



REPORT
PUBLIC WORKS/RECREATION/ARENA
COMMITTEE

DATE: September 21, 2020

REPORT NO: PW-27-2020

SUBJECT: **2019 Road Needs Study & Gravel Road Assessment**

CONTACT: Mike DiPaola, P.Eng., Director of Public Works & Recreation

OVERVIEW:

- Preserving our Township's municipal roadway infrastructure is paramount to ensuring viable transportation of people and goods.
- At present, the average condition (PCI – Pavement Condition Index) of the Township's road network (Consisting of 58 kms of Asphalt; 202 kms of Surface Treatment; & 127 Kms of Gravel) is 75 out of 100.
- The optimal annual resurfacing and reconstruction budget (Capital Budget) to maintain the current network condition of 75 is \$1.4 Million. This optimal budget is to maintain and sustain the existing roadway network and does not include funding for any capacity improvements (new roads, additional lanes, and wider pavements) or enhancements (upgrading gravel roads to hard top).
- The short term or "NOW" funding to undertake the required road maintenance activities (Roads Operating Budget) is in the order of \$500,000.
- At present, the average condition (PCI – Pavement Condition) of the Township's gravel road network (127 kms) is 79 out of 100.
- Based on a detailed Gravel Road Assessment that was undertaken as part of this Study, six (6) gravel roads can be considered for hard top upgrades, which would require a total investment of approximately \$7.1 Million over an eight (8) year period.

RECOMMENDATION:

1. THAT, Report PW-27-2020, re: 2019 Roads Needs Study & Gravel Road Assessment, dated September 21, 2020, be received for information.

ALIGNMENT TO STRATEGIC PLAN:

Theme 1:

- Strong Transportation Connections – West Lincoln has transportation infrastructure that is safe for motorists, cyclists and pedestrians, and networks that are well maintained and connected within our Community, with other Niagara Communities and major highways.

Theme 6:

- Efficient, Fiscally Responsible Operations – The Township of West Lincoln is a lean organization that uses sustainable, innovative approaches and partnerships to streamline processes, deliver services and manage infrastructure assets.

BACKGROUND:

The Township has undertaken previous Roads Needs Studies in 2011 and 2014.

West Lincoln is comprised of agricultural land, industrial and commercial sectors as well as areas for rural and urban living. The Township owns and maintains approximately 387 kilometres of roadway as follows:

Surface Type	Length (kms)
Asphalt Pavement	58
Surface Treatment	202
Unpaved (Gravel Surface)	127
Total	387

Approximately 67 percent of the Township roads are hard surfaced with 33 percent surfaced with gravel.

The Township's 2019 Capital Budget Program included a comprehensive Roads Condition Assessment and Needs Study.

The intent of this project was to conduct a comprehensive inventory of roads and road corridor features and provide complete condition assessments of each road section and feature. This Needs Study was intended to identify maintenance, repair and rehabilitation needs for operations and capital works plans to support reduced life cycle cost and to protect and prolong the useful life of the road system.

In addition, the Township's gravel surfaced road network was developed over many years without any specific pavement design. Annual maintenance includes repair of locally deficient areas, gravel replacement and grading. The Township would like to investigate and potentially begin a program to upgrade the gravel roadways to a hard surface in the coming years.

In order to determine the current condition of the hard surfaced roads as well as the structural capacity of the unpaved gravel roadways and prioritize potential candidates for

upgrading, the services of a specialty pavement design firm was required to develop and implement a procedure for the evaluation of the existing gravel surfaced roadway and to provide suggested roadway candidates for upgrading the roadway surface.

Staff developed terms of reference for this assignment and issued a Request for Proposal back in June of 2019. Applied Research Associates Inc. (ARA) was retained for this Project and it is now completed.

CURRENT SITUATION:

Current Network Condition

In 2019, all of the pavement sections in the Townships road network were inspected in accordance with MTO procedures. A summary of the 2019 Pavement Condition Index (PCI) by pavement type is provided in Table 1-1 below. The current average condition rating of the Township’s entire pavement network is 75 out of 100.

Table 1-1. Summary of 2019 PCI by Pavement Surface Type.

Surface Type	PCI	Std. Deviation	Range
HCB (Asphalt)	73	13	41-93
LCB (Surface Treatment)	75	9	30-90
Gravel	79	9	5-94
Entire Pavement Network	75	11	5-94

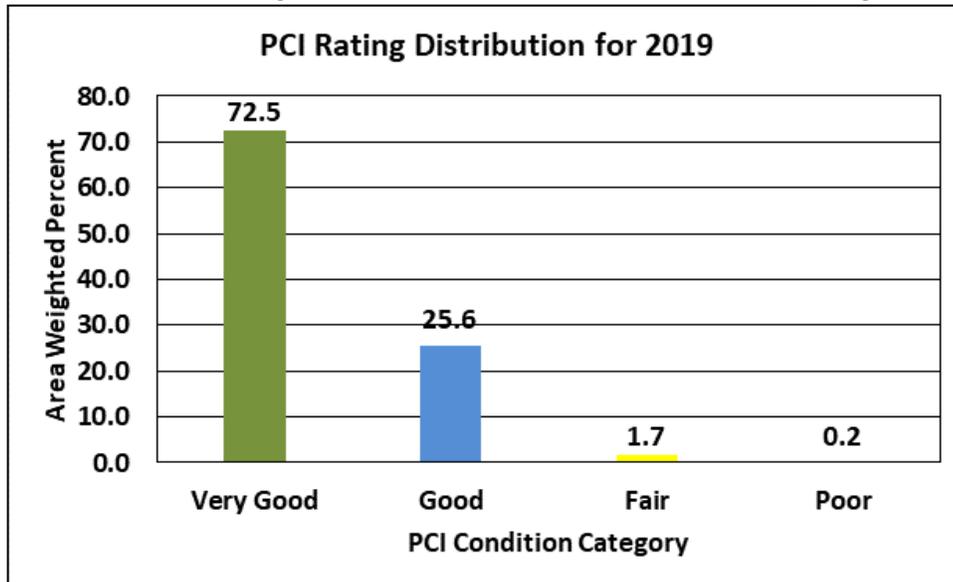
The ranges of PCI for each condition category are provided in Table 1-2 below.

Table 1-2. Pavement Condition Distribution Ranges

PCI Range	Condition
75 - 100	Very Good
61 – 75	Good
51 – 60	Fair
0 – 50	Poor

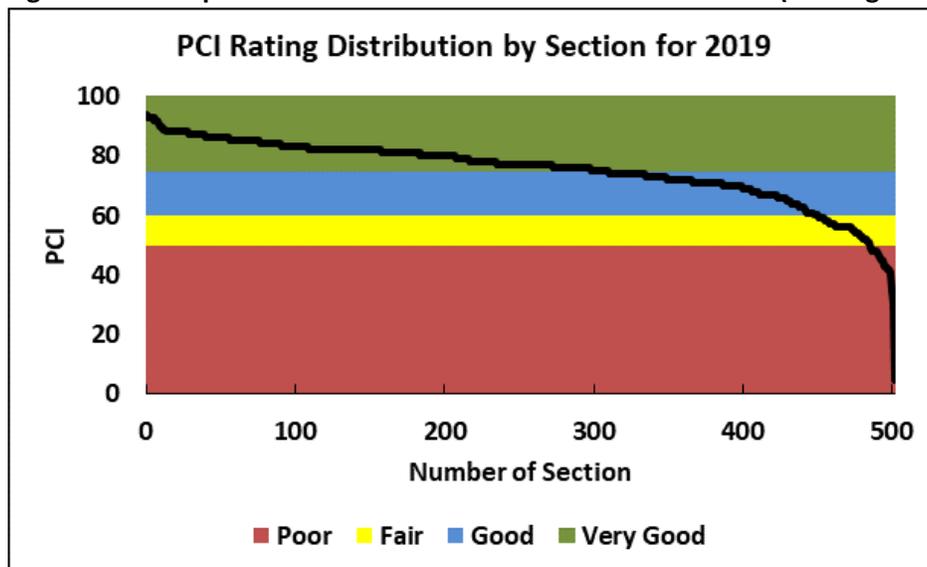
From Figure 1-3 below, the PCI (Weighted by Area) shows 0.2% in poor condition with 1.7% in the fair category with an overall 98% of the pavements area in good to very good condition.

Figure 1-1. Condition Bin Rating Distribution of PCI for Pavement Sections (Weighted by Area)



From Figure 1-4 below, there were 17 road sections in the “Poor” PCI category and 35 road sections in the “FAIR” category, with 335 road section in the “Good to Very Good” category.

Figure 1-2. Complete Distribution of PCI for Pavement Sections (Unweighted)

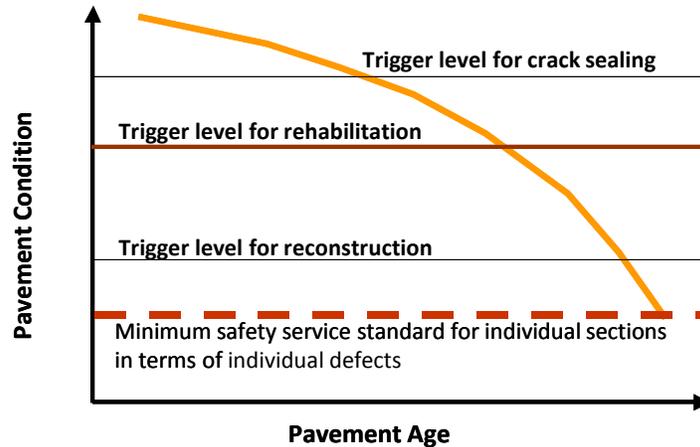


Long Term Pavement Condition & Network Needs Forecast (10 Year Plans)

In order to develop a pavement condition and future investment needs forecast, performance models are used in conjunction with trigger values to initiate an action to maintain or improve the condition of the pavement. Longer-term forecasts are typically based on the pavement condition index (PCI) values. Short-term forecasts; actions recommended for the following year or two are based on a combination of PCI along with

more project level detailed information such as pavement distress type, extent and severity of pavement distresses, and if available, structural capacity and/or pavement roughness. Generic examples of action trigger values are shown in Figure 1-5.

Figure 1-5. An example of Pavement Maintenance and Rehabilitation Trigger Values



Based on the performance models and the expected performance of rehabilitation and reconstructed roadways, the general trigger level for rehabilitation (or resurfacing) is 60 while the trigger level for reconstruction (rebuilding or major rehabilitation) is 45. These trigger levels are important when establishing the long term forecasts presented below and in the Appendices.

Long term forecasted analysis, within the Pavement Management System, is used to review alternatives and help estimate either the network condition for set budgets, or the required budget for a set pavement condition.

Long Term Forecasted Analysis – “Needs Analysis”

The first analysis (Appendix 1) estimates the budget necessary to maintain the network in the ideal condition. This “Needs Analysis” assumes that an “unlimited budget” is available and would include all resurfacing and reconstruction actions necessary to meet performance goals.

Work to be carried out for all pavement qualified for “resurfacing” would be undertaken when a critical pavement condition index (PCI) level of 60 out of 100 is reached. Similarly, construction work for roads qualifying for “reconstruction” would be undertaken once a minimum PCI of 45 is reached.

This type of analysis is used to assess work “backlog” and assists in estimating long-term network budget needs. The table in Appendix 1 shows a current 2020 reconstruction and resurfacing need in the order of \$10 million and \$2.5 million respectively. This table also summarizes (by year) the total 10 year reconstruction and resurfacing need in the order of \$27 million.

Pavement Condition Index Changes for Various Funding Levels

The second analysis is a 10 year pavement condition forecast based on different funding scenarios. Appendix 2, presents 10 year budget scenarios ranging from \$500,000 to \$2,500,000 per year. From this figure, it can be seen that an annual road budget of \$500,000 would result in an average PCI of 57 by year 2029. This would mean that, on average, the entire Township road network would require resurfacing.

The target PCI of 75 across the Township would be appropriate for a transportation network of West Lincoln’s size. In order to attain a network condition of 75, the optimal annual budget would be in the order of \$1.4 million.

In order to achieve network sustainability, a strong commitment to these budget levels is desirable to ensure that the backlog or reconstruction or resurfacing needs does not increase. Project specific details are presented in the year of budget approval through the annual budget process to these investments proceeding.

Short Term Forecasts – Pavement Maintenance Needs / Activities

Short term forecasts (generally 1 to 2 years) can be more precise in terms of maintenance by using the distress type, extent and severity data. Maintenance activities are typically used for pavements with condition ratings in the 70 to 80 range and are broken down into additional categories depending on the distress type, extent and severity of the individual sections.

The criteria for the selection of maintenance activities are summarized in the table below.

Short-Term Forecast Selection Criteria

Action	Designation	General Selection Criteria
Deep Patching	M1	Alligator cracking present, high severity, few to intermittent extent
Shallow Patching	M2	Alligator cracking present, low to medium severity, few to intermittent extent
Crack Sealing	M3	Any cracking present except alligator cracking, low to medium severity, extent frequent or extensive

The short-term forecast then multiplies the area of pavement times the unit cost per area to determine the cost to complete the work. The results of the short-term maintenance only analysis are shown in the table below.

Short-Term Forecast Maintenance Needs Only – 2020

Action	Designation	Cost (\$)
Deep Patching	M1	70,000
Shallow Patching	M2	334,652
Crack Sealing	M3	92,852
Total		\$498,084

The Township's annual budget (operating budget for hard top roads) to undertake these pavement maintenance activities are in the order of \$200,000. Consideration should be given to increase this annual budget.

Gravel Road Assessment

The work for this project also included the development of a procedure to evaluate competing alternatives for the maintenance and rehabilitation of gravel surfaced roadways. A workshop was held in the Township offices to discuss alternatives for the comparison of benefits and costs of the competing alternatives, and to develop a decision matrix to assess the criteria and benefits of upgrading roadways from a gravel surface to a hard top surface (surface treatment). Participants in this workshop included asset management and pavement engineering experts, Public Works Engineering staff, and Public Works Operations staff. During the workshop, a list of potential decision factors that would influence the type of pavement surface was developed along with weighting factors for each. This list was shortlisted to the 5 decision factors that are included in the table below:

Decision Factors and Weighting

Factor	Weighting
Capital Cost	25
Operation and Maintenance Cost	20
Traffic/Connectivity	20
Structural Capacity	20
Social/Environmental Impact	15

The results of the gravel road pavement surface condition surveys and structural capacity determination were used to complete a network level analysis of the entire Township gravel surface network. This was intended to prioritize all of the gravel road sections for possible upgrade to a hard top surface. The capital and operation and maintenance costs were the same for all existing gravel sections. The traffic/connectivity factors were assessed considering the 2019 traffic estimates and a visual examination of the gravel roadways. The remaining life estimates were determined from the FWD test data for those sections that were tested or based on the 2019 PCI values from the pavement inspections. The social/environmental factors were determined from the Google Earth images and consideration of the provision of a hard top surface. Based on the analysis, a shortlist of 20 roadways was developed for potential upgrade to a hard top surface.

While each of the 20 shortlisted roadways were considered to be good candidates for upgrade, other project level considerations such as pavement surface width, desire to provide consistent roadway surface types in each section along the length of a roadway, level of service provided by roadways directly adjacent to the candidate roadway and active use of the roadway for commercial or recreational use, may also play a factor in the final decision process. Therefore, a secondary project level analysis was completed to prioritize the roadways within the top 20 candidates. The secondary criteria and logic behind it use was as follows:

- Width > 6 m:** Roads with an existing surface width equal to or greater than 6 m will meet current roadway surface standards. Roadways with a width of less than 6 m will require more expensive platform widening, potential widening and adjustment to other roadway features such as ditches, guide rail, etc.
- Hard Surface Connector:** Upgrading gravel surface that currently connect to two gravel surface roads were given a priority level of 0. If the gravel roadway section connects to one gravel surface and one hard top surface roadway sections it was given a priority level of 1. If the gravel roadway section currently connects to a hard top surface at each end of the section, it was given a priority level of 2 (highest priority). The higher priority level reflects the desire to provide continuity of roadway surfaces across the network.
- Parallel Roads:** The parallel roads criterion weighs the preference of upgrading a candidate section based on the surface type of parallel roadways on either side of the upgrade candidate. If hard top roadways are present immediately on either side of the candidate it was given a priority level of 0. If there is one hard top and one gravel surface roadway on either side of the candidate section, it was given a priority level of 1 and if only gravel surface roadways are present on either side of the candidate section it was given a priority level of 2 (highest priority).

The project level prioritization criteria was then applied to the top 20 upgrade candidates from the network level analysis. The top six (6) roadways from this analysis, which may be considered for upgrade to a hard top surface, are shown in Appendix 3 along with the suggested timing and estimated cost. Appendix 3 shows a total investment of approximately \$6.6 million over an eight (8) year period.

FINANCIAL IMPLICATIONS:

Based on the 2019 Roads Needs Study, the budget required to maintain the Township's existing pavement inventory over the next 10 years is \$14 million. This translates to an annual Roads Capital Budget allowance of approximately \$1.4 million.

The short term or "NOW" funding to undertake the required road maintenance activities (Roads Operating Budget) is in the order of \$500,000.

In addition to the above, if the Township implements a program to upgrade some gravel roadways to a hard top surface, an additional investment of \$7.1 million over an eight (8) year period would be required.

The 10-year capital roads program (attached as Appendix 4) in the 2020 Budget generally provides a funding envelop that accommodates the investment levels outlined in this report to sustain our existing roadway infrastructure. The current 10-year plan includes a funding

mix that includes grants, development charges and approximately \$8.5 million in debentures. There is pressure in 2023 and 2024 based on specific network expansion needs such as South Grimsby Road 6 and Spring Creek Road extensions as well as the St. Ann's Road rehabilitation project. Staff will continue to prioritize the needs and analyse opportunities for consideration as part of the 2021 Budget.

INTER-DEPARTMENTAL COMMENTS:

This Report was reviewed by Director of Finance, CAO, and the Township Clerk.

CONCLUSION:

This report was prepared to update the Public Works/Recreation/Arena Committee and Township Council on the current condition of the Township's road network and provides some guidance with respect to funding needs to maintain our pavements in an optimal condition. This report also provides gravel roadways that would be good candidates for upgrade to a hard surface along with the funding requirement to undertake this initiative.

Prepared & Submitted by:

Approved by:



Mike DiPaola, P.Eng
Director of Public Works & Recreation

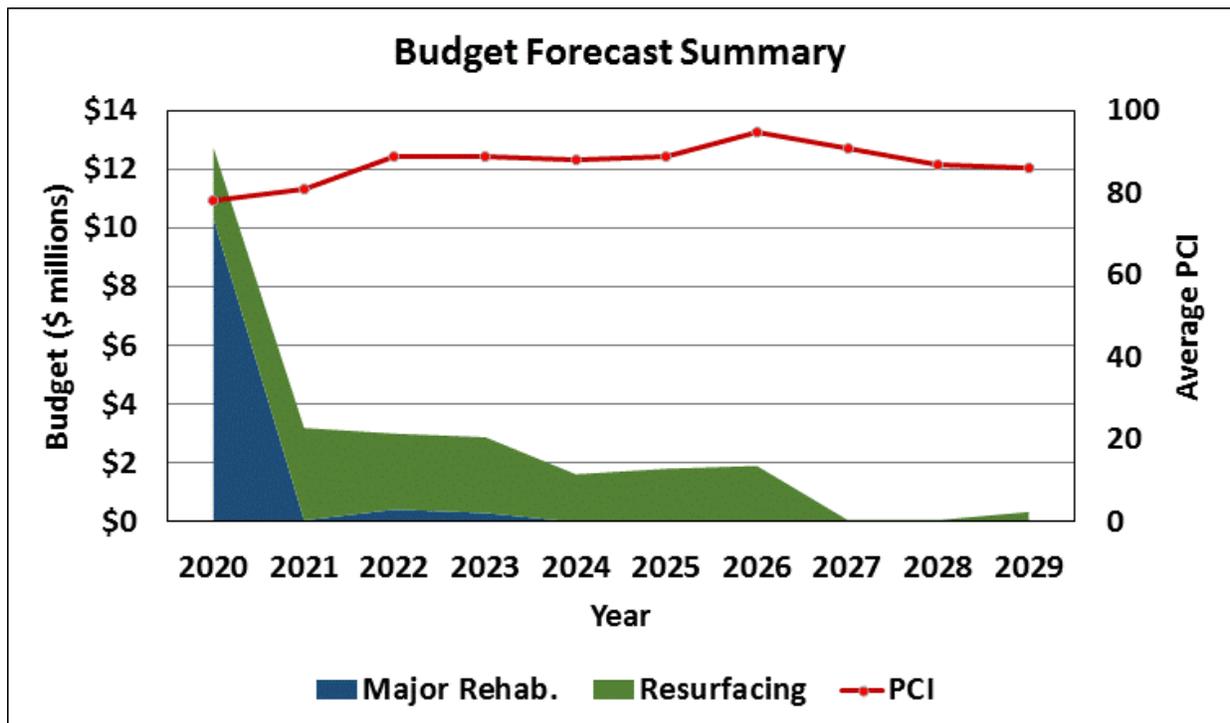
Beverly Hendry
Chief Administrative Officer

- APPENDIX 1 – Summary of Reconstruction & Resurfacing Needs Unlimited Budget**
- APPENDIX 2 – Pavement Condition Index for Various Funding Levels**
- APPENDIX 3 – Candidate Gravel Roads for Upgrading to Hard Top**
- APPENDIX 4 - 10 Year Capital Plan for Roads**

APPENDIX 1

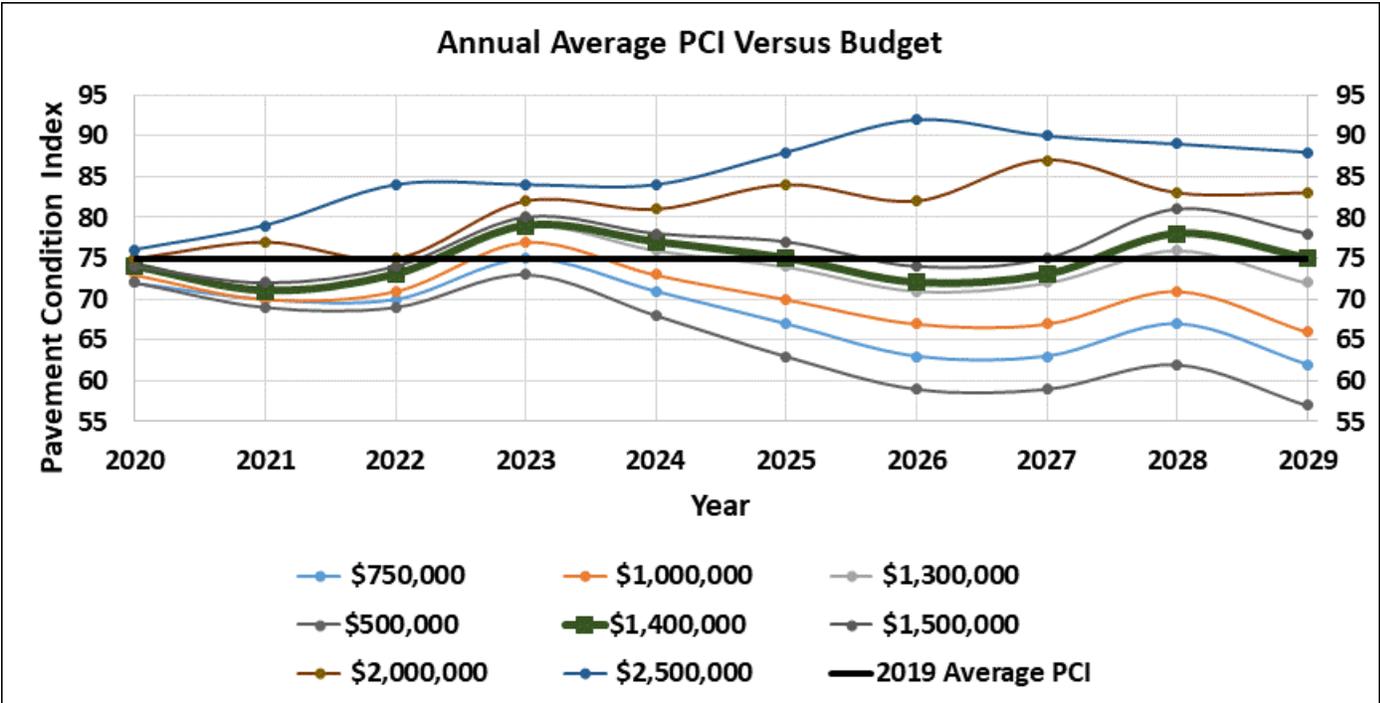
Summary of Major Rehabilitation and Resurfacing Needs – Unlimited Budget.

Year	Major Rehab. (\$)	Resurfacing (\$)	Yearly Total (\$)	Network PCI
2020	9,942,530	2,479,979	12,422,510	78
2021	58,884	3,166,337	3,225,221	82
2022	425,876	2,343,117	2,768,993	88
2023	311,040	2,581,905	2,892,945	89
2024		1,628,762	1,628,762	88
2025		1,826,453	1,826,453	89
2026		1,886,766	1,886,766	95
2027		75,175	75,175	91
2028		42,444	42,444	87
2029		325,222	325,222	86
Total	\$ 10,738,331	\$ 16,356,159	\$ 27,094,490	

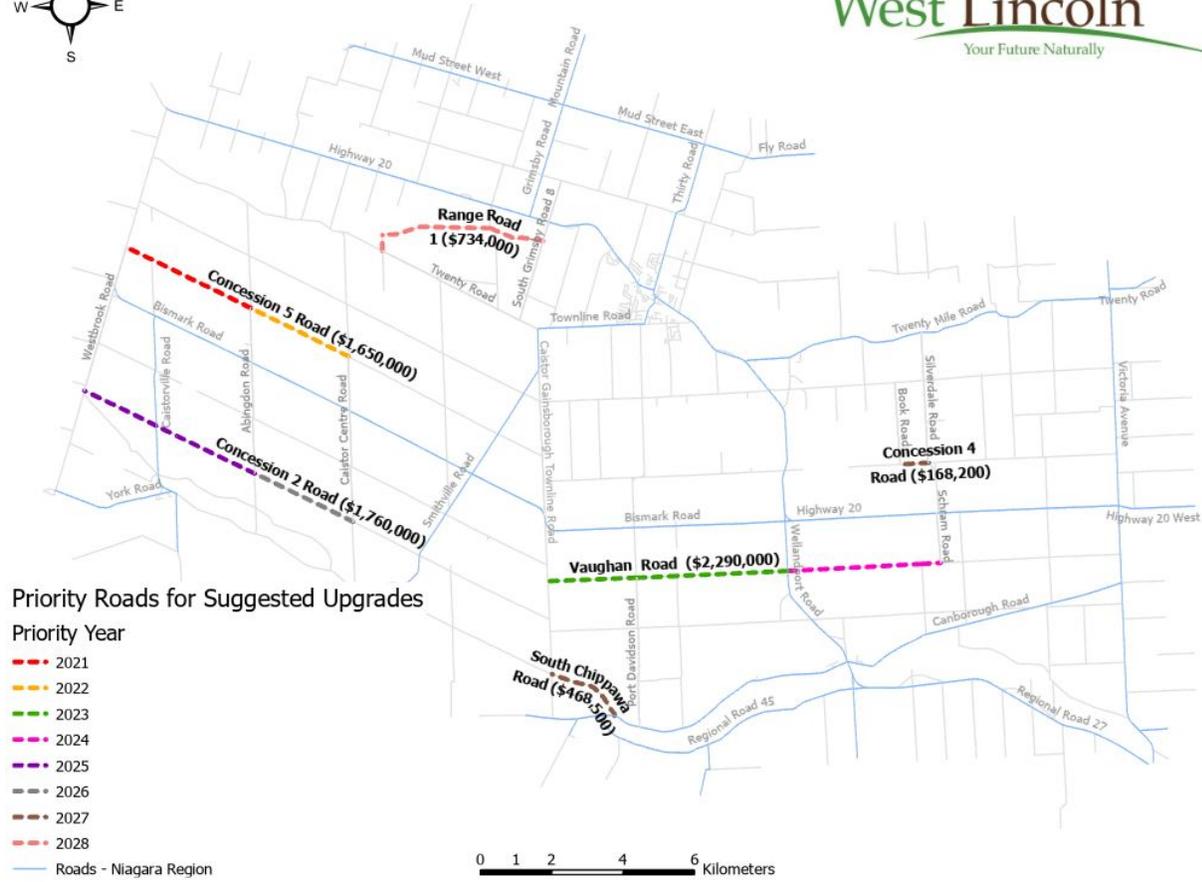
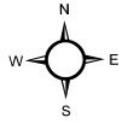


APPENDIX 2

Overall Summary of Annual Budget Versus Network PCI in 2029.



APPENDIX 3



Road	From/To	Length (km)	Timing	Cost
Concession 5	Westbrook to Caister Centre	6.95	2021/2022	\$ 1,650,000
Vaughan Road	Caister Gainsborough Townline to Heaslip Road	10.49	2023/2024	\$2,290,000
Concession 2	Westbrook Road to Caisterville Road	8.38	2025/2026	\$1,760,000
Concession 4	Silverdale Road to Book Road	0.8	2027	\$ 168,200
South Chippawa Road	Caister Gainsborough Townline to Port Davidson Road	2.23	2027	\$ 468,500
Range Road 1	South Grimsby Road 10 to Twenty Road	3.67	2028	\$ 734,000
			Total	\$ 7,070,700

Average investment of \$884,000 over 8 years (4 km/yr)

APPENDIX 4

10 Year Capital Plan for Roads

Service Area _06110_Roads_Paved
Account Type Expenditure

Sum of Amount	Column Labels										
Row Labels	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Grand Total
Equipment							10,000				10,000
Hot Mix	330,000	200,000	770,000	5,246,000	3,786,000	310,000	585,000	500,000	500,000	500,000	12,727,000
Surface Treatment	1,080,000	780,000	1,230,000	240,000	415,000	145,000	891,000	1,500,000	1,500,000	1,500,000	9,281,000
Grand Total	1,410,000	980,000	2,000,000	5,486,000	4,201,000	455,000	1,486,000	2,000,000	2,000,000	2,000,000	22,018,000

Service Area _06110_Roads_Paved
Asset Type (Multiple Items)

Sum of Amount	Column Labels										
Row Labels	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Grand Total
Capital Reserve	(27,000)	(90,000)	(150,000)		(52,100)						(319,100)
Debenture		(346,500)	(967,500)	(587,000)	(560,500)		(848,600)	(1,680,000)	(1,500,000)	(2,000,000)	(8,490,100)
Development Charges	(141,000)	(98,000)	(200,000)	(4,649,000)	(420,100)	(45,500)	(147,600)				(5,701,200)
Equipment Reserve							(10,000)				(10,000)
Gas Tax	(699,300)	(445,500)	(499,500)	(167,000)	(321,400)	(409,500)	(479,800)	(320,000)	(500,000)		(3,842,000)
OCIF	(272,700)										(272,700)
Provincial Grant			(183,000)	(83,000)	(2,846,900)						(3,112,900)
Road Settlement Reserv	(270,000)										(270,000)
Grand Total	(1,410,000)	(980,000)	(2,000,000)	(5,486,000)	(4,201,000)	(455,000)	(1,486,000)	(2,000,000)	(2,000,000)	(2,000,000)	(22,018,000)