course

A levelling course can be applied to an existing road using an HL-2 asphalt mixture. This mixture is known as a sand mix, with no aggregate greater than 9.5 mm. It can be used to level existing paved surfaces that have severe tire rutting, depressions or potholes to provide a uniform riding surface. Therefore, it is intended to be an asphalt lift of varying thickness. It can also be used as a surface course on low speed traffic areas. Due to the nature of the product, it will generally last for between two and seven years before additional rehabilitation work is required.

In our experience, leveling courses typically range in thickness from 12 mm to 25 mm. A levelling course was installed by the Township on a portion of Victoria Road South in 2018.

4.3.3 Slurry Seal

A slurry seal is a thin layer of asphalt placed over an existing surface that delays the appearance of surface defects caused by environmental factors by helping to seal any voids in the surface. This seal protects pavement by restoring flexibility and providing a new 1mm to 6 mm driving surface. Slurry seals are a low-cost option to correct minor surface problems such as cracks, and provides winter benefits such as reduced salt absorption and skid resistance. The new driving surface has characteristics similar to an HL3 surface course and is only suitable for low volume roads. Fog seals can be used for high volume roads, as their composition differs in that it does not contain aggregate. To our knowledge, slurry seal has not been used in the Township.

4.3.4 Preservation Seal

A preservation seal can be added to new or used pavement to reduce lifecycle cost and environmental impact. The seal penetrates the pavement creating a more durable pavement by rebalancing the chemistry of oxidized asphalt to delay the aging process, which is believed to add approximately 5-7 years of additional service life to

the road [5]. An example of a proprietary product used as a preservation seal is Reclamite. To our knowledge, preservation seal has not been used in the Township

4.3.5 Surface Treatment

Surface treatment is an asphalt emulsion and aggregate cover that is applied to an existing asphalt or gravel road that has been properly prepared to accept the treatment. Once prepared, an asphalt emulsion is applied to the road surface followed by spreading of clean stone aggregate. The surface is then rolled using a rubber tire roller and loose aggregate is swept off the road surface. Typically, surface treatments are applied in multiple layers of approximately 7 mm to 10 mm over multiple years. Surface treatment can also be applied to low volume asphalt roads to extend the service life of these road sections.

It is important to note that surface treatment, no matter the number of courses, does not add structural stability to the road. For this reason, it should only be used to preserve roads with good structural integrity as a sealant or to provide a smooth driving surface. It is also not advisable to use a surface treatment on high volume roads or those with a heavy truck traffic. To our knowledge, surface treatment over asphalt has not been used in the Township as a surface maintenance practise (there are some existing surface treated roads).

4.4 Advanced Evaluation Systems

4.4.1 Geotechnical Investigations

Geotechnical investigations can be completed by advancing boreholes through the road section and into the subgrade material to determine the composition of the existing road base and characteristics of the subgrade material that supports the travelled road surface. The boreholes can provide a vertical stratigraphy of the various soils, information on strength and moisture content and position of groundwater. While geotechnical investigations are a very useful tool, it is important to understand that they are an approximation of the existing subsurface conditions as it is impractical to obtain a complete understanding for an entire site (or road) though information collected at discrete points spread out over the area.

4.4.2 Performance Modeling

A Road Management System (RMS) is an asset management tool based on a performance modelling software that can protect public investment by ensuring the best value from the funds provided. Some examples of RMS include proprietary software systems such as ‘WorkTech’ and non-proprietary systems developed using spreadsheet/database formats. An RMS will give defensible recommendations for additional funding requirements. This can help ensure that funding is allocated based on mitigating risks and ensuring the cost-effective lifecycles. It is important to consider personnel availability, the deliverables desired and the data available for analysis when selecting the appropriate software for the RMS. This modeling is only useful if condition data (e.g., PCIs) are available, regularly updated and staff are dedicated to maintaining database.

4.4.3 Falling Weight Deflectometer

A falling weight deflectometer test applies a load to the road surface and records the deflection of the force to the surrounding pavement. It is a trailer mounted device that can be easily moved to new areas for testing. This test is used to approximate the structural adequacy and capacity of an existing road surface through non-destructive methods.

5. CRITERIA FOR PRIORITIZING UNPAVED ROADS

Based on the Township’s 2019 Asset Management Plan, surface treatment and/or reconstruction should only be considered if **all** the following criteria are met [2]:

- Full regrading is completed more than six times during each of two consecutive non-winter periods (May 1 to November 1); and,

- An inspection of the gravel base has been completed by a qualified engineer and confirms that the road base can support a hard-top surface, without additional construction required; and,
- The traffic volume (annual average daily traffic, AADT) exceeds 400 vehicles; and,
- The Township has approved funding for the project.

In addition to the criteria outlined in the Asset Management Plan, we recommend that the following criteria be considered as part of the decision making process:

- High maintenance costs of the existing gravel road
- Condition of existing drainage
- Existing platform/shoulder width (typically 8 m minimum for Township roads)
- Sightlines at intersections and driveways
- Horizontal/vertical alignment of the existing road and associated speed limits
- Type of traffic (% of trucks)
- Review of existing infrastructure on the road section and its ability to accommodate a hard-surfaced road (e.g., bridges and culverts)
- Risk management (e.g., is the road section prone to accidents or heavy pedestrian/cyclist traffic?)
- Isolation from other gravel roads (i.e., hard-surfacing a gravel road that is surrounded by other gravel roads) and/or providing continuity to the existing hard-surfaced network
- Future development

These additional criteria could be applied on a case by case basis at the discretion of the Township. As an example, roads on which future development is not anticipated may still be candidates for hard surfacing.

6. ALTERNATIVES FOR SURFACING ROADS

6.1 Gravel

Gravel roads require regular routine maintenance in the form of grading, dust control and gravel addition to maintain a suitable road profile. Based on our conversations with Township staff, we understand that the Township allocates approximately $80,000 on an annual basis for purchasing gravel to maintain the portion of roads that are scheduled to receive fresh gravel (approximately half of the gravel road system). This cost represents the purchase and delivery of gravel material only. Additional costs for traffic control and grading of the existing road base are completed by Township forces and not accounted for in this cost.

Due to the regular maintenance that gravel roads receive, they are considered to have nearly unlimited service life.

Cost considerations for gravel roads include the following:

Supply and delivery of granular material, $80,000 per 28 km (biennially)
Estimated equipment and operator to grade granular material, $30,000 per 55 km (annually)
Estimated routine grading maintenance after large rainfall events or heavy traffic, $15,000 (annually)
Estimated budget for water or calcium chloride for dust suppression, $58,800 (annually)

All costs above (to be confirmed by the Township) do not include HST.

6.2 Asphalt (Bituminous Concrete)

Asphalt is composed of bituminous and aggregate materials (sand, aggregate and asphalt cement) and is either constructed in one homogenous surface layer or two or more lifts comprised of a surface/wearing course and one or more base courses [1]. In Ontario, asphalt mixes are typically heated to increase workability before spreading onto the road surface. Mixes designed to be applied using this methodology are generally referred to as Hot Mix Asphalts (HMA). To reduce energy usage and greenhouse gas emissions associated with road construction, Warm Mix Asphalts (WMA) can be specified or a mix design can allow for the usage of RAP (or both). High RAP content can affect the life expectancy of asphalt and it is difficult to verify that the asphalt supplied to site contains the RAP content specified. RAP is permitted on Township capital road projects, subject to the maximum percentages permitted by the Ontario Provincial Standard Specifications for the mix of asphalt being supplied.

The life expectancy of a properly designed asphalt road with suitable road base construction and adequate drainage is 15-25 years. Maintenance practices may extend the life of asphalt beyond this range, but not measurably, as most deficiencies that appear at the beginning of an asphalt road's service life are the result of defects of the granular base and not the asphalt layer itself. Paving a road with an insufficient base integrity or in unfavourable weather conditions (e.g., wet and cold) can severely reduce the life expectancy of the road.

Recent work in the Township to pulverize an existing asphalt road surface, grade and compact the road base and pave a single lift of HL-4 Surface Asphalt has been completed on the following road sections:

- Forestell Road (2018), 3.3 km, $306,900
- Ellis Road (2017), 2.0 km, $182,900
- Forestell Road (2017), 2.0 km, $155,400
- Leslie Road West (2016), 2.1 km, $141,200

Recent work in the Township to remove an existing asphalt road surface, grade and compact the road base and pave one lift of HL-8 Base Asphalt and one lift of HL-4 Surface Asphalt has been completed on the following road sections:

- Laird Road (2017), 4.0 km, $543,300
- Victoria Road (2016), 0.5 km, $89,400

Maintenance of asphalt paved roads in the Township is generally minimal for the first 5-10 years of service life. Once roads approximately reach this threshold, issues such as shoulder gravel and potholes may become more prevalent and require maintenance. Based on discussions with Township staff, we estimate that approximately $20,000 per year is allocated for the maintenance of hard-surfaced roads.

All costs above do not include engineering or HST.

6.3 Surface Treatment

A surface treatment, also know and 'Tar and Chip', can be applied directly to an aggregate base course to provide a seal for the base and act as the road wearing surface. The treatment consists of an asphalt emulsion primer (for gravel roads), asphalt emulsion binder and aggregate. The selected primer is sprayed on to the existing gravel road surface, and must have a low enough viscosity to penetrate the granular base layer. This will help to strengthen the granular base layer and connect it to the surface treatment applied above.

Generally, gravel roads are treated with a double application of surface treatment. The first surface treatment layer that is placed on the gravel surface has a larger aggregate diameter. The next surface treatment layer consists of an asphalt binder with a smaller aggregate embedded at a rate that leaves 15-25% of aggregate diameter between the rocks. This spacing allows for the rocks to settle into the most stable position.

As the wearing surface, a surface treatment can provide a smooth riding surface and protect the base from infiltration. The estimated service life for a surface treatment is approximately seven years, at which time potholes can be filled, tire ruts can be padded with asphalt and another layer of surface treatment can be added.

It is important to note that no matter the number of courses, surface treatment does not improve the strength of the road base structure. For surface treated roads, the structural strength of the road is provided by the granular road base and subbase.

Surface treatment is also generally thought to be a 'louder' wearing surface when ridden on by vehicles, which should be considered in residential areas.

The Township does not have an extensive inventory of surface treated roads. Generally speaking, their maintenance is similar to asphalt paved roads in that gravel shoulders and potholes will require maintenance. Surface treated roads require another application of single-lift surface treatment approximately every seven years. Prior to applying additional lifts, potholes and areas that have tire rutting require asphalt padding.

Data for paving surface treatment on roads from adjacent municipalities has been reviewed, and is summarized as follows:

- Minor Pulverization (200 m), road grading and double application surface treatment in North Dumfries $95,400 + HST for 2.1 km (report PW-06-2019)
- Resurface existing surface treated roads with single lift of surface treatment:
  - Costs for asphalt padding (approximately $136,400 for 55,400 m2 per Woolwich report E45-2018)
  - Costs for surface treatment in 2018 for Woolwich ($175,900 for 55,400 m2 per report E17-2018)
  - Woolwich typically accounts for asphalt padding costs of approximately $50,000 as part of its annual surface treating work, which is usually 6 km to 7 km in length.
- Single Surface Treatment Milton/Burlington/Halton Hills: $282,500 m2 for $985,300+HST (Town of Milton bid 19-027)

All costs above do not include engineering or HST.

6.4 Concrete

Concrete is a rigid pavement design that is less influenced by deformations of the subgrade. Therefore, less granular road base and subbase is required for construction of a structurally adequate road. Generally, concrete is applied in a slab thickness of approximately 150 mm to 250 mm. We are not aware of any concrete roads within the Township, nor are we aware of any other local municipalities in the area that are regularly specifying rigid pavement designs. We believe this to be due to the much higher cost as compared to other alternatives. Therefore, we have not included any cost information on concrete roads as part of this report. Its inclusion is only to provide additional information for Township staff.

6.5 Life-Cycle Cost Comparison

TO BE COMPLETED FOLLOWING REVIEW WITH TOWNSHIP

7. IMPLEMENTATION PROCEDURE

To assist the Township with implementation of hard-surfacing its existing gravel roads, we propose the following multi-step evaluation process for consideration:

7.1 Step 1: Desktop Evaluation

In accordance with the Township's Asset Management Plan, we recommend that Township staff review the roads that meet the following criteria:

- Roads that require regrading more than six times during two consecutive non-winter periods
- Roads that have traffic counts (AADT) that exceed 400 vehicles per day

Once these road sections have been identified, we suggest that the following criteria be applied at a desktop level:

- Review historic maintenance costs for road section
- Review type of traffic (% of trucks) using the road section
- Evaluate adjacent road sections for connectivity of paved roads and isolation of gravel roads
- Review anticipated development in the area over an appropriate horizon (e.g., 20 years)
- Risk management

7.2 Step 2: Field Review

Once the desktop review has been completed, field reviews should be completed on each road section to assess the following from a visual perspective:

- Condition of existing drainage (ditches, culverts, etc.)
- Existing platform / shoulder width
- Sightlines at intersections and driveways
- Risk management

As part of the field review, considerations should be given to additional studies, investigations or data collection that will be important for design of the road section including:

- Inspection of the gravel base confirming the road can support hard-surfacing
- Horizontal and vertical alignment of the existing road and associated speed limits
- Inspection of any culvert or bridge structures on the road section

Collection of this data may require expenditures by the Township to retain the services of qualified firms to complete the data collection, analysis and provide recommendations.

We note that the inspection of the gravel base to confirm if the road can support hard-surfacing is one of the four criteria identified in the 2019 Asset Management Plan that must be met for a gravel road section to be considered for hard-surfacing.

7.3 Step 3: Preliminary Design Evaluation

Once the necessary information has been collected as part of the field review, a preliminary scope of work should be prepared including an estimated construction cost estimate. This estimate should include the costs to hard-surface the road section, as well as all other necessary capital works (e.g., road base upgrades, ditching, road widening, vertical/horizontal realignment, etc.) and associated works (e.g., mobilization, traffic control, bonding and insurance, contingencies, materials testing, etc.). The estimated construction cost estimate and engineering costs should be compared against the Township's available capital works budget to confirm that the project has the necessary allocation of funds, as noted in the Township's 2019 Asset Management Plan.

Following confirmation that there are sufficient funds available to complete the works, the next steps involved would be the completion of detailed design, obtaining all permits and approvals, tendering and construction.

8. SUMMARY

Investments in the maintenance and renewal of the Township's road network represent a substantial allocation of its capital and operating budget. This report has been prepared to provide background information on the following:

- A general review of the construction of roads
- Information on the Township's current practices for road maintenance and renewal
- Information on methods for maintaining roads
- Criteria that should be considered for the hard-surfacing of gravel roads
- Methods for surfacing roads
- Implementation considerations for assessing the feasibility for hard-surfacing gravel roads

We trust our report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED

Per:

Matt Scott, P.Eng.
Project Manager, Partner

Per:

Steve Conway, C.E.T., rcsi, PMP
Branch Manager, Partner

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APPENDIX A:
MAP OF TOWNSHIP ROADS

THE TOWNSHIP OF
Puslinch

N

LEGEND

123 PUSLINCH ASSET NUMBER

PAVED ROAD

GRAVEL ROAD

MAP OF ROAD ASSETS

TOWNSHIP OF PUSLINCH

BluePlan ENGINEERING

116117
FEBRUARY 2017
Scale: 1:90000 | NAD 1983 UTM Zone 17N

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APPENDIX B:
FINANCIAL ANALYSIS OF ROAD SURFACING ALTERNATIVES

THE CORPORATION OF THE TOWNSHIP OF PUSLINCH

BY-LAW NUMBER 042-2019

Being a by-law to confirm the proceedings of the Council of the Corporation of the Township of Puslinch at its Special Council meeting held on July 16, 2019.

WHEREAS by Section 5 of the *Municipal Act, 2001, S.O. 2001, c.25* the powers of a municipal corporation are to be exercised by its Council;

AND WHEREAS by Section 5, Subsection (3) of the *Municipal Act,* a municipal power including a municipality's capacity, rights, powers and privileges under section 8, shall be exercised by by-law unless the municipality is specifically authorized to do otherwise;

AND WHEREAS it is deemed expedient that the proceedings of the Council of the Corporation of the Township of Puslinch at its Special Council meeting held on July 16, 2019 be confirmed and adopted by By-law;

NOW THEREFORE the Council of the Corporation of the Township of Puslinch hereby enacts as follows:

1) The action of the Council of the Corporation of the Township of Puslinch, in respect of each recommendation contained in the reports of the Committees and each motion and resolution passed and other action taken by the Council at said meeting are hereby adopted and confirmed.

2) The Head of Council and proper official of the Corporation are hereby authorized and directed to do all things necessary to give effect to the said action of the Council.

3) The Head of Council and the Clerk are hereby authorized and directed to execute all documents required by statute to be executed by them, as may be necessary in that behalf and the Clerk authorized and directed to affix the seal of the said Corporation to all such documents.

READ A FIRST, SECOND AND THIRD TIME AND FINALLY PASSED THIS 16th DAY OF JULY, 2019.

_____

James Seeley, Mayor

_____

Nina Lecic, Deputy Clerk