



CONSULTING ENGINEERS
& SCIENTISTS

FINAL REPORT

FLAMBOROUGH QUARRY HAUL ROUTE STUDY HAUL ROUTE VIBRATION REPORT

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Conditions Report
Flamborough Quarry Haul Route Study – Traffic Noise Report

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INTRODUCTION

St. Marys Cement (Canada) Inc. has proposed to develop a Dolostone Quarry on Part of Lots 1, 2 and 3, Concession 11, Geographic Township of East Flamborough, in the City of Hamilton. The property is located on the north side of 11th Concession, just west of Milborough Line.

In April 2006 Dillon Consulting Limited prepared Terms of Reference for the Quarry Haul Route Evaluation on behalf of the City of Hamilton. Components of the Terms of Reference require that Alternative Haul Routes are identified, the existing baseline conditions of each alternative route are described, and a comparative analysis and evaluation is carried out. iTRANS Consulting Inc. have identified five Alternative Haul Routes that are described and analyzed in the following report in the context of vibration.

This report documents the consultant team, describes the environment, defines the analysis criteria and indicators, reports the analysis and results, and offers recommendations and mitigating measures.

RWDI AIR Inc. (RWDI) was retained by St. Marys Cement (St. Marys) and iTRANS Consulting Inc. (iTRANS) to evaluate traffic-induced vibration levels resulting from proposed haul routes. This report is designed to support the requirements of the Haul Route Evaluation study. It documents an evaluation of potential vibration impacts along the haul routes due to truck traffic, discusses the criteria and indicators of impacts, and discusses the potential for feasible mitigation measures to be applied to the preferred haul route. Other quarry-related vibration sources, such as blasting, will be dealt with separately as part of the Aggregate Resource License application.

1. DESCRIPTION OF THE CONSULTANT TEAM

A study team consisting of RWDI AIR Inc. (RWDI) staff undertook the vibration assessment and evaluation of route alternatives. The actual individuals and their specific roles are provided as follows:

- Scott Penton, P.Eng., Noise and Vibration Specialist: Supervised all technical aspects of the study and was responsible for ensuring that all work conformed to RWDI's standards for

quality assurance. Mr. Penton has extensive experience in evaluating road traffic and haul route traffic noise and vibration impacts.

- Nigel Taylor, M.Sc., CCEP., Project Manager: Provided technical direction and was responsible for the day-to-day communication with the Flamborough Quarry Haul Route Study Project Team.

2. DESCRIPTION OF THE ENVIRONMENT

Ground-borne vibration from transportation systems can be a concern for nearby residents. Extremely high vibration levels can cause buildings to shake, windows to rattle, and rumbling sounds to be heard. Ground-borne vibration impacts frequently occur for rail transportation systems, such as freight and passenger trains, light rapid transit systems, and subway lines. However, vibration impacts from roadway sources such as heavy truck traffic and bus traffic are extremely uncommon (FTA 2006).

Vibration impacts can be broken down into two categories: *perceptible vibration*, which ground-borne vibration can produce perceptible (“feelable”) levels of motion within buildings, and *ground-borne noise*, where ground-borne vibration is radiated by building walls as audible sound.

Typical background vibration levels due to distant traffic or the motion of vegetation (trees) driven by the wind, are at approximately 0.01 mm/s.

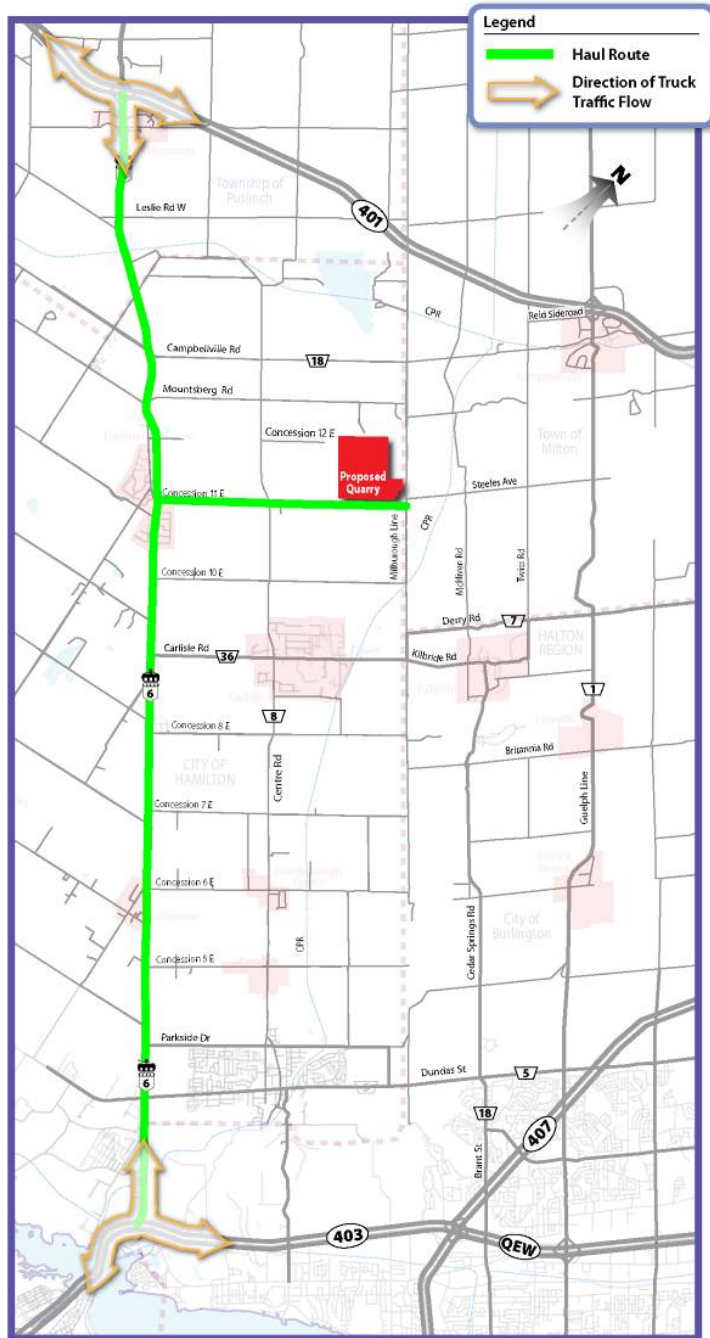
2.1 Inventory of Key Features

The proposed St. Marys Flamborough Quarry is located on the north-west corner of the intersection of Concession 11 E and Milborough Line, in the City of Hamilton. The site features a very thick deposit of amabel dolostone formation that is capable of supplying more than three-million tonnes of high quality aggregates annually.

The St. Mary’s haul route alternatives are located north of Highway 5 and south of Highway 401 between Highway 6 and Guelph Line. The study area is predominantly rural, with homes and farms along the various roadways. There are also a few villages and some smaller built up areas.

As summarized by iTRANS (2008), a total of five haul route alternatives are being considered which comprise 11 different road segments.

2.1.1 Alternative Haul Route 1:



In the case of Alternative Haul Route 1, truck traffic destined for Highway 401 east would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 eastbound on-ramp.

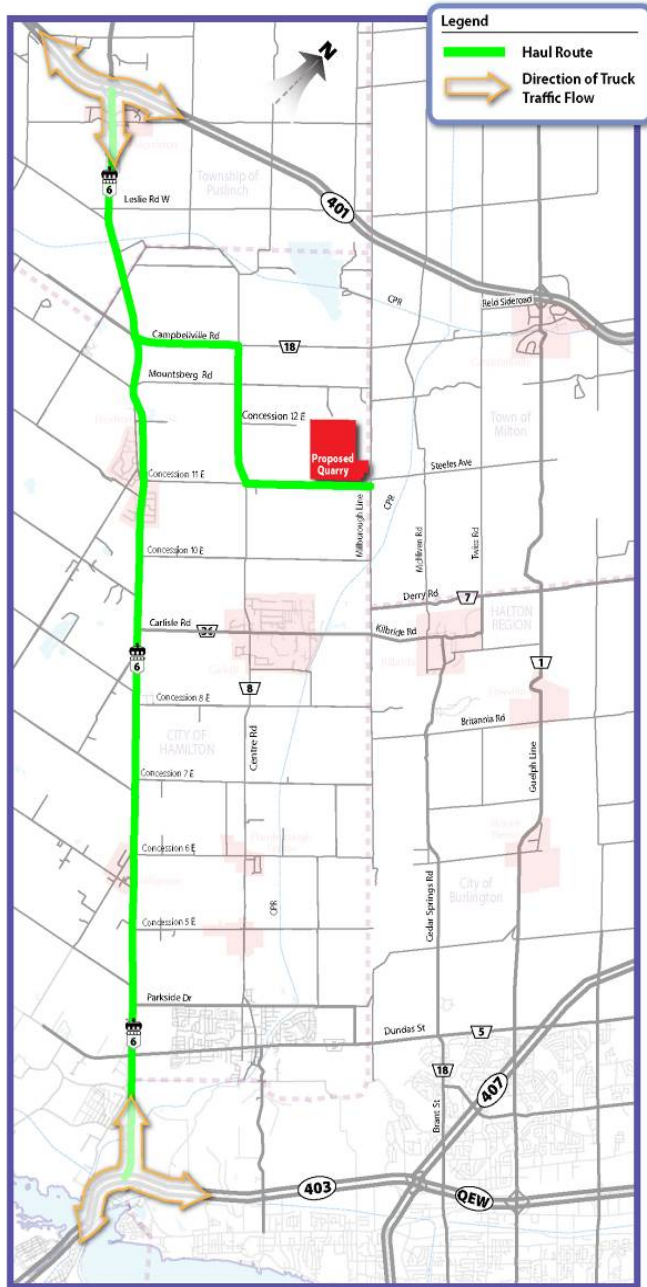
Truck traffic destined for Highway 401 west would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403/QEW westbound on-ramp.

Figure 1: Alternative Haul Route 1

2.1.2 Alternative Haul Route 2:



In the case of Alternative Haul Route 2 truck traffic destined for Highway 401 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and north on Highway 6 to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403 /QEW westbound on-ramp.

Figure 2: Alternative Haul Route 2

2.1.3 Alternative Haul Route 3:

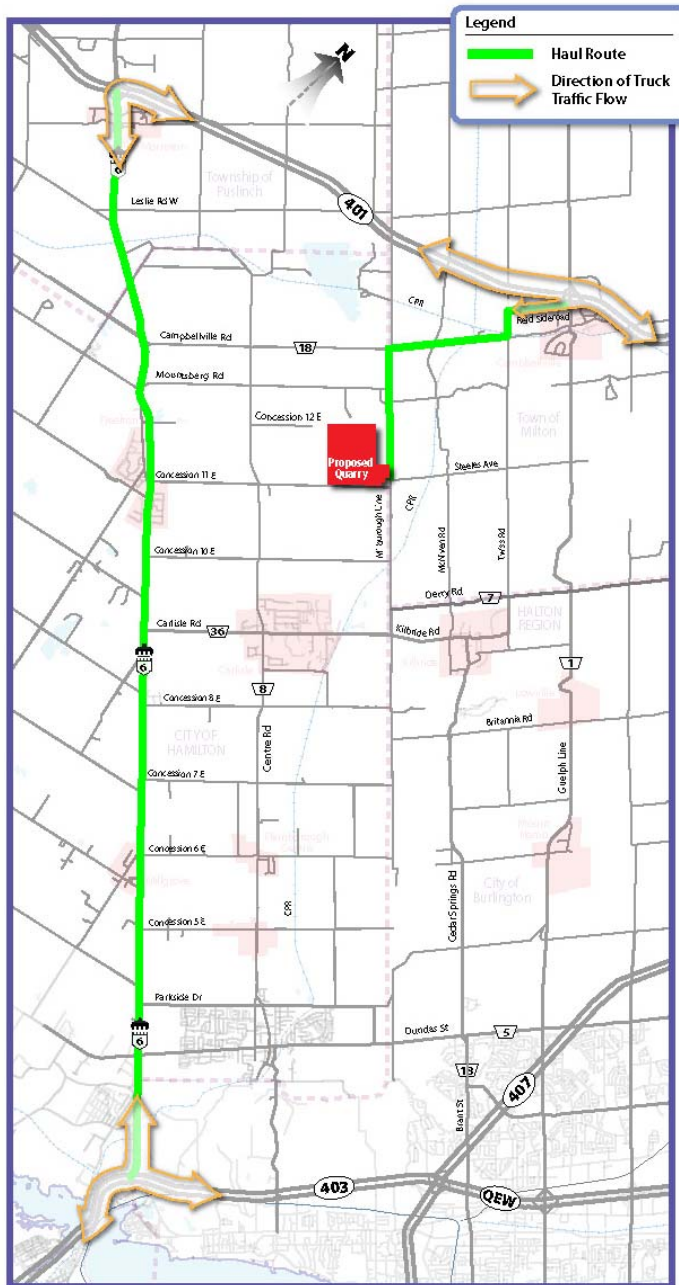


Figure 3: Alternative Haul Route 3

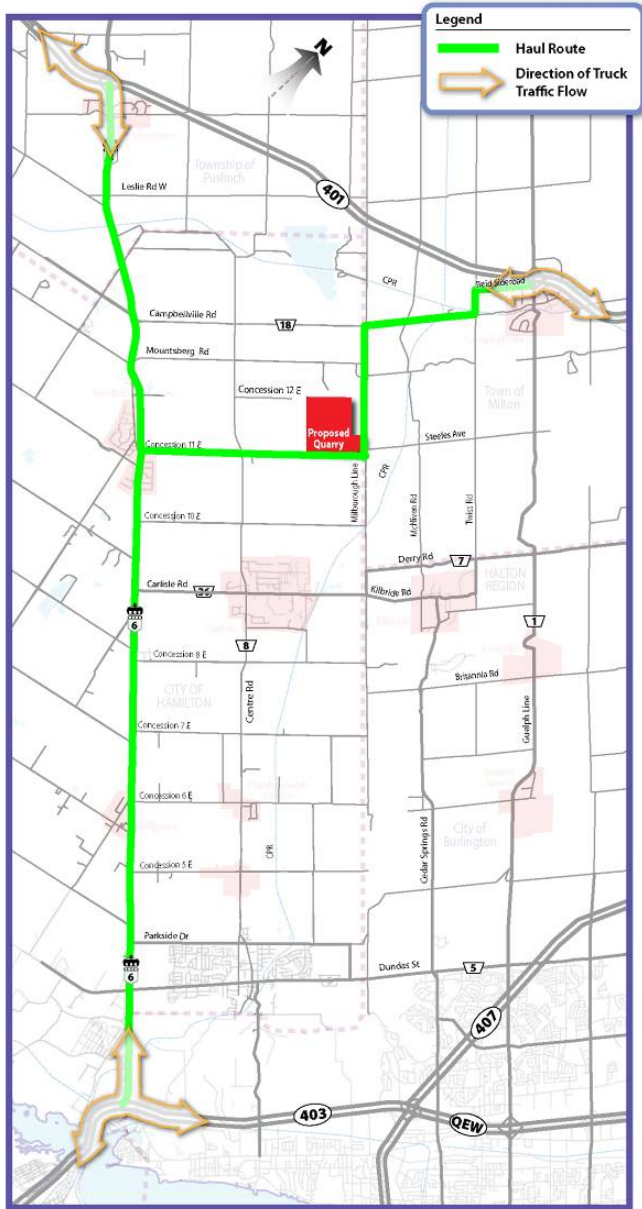
In the case of Alternative Haul Route 3, truck traffic destined for Highway 401 east would travel north on Milborough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel north on Milborough Line, then east on Campbellville Road, north on Twiss Road, east on Reid Sideroad and north on Guelph Line to the Highway 401 westbound on-ramp

Truck traffic destined for Highway 403/QEW east would travel north on Milborough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp. From here, there are several alternatives to reach the destination including taking the 407 ETR south to Highway 403.

Finally, truck traffic destined for Highway 403 west would travel north on Milborough Line, east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401. From here, there are several alternatives to reach the destination including taking the 407 ETR southwest or Highway 6 south to the 403/QEW.

2.1.4 Alternative Haul Route 4:



In the case of Alternative Haul Route 4, truck traffic destined for Highway 401 east would travel north on Milborough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403 eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403 westbound on-ramp.

Figure 4: Alternative Haul Route 4

2.1.5 Alternative Haul Route 5:

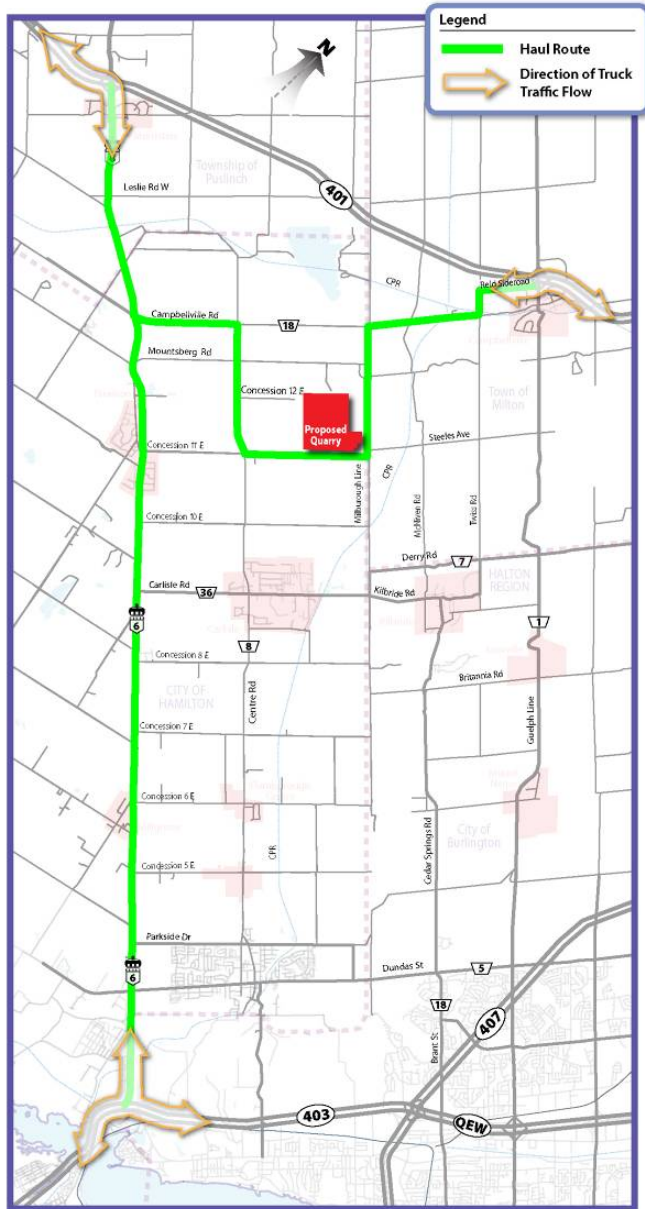


Figure 5: Alternative Haul Route 5

In the case of Alternative Haul Route 5, truck traffic destined for Highway 401 east would travel north on Milborough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, then north on Centre Road, then west on Campbellville, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403 /QEW westbound on-ramp.

2.2 Roadway Cross-Sections

For many haul route links, the roadways will require upgrades. For this study two types of cross-sections are proposed: rural (requires property acquisition) and urban (within the existing right-of-way). The final haul route roadway design may be all rural cross-sections, all urban, or some combination. Haul route cross-sections are discussed in **Appendix A**.

A rural cross-section has been assumed for this analysis. However, vibration results for urban cross-section would not be different. As the roadway will generally be centered in the right-of-way regardless of the cross-section design, distances from traffic lanes to the receptors will not differ between cross-section alternatives. The different features of the roadway designs (e.g., a ditch for storm water management for the rural cross-section, versus storm sewers for the urban section) will not affect significantly affect vibration propagation.

3. ANALYSIS CRITERIA AND INDICATORS

Vibration may be measured using a number of different descriptors. One of the most commonly used descriptors in Ontario is *vibration velocity*, measured in mm/s, and this metric is used in this report.

Based on international standards, the threshold of perception for vibration is approximately 0.10 mm/s. The US Federal Transit Administration (FTA) recommends the following limits for vibration (FTA 2006):

Table 1: Recommended Transportation Vibration Levels (From FTA)

Location / Source	Criteria
Residential Daytime	0.14 mm/s
Residential Night-time	0.10 mm/s
Ground-Borne Noise	25 dB

With respect to ground-borne noise, vibration levels meeting the residential daytime criterion of 0.14 mm/s will produce ground-borne noise levels meeting or below the 25 dB criteria. Thus, if the limits for perceptible vibration are met, then the limits for ground-borne noise will also be met.

4. ANALYSIS

4.1 Data Sources

Data on typical vibration levels produced by heavy trucks at various speeds were obtained from past measurements conducted by RWDI, and from the prediction methods outlined in the US FTA *Transit Noise and Vibration Impact Assessment* manual (FTA 2006).

4.2 Assumptions

A review of setback distances indicates that the majority of residential buildings are located at least 20 m (65 ft) from the closest lane of traffic on the proposed haul route links, although some houses are closer. It is assumed that following roadway upgrades, no building will be closer than 15 m to a proposed haul route roadway lane (49 ft). Note that the proposed 22 m wide “Class 1” road rights-of-way already incorporates a distance of 7.3 m (24 ft) from the edge of the right-of-way to the roadway lane, composed of the road shoulder, gravel backfill, ditch, and 1 m buffer.

4.3 Methodology

Vibration levels increase with increasing speed. Therefore, predictions of haul truck-induced ground vibration were made for four speeds, 50, 60, 70 and 80 km/h.

A range of predicted vibration levels was calculated, including the minimum, maximum and average vibration levels anticipated from heavy truck pass-bys on the proposed haul route links. Vibration levels at a 15 m setback distance were then examined.

4.4 Results

The results of the analysis are shown graphically in Figures 6 to 9.

Range of Expected Truck-Induced Vibration Levels - 50 km/h

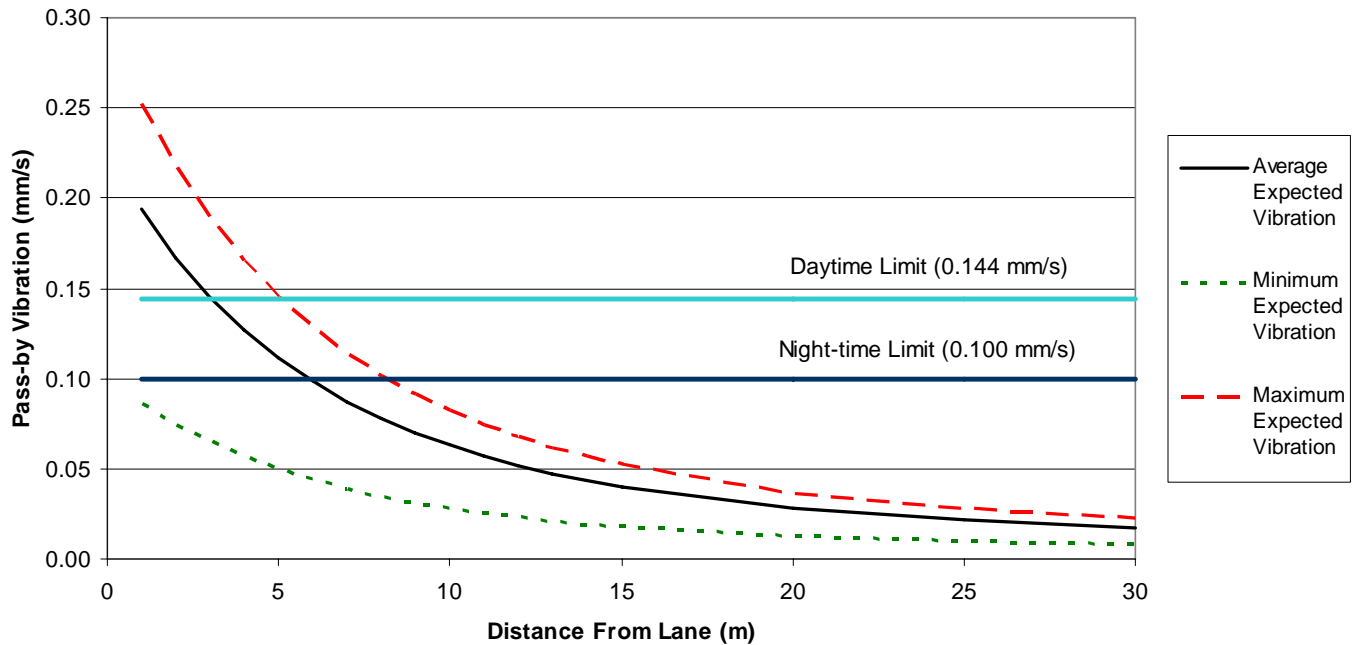


Figure 6: Truck-Induced Vibration Levels at 50 km/h

Range of Expected Truck-Induced Vibration Levels - 60 km/h

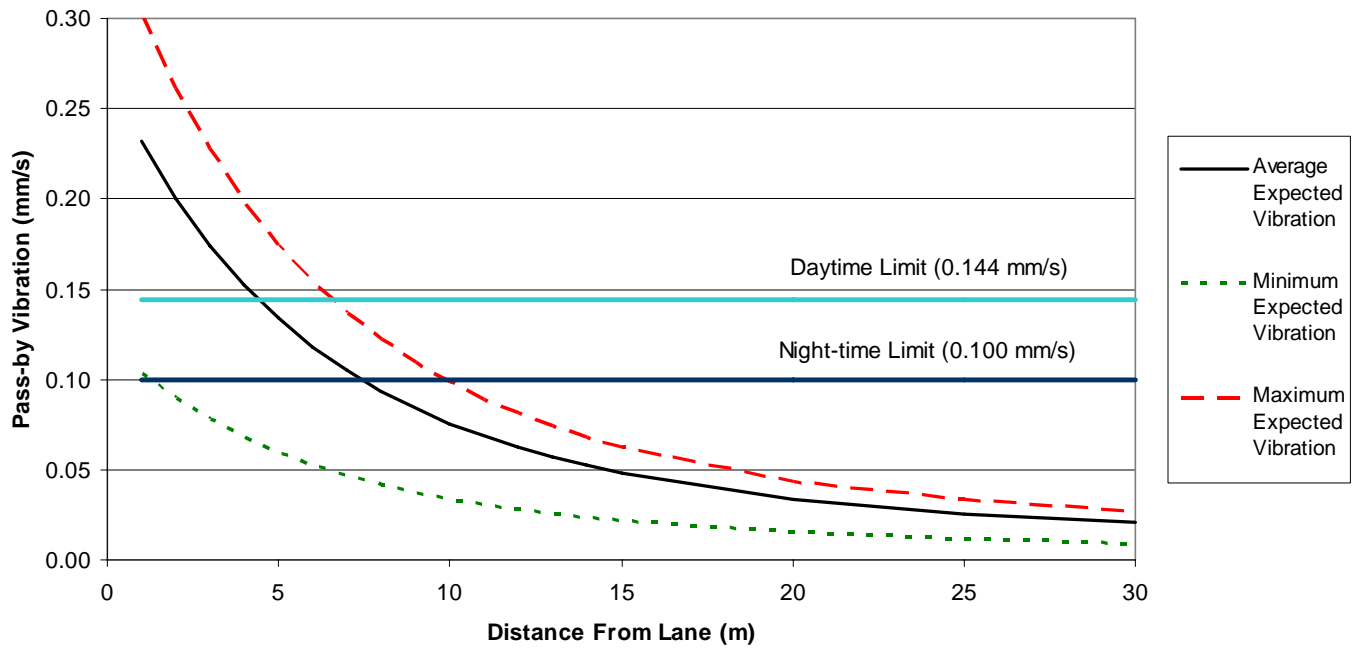


Figure 7: Truck-Induced Vibration Levels at 60 km/h

Range of Expected Truck-Induced Vibration Levels - 70 km/h

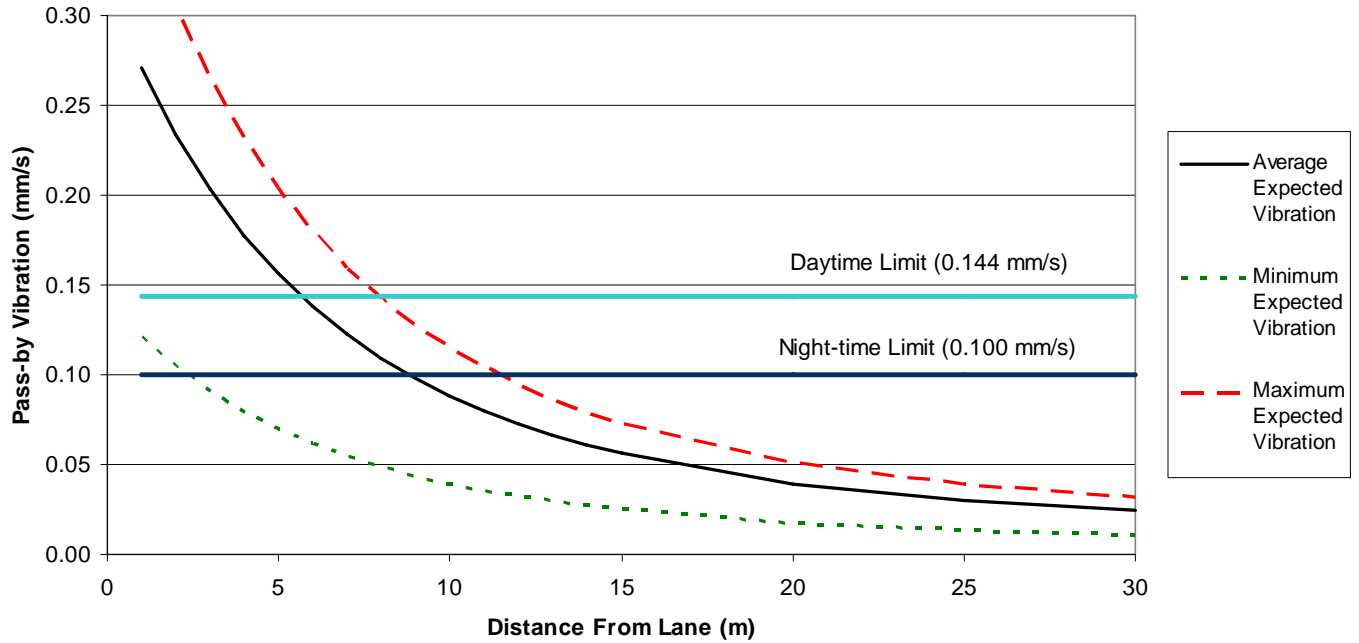


Figure 8: Truck-Induced Vibration Levels at 70 km/h

Range of Expected Truck-Induced Vibration Levels - 80 km/h

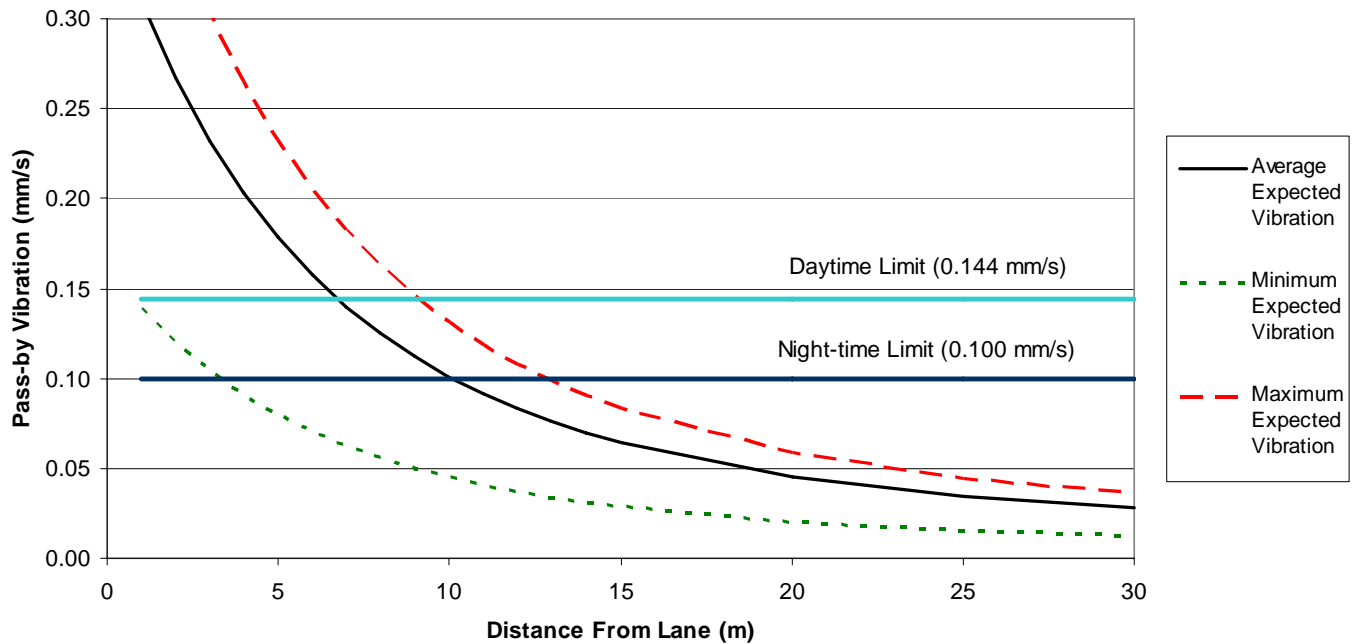


Figure 9: Truck-Induced Vibration Levels at 80 km/h

Even at 80 km/h, the night-time guideline limit of 0.10mm/s will be met at all distances greater than 10 to 13 m. The daytime limit of 0.144 mm/s will be met at distances greater than 7 to 9 m. Note that the distance from the road lane to the edge of the right-of-way for the proposed Class 1 rural cross-section is 7.3 m. Thus, on average, pass-by vibration levels at 80 km would meet the daytime criteria at the edge of the right-of-way.

Thus, haul truck-induced vibration levels are expected to be imperceptible at all vibration sensitive receptors. The potential for truck-induced vibration impacts for all alternatives is low.

Table 2: Potential for Transportation-Induced Vibration Impacts For The Proposed Alternative Haul Routes

Criteria	Indicators	Alternative Haul Route 1	Alternative Haul Route 2	Alternative Haul Route 3	Alternative Haul Route 4	Alternative Haul Route 5
Vibration impact on community	Number of residences likely to experience vibration impacts as a result of increased truck traffic.	Low	Low	Low	Low	Low

5. RECOMMENDATIONS

Vibration mitigation is not required. Perceptible vibration from heavy truck pass-bys on the proposed haul routes is not anticipated, and impacts from ground-borne noise are not predicted.

REFERENCES

U.S. Department of Transportation – Federal Transit Administration (FTA), Report No. FTA-VA-90-1003-06, *Transit Noise and Vibration Impact Assessment*, May 2006.

APPENDIX A

CROSS-SECTION DESIGN AND ANALYSIS

For this study two types of cross-sections are proposed: rural (requires property acquisition) and urban (within the existing right-of-way). For the purpose of the analysis the rural cross-section was applied as it has the most significant impacts due to property acquisition and was therefore deemed more conservative. However, given the challenges that can be associated with land acquisition, the urban design that fits the existing right-of-way was also given consideration. It was concluded that this design would not require land acquisition however it would have a more significant impact on the existing character of the road and has a higher associated cost of construction.

Figure 1, Figure 2, Figure 3, and Figure 4 illustrate the proposed road bed design and shows rural and urban alternative cross-sections for both Type 1 and Type 3 sections.

Type 1

With the rural cross-section the proposed right-of-way is 2.0m greater than the existing 20m right of way. This cross-section allows for 3.75m travel lanes, 1.0m paved shoulder, 0.5m gravel shoulder, 0.5m rounding, and a drainage ditch.

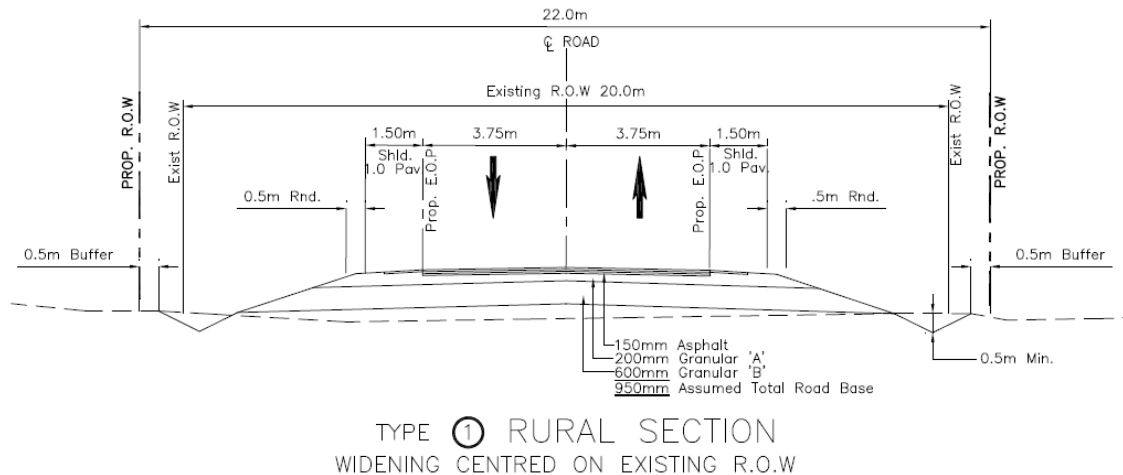


Figure 1: Type 1 Rural Cross-Section

With the urban cross-section the proposed right-of-way fits into the existing 20m right-of-way. The cross-section allows for 3.75m travel lanes, and a 1.5m paved shoulder with curb and gutter.

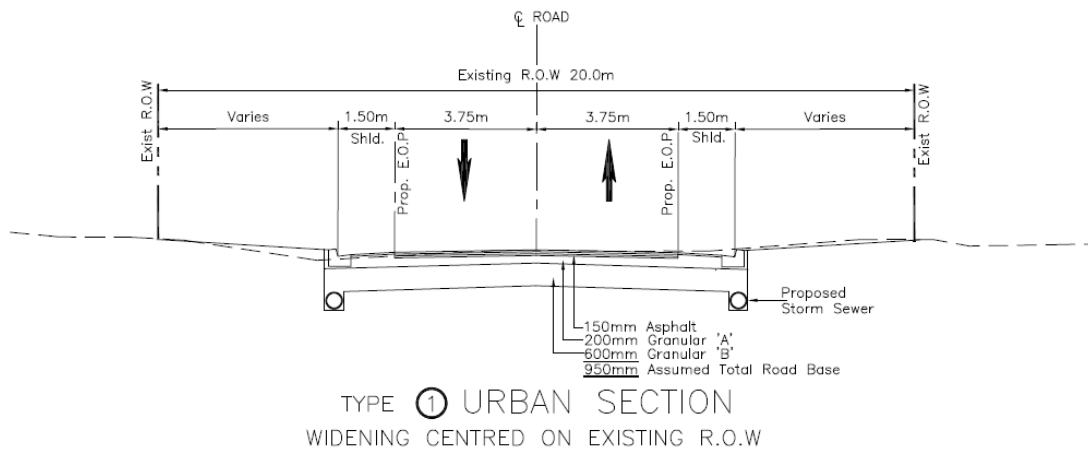


Figure 2: Type 1 Urban Cross-Section

Type 3

With the rural cross-section the proposed right-of-way is 3m to 7.5m greater than the existing right-of-way depending on the varying existing cross-section. This cross-section allows for 3.75m travel lanes, 1.0m paved buffer, 1.5m paved bike lane, 1.0m gravel shoulder, 0.5m rounding, a drainage ditch and a 0.5m buffer.

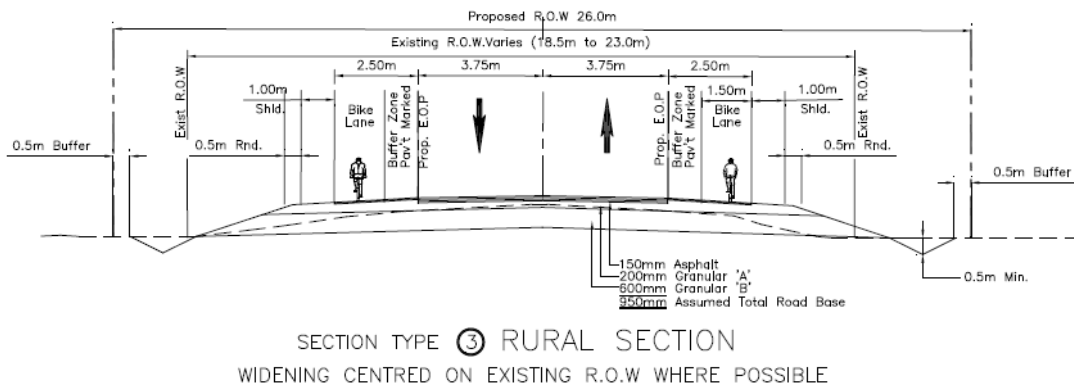


Figure 3: Type 3 Rural Cross-Section

With the urban cross-section the proposed right-of-way can be fit into the existing right-of-way that varies from 18.5m to 23m. The cross-section allows for 3.75m travel lanes, a 1.0m paved buffer, a 1.5m paved bike lake, and curb and gutter with a minimum boulevard of 3m.

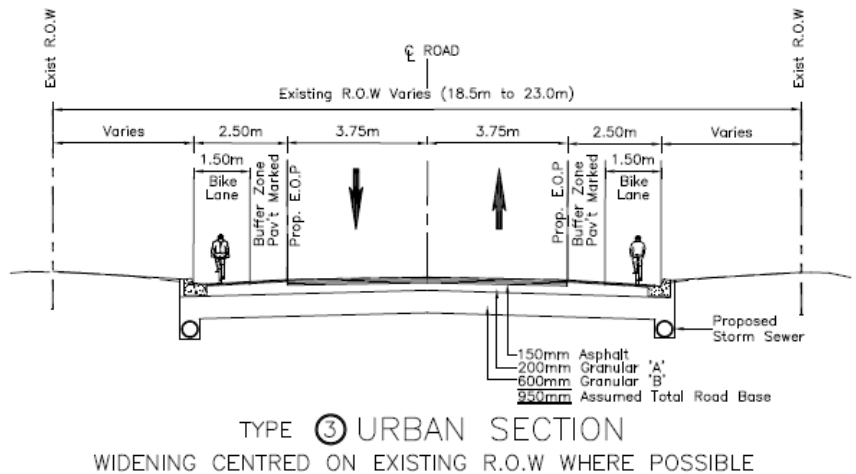


Figure 4: Type 3 Urban Cross-Section

It is important to note that both Type 1 and Type 3 section designs do not account for any changes in the existing profile and assume that widening is at existing profile grade.

While the urban cross-section fits into the existing right-of-ways, the storm sewer infrastructure and appurtenances increase the construction costs approximately 50 percent over the rural design. It is a trade off between the cost (and challenge) of purchasing land and constructing a more expensive infrastructure.

Applying the rural cross-section that would require land acquisition is a conservative approach for haul route comparative evaluation purposes. The decision on which cross-section to move forward with would be decided at the detailed design stage of an Environmental Assessment when pavement recommendations are finalized. Typically, resolution of the design details would occur during the subsequent Municipal Class EA process.