The Corporation of the City of Kawartha Lakes

Council Report

Report Number PW-2013-015

Date: September 24, 2013
Time: 2:00 p.m.
Place: Council Chambers

Ward Community Identifier: All

Subject **Proposed Five-Year Gravel Resurfacing Plan, Gravel vs. Hardtop Cost Analysis and Review of Gravel-to-Hardtop Upgrading Criteria**

Author/Title: Adam Found **Signature:**
Senior Engineering Technician

Michael Farquhar **Signature:**
Supervisor, Technical Services

Recommendation(s):

RESOLVED THAT Report PW-2013-015, **Proposed Five-Year Gravel Resurfacing Plan, Gravel vs. Hardtop Cost Analysis and Review of Gravel-to-Hardtop Upgrading Criteria**, be received.

THAT Council endorses the Proposed Five-Year Gravel Resurfacing Plan in principle, as generally outlined in Appendix 1 to Report PW2013-015 as a guide for prioritizing and coordinating annual gravel resurfacing needs from 2014 to 2018; and

THAT staff be directed to update the Five-Year Gravel Resurfacing Plan annually through Council's capital budget deliberations based on annual identified road project priorities and budget circumstances.

DEPARTMENT HEAD: **TREASURER/OTHER:**

CHIEF ADMINISTRATIVE OFFICER

Background:

At the October 23, 2012 Council Meeting the following resolution was passed:

> ***RESOLVED THAT*** *staff be requested to develop a five year plan for gravel roads maintenance and upgrades including an in-depth evaluation of the long-term cost of gravel versus hardtop surface;*
>
> ***THAT*** *the report identify the current criteria to upgrade a road from gravel to hardtop and include consideration of expansion of the criteria for the circumstances related to change of land use such as the approval of a new subdivision; and*
>
> ***THAT*** *staff report back by the end of the third quarter 2013.*

CARRIED CR2012-1148

The purpose of this report is to address Council Resolution CR2012-1148 and provide Council with relevant background information on gravel resurfacing and hardtop roads.

Gravel Resurfacing

Gravel resurfacing is an integral part of maintaining the structure of a rural gravel road system. Gravel roads depreciate over time due to regular wear and tear caused by weather, traffic, winter maintenance and other factors. To offset this depreciation and restore an adequate level of service, gravel roads need to be resurfaced with a lift of fresh gravel on a regular basis.

Resurfacing increases the ability of a road to:

- Be graded properly
- Maintain a proper crown
- Maintain surface integrity
- Accept and maintain calcium chloride and residual calcium chloride
- Facilitate roadside drainage
- Resist the formation of potholes

Broadly speaking, gravel roads in the City of Kawartha Lakes have been resurfaced with a lift of 7.5 cm (3 inches) about every 5 -15 years depending on road conditions, traffic volumes and a number of other considerations. Ideally, a lift thickness of at least 10.0 cm (4 inches) should be applied in most circumstances; however lift thickness and resurfacing frequency can be traded off to some extent.

Each year, the City undertakes a capital gravel resurfacing program to provide improvements to the approximately 930 km of gravel road (representing approximately 1/3 of the City's road system) within the City. Some gravel roads may require resurfacing every 3 - 5 years (higher traffic volumes and significant truck traffic) while others may require gravel resurfacing only every 15 years (short dead-end roads with low traffic volumes) depending on road factors and lift thickness applied. Historically, the City has applied a lift thickness of only 7.5 cm whereas the minimum ideal lift thickness is 10.0 cm given the current state and degree of utilization of the City's gravel road system. Table 1 below compares actual and minimum ideal gravel resurfacing application rates:

Table 1 - Gravel Resurfacing Application Rates

Scenario	Lift (cm)	Tonnes/m^2	Tonnes/Km
Actual: Historical Average	7.5	0.169	844
Minimum Ideal: 2014 Onward	10.0	0.225	1125

Based on an average road width of 5.0 m and a gravel density of 2.25 tonnes/m^3.

The Department of Public Works hence plans to apply 10.0 cm lifts going forward, and on this basis Table 2 below summarizes the cost of the gravel resurfacing program for 2013 and 2014 (projected) on a per tonne and a per km basis:

Table 2 - Average Gravel Resurfacing Costs

Cost Centre	2013				Projected 2014		
	$ Per Tonne	$ Per Km @ 7.5 cm Lift	$ Per Km @ 10.0 cm Lift	%	$ Per Tonne	$ Per Km @ 10.0 cm Lift	%
Supply	5.81	4,901	6,534	54.41%	5.98	6,731	53.73%
Haulage	3.16	2,666	3,554	29.60%	3.25	3,661	29.23%
Quality Assurance	0.06	51	68	0.56%	0.06	70	0.56%
Calcium Chloride	0.42	356	474	3.95%	0.43	489	3.90%
Net HST	0.17	140	187	1.56%	0.17	193	1.54%
Staff & Equipment	1.06	893	1,191	9.92%	1.23	1,384	11.05%
Total	10.67	9,007	12,009	100.00%	11.13	12,526	100.00%

Based on an average road width of 5.0 m and a productivity factor of 225 tonnes/hour. Staff & equipment costs for 2014 reflect the Collective Agreement and anticipated 2014 fleet rates, and all other 2014 costs reflect a 3.0%/annum inflationary factor over 2013 values in the interest of being conservative.

As indicated in Table 2, supply and haulage of gravel together represent over 80% of total cost and moving ahead with the minimum ideal lift thickness of 10.0

cm staff project gravel resurfacing will cost $11.13/tonne or $12,526/km in 2014 for the average road section.

For the four years prior to 2011, annual gravel resurfacing funding allowed the City to maintain a 7.7-year cycle of the gravel road system but with a mere 7.5 cm lift application. That said, in several of the years noted above, the expenditures made for gravel resurfacing were significantly less than the approved budget for this cost centre (based on a review of tender reports for this time period.

Recent funding levels however have more than doubled this cycle time, even with maintaining the low 7.5 cm lift application, as indicated in Table 3 below:

Table 3 - Annual Gravel Resurfacing Quantities

Scenario	Budget ($)	Tonnes	Km	Lift (cm)	Cycle (years)
Actual: 2007-2010 Average	907,761	101,700	120.5	7.5	7.7
Actual: 2011-2013 Average	420,119	42,900	50.8	7.5	18.3
Actual: 2013	483,000	49,400	58.5	7.5	15.9
Minimum Ideal: 2014	1,164,956	104,625	93.0	10.0	10.0
Proposed: 2014	1,000,000	89,810	79.8	10.0	11.6
Minimum Ideal: 2015	1,199,905	104,625	93.0	10.0	10.0

Based on an average road width of 5.0 m and a 930 km gravel road system. The 2007-2010 averages for tonnes and km are based on 2009 and 2010 only since corresponding quantities could not be retrieved for 2007 or 2008.

The 2011-2013 average and 2013 quantities exclude the Municipality of Clarington's 50% share of the 2013 Boundary Road gravel resurfacing project. 2014 quantities are based on average 2014 costs as projected in Table 2 and 2015 quantities are based on a 3.0% inflationary factor over projected 2014 costs in the interest of being conservative.

Since 2011, funding for gravel resurfacing has been down by more than 50% of average pre-2011 budget levels noted above while gravel costs have risen faster than inflation. Given the state of the City's gravel road system and with the average section of gravel road conveying 82 vehicles/day, a 7.5 cm lift application rate is insufficient to maintain gravel road integrity and effectively mitigate potholes. Staff now consider a lift application of 10.0 cm to be minimally ideal (also a typical, minimum industry standard). With funding continued at 2011-2013 average levels and moving forward with a 10.0 cm lift application, the cycle time of the City's gravel road system would increase by 1/3 from about 18 years to about 24 years (though this impact is not shown in Table 3), with lower-traffic roads incurring a much longer cycle.

As for the ideal gravel resurfacing frequency, it depends on many factors, a major one of which is average annual daily traffic (AADT) as it is a significant determinant of road deprecation and a strong indicator of the benefit to road users. Clearly, low AADT roads (e.g. dead ends) and roads with adequate road bases will not require gravel resurfacing as frequently as high AADT roads and roads with inadequate road bases. Ideal gravel resurfacing frequency also depends critically on the lift thickness applied. The thicker the lift applied, the less frequent gravel resurfacing is required. This tradeoff however is limited in that lift thickness has diminishing returns to resurfacing frequency extension. Given this limitation and with the average gravel road section in the City having an AADT of 82, staff believe resurfacing the average gravel road section approximately every 10 years would be minimally ideal, recognizing that high-traffic gravel roads will require about a 5-year cycle.

Current funding levels are insufficient if the City is to provide at least a minimal level of service in regard to gravel resurfacing going forward. To reposition the importance of this program and shift it back on track, staff are proposing through the capital budgeting process that gravel resurfacing funding be increased to a level that would permit at least a 10-year cycle with a 10.0 cm lift application, occurring in two steps: $1,000,000 of funding in 2014 and $1,200,000 in funding for 2015 with annual inflationary increases applied thereafter as required. Staff has offset the proposed 2014 increase in funding with proposed decreases elsewhere in the Capital Budget and expect to make similar accommodations for the proposed 2015 increase.[1]

Hardtop Roads in Rural Areas

A rural hardtop (i.e. hi-float surface treatment) road is often considered an alternative to a gravel road. While compared to gravel roads, hardtop roads provide a higher level of service and generally have lower maintenance costs (initially), the tradeoff is that hardtop roads have substantial upfront and interim capital costs. However, when hardtop roads are constructed on inadequate road base or are left in place beyond their useful life, their operating costs often exceed that for gravel roads and the level of service can often fall below that of gravel roads. Proper construction of a hardtop surface often requires road base repairs and roadside upgrades (e.g. ditching). The average useful life of a hardtop road is 15 years provided a single surface treatment (SST) investment is made in about year 8 of the initial double surface treatment (DST) investment's lifecycle.

[1] It should be noted that approximately 45% the proposed 2014 gravel resurfacing program is to be funded from aggregate reserves. In the future, this funding may be focused on aggregate haul routes subject once the secondary haul route plan is complete.

There are two components to the cost of a road: capital and operating. A capital work is defined as either a reconstruction of the road or an otherwise substantial improvement made to the road intended to extend its useful life. Capital works are normally incurred infrequently and generally provide a stream of benefits lasting more than one year. In contrast, an operation is defined as an act of ongoing or regular maintenance to a road intended to maintain its expected useful life. Operations normally recur at least annually and generally provide a stream of benefits lasting less than one year. Like any other asset, the total cost of a road is defined as the present value of the sum of operating and amortized capital costs over the useful life of the road.

While gravel and hardtop roads share a number of operating cost centres, such as ditching and roadside grass cutting, there are some cost centres they do not share as indicated in Table 4 below:

Table 4 - Major Cost Centres Not Common Between Gravel and Rural Hardtop Roads

Cost Classification	Gravel Roads		Rural Hardtop Roads	
	Cost Centre	Average Frequency	Cost Centre	Average Frequency
Capital	Gravel Resurfacing	Every 10 years	Double Surface Treatment (DST)	Every 15 years
			Single Surface Treatment (SST)	8th year of DST lifecycle
Operating	Grading & Gravel Patching	2-5 times during April-November for grading and as needed in the spring for gravel patching	Pothole Repair and Patching	Variable: light at first then heavier with road age
	Calcium Chloride	Annually during May-June		

Generally speaking, and as indicated later in the report, the total cost in present value of a hardtop road vastly exceeds that of a gravel road. However, cost is only one-half of the equation; the total benefit derived from the level of service provided by the road is just as important. Since hardtop roads provide a level of service higher than that provided by gravel roads, the additional benefit provided by hardtop can make hardtop a worthwhile investment. Hence, the decision to (or not to) hardtop a gravel road will depend heavily on the extent of this additional benefit. While this benefit often difficult to quantify, it can generally be approximated using measures such as traffic counts, household density and current/forecasted demand estimates. Criteria can be developed around such measures such that the decision to hardtop a gravel road can be made as objectively as possible. The current inventory of hardtop or low-cost bituminous roads within the City is 997 km, or roughly 37% of the entire road inventory.

In 2012 report ENG2012-014 “Proposed Five-Year Roads Capital Plan (2013-2017)” was brought forward by Development Services and adopted by Council by the following resolution:

> ***RESOLVED THAT*** *Report ENG2012-014, "Proposed Five-Year Roads Capital Plan (2013-2017)", be received;*
>
> ***THAT*** *Council endorses the Proposed Five-Year Roads Capital Plan as generally outlined in Appendix "A" to "D" respectively to Report ENG2012-014 as a guide for prioritizing and coordinating annual road capital projects from 2013 to 2017' and*
>
> ***THAT*** *staff be directed to update the Five-Year Roads Capital Plan annually through Council's capital budget deliberations based on annual project approvals and changes in project priorities and budget circumstances.*

CARRIED CR2012-1072

Report ENG2012-014 outlined criteria given for the upgrade of an existing gravel road to a hardtop road with the main trigger being an AADT of 600 vehicles per day or greater, with the exception of boundary road requests and Council resolutions for the consideration in future capital budgets. The report also conducted a cost comparison of hardtop roads and asphalt roads within rural residential areas, where roughly 186 km of the road network could be considered to lie in rural residential areas of which 30 km were already included in the 5-year hi-float plan. The report stated at the time that the treatment type of a DST (double hi-float) and fog seal would be used within these areas and that on a case-by-case basis hot mix asphalt would be utilized.

Addressing CR2012-1148

This report builds on the background information presented above, Report PW-2013-001, Proposed 2013 Gravel Resurfacing Program (dated February 12, 2013) and Report ENG2012-014, Proposed Five-Year Roads Capital Plan (2013-2017), (dated October 2, 2013) to address Council Resolution CR2012-1148.

This resolution directed staff at Public Works and Development Services to take action on the following four specific matters by September 30th, 2013:

1. Develop a 5-year capital gravel resurfacing plan for 2014-2018.

2. With a report to Council:
    a. Evaluate the long-term cost of gravel vs. hardtop surface.

b. Identify the current criteria to upgrade a road from gravel to hardtop.
c. Consider expansion of the criteria in relation to changes in land use.

Public Works and Engineering Division of Development Services have collaborated to address this resolution.

Rationale:

This section details the 5-Year Capital Gravel Resurfacing Plan, cost analysis of gravel vs. hardtop road surface and the review of criteria for upgrading gravel to hardtop.

5-Year Capital Gravel Resurfacing Plan

Department of Public Works staff has developed a Five-Year Capital Gravel Resurfacing Plan, attached herein as Appendix 1 and summarized below in Table 5 showing estimated tonnages:

Table 5: Five-Year Gravel Resurfacing Plan Summary

Year	West Area		East Area		City	
	Km	Tonnes	Km	Tonnes	Km	Tonnes
2014	42.32	50,270	37.41	40,000	79.73	90,270
2015	46.81	53,010	49.71	55,370	96.52	108,380
2016	54.72	57,920	44.78	50,100	99.50	108,020
2017	49.01	50,800	58.09	59,550	107.10	110,350
2018	48.51	51,780	48.95	57,020	97.46	108,800
Total	**241.36**	**263,780**	**238.94**	**262,040**	**480.31**	**525,820**

The five-year plan:

- Currently covers approximately 50% of the City's gravel road system over 2014-2018 and is based on planned 2014 and proposed 2015-2018 capital funding levels, leaving room to add provisional roads each year.

- Establishes a vision moving forward and will be updated annually based on historical resurfacing projects, road conditions, identified problematic road sections, traffic patterns and information from IssueTraq.

- Will assist in determining resurfacing priorities on an ongoing basis subject capital funding levels and periodic amendments based on changing conditions and priorities.

- Moves away from the status quo of piecemeal and geographically-fragmented allocation of gravel, rationalizing allocation into rotating geographic clusters where reasonably possible to reduce costs and ensure roads are resurfaced more holistically.

Evaluation of Long-Term Cost of Gravel vs. Hardtop (i.e. Hi-Float)

As noted earlier, the long-term cost of a hardtop road vastly exceeds that of a comparable gravel road, as detailed in Table 6 below:

Table 6 - Cost Analysis: High-Traffic Gravel Road vs. Rural Hardtop Road

Road Type	Cost Classification	Cost Centre	Lifecycle (years)	Undiscounted Cost Per Km Per Occurrence ($)	Year in Which Cost is Incurred During Lifecycle of DST	Present Discounted Cost Per Km Over Lifecycle of DST	
						By Cost Centre ($)	Total ($)
High-Traffic Gravel	Capital	Gravel Resurfacing (10.0 cm Lift)	5	12,526	1, 6 and 11	27,825	87,124
	Operating	Grading, Patching & Calcium Chloride	1	1,367	Each Year	13,322	
		Other	1	4,718	Each Year	45,977	
Rural Hardtop	Capital	Double Surface Treatment (DST)	15	76,220	1	76,220	135,688
		Single Surface Treatment (SST)	7	11,897	8	7,409	
	Operating	Pothole Repair & Patching	1	624	Each Year	6,083	
		Other	1	4,718	Each Year	45,977	

All costs are per km and are projected for 2014. Capital costs are based on a standard road width of 5.0 m and on 2013 Capital Budget and tender results inflated by 3%/annum to 2014. Operating costs are based on actual total roads maintenance costs (including administration) incurred in 2012 inflated by 3%/annum to 2014 where the $14,145,724 spent in 2012 has been apportioned as much as possible between gravel and hardtop roads. Costs per km are based on a 930 km gravel road system and a 1,750 km combined asphalt/hardtop road system of which 1,000 km are hardtop. A gravel road is considered high-traffic if requires gravel resurfacing every 5 years.

A financial cost is undiscounted if it is the current dollar value that will actually be spent, whereas a financial cost is discounted (i.e. in present value) if it reflects the preference for costs to be deferred into the future. Present value for this table is based on an assumed internal rate of return of 7.0%/annum over the useful life of an investment/expenditure, hence there is an indifference between spending $1.00 now and spending $1.07 a year from now.

The total present discounted cost per km of a hardtop surface today is more than 55% of that for a gravel surface over the expected lifecycle of a hardtop surface. This gap would be even larger had hardtop been compared to a low-traffic gravel road that would be resurfaced only every 10 years instead of every 5 years.

Criteria for Upgrading Gravel to Hardtop

As previously noted, Report ENG2012-014 was brought forwarded based upon the analysis undertaken through the 2011 Roads Needs Study which outlined the immediate, 1-5 and 6-10 year needs of the City's road inventory. Based upon these needs, target levels for program funding were established within the Urban Rural Resurfacing, Hot Mix and Hi-Float programs for maintaining an overall network adequacy of 72%. Due to the size of the network and limited tax base, the upgrading of a gravel road with less than 600 AADT was not considered by Engineering Division except through a boundary road request or resolution made through Council, for consideration. Based on the 2011 roads needs data, there are currently no gravel road sections that meet or exceed the 600 AADT threshold, however 48 km of gravel road have an AADT between 200 and 400 vehicles and 854 km of gravel roads have less than 200 AADT.

If the City was to consider upgrading gravel roads outside of the stated criteria, then it should consider sections with 200-400 AADT only (a total of 48 km) and then further identify ones with higher truck traffic. The capital cost to upgrade this 48 km inventory to hardtop is estimated at $3 to $4 million by the Engineering Division. In comparison, the City's budget for the 2013 Hi-Float program is $2.2 million for the resurfacing of existing hardtop roads with the exception of $50,000 for upgrading of two boundary roads sections. Based on a 10-year upgrading forecast, the City would need to add $360,000 to $400,000 per year in addition to the current Hi-Float program to maintain the 72% target road adequacy level of service as well as to upgrade the additional 48 km of gravel road.

Otherwise, the City would have to decrease the amount of annual hardtop resurfacing from the existing capital Hi-Float program to create the necessary budgetary room, which will invariably lower road adequacy and level of service. If this latter alternative is adopted without any additional funding to the Hi-Float program to account for the addition of 48 km to the hardtop inventory, Engineering Division estimates that road adequacy will fall from 72% to approximately 55%. The Engineering Division does not recommend such a decrease in level of service.

Through the capital budgeting process, the Engineering Division is instead proposing a revamping of the Hi-Float program. Under this proposal, the program name would change to Rural Resurfacing and the scope of work would allow for the use of asphalt products on sections of road classified as rural

residential areas found in the 5 year plan. Asphalt will generally last 7-8 years longer than hardtop. The method being proposed is largely based on spot repair and overlaying of hardtop roads with an HL-2 high-stability asphalt product instead of undertaking conventional pulverization followed by DST. Over the past 8 years in the City, this method has in fact been implemented on a pilot basis on certain road sections which have been monitored for deterioration of condition. Monitoring has revealed that the HL-2 overlay has outperformed equally-aged hardtop surfaces.

Through utilizing this method of upgrading deteriorated hardtop rural residential roads with an asphalt product, the lifecycle of existing hardtop is extended and future capital costs therefore deferred, creating the potential to realize cost savings. These savings could then be applied to the upgrading of gravel road sections within rural residential areas where demand for hardtop is particularly high despite lower AADT counts. Such an approach would need to be facilitated by long-term planning to ensure cost savings are identified and applied effectively.

Other Alternatives Considered:

Council may choose to maintain existing gravel resurfacing funding levels, reject the new Rural Resurfacing program being presented through the 2014 capital budgeting process and/or add new roads into the hardtop road inventory. Increases to capital funding for programs supporting hardtop roads would be required to maintain road system adequacy should Council choose to increase the hardtop road inventory.

Financial Considerations:

To achieve an acceptable level of service with regard to gravel resurfacing, funding for this program should be increased to at least $1.2 million/year based on current costs and prices. In present value, the total (capital + operating) cost of a rural hardtop road over its lifecycle exceeds that of a comparable high-traffic gravel road by over 55%.

Staff therefore do not recommend upgrading all of the City's 48 km of gravel road with AADT > 200 to hardtop, but would rather encourage Council to consider the more precise and targeted approach via the Rural Resurfacing program being presented through the 2014 capital budgeting process.

Actual annual capital budgets for gravel resurfacing and hardtop programs will be approved by Council during annual capital budget deliberations.

Relationship of Recommendation(s) To Strategic Priorities:

1. **Enhancing Tourism**;
2. **Managing Aggregates**;
3. **Developing a Knowledge-Based Economy** (with a focus on the water and agricultural sectors for job creation); and
4. **Creating Connections** (with a focus on infrastructure, communications and relationships

This report and recommendations therein, support either directly or indirectly priorities 1, 2 and 4.

Review of Accessibility Implications of Any Development or Policy:

Not applicable.

Servicing Comments:

Not applicable.

Consultations:

Doug Downing, Area Manager of Roads Operations – West
Pat Russell, Area Manager of Roads Operations – East
Michelle Hendry, Director of Public Works
Ron Taylor, Director of Development Services

Attachments:

Appendix 1 – Proposed Five-Year Capital Gravel Resurfacing Plan

5 Year Gavel Resurfacing - Septem

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