



ENGINEERING DEPARTMENT MEMORANDUM

TO: MAYOR J. LEHMAN AND MEMBERS OF COUNCIL

FROM: M. BROWN, P. ENG., INFRASTRUCTURE PROGRAM ENGINEER

NOTED: B. ARANIYASUNDARAN, P. ENG., PMP, DIRECTOR OF ENGINEERING
A. MILLER, RPP, GENERAL MANAGER OF INFRASTRUCTURE, AND GROWTH
MANAGEMENT
M. PROWSE, CHIEF ADMINISTRATIVE OFFICER

RE: PAVEMENT CONDITION ASSESSMENT PROJECT UPDATE (WARDS: ALL)

DATE: NOVEMBER 18, 2019

Background

On July 18, 2019, Planning and Asset Management branch brought forward a Memorandum to members of Council titled "Pavement Management for Wards 1, 2, 6, 8 and 9". The memo explained key terms and objectives of Pavement Management such as lifecycle intervention activities, window of opportunity and specific information related to the road resurfacing program. The final section of the memo discussed the Road Condition Assessment that was underway and stated that Planning and Asset Management branch would provide the results of the Road Condition Assessment in the Fall of 2019.

The City of Barrie retained the services of StreetScan to complete the Road Condition Assessment. The work was started and completed by the consultant in 2019 and staff have completed their quality control review of the data. This evaluation will be the third Pavement Condition Assessment that the City has completed (2010, 2014 and 2019).

The Road Condition Assessment was completed using vehicles that are outfitted with an array of sensors including 2D and 3D cameras, to measure various types of cracks and defects in pavement. StreetScan's vehicles drove all roads within the City limits to gather the critical data to develop the Pavement Condition Index (PCI) for each section of Barrie's road network. This is a key input into determining the appropriate time to apply lifecycle intervention activities and which type of activity is appropriate.

At the same time as the data was being gathered for the road condition, the trucks were also collecting data through ground penetrating radar. This information was used to determine the approximate depth of asphalt on local roads, which will be used as an initial screening tool to determine which roads have sufficient asphalt thickness for partial depth resurfacing to occur.

Results and Analysis of the Road Condition Assessment

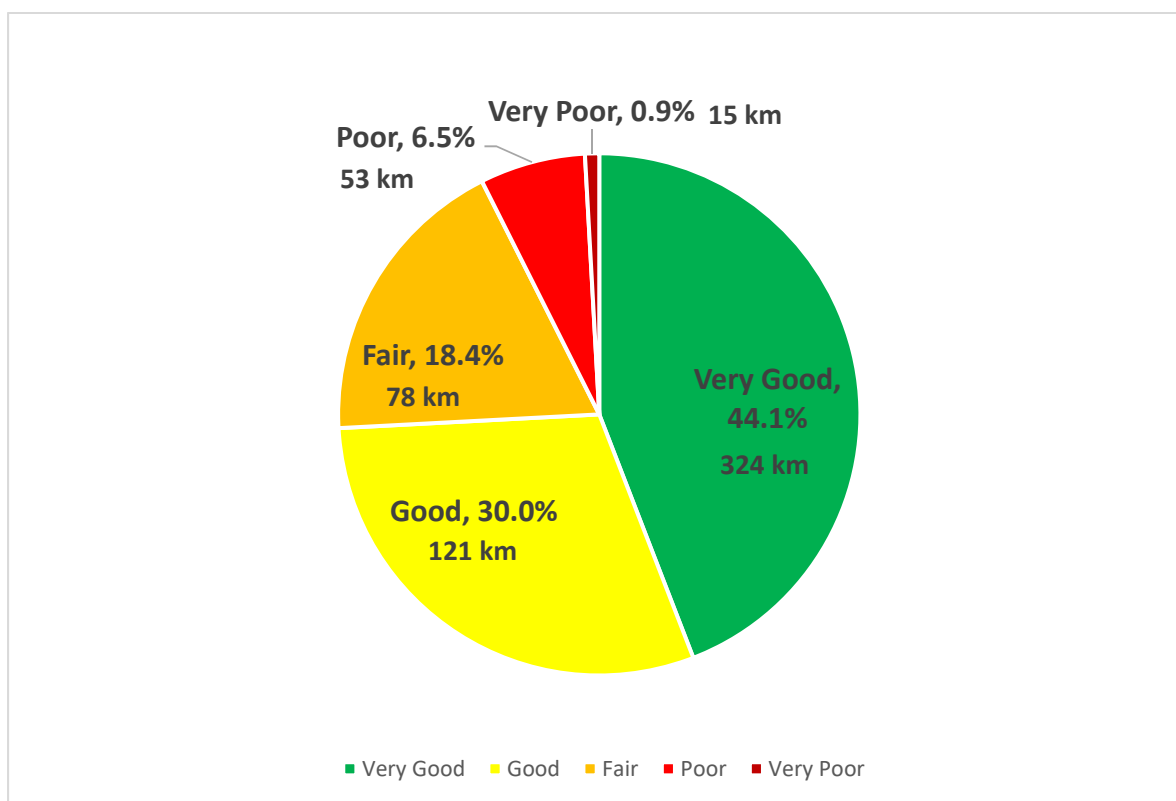
PCI is a numerical index between 0 and 100 which is used to indicate the general condition of a pavement (with 0 representing total asset failure and 100 representing new pavement). PCI is an ASTM (American Society for Testing and Materials) standard that represents a weighted aggregated score for a road section by determining the severity and extent of distresses (e.g. cracking, raveling, bumps and sags, patching, potholes, rutting, shoving, etc.). The condition data is converted into PCI value (based on algorithms/formulas) because it provides a numerical value to road segments so that they can be prioritized against one another while reducing, or eliminating, any subjective influences.

Once a PCI is derived from the field results, the City then converts the numerical value into a condition rating, such as very good, good, fair, poor and very poor. This is done to simplify the final results and put them in PCI ranges that are based on the asset's current position or place on the asset deterioration curve and make them easily understandable. The PCI ranges that the condition ratings are based upon were developed through the Transportation Asset Management Plan dated December 2015 and can be reviewed on the City's Asset Management website. This document recommends the City perform regular condition assessments to gain the critical knowledge needed to determine the lowest lifecycle strategies.

The correlation between the condition rating, classification of road and PCI range can be found in Appendix A.

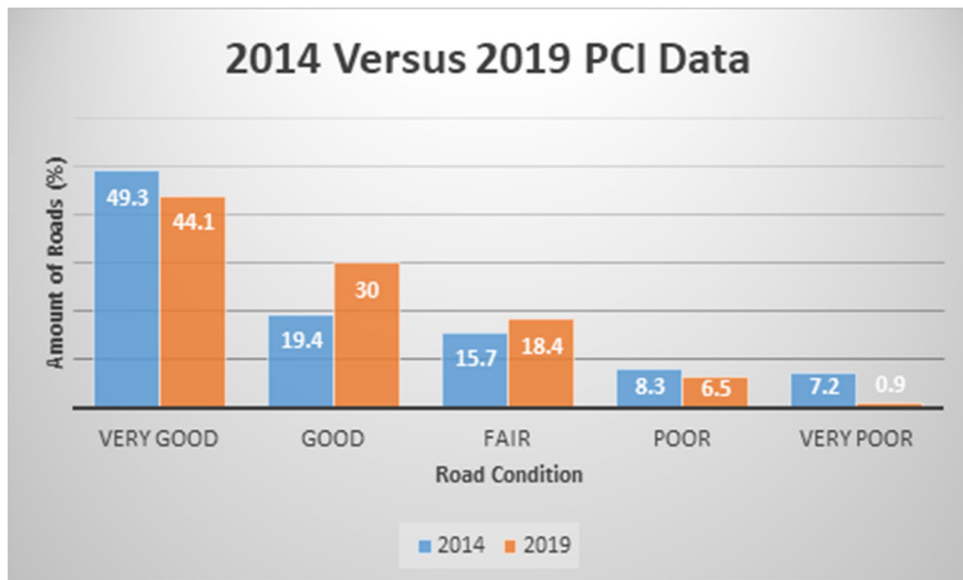
The majority of the City's roads are in good to very good condition (approximately 74%) with only approximately 25% in fair to poor condition and 1% in very poor condition. While PCI is often used in discussions about individual road sections, it can also be aggregated into an overall score for the entire road network. The results of the data collection indicate that Barrie's road network has an average PCI of 75 (good condition). This is to be expected as there has been a large amount of development and growth within the City over the past 20-30 years, meaning that many of the City's roads are relatively young and haven't had a chance to deteriorate to any significant degree. The City of Barrie's overall road network PCI summary can be found below in Figure 1.

Figure 1: Condition of City of Barrie Road Network



The City typically completes Pavement Condition Assessments every 4 years. Between the years that the assessments are completed, the PCI is artificially degraded to provide a closer approximation to what can be found in the field. Although this process is based on research, it is still theoretical and it is important to update with regular condition assessments. Once the City has a number of condition assessments completed, staff within the Planning and Asset Management branch will be able to analyse the data to determine Barrie's unique degradation curves for arterial, collector and local roads and more accurately predict how roads will deteriorate.

In 2014, the average PCI for Barrie's road network was 76 and in 2019, the current average PCI for the road network is 75. Comparing the 2019 condition assessment data with the 2014 data, it can be seen that the amount of roads in each condition rating has changed over the past 5 years.



These results are to be expected since there will always be a transfer of roads moving from one condition level to another. The important information to note is that the amount of poor and very poor roads have decreased. As the City continues to proceed with the preservation mindset, it is anticipated that the majority of the roads will consistently be between fair and very good. Once a road reaches the good to fair condition, it will be preserved, which will increase its condition back to very good.

The majority of the roads that are currently in poor to very poor condition are located within older neighbourhoods (Brock Park, Queens Park, Allandale, Grove, Wellington, etc.). Many of these neighbourhoods are planned to be reconstructed through Neighbourhood Renewal Program (NRP) projects in the 10 year Capital Plan.

Visual examples of each condition rating can be found in Appendix B. As shown in the photos, there are many different types of distresses and combination of distresses that could cause a road to be in a certain condition rating. Although one road might look worse than another, the type of distress, severity and extent all play a big part in determining the condition rating of a road.

This project also provided the City with asphalt depths for local roads. Staff will use this information as an initial screening tool to determine which local roads have enough asphalt present for partial depth resurfacing to occur.

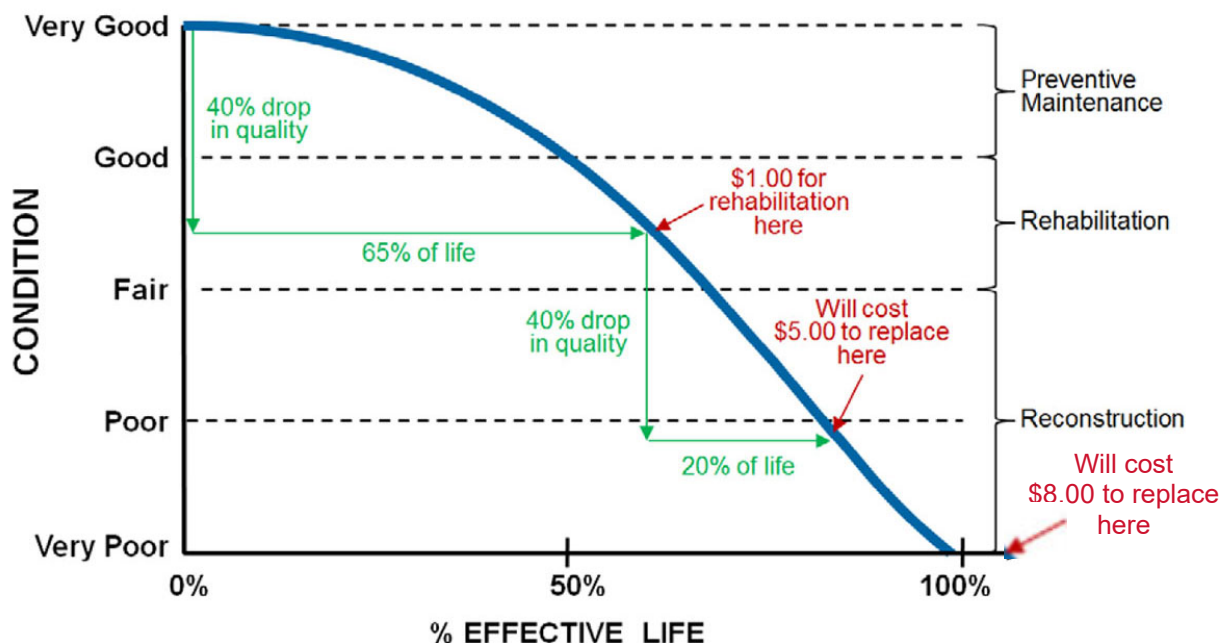
Shifting Mindset

Within the last 8 years, the City has shifted from a 'worst first' mentality (fix the roads that are poor to very poor condition first) to a more proactive approach by preserving the assets that are in fair to very good condition. While it is unfortunate that there are poor and very poor roads within the City, statistically, the number of these roads is very small, which can be seen in the above pie chart. The concept of shifting to a more proactive approach means that more work will be completed to preserve the roads that are still in fair to very good condition, while still investing funds to fix the roads that are in poor to very poor condition. More detailed information regarding the various pavement management strategies and programs that the City uses, is available on the Pavement Management [website](#).

Pavement Management

The pavement degradation curve shown below (also posted on the Pavement Management [website](#)) shows that the degradation of pavement is fairly slow when moving from the very good to good condition. However, once the pavement has deteriorated to fair, the rate of degradation speeds up and the pavement deteriorates quite quickly. For this reason, it is important to continue to invest in preserving the assets in good to very good condition, so that those roads do not transition into the more costly/lower condition rating ranges. When roads transition into the lower condition rating ranges, not only does the construction cost increase, but the operational costs also increase due to the increased number of pot holes and patching that is required.

Figure 2: Typical Asset Decay Curve



SOURCE: TRANSPORTATION ASSET MANAGEMENT PLAN (DECEMBER 2015)

As noted on the City's Pavement Management [website](#), investing \$1 in preservation activities, will defer \$8 in reconstruction costs. When investing the \$1 in preservation activities, the action will increase the PCI of the pavement to almost 100% (back to very good condition). The primary message that can be drawn from this analysis is that the City must continue to be strategic with regard to our road spending strategy and ensure a balance in investing between full reconstructions and preserving the roads that are in good to very good condition. Over the past few years, this strategy has been embraced by City staff and Council, as investment in the proactive Road Resurfacing Program has increased.

Pavement preservation activities are often equated to fixing the roof on your house. Replacing the shingles at regular intervals prevents water from getting into the structural components of the building, which could cause expensive structural damage. Appropriately timed preventative investment in roads, keeps water out of the pavement layers, preventing cracks and other defects from forming.

Conclusion

As a City with fairly young infrastructure, Barrie has a significant amount of newer roads that are in fair to very good condition (still within approximately the first 65% of their life). It is important to maintain or improve the overall PCI of the City's road network in order to provide pavement at a level of service that residents expect and desire, and also to keep costs to a minimum over the long term. The condition assessment data collected will provide valuable input as staff continue to collaborate across teams to provide a balanced candidate list that addresses both reconstruction and preservation of roads. City staff understand that they must be strategic when recommending where to invest to achieve the greatest value over the long term.

Appendix A

Correlation between PCI and Condition

PCI Label	Road Classification	PCI range	Description of distresses	Approx. % of segment covered by distresses
very good	Arterial	90-100	No major distresses. Possibly some crack seal in place.	0-5%
	Major Collector	85-100		
	Minor Collector	80-100		
	Local	70-100		
good	Arterial	75-89	Recent crack seal starting to fail, longitudinal + transverse cracks, some recent and clean patches.	5-10%
	Major Collector	70-84		
	Minor Collector	65-79		
	Local	55-69		
fair	Arterial	60-74	Moderate to severe block cracking, alligator cracking, potholes, and aging patches.	10-25%
	Major Collector	55-69		
	Minor Collector	50-64		
	Local	40-54		
poor	Arterial	45-59	Increased quantity of alligator cracking, block cracking, potholes, and patches.	25-50%
	Major Collector	40-54		
	Minor Collector	35-49		
	Local	25-39		
very poor	Arterial	0-44	Severe alligator cracking. Failed patches, large quantity of deep and/or wide potholes. Ride quality is severely affected by deep and dense potholes, failed patches, and alligator cracking.	50-100%
	Major Collector	0-39		
	Minor Collector	0-34		
	Local	0-24		

Appendix B



Example of a Road in Very Good Condition - Morrow Road



**Example of a Road in Good Condition - Ferndale Road
(Mild Crack Sealing)**



**Example of a Road in Good Condition - Toronto Street
(Mild Edge Cracking)**



**Example of a Road in Fair Condition - Tiffin Street
(Wheel Track and Edge Cracking)**



**Example of a Road in Fair Condition - Edgemoor Drive
(Moderate Edge and Transverse Cracking)**



**Example of a Road in Poor Condition - Maple Avenue
(Map Cracking)**



**Example of a Road in Poor Condition - Mary Street
(Wheel Track Cracking and Rutting)**



**Example of a Road in Poor Condition - Thomas Street
(Moderate Patching, Wheel Track Cracking and Depressions)**



**Example of a Road in Very Poor Condition - Agnes Street
(Asphalt Patching, Edge and Wheel Track Cracking and Depressions)**



**Example of a Road in Very Poor Condition - East Street
(Significant Map/Alligator Cracking and Depressions)**



**Example of a Road in Very Poor Condition - John Street
(Transverse and Longitudinal Cracking, Depressions, Potholes and Rutting)**