Economics AECOM

City of Greater Sudbury

Cost-Benefit Analysis of Maley Drive Extension – Phase 1

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Executive Summary

The purpose of this brief is to assess the economic feasibility of the Maley Drive Extension Phase I project. The Maley Drive Extension Phase I project is a combination of new road and reconstruction/rehabilitation of existing road which extends from the College Boreal entrance to 300 metres east of Lansing Avenue. By providing a new east-west arterial road, its intent is to alleviate traffic congestion and promote economic activity while improving safety.

The Project's economic feasibility is assessed through a Cost-Benefit Analysis which is meant to determine the positive economic benefits to the City of Greater Sudbury. The Analysis is performed for the expected useful life of the project which is set at 30 years. The project's benefits are expected to start after completion of the road, in 2019 and remain at the same level for the duration of the project.

Using simulation model analysis, AECOM has developed estimates of vehicle hours travelled (VHT) and vehicles kilometers travelled (VKT) without and with project for the entire network. A decrease in each of these parameters translates into the following economic benefits: vehicle time savings for automobiles and trucks, vehicle operating cost savings and greenhouse gas emissions reduction. These have been quantified and monetized in the analysis. Results indicate that:

- The project will alleviate traffic congestion and generate time savings of about 457 000 vehicles hours per year for auto drivers and 50 800 VHT for truck drivers. In monetary terms, this represents savings of **$11.1 million per year** in 2015 dollars.
- Overall, auto drivers will save **$1.15 million** annually while truck drivers will save approximately **$360,000** per year in vehicle operating costs.
- Greenhouse gas emissions will be reduced by 2,459 metric tons of CO_2 eq. which amounts to monetized savings of about **$218,000 per year.**
- The projects' costs are twofold: an initial capital cost of **$80 million** spread over three years and annual operating costs of **$170,000** consisting of winter maintenance.
- A **2.75 cost/benefit ratio** suggests that costs are largely surpassed by benefits.
- **The project creates a net economic value of $135.6 million in present value terms (at a 3.5% real discount rate), which is equivalent to an economic rate of return of 13.6%.**

Results of this analysis are deemed conservative as additional potential benefits have been identified but have not been quantified. This Cost-Benefit Analysis suggests that the Maley Drive project is economically feasible and that it would deliver considerable net economic value to road users in the area and the Greater Sudbury community at large.

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1. Purpose of Brief

The purpose of this brief is to assess the economic feasibility of the Maley Drive Extension Phase I project. In essence, this means assessing in the broadest terms the economic return on investment for the City of Greater Sudbury to proceed with the construction of the proposed road extension project. The Maley Drive Extension Phase 1 project ("Maley Drive project") is a combination of new road and reconstruction/rehabilitation of existing road which extends from the College Boreal entrance to 300 metres east of Lansing Avenue. Its intent is to alleviate traffic congestion and promote economic activity while improving safety.

The economic assessment is undertaken from a broad public sector perspective and hence, takes into account not only the financial implications of proceeding with the project, but also the transportation user benefits and the economic and environmental impacts of the extension.

The intent of the brief is to explore the economic feasibility of the Maley Drive project developed as part of the City's Official Transportation Plan and provide the business case rationale for the City of Greater Sudbury and senior levels of government to prioritize and fund this investment in improved mobility and related economic, social and environmental outcomes. This report also explains how users of the new roadway – including residents and businesses in Greater Sudbury – will benefit from the investment and hence, should support the investment and funding decisions required to deliver the project.

2. Overview of Benefit-Cost Methodology

2.1 Economic Feasibility

The purpose of the economic feasibility assessment is to determine the positive economic benefits to the organization that the proposed project will provide.Cost-benefit analysis is the generally accepted analytical tool of choice in transportation economics for the evaluation and justification of major transportation network improvements, including capital projects as well as changes in user fees, fare structures and the pricing of travel in general.

In contrast to economic impact analyses, these costs and benefits are derived based on the capital and operating costs of the project and the microeconomic decisions of individuals, households and businesses – before and after the project under evaluation is put in place. The scope of impacts covers all resulting changes in private and social welfare. This means that the evaluated benefits and costs cover changes in:

- consumer surplus – the difference between the value individuals attribute to a trip and the out-of-pocket costs and time costs incurred on the trip
- externalities of travel behaviour – defined as those costs and benefits which each individual trip imposes on other travellers or on the public at large and which are not absorbed in individual travel decisions. These externalities include costs of environmental emissions (although some of these emission costs may already be factored into individual travel decisions as a result of fuel taxes) and some but not all congestion costs

These costs and benefits are designed to be quantified and valued on an incremental basis. This is an essential feature of cost-benefit theory, which in turn allows this methodology to be used as the primary tool for project justification. In other words, the evaluated costs and benefits are inextricably linked with the project or investment program under evaluation – they are only realized if the project is implemented.

Itemized benefits and costs typically evaluated in Canada for each option under consideration (relative to a base case) include:

- travel time savings, including lower generalized costs from fewer or more convenient interchanges, based on value of time estimates related to journey purpose (business travel, commuting to/from work, and other trip purposes)
- financial (out-of-pocket) costs incurred or saved, including capital costs, operating and maintenance costs, savings in automobile usage costs and other out-of-pocket costs, such as parking charges, fares or road tolls over the evaluated horizon
- safety impacts, which attributes financial (i.e. out-of-pocket) and welfare costs to accidents, including those which result in minor injuries, serious injuries and death
- environmental costs, including changes in the economy-wide costs and welfare costs associated with greenhouse gas emissions as well as changes in local air emissions

These benefits and costs above are usually based on trip and travel time changes obtained from simulations of transportation network models for each option under evaluation (relative to a base case). These models are typically four-stage transportation models with detailed representations of the surface transportation network and its capacity. The models rely on population and employment forecasts, which are exogenous to the model and which in turn drive trip generation rates. The models also rely on land-use input assumptions. All of the above population, employment and land-use assumptions are usually held fixed between alternative scenario evaluations.

Table 2-1 below shows the expected impacts of the Maley Drive project. Only impacts that have been quantified and monetized are included in the cost-benefit analysis presented in section 4.

Table 2-1 Maley Drive Project Impacts

Account	Impacts	Monetized
Costs		
Financial Account	Capital Costs	Yes
	Maintenance Costs	Yes
Benefits		
Transportation User Benefits Account	Travel time savings	Yes
	Vehicle operating cost savings	Yes
	Safety benefits	No
Environmental Account	Greenhouse gas emissions	Yes
	Local air quality impacts	No
	Noise and vibration impacts	No
Economic Development Account	Standard economic impacts	No
	Land value impacts	No

Impacts are quantified and monetized on an annual basis for the length of the project's useful life. The analysis results in three criteria outputs: the Net Present Value (NPV), the Cost/Benefit Ratio (C/B) and the Economic Rate of Return (ERR).

The project's NPV represents the sum of discounted benefits minus the sum of discounted costs. A positive NPV suggests the project is cost-effective. It is calculated according to the following equation:

$$NPV = \sum_{t=1}^{T} \frac{Benefits_t}{(1+\rho)^t} - \sum_{t=1}^{T} \frac{Costs_t}{(1+\rho)^t}$$

where ρ is the discount rate and T the project's duration.

The Cost/Benefit Ratio represents the sum of discounted benefits divided by the sum of discounted costs. A cost-effective project will have a ratio higher than 1. This parameter gives a sense of the magnitude of benefits compared to costs. It is calculated according to the following equation:

$$C/B = \sum_{t=1}^{T} \frac{Benefits_t}{(1+\rho)^t} \div \sum_{t=1}^{T} \frac{Costs_t}{(1+\rho)^t}$$

where ρ is the discount rate and T the project's duration.

Finally, the ERR represents the discount rate at which the sum of discounted benefits is equal to the sum of discounted costs. In other words, it assesses the project's economic value. If the ERR is superior to the discount rate, the project is viable as it generates economic value.

3. Description of Proposed Project and Impacts

3.1 Business as Usual (BAU) vs Proposed Project

All traffic crossing the northerly edge of the developed areas of the City of Sudbury is currently restricted to using either LaSalle Boulevard or the Kingsway, the only two major east-west through routes. The purpose of the Project is to provide a new east-west arterial road to alleviate congestion on these two roads and in the city overall.

The figure below illustrates Phase 1 of the proposed Maley Drive Extension.

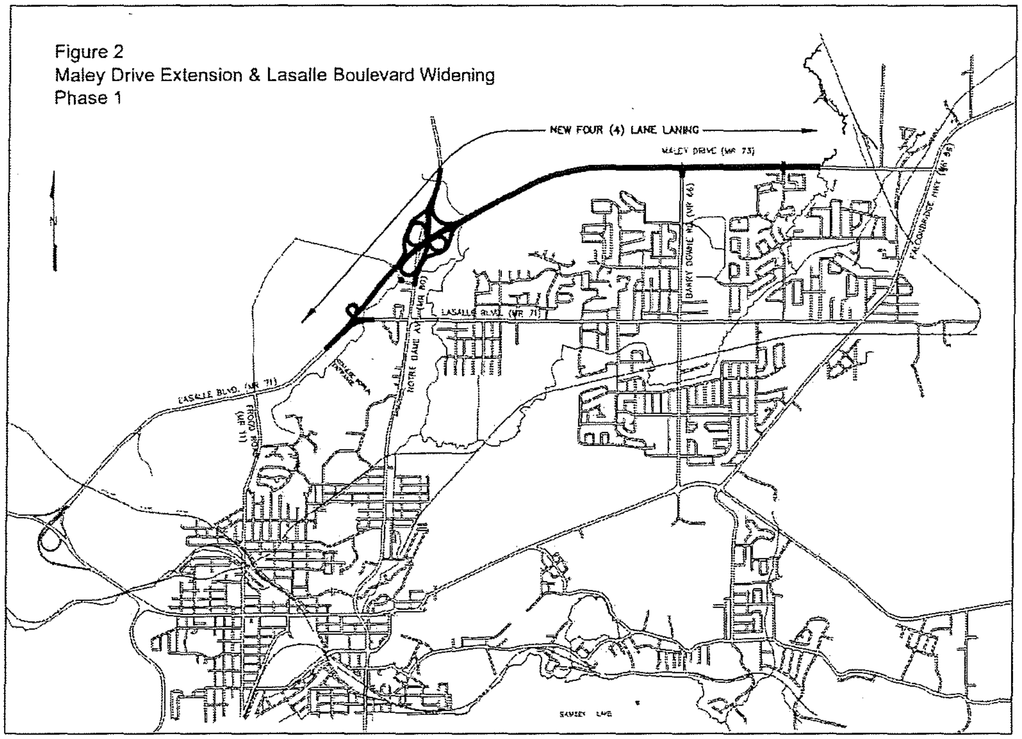

Figure 2
Maley Drive Extension & Lasalle Boulevard Widening
Phase 1

Using simulation model analysis, AECOM estimates that traffic in the entire network during evening peak hour would be 9,740 vehicles hours travelled (VHT) in the business as usual (BAU) scenario in 2021. When the new Maley Drive Extension is integrated to the model, traffic forecasts for 2021 drop to 9,283 VHT. This represents a net saving of 457 VHT per peak hour.

4. Benefit-Cost Results and Implications

The Cost-Benefit Analysis is performed for the expected useful life of the Maley Drive project which is set at 30 years. The project's benefits are expected to start after completion of the road, in 2019 and remain at the same level for the duration of the project. A list of assumptions, data values and sources used in the analysis is available in Appendix A. Benefits and costs are presented in detail in the next sections. They are followed by a presentation of the analysis results.

4.1 Travel Time Savings

Travel time savings represent the most important benefit of the project. As indicated in the previous section, model analysis suggests that 457 VHT would be saved during evening peak hour by car drivers over the entire network. These savings are generated by:

- Faster routes for drivers diverting from Lasalle Boulevard or Kingsway to the new Maley Drive
- Alleviated traffic in the rest of the network due to traffic diversions to the new road

These simulated travel time savings are also assumed to apply to the morning peak hour and to the two shoulder hours on each side of the peak hours (although only 50% of the peak hour travel time savings are assumed to be realized during the shoulder hours). Annually, this represents a total of 457 000 VHT per year, assuming there are 250 working days in a year.

These savings are for auto drivers only. The project design standards suggest that 10% of traffic could be generated by trucks. Therefore, the analysis for this report is based on 10% of overall time savings can be attributed to truck, which amounts to about 50 800 VHTs per year.

It is possible that there are additional time savings throughout the day (outside of the peak and shoulder hours), but AECOM has chosen to remain conservative in the context of this assessment.

Travel time savings can be monetized by applying a value for the drivers' time. **Total travel time savings amount to $11.1 million per year**, based on value of time of $16 per hour for automobile drivers and $75 per hour for truck drivers. (See Appendix A for an elaboration of assumptions and data sources.)

4.2 Other Impacts

Cost impacts include capital and maintenance costs. Capital costs amount to $80 million to complete the whole extension project. This investment is assumed to be spread evenly throughout the 3 years of construction, from 2016 to 2018. Maintenance costs include annual winter and summer maintenance and occasional crack sealing, and minor pavement rehabilitation expenses. Annual winter and summer maintenance costs represent $170,000 annually. Major rehabilitation costs are excluded because these would not be incurred within the 30-year service life assumed here. A crack sealing operation representing $75,000 is accounted for on the 7th year of the project.

Other estimated benefits in the analysis include vehicle operating costs and greenhouse gas emissions savings. All three benefits are estimated on the basis of saved vehicle kilometers travelled (VKT). Using model simulation, savings amount to 2,649 VKT during evening peak hours. Daily traffic is generally considered to represent about 10 times that of peak hour traffic. **Total vehicle kilometer savings amount to 6,622,500 VKT per year** (considering a 250 working days). This again can be considered a conservative estimate as additional savings are most probably generated during weekends.

The reduction in VKT results in vehicle operating cost savings. An operating cost per kilometer of $0.17 was used to estimate the cost savings for cars, based only on auto operating costs, such as fuel, maintenance and tire use for a mid-size vehicle. It does not take into account any reduction in vehicle ownership costs. **The savings in auto operating costs are approximately $1.15 million per year.** For trucks, an operating cost per kilometer of $0.49 was used. **The savings in truck operating costs are approximately $360,000 per year.**

Greenhouse gas emissions are estimated by converting consumed fuel by cars and trucks into CO2 equivalent emissions. In the case of cars, an average of 12 liters are consumed by 100 km, resulting into a fuel saving of

794,700 liters and in the case of trucks, 45.5 liters of diesel are consumed by 100 km, resulting into a diesel saving of 334,804 liters. These combined fuel savings amount to 2,459 metric tons of CO2 eq. emissions saved. Considering a unit cost of $88.5 per metric ton, **monetized greenhouse gas emissions savings amount to approximately $218,000 per year**.

Table 4-1 Summary of Costs and Benefits Values

Impact	Value ($ 2015)	Year of Impact
COSTS		
Capital Costs	$80 million (total)	2016-2018
Maintenance Costs - Winter/summer maintenance - Crack sealing	 $170,000 per year $75,000	 2019-2048 2025
BENEFITS		
Travel time savings - Car drivers - Truck drivers	 $7,312,000 per year $3,808,000 per year	 2019-2048 2019-2048
Vehicle operating cost savings - Car drivers - Truck drivers	 $1,152,000 per year $ $360,000 per year $	 2019-2048 2019-2048
Greenhouse gas emissions	$218,000 per year $	2019-2048

4.3 Overall Benefit-Cost Analysis Results

Based on combined transportation user benefits and environmental benefits of $213 million in present value terms over the full 30-year evaluation period (or $385.5 million undiscounted) and capital and operating costs of $77.5 million over the same period ($85 million undiscounted), the net benefits amount to $135.6 million. This represents the net economic value created by the Maley Drive Extension investment.

In benefit-cost terms, it represents a ratio of $2.75 of benefits for every $1 of capital and operating costs invested in the Maley Drive project. Yet another way of representing the same benefit and cost figures is through the rate of return of 13.6% for the Maley Drive investment.

Table 4-2 Benefit-Cost Analysis Results

Impact (2016-2048)	Value ($ 2015)
COSTS	
Net present value (NPV)	$135,600,000
Cost-benefit ratio (C/B)	2.75
Economic rate of return (ERR)	13.6%

4.4 Summary and Implications

Expressed in terms of an economic feasibility, the cost-benefit analysis shows that the Maley Drive Extension Phase I project is creates a net economic value of $135.6 million in present value terms and that the economic rate of return is 13.6%.

It is important to keep in mind that these positive results represent only the strict economic test of whether the project is feasible. Further potential benefits have been identified which have not been quantified and which further contribute to the argument that the Maley Drive Extension Phase I project is a positive investment for the community. For instance, economic development account benefits such as job creation and land value uplift were not accounted for but can also be generated by the project. The diversion of trucks away from central roads will also contribute to increasing the life quality in Greater Sudbury. This Cost-Benefit Analysis suggests that the Maley Drive project is economically feasible and that it would deliver considerable net economic value to road users in the area and the Greater Sudbury community at large.

Appendix A

List of Assumptions, Input Values and Sources

Appendix 1 List of Assumptions, Input Values and Sources

Factor/Assumption	Value	Source
Discount Rate (%, real terms)	3.50%	AECOM
Project useful life (years)	30 years	AECOM
Number of working days in a year (days)	250	AECOM
Value of time - auto drivers (2015 $/hr)	16 $	Ministry of Transportation of Ontario (MTO)
Value of time - truck drivers (2015 $/hr)	75 $	MTO
Car operating cost (2015 $/km)	0.176	CAA auto operating costs for mid-size car, excluding ownership costs for 2012, adjusted to 2015 with Ontario CPI
Truck operating cost (2015 $/km)	0.326 $	Transport Canada (TC) 2008 operating costs of truck in Canada, excluding ownership and driver costs, 2008 value adjusted to 2015 with Ontario CPI
Fuel consumption - Cars (litres/100 km)	12	TC CVUS Results 2014 for cars, pickups, SUVs and other light vehicles
Fuel consumption - Trucks (litres/100 km)	45.5	TC CVUS Results 2014 for Straight Trucks, Tractor Trailers and Cargo Vans
GHG Emission - Cars (CO_2 eq. Kg/Litre of fuel)	2.289	Environment Canada, National Inventory Report 2011, Greenhouse Gas Sources and Sinks in Canada
GHG Emission - Trucks (CO_2 eq. Kg/Litre of diesel)	2.663	Environment Canada, National Inventory Report 2011, Greenhouse Gas Sources and Sinks in Canada
Cost of GHG emissions (2015 $/Metric ton)	87.9	Quebec Transport Ministry, Cost-benefit analysis guide, 2011 value adjusted to 2015 with Ontario CPI
Ontario CPI		CANSIM Tables 326-0020 and 326-0021 for 2007-2015