Ontario Ministry of Transportation

Highway 17 Planning & Class EA Study
Noise Review
GWP 5670-10-00

Prepared by:

AECOM
5600 Cancross Court, Suite A 905.501.0641 tel
Mississauga, ON, Canada L5R 3E9 905.501.0181 fax
www.aecom.com

Project Number:

60241599

Date:

July, 2014

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
2	X	Ministry of Transportation

Revision Log

Revision #	Revised By	Date	Issue / Revision Description

AECOM Signatures

Report Prepared By:

James Au, P.Eng., INCE
Acoustic Engineer

Report Prepared By:

Brian Bulnes, EIT
Acoustic Engineering Intern

Report Reviewed By:

Alex Dundon, P.Eng., INCE, MIEAust
Senior Acoustic Engineer

Executive Summary

The Ontario Ministry of Transportation has retained AECOM to undertake a Class Environmental Assessment to identify a recommended plan for a four-lane Highway 17 within the study limits with access restricted to interchange locations.

The planning alternatives included segments of widening/improving the existing highway and segments of realigned highway, with interchanges at key connection points and new service roads for some areas. In the Rutherglen and Amable du Fond areas, widening of the existing highway is not possible due to physical constraints and environmental conditions. Therefore, realignment alternatives were generated for these two areas while widening alternatives were generated for the Pimisi Bay and Pautois Creek areas. The evaluation of highway planning alternatives was completed on a comparative basis for each of the four highway realignment and widening alternative areas (with associated interchanges and service roads) and a recommended plan was identified in January 2014, prior to this assessment being conducted.

A detailed noise assessment was completed for the recommended plan which includes improvements to Highway 17 from an undivided two lane highway to a four lane controlled access divided freeway along a new alignment.

According to noise predictions, the proposed changes to Highway 17 would result in medium to high changes in noise level perception at several nearby receptors (e.g. residences) due to the realigned portions of the highway, which are primarily in greenfield areas. The noise assessment has been completed using predicted 2035 traffic volumes.

At one location (R18), a noise barrier appears to be warranted based on MTO policy. The necessity for noise mitigation, (as presented in Section 4.2), is recommended for further exploration and examination during detail design for one receptor (R18) where initial analysis indicates that:

- The increase in noise caused by the recommended plan at this location is greater than 5 dB;
- A noise barrier at this location with a height of 5 metres and a length of 28 metres would meet the minimum noise reduction requirement of 5 dB; and
- A noise barrier is considered economically feasible because the barrier cost per household is less than the MTO rule of thumb ‘ballpark’ cost limit of $100,000 per receptor.

Noise resulting from construction of the recommended plan varies based upon a variety of factors such as time and location of operation, size and concurrent use of equipment, and staging of construction. As equipment information is only available from the contractor that is awarded the construction contract, general recommendations to minimize the impact of construction noise have been provided.

Table of Contents

List of Figures

List of Tables

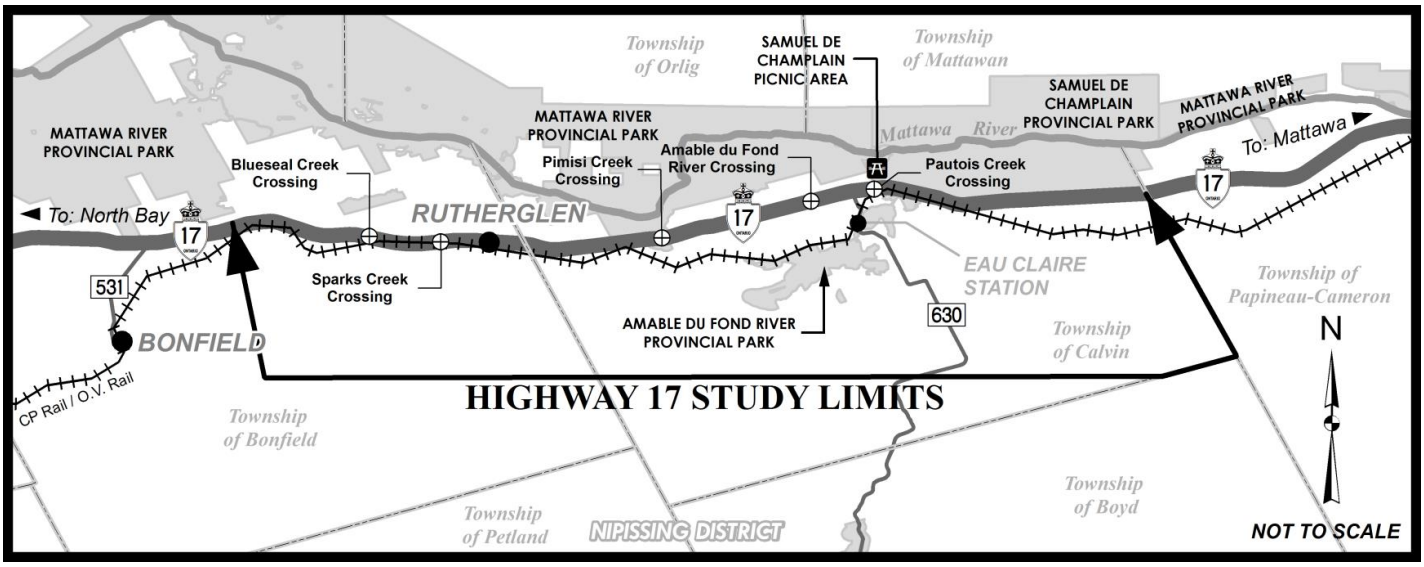
Appendices

Appendix A: Recommended Plan
Appendix B: Area of Investigation
Appendix C: Detailed Assessment Receptor Locations
Appendix D: Zoning Plan
Appendix E: Proposed Noise Barriers
Appendix F: Traffic Data
Appendix G: Traffic Noise Calculations

1. Introduction

The Ontario Ministry of Transportation has retained AECOM to undertake a Class Environmental Assessment to identify a recommended plan for a four-lane Highway 17 within the study limits with access restricted to interchange locations. The study limits are shown in **Figure 1.1** below and involve a 23.5 km section of Highway 17 from Bonfield easterly to the boundary road between the Townships of Calvin and Papineau-Cameron.

Figure 1.1: Class EA Study Limits



Within the Study Area, Highway 17 is primarily a two lane highway with limited access restrictions and access in both directions provided via private driveways and local roadways. This planning, preliminary design and Class EA study has been completed to identify a preferred plan for Highway 17 to improve future traffic operations and to enhance highway safety from Bonfield to the boundary road of Calvin Township and the Township of Papineau-Cameron.

As outlined in the Study Design Report (AECOM 2012) for this project, the study involved the development and evaluation of a range of alternatives which could address the transportation needs of the study area. Specifically, the alternatives considered included:

- widened/improved provincial highway;
- realigned provincial highway; and
- combinations of the above.

The cross section for the highway is a freeway with two lanes in each direction and a 30m median within a total right-of-way width of 110m, and access restricted to interchanges. Highway planning alternatives were generated within the Study Area and in consideration of the environmental constraints. The planning alternatives included segments of widening/improving the existing highway and segments of realigned highway, with interchanges at key connection points and new service roads for some areas. In the Rutherglen and Amable du Fond areas, widening of the existing highway is not possible due to physical constraints and environmental conditions. Therefore, realignment alternatives were generated for these two areas while widening alternatives were generated for the Pimisi Bay and Pautois Creek areas. The evaluation of highway planning alternatives was completed on a comparative basis for

each of the four highway realignment and widening alternative areas (with associated interchanges and service roads) and a recommended plan was identified in January 2014 as shown in **Appendix A**.

The purpose of this report is to document the detailed noise assessment undertaken for the recommended plan to identify noise impacts and potential noise mitigation.

2. Environmental Highway Traffic Noise Guidelines

2.1 Criteria

This assessment has been completed in accordance with the requirements stipulated in MTO's *Environmental Guide for Noise* (the Guide) published in 2006.

Under the Guide, the "noise impact" is defined as the difference between the "No Project" and the "With Project" noise levels during the subject year of assessment (Horizon Year), which is typically 10 years post-construction.

The Guide requires that the most exposed side of a dwelling unit be assessed as part of an initial screening. If the initial screening indicates that noise mitigation investigation is required, the point of assessment for determining the noise mitigation requirements is the Outdoor Living Area (OLA).

The OLA can be situated on any side of a noise sensitive area which accommodates outdoor living activities, and is generally taken to be the backyard. For this assessment, the location has been taken as 3 metres from the façade with a height of 1.2 metres above ground level.

The criteria for investigating potential noise mitigation are based on both the noise impact and the overall noise level due to the project. These criteria are outlined in **Table 2.1**.

Table 2.1: MTO Criteria for Investigation of Noise Mitigation

Change in Noise Level Above Future Ambient[1]/Projected Noise Levels with Proposed Improvements	Mitigation Effort Required
< 5 dB Change AND <65 dBA Overall	• None
≥ 5 dB Change OR ≥ 65 dBA Overall	• Investigate noise control measures on right of way • Introduce noise control measures within right of way and mitigate to ambient if technically, economically, and administratively feasible. • Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation, over first row receivers.

The Guide recognizes that an important assessment criterion for the existing dwellings is the change in noise level above ambient sound levels. **Table 2.2** complements the Guide by providing the perceived impact of changes in sound level.

[1] *Noise impact*

Table 2.2: Perceived Impact of Increased Sound Levels[2]

Increased Sound Level Above Ambient (dB)	Perception	Perceived Impact
0 to 3	Potentially Perceptible	Minor
3 to 5	Perceptible	Low
5 to 10	Up to twice as loud	Medium
Greater than 10	Twice as loud or greater	High

2.2 Noise Sensitive Areas

Predicted noise levels are assessed at noise sensitive areas. Land uses designated as noise sensitive by the MTO *Environmental Guide for Noise* consist of the following:

- Private homes such as single family residences (the only applicable land use for this study)
- Townhouses
- Multiple unit buildings, such as apartment buildings with OLAs for use by all occupants
- Hospitals, nursing homes for the aged, where there are OLAs for the patients

Land uses that do not qualify as noise sensitive by the MTO *Environmental Guide for Noise* consist of the following:

- Apartment balconies above ground floor
- Educational facilities (except dormitories with OLAs)
- Churches
- Cemeteries
- Parks and picnic areas which are not inherently part of a NSA
- Daycare centres
- All commercial and industrial areas

[2] *Adapted from "*Engineering Noise Control, Theory and Practice*" 4th edition, David A. Bies and Colin H. Hansen, 2009*

3. Assessment of the Recommended Plan – Methodology

Several options, including the Do Nothing option, were considered early in the Environmental Assessment process and were eliminated from further consideration as these options did not address the long term operational safety and capacity goals (2035 subject year of assessment) for the highway and therefore did not address the objectives of the project. The assessment of the recommended plan was based on the predicted overall noise level and the noise impact, which is defined as the noise level difference between:

- No Project – no changes to the existing road configuration.
- With Project – a four lane divided controlled access freeway along a widened / realigned alignment, replacing the existing Highway 17. The recommended plan for the highway is shown in **Appendix A**.

3.1 Traffic Data

The road traffic data is summarized in **Table 3.1.1**. The road improvements for this project are planned to improve the safety along the highway within the study limits and increase the long term traffic capacity. The total traffic volume for both the No Project and With Project options are the same. Given that the With Project option sees the highway divided and a wide median implemented, the total traffic volume was equally divided to reflect the two directions of travel on the widened/realigned highway. The traffic volumes were not divided for the No Project option as the lanes of travel are immediately adjacent to one another. All road traffic data referenced below is provided in **Appendix F**.

Table 3.1: Traffic Data[3]

Source	No Project (2035)				New Alignment (2035)				General Characteristics		
	SADT	%M.T.	%H.T.	Speed Limit (kph)	SADT	%M.T.	%H.T.	Speed Limit (kph)	Grade %	Pavement Type	Day/Night Split
Existing Highway Alignment	10200	5.77	9.23	90	-	-	-	-	<2	1	85/15
New Highway Alignment EB	-	-	-	-	5100	5.77	9.23	100	<2	1	66/33
New Highway Alignment WB	-	-	-	-	5100	5.77	9.23	100	<2	1	66/33

3.2 Area of Investigation

The area of investigation was determined by creating 5 dB contour lines from the proposed project to where there is no predicted increase over the future ambient noise levels. The approved prediction methodology in the Guide (Ontario Road Noise Analysis Method for Environment and Transportation – ORNAMENT) is a receptor based prediction methodology, using text inputs and outputs to create a separate model for each receptor. This does not lend itself to creating noise contours.

To generate noise contours, a graphical noise prediction software (CADNA/A), implementing a different prediction methodology (ISO 9613-2), was calibrated to approximate ORNAMENT results. A variation of only +/- 1dB is expected over typical gentle sloping terrain. Topography was not incorporated into the generation of the noise contours as the prediction models differ too greatly in terms of topography effects on noise prediction; because the

[3] *SADT – Summer Average Daily Traffic*
%M.T. – Medium Truck Percentage
%H.T. – Heavy Truck Percentage

purpose of the noise contours is to identify the areas requiring detailed assessment, where established criteria is potentially met and/or exceeded.

The noise contours are presented in Appendix B, with the areas requiring a detailed assessment using the approved STAMSON prediction methodology presented in Section 3.3.

The Study Area can be classified as a Class 3 rural area as per the definitions provided in various Ministry of the Environment Ontario (MOE) noise guidelines. Where no dominant sources of noise exist, the Guide suggests an ambient noise level of 45 dBA for Class 3 areas. Therefore, the future No Project ambient noise levels in the Study Area were taken as the greater of 45 dBA or the future No Project noise levels due to the existing roadways.

3.3 Areas Requiring Detailed Assessment

A review of the Study Area and the noise contours prepared as described in the above section indicates that there are several noise sensitive areas north and south of the alignment that require a detailed noise assessment. The noise sensitive areas consist of several single residences and a group of three residences in one area.

Eighteen assessment locations have been identified as representative of the worst case noise sensitive locations. These locations are detailed in **Table 3.2** and on the plan provided in **Appendix C**, with zoning plans provided in **Appendix D**.

Table 3.2: Assessed Noise Sensitive Locations

Assessment Location	Description	Receptors Represented
R01	South of Highway 17, 1.02km from Highway 17 and Trout Pond road intersection.	Group of three residences
R02	South of Highway 17, 414 metres east along Trunk road from Trunk and Fichault road intersection, and 146 metres north of trunk road.	Single residence
R03	South of Highway 17, 597 metres east along Trunk road from Trunk and Fichault road intersection, and 24 metres south of Trunk road.	Single residence
R04	South of Highway 17, 818 metres right from Trunk and Fichault road intersection, and 98 metres north of Trunk road.	Single residence
R05	South of Highway 17, 939 metres east along Trunk road from Trunk and Fichault road intersection, and 142 metres south of Trunk road.	Single residence
R06	South of Highway 17, 384 metres west along Trunk road from Trunk and McNutt road intersection, and 45 metres north of trunk road.	Single residence
R07	South of Highway 17, 286 metres west along Trunk road from Trunk and McNutt road intersection and 106 metres south of Trunk road.	Single residence
R08	South of Highway 17, 392 metres south along McNutt road from Trunk and McNutt road intersection and 220 metres west of McNutt road.	Single residence
R09	South of Highway 17, 750 metres along McNutt road southeast of Trunk and McNutt road intersection.	Single residence
R10	South of Highway 17, 1.02 km southeast along Rutherglen line from Trunk road and Rutherglen line intersection.	Single residence
R11	55 metres south of Highway 17, 767 metres west from Highway 17and Columbia road intersection along Highway 17.	Single Residence
R12	35 metres north of Highway 17, 407 metres east from Highway 17 and Columbia road intersection along Highway 17.	Single Residence

Assessment Location	Description	Receptors Represented
R13	100 metres north of Highway 17, 1.69 km west from the Highway 17 and Highway 630 intersection along Highway 17.	Single Residence
R14	493 metres south of Highway 17, along Highway 630, and 90 metres east from Highway 630.	Single Residence
R15	South of Highway 17, 118 metres along Suzanne road, east of the Suzanne and Donalds road intersection.	Single Residence
R16	322 metres south of Highway 17, 1.58 km west from the Highway 17 and Champlain Provincial Park road intersection along Highway 17.	Single Residence
R17	300 metres south of Highway 17, 1.32 km west from the Highway 17 and Champlain Provincial Park road intersection along highway 17.	Single Residence
R18	112 metres south of Highway 17, 548 metres east from the Highway 17 and Boundary road intersection along Highway 17.	Single Residence

3.4 Noise Prediction Procedure

As set out in the Guide, traffic noise levels were calculated using the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) method, implemented in the STAMSON (version 5.04) software.

The prediction model inputs include the following considerations:

- Road traffic data (see **Section 3.1**)
  - Volumes
  - Speed limit
  - Vehicle composition (percentage Medium and Heavy Trucks)
- Ground characteristics
  - Roadway surface type (e.g. Asphalt, concrete)
  - Ground topography
  - Ground type between assessment locations and roadways
  - Roadway layout
- Shielding effects
  - Berms
  - Barriers
  - Housing

The traffic data used in the assessment of the recommended plan is described in **Section 3.1**.

As this project involves the widening and realignment of existing Highway 17 to a freeway cross section, the assessment of the noise levels was based on the 24 hour equivalent sound level ($L_{eq, 24hr}$) as required by the Guide. To assess the noise impact, the predicted “No Project” noise levels (year 2035) were compared to those of the predicted “With Project” noise levels (year 2035).

As required in the Guide, noise levels on the most exposed side of a noise sensitive land use were calculated to determine if a noise mitigation investigation would be required. If a noise investigation was required, the noise levels were assessed at the OLA location, which is the point of assessment for noise mitigation as noted in the Guide.

The modeling assumed a typical asphalt road surface would be used. If a concrete road surface is used, the With Project noise levels are expected to be up to approximately 3 dB higher than those levels detailed below.

4. Assessment of the Recommended Plan – Results and Recommendations

4.1 Results

Table 4.1 shows the predicted future "No Project" and "With Project" noise levels, as well as the resulting change in noise levels due to the recommended plan. Also shown in **Table 4.1** is the perception of the noise impact and the requirement for noise mitigation investigation. Calculation inputs are provided in **Appendix G**.

As indicated in **Section 3.2**, the Study Area can be classified as a Class 3 rural area as per the definitions provided in various Ministry of the Environment Ontario (MOE) noise guidelines. Where no dominant sources of noise exist, the Guide suggests an ambient noise level of 45 dBA for Class 3 areas. Therefore, the future No Project ambient noise levels in the Study Area were taken as the greater of 45 dBA or the future No Project noise levels due to the existing roadways.

Table 4.1: Noise Assessment Results – Most Exposed Side

Location	Projected Future Overall Traffic Noise $L_{eq,24hr}$ (dBA)		Projected Future Noise Impact		Mitigation Investigation Requirement	
	No Project	With Project	Change (dB)	Perception	≥65 dBA	≥5 dB impact
R01	45.0	48.1	3.1	Low	No	No
R02	45.0	50.9	5.9	Medium	No	Yes
R03	45.0	52.0	7	Medium	No	Yes
R04	45.0	58.6	13.6	High	No	Yes
R05	45.0	50.9	5.9	Medium	No	Yes
R06	50.3	52.5	2.2	Minor	No	No
R07	45.0	50.3	5.3	Medium	No	Yes
R08	45.0	58.3	13.3	High	No	Yes
R09	45.0	51.1	6.1	Medium	No	Yes
R10	45.0	55.7	10.7	High	No	Yes
R11	59.1	66.7	7.6	Medium	Yes	Yes
R12	64.3	57.3	-	-	No	No
R13	56.7	53.3	-	-	No	No
R14	48.1	61.0	12.9	High	No	Yes
R15	45.0	50.4	5.4	Medium	No	Yes
R16	48.7	56.5	7.8	Medium	No	Yes
R17	49.6	57.6	8.0	Medium	No	Yes
R18	56.4	61.9	5.5	Medium	No	Yes

The noise level limit of 65 dBA is exceeded at one of the assessed locations (R11) and the noise impact exceeds the 5 dB criterion at the majority of the assessed areas (R02 through R05, R07 through R11 and R14 through R18). Noise mitigation investigation was therefore required for the OLAs of 14 assessed locations. The mitigation investigation is described in the following section.

4.2 Noise Mitigation Investigation

As required by the Guide, the OLA is the point of assessment for noise mitigation investigation; in the case of this project the OLAs are located on the most exposed side of the assessed locations.

Further investigation has been conducted to determine the feasibility of mitigating noise from the project. As per the Guide, noise mitigation must provide an average of at least 5 dB of attenuation over the first row of receptors. It is MTO's position, based upon their experience, that noise barriers with heights greater than 5 metres are considered impractical from cost and constructability standpoints. A summary of noise barrier performance is provided in **Table 4.2**.

Table 4.2: Predicted Noise Reduction by Noise Barrier

Assessment Locations (see Table 4.1 for Investigation Requirement)	Projected Future Overall Traffic Noise $L_{eq,24hr}$ (dBA)		Noise Reduction (dB)	Achieves 5 dB Reduction
	Unmitigated	Mitigated		
R02	50.9	45.2	5.7	Yes
R03	52.0	47.2	4.8	No
R04	58.6	53.3	5.3	Yes
R05	50.9	45.6	5.3	Yes
R07	50.3	49.6	0.7	No
R08	58.3	54.6	3.7	No
R09	51.1	51.1	0.0	No
R10	55.7	50.7	5.0	Yes
R11	66.7	66.7	0.0	No
R14	61.0	60.4	0.6	No
R15	50.4	50.4	0.0	No
R16	56.5	56.5	0.0	No
R17	57.6	57.6	0.0	No
R18	61.9	56.9	5.0	Yes

The above results indicate that a noise barrier with a height of 5 metres would meet the minimum noise reduction requirement of 5 dB for receivers R02, R04, R05, R10, and R18. Noise barriers providing the minimum 5 dB reduction requirement were consolidated to produce recommendations and approximate costing. This is summarized in **Table 4.3**.

Table 4.3: Resultant Noise Barriers and Approximate Costing

Assessment Locations	Receptors with 5 dB Reduction	Barrier Height (m)	Barrier Length (m)	Barrier Cost ($)	Approx. Cost/Receptor($)	Considered Economically Feasible
R02	1	5	669	1,672,500	1,672,500	No
R04	1	5	253	632,500	632,500	No
R05	3	5	2544	6,360,000	2,120,000	No
R10	1	5	59	147,500	147,500	No
R18	1	5	28	70,000	70,000	Yes

Per MTO policy, although the noise caused by the recommended highway plan is ≥5 dB, noise mitigation is not feasible for:

- Receptors R03, R07, R08, R09, R11, R14, R15, R16, and R17, as these barriers do not meet technical feasibility requirements of reducing noise levels by a minimum 5 dB (see **Table 4.2**).
- Receptors R02, R04, R05 and R10, as barriers are not considered economically feasibility as the barrier cost per household exceeds the MTO rule of thumb 'ballpark' cost limit of $100,000 per receptor (see **Table 4.3**).

Per MTO policy, a noise barrier at R18 appears to be warranted because:

- The increase in noise caused by the recommended plan at this location is ≥5 dB impact (see **Table 4.1**);
- At this location a noise barrier with a height of 5 metres would meet the minimum noise reduction requirement of 5 dB (see **Table 4.2**); and
- It is considered economically feasible because the barrier cost per household is less than the MTO rule of thumb 'ballpark' cost limit of $100,000 per receptor (see **Table 4.3**).

The necessity for noise mitigation for receptor R18 is recommended for further exploration and examination during detail design once the horizontal and vertical alignment of the new highway has been developed in greater detail and the property acquisition process for this receptor is complete.

Noise mitigation recommendations at this stage of the project are preliminary in nature and should be reviewed further during the detailed design phase of this project and in consideration of the outcome of the property acquisition process.

5. Construction Noise

5.1 Municipal Noise Control By-Laws

The Township of Bonfield sets out noise restrictions and requirements in Noise Control By-Law 86-6. As with most municipal guidelines, the By-law is directed mainly at typical residential and commercial concerns and addresses those concerns in a qualitative manner. Relevant portions of the By-law are as follows:

- Operation of any item of motor vehicle, motorcycle, or any other vehicle whatsoever without effective muffling devices in good working order and in constant operation is prohibited.
- The discharge of exhaust from any steam engine, stationary internal combustion engine, motor vehicles or motorcycles, except through a muffler or other device which prevents loud or explosive noise is prohibited.
- Noise created by any vehicle which beats material, articles, or objects loaded on such vehicle in a manner calculated to disturb the repose of residence between 9:00 PM and 6:00 AM on the following day is prohibited.

The Township of Calvin does not currently have a noise By-law or policy.

In past projects, MTO has provided a public notice to all affected residents within a 500 metre radius of the project limits. The notice has been delivered approximately 3-4 weeks prior to overnight construction activities and included the following information:

- General information regarding the anticipated construction activities
- The address (if available) or general area where the activity will take place
- The start and end date, and time of the activity
- The sources of the noise
- Methods of noise reduction
- A contact name/business or organization's name, address and phone number, email and fax.

Notification was also provided to the local councillors within the Project Area.

5.2 Construction Noise Control Recommendations

The Guide requires that the noise study documentation address the following for construction noise:

- Analysis of construction noise impacts and requirements for special provisions
- Identification of Noise Sensitive Areas
- Identification of municipal noise control By-laws
- Need to obtain noise By-law exemptions
- An explanation of any hardships to MTO caused by municipal noise control By-laws
- Construction noise complaint process

The severity of construction noise impact at Noise Sensitive Areas is dependent on various factors such as time and location of operation, size and concurrent use of equipment, and staging of construction. As equipment information is only available from the contractor awarded the construction contract, general recommendations relating to the management of construction noise are provided as follows:

- Adhere to applicable local By-laws. Where adherence to the local By-laws is not possible and mitigation is not feasible, an exemption should be obtained from the municipality before construction.

- Avoid construction activity during the night time, where not required, to reduce the potential impact of construction noise.
- Construction equipment noise emissions should comply with MOE guidelines NPC-115 and NPC-118.
- Contract documents provided to the contractor should contain general noise control measures to mitigate the noise impact at noise sensitive areas including two standard clauses regarding equipment noise:
    - Unnecessary noise caused by faulty or non-operating components must be addressed by regularly maintaining all equipment.
    - Duration of construction equipment idling is to be restricted to the minimum time necessary to complete the specified task.
- A noise complaint process may be set in place.
- Provide a public notice to all affected residents within a 500 metre radius of the project limits when overnight construction activities are to occur. The notice is to be delivered at least 3 weeks prior to the overnight construction activities and shall include the following information:
    - General information regarding the anticipated construction activities
    - The address (if available) or general area where the activity will take place
    - The start and end date, and time of the activity
    - The sources of the noise
    - Methods of noise reduction
    - A contact name/business or organization's name, address and phone number, email and fax.
- Provide notification to the local councillors within the Project Area.

Noise sensitive areas for the construction phase of this project will be the same as the noise sensitive areas included in the assessment of traffic noise impacts in the above sections.

A review of the Township of Bonfield Noise Control By-law (86-6) has been completed for sections relevant to this project. As with most municipal guidelines and By-laws, these By-laws are directed mainly at typical residential and commercial concerns. The Township of Calvin does not currently have a noise By-law or policy. The amalgamated relevant portions of the By-law are as follows:

- Operation of any item of motor vehicle, motorcycle, or any other vehicle whatsoever without effective muffling devices in good working order and in constant operation is prohibited.
- The discharge of exhaust from any steam engine, stationary internal combustion engine, motor vehicles or motorcycles, except through a muffler or other device which prevents loud or explosive noise is prohibited.
- Noise created by any vehicle which beats material, articles, or objects loaded on such vehicle in a manner calculated to disturb the repose of residence between 9:00 PM and 6:00 AM on the following day is prohibited.

The need for an exemption to the Township of Bonfield noise control bylaw, and confirmation that no such by-law is in place in the Township of Calvin should be determined during detail design for the project when a construction staging strategy has been developed. Construction infringing on the noise By-law should be discussed with the municipality and exemptions shall be sought if required.

An example noise complaint process is provided below:

- Any initial complaint from the public will require verification by the Ministry that all noise control measures to be applied are in effect. The Ministry will investigate any noise concerns, advise the contractor of any problems, and enforce its contract.
- Notwithstanding compliance with any noise control measures identified in the contract documents, a persistent complaint will require the Ministry to undertake a field investigation to determine noise level emissions. Where noise level emissions, for that construction equipment in use, exceed the sound level

criteria for construction equipment contained in the MOE Model Municipal Noise Control By-law, the Ministry shall require the contractor to comply with the sound level criteria where quieter alternative equipment is reasonably available. When this occurs, the Ministry shall pay the contractor for the costs incurred. Where a quieter alternative is not reasonably available, the equipment in use will be accepted.

6. Conclusions/Recommendations

The recommended plan involves improvements to Highway 17, upgrading it to a four lane controlled access freeway, from 2.2 km east of Highway 531 easterly and ending 8.0 km east of Highway 630. The recommended plan is expected to have a medium to high perceived noise impact at some noise sensitive receptors.

The necessity for noise mitigation, as presented in **Section 4.2**, is recommended for further exploration and examination during detail design for one receptor (R18) where initial analysis indicates that a barrier 5m high and 28m in length could address traffic noise levels from the widened /realigned Highway 17 at an approximate cost of $70,000.

Noise from the construction of the road widening varies based upon a variety of factors such as time and location of operation, size and concurrent use of equipment, and staging of construction. Much of this information is currently unavailable; therefore general recommendations to minimize the impact of construction noise have been provided in **Section 5.1**.

7. References

1. Ministry of Transportation Ontario, *MTO Environmental Guide for Noise*, October 2006.
2. ITE Journal, *Traffic Volume Adjustments for Impact Analysis*, James A. Bonneson, April 1987.
3. Ontario Ministry of the Environment, *Ontario Road noise Analysis Method for Environment and Transportation (ORNAMENT)*. Queen's Printer for Ontario, 1990.
4. Ontario Ministry of Environment, "Noise Assessment Criteria in Land Use Planning Publication LU-131", October 1997.
5. United States Federal Highway Administration, "*FHWA Traffic Noise Model Version 2.5"*, April 2004
6. The Corporation of the Township of Bonfield, *By-Law No. 86-6 – Being a By-Law to Control Noises in the Township of Bonfield*, 1986-05.

Appendix A

Appendix A: Recommended Plan

(Please refer to TESR Appendix A)

Appendix B

Appendix B: Area of Investigation

GEORGES ROAD
SHIELDS POINT ROAD
ROCK RIDGE LANE
TALON LAKE ROAD
TALON LAKE DAM RD
PINE LAKE ROAD
TROUT POND ROAD
HIGHWAY 17
VONDOELER ROAD
VON DOELER ROAD
TALON CRESCENT
MCNUTT ROAD
RUTHERGLEN LINE
COLUMBIA ROAD
MOREAU ROAD
TRUNK ROAD
TROUT POND ROAD
FICHAULT ROAD
DEVELOPMENT ROAD
FARMERS LINE
MOUNT PLEASANT ROAD

Design Legend
Highway 17 Design

N
W E
S

1:30,000
Kilometres
0 0.25 0.5 1 1.5
Co-ordinate System: NAD 1983 UTM Zone 17N

Legend

- Impacted Residences
- Residents within area of 5 Decibel Increase
- Residential Removals
- Area Residences
- Increase of 5 Decibels

Decibel Level
- 45 db
- 50 db
- 55 db
- 60 db
- 65 db

Highway 17
Bonfield to East of
Samuel de Champlain
Provincial Park

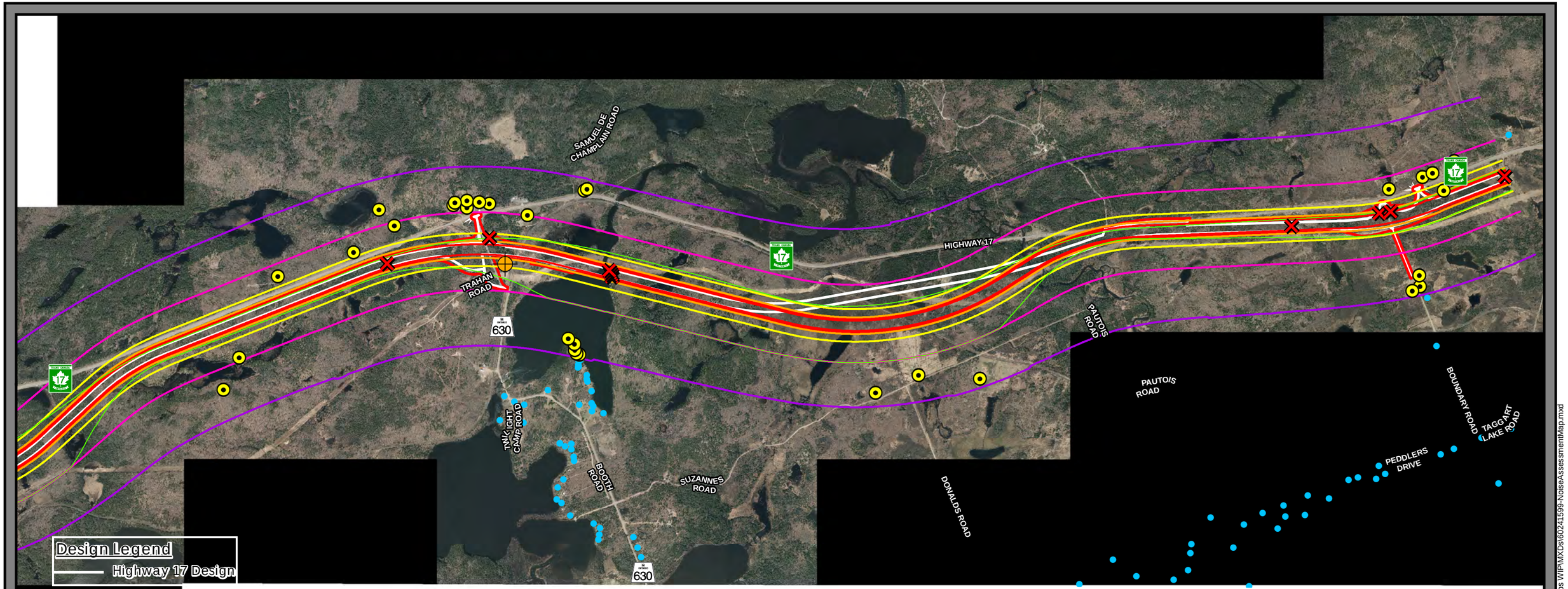
Noise Assessment Map

Ministry of Transportation Ontario
December, 2013

AECOM

60241599

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps\WIP\MXDs\60241599-NoiseAssesmentMap.mxd



N
W E
S

1:30,000

Kilometres

0 0.25 0.5 1 1.5

Co-ordinate System: NAD 1983 UTM Zone 17N

Legend

- Impacted Residences
- Residents within area of 5 Decibel Increase
- Residential Removals
- Area Residences
- Increase of 5 Decibels

Decibel Level

- 45 db
- 50 db
- 55 db
- 60 db
- 65 db

Highway 17
Bonfield to East of
Samuel de Champlain
Provincial Park

Noise Assessment Map

Ministry of Transportation Ontario
December, 2013

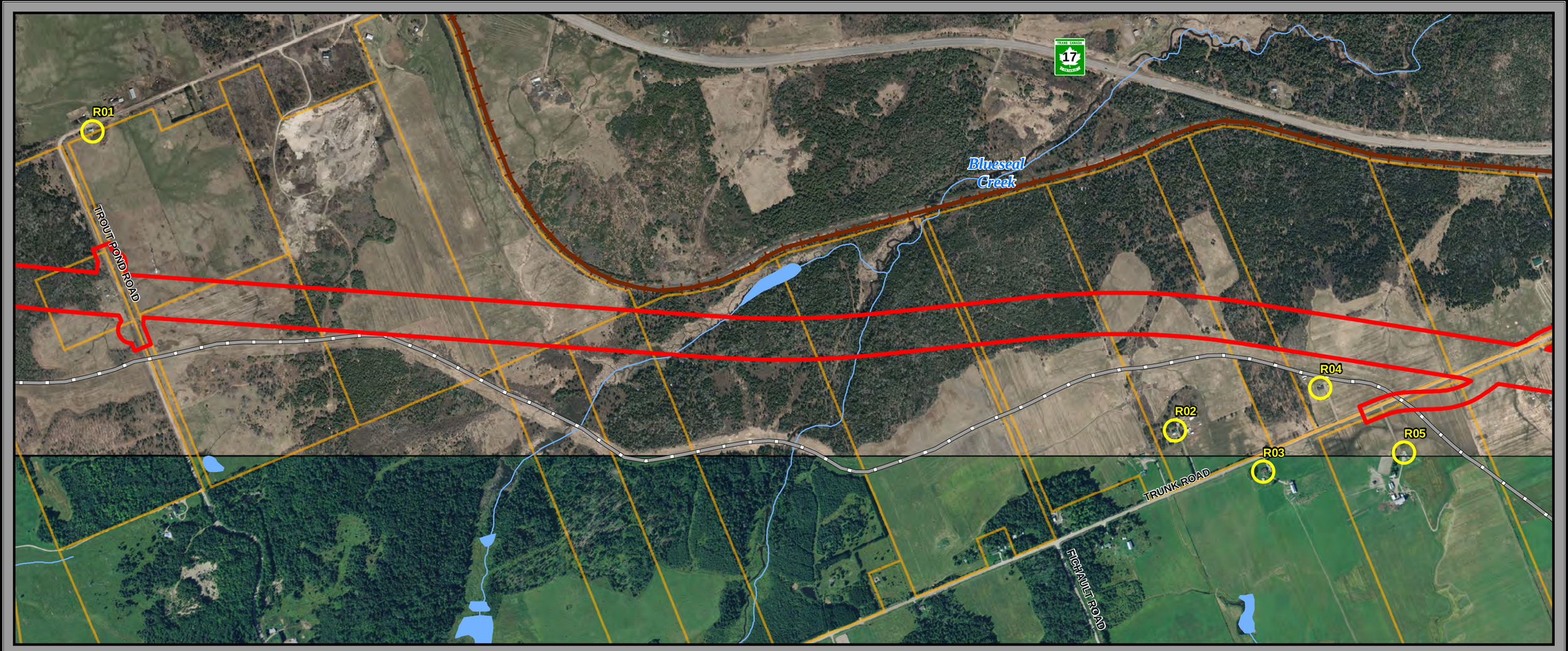
AECOM

60241599

Path: P:\60241599\400-Technical Information & Discipline Work in Progress\404-Socio-Economic-Land Use Maps VIP\MXDs\60241599-NoiseAssesmentMap.mxd

Appendix C

Appendix C: Detailed Assessment Receptor Locations



Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

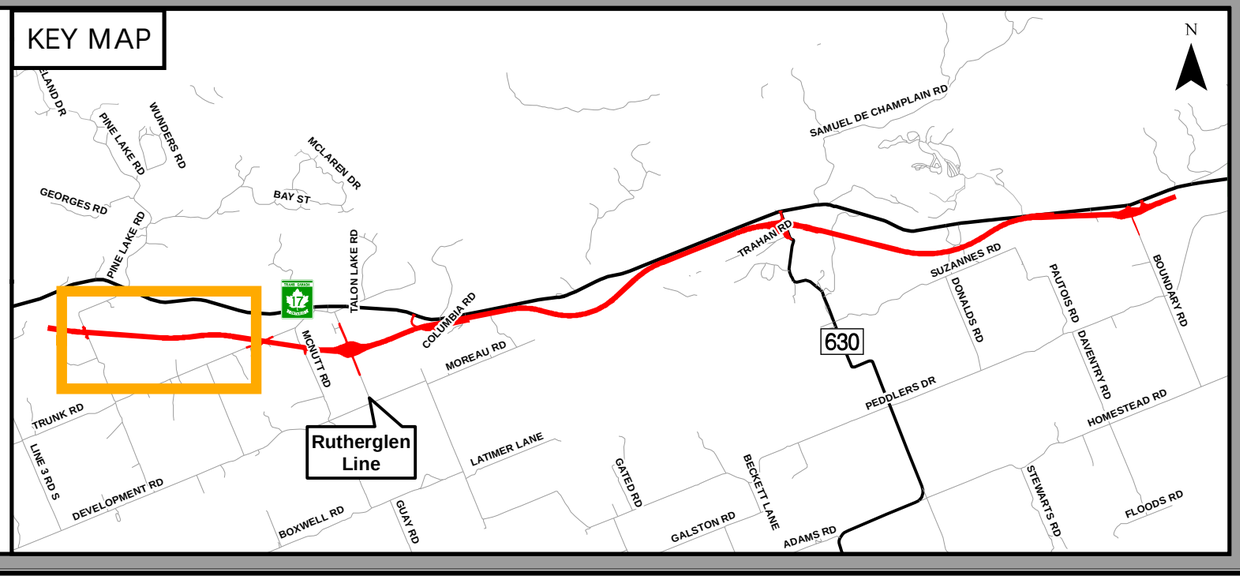
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

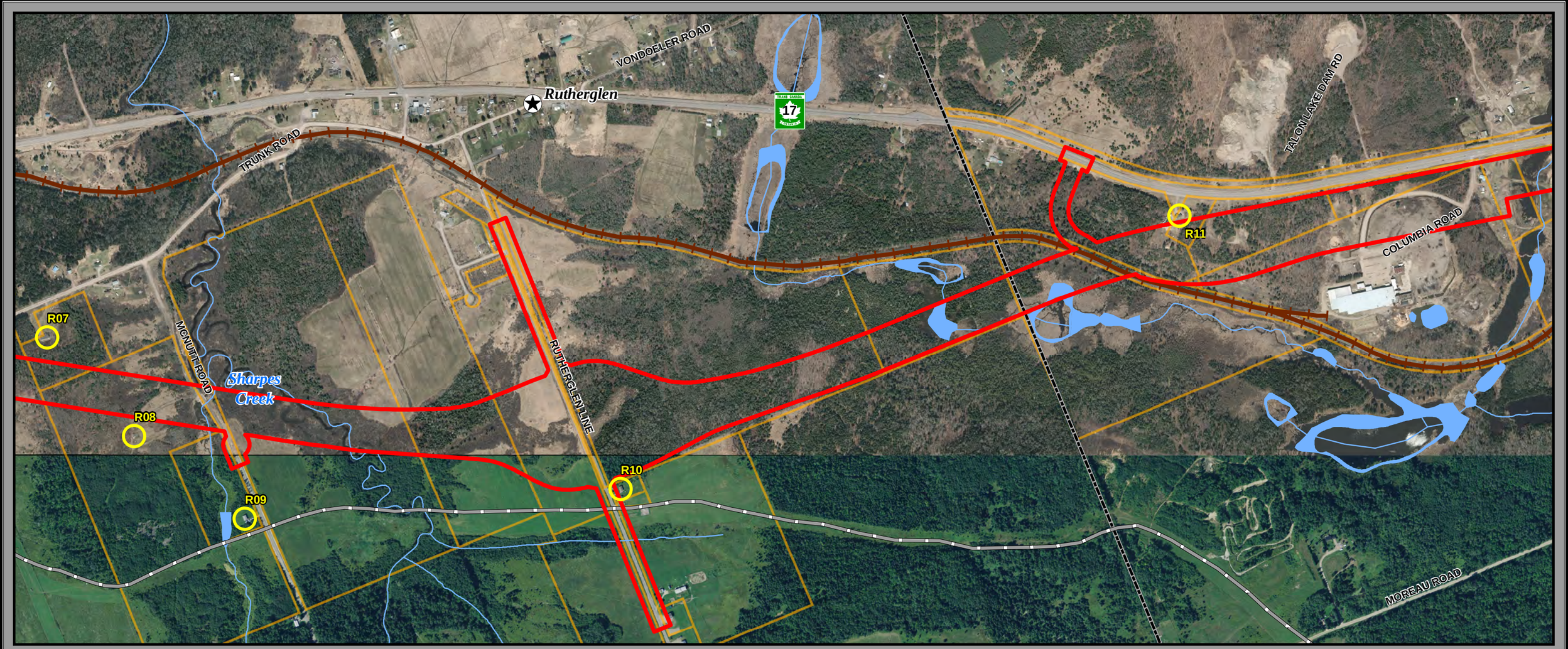
Noise Receptor Map: 1

Figure: 1

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps\WIP\MXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd



Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

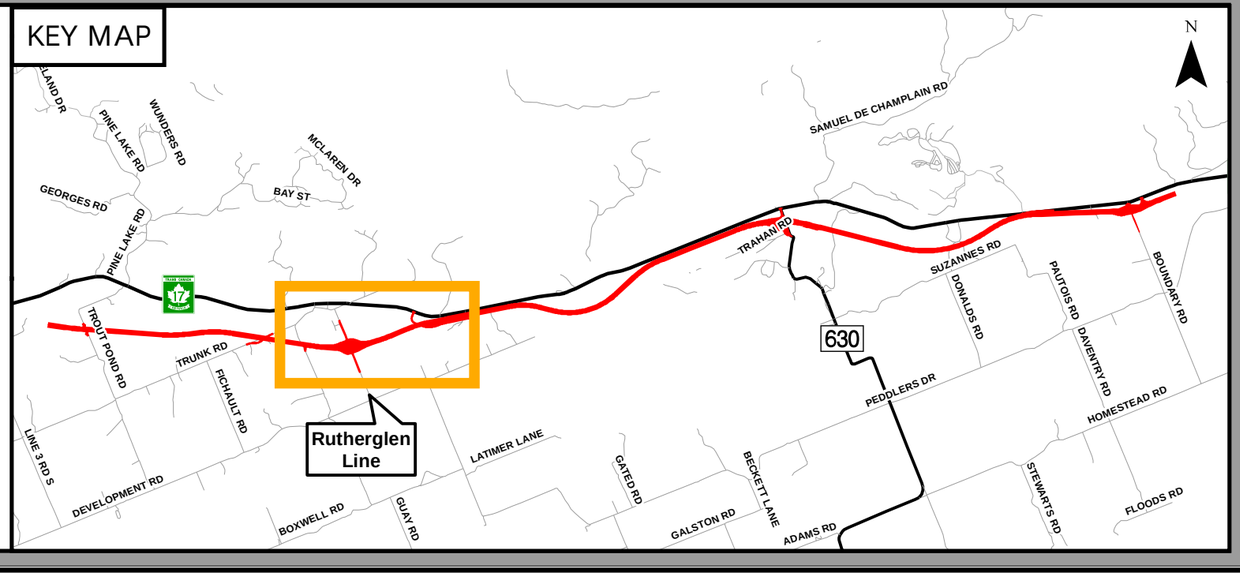
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor Map: 2

Figure: 1

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps WIP\MXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

MATTAWA RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

Mattawa River
(rivière
Mattawa)

TALON LAKE DAM RD

R12

COLUMBIA ROAD

MOREAU ROAD

Johnston
Lake

Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

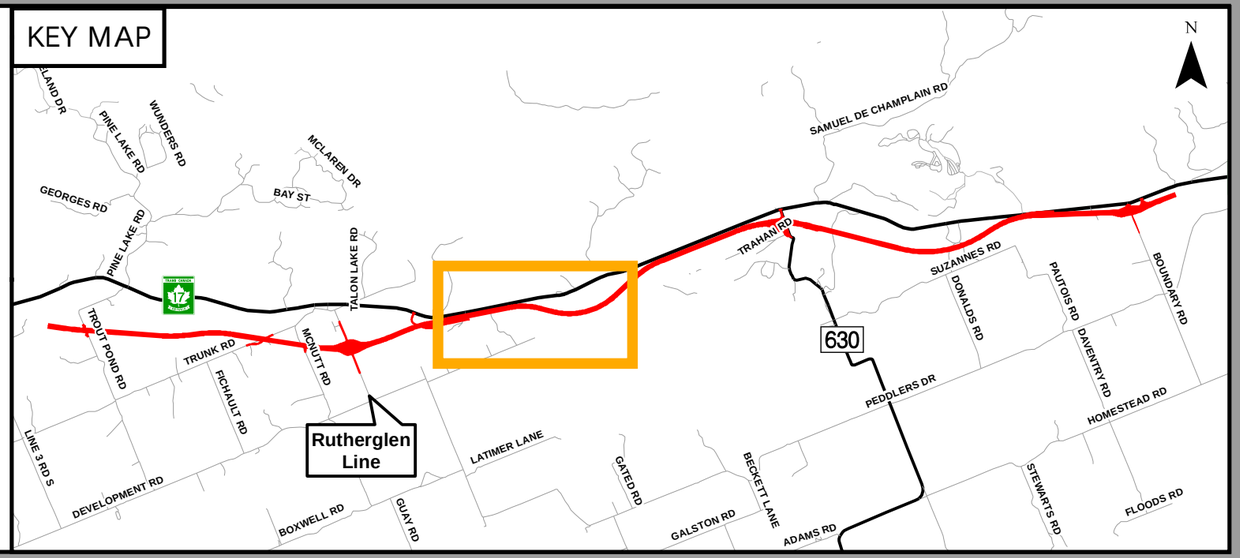
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor Map: 3

Figure: 1

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps\WIP\MXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

MATTAWA RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

SAMUEL DE
CHAMPLAIN
ROAD

SAMUEL DE
CHAMPLAIN
PROVINCIAL PARK

17

*Amable
du Fond River*

R13

R14

630

TRAHAN ROAD

AMABLE DU FOND RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

*Crooked
Chute Lake*

Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

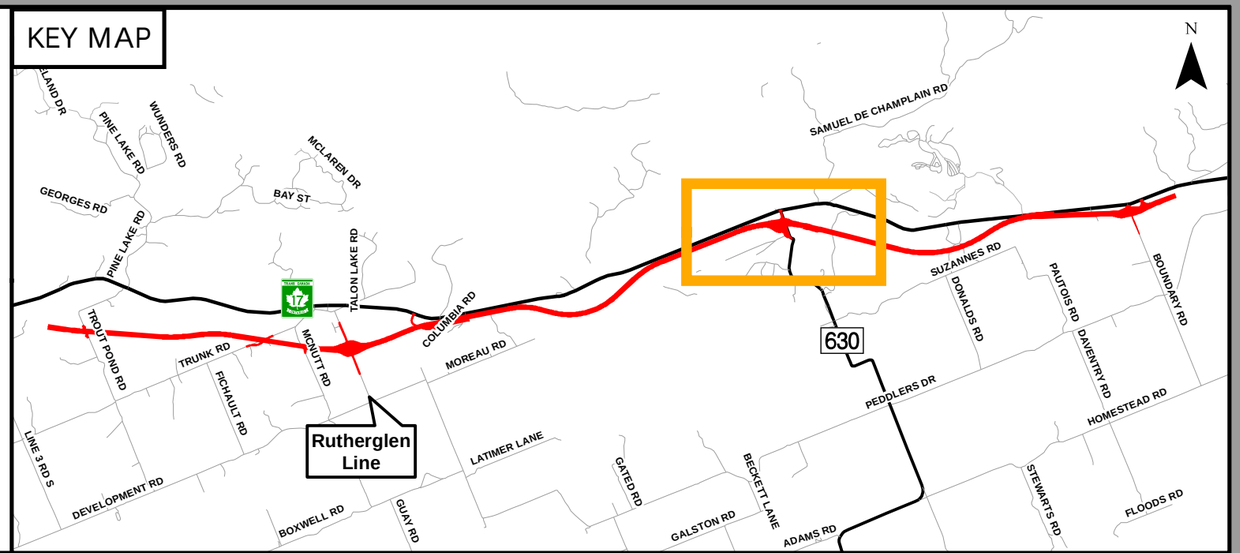
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor
Map: 4

Figure: 1

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps\WIPMXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

SAMUEL DE CHAMPLAIN PROVINCIAL PARK

Amable du Fond River

Pautois Creek

TRANS CANADA 17

R16

R17

R15

SUZANNES ROAD

DONALDS ROAD

PAUTOIS ROAD

Pautois Creek

PAUTOIS ROAD

Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

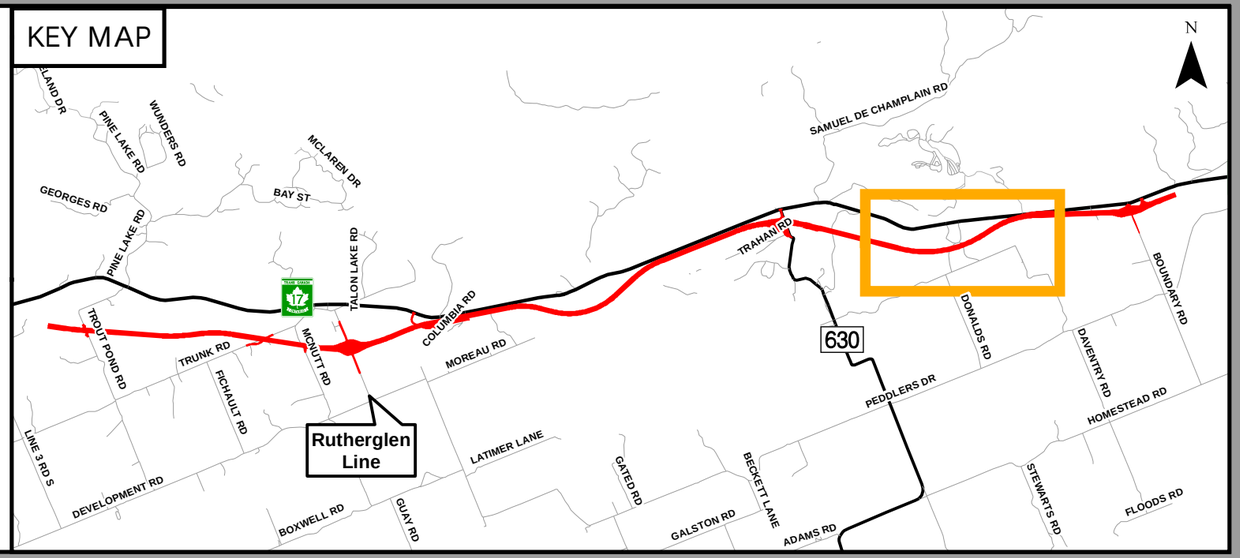
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor Map: 5

Figure: 1

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps WIPMXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

SAMUEL DE CHAMPLAIN PROVINCIAL PARK

17

R18

BOUNDARY ROAD

TAGGART LAKE ROAD

Pautois Creek

Pautois Creek

SUZANNES ROAD

PAUTOIS ROAD

Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

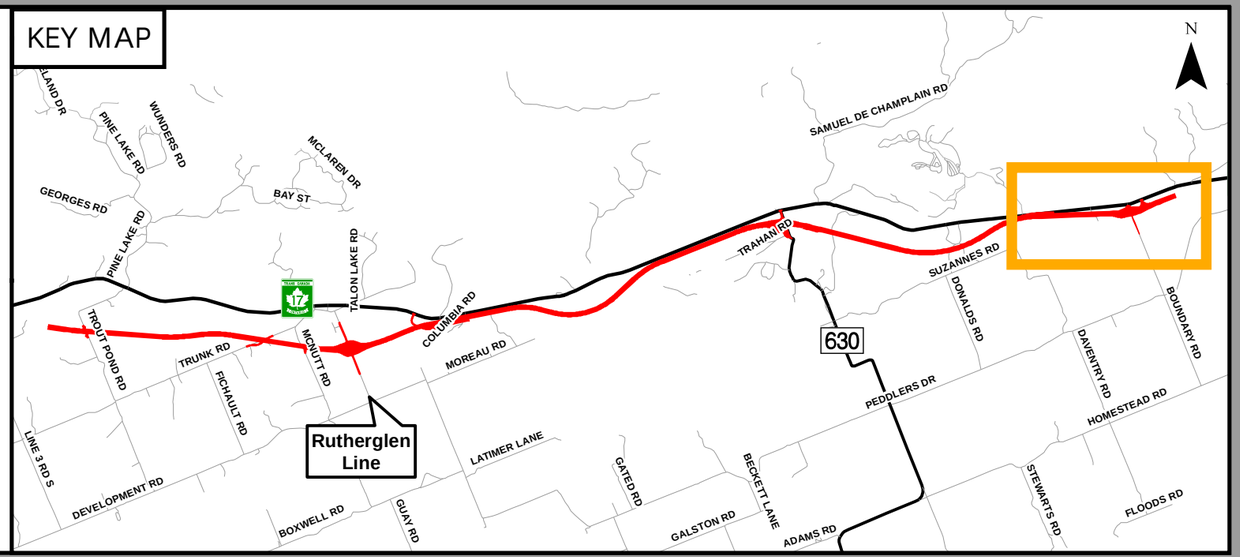
0 125 250 500
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor Map: 6

Figure: 1

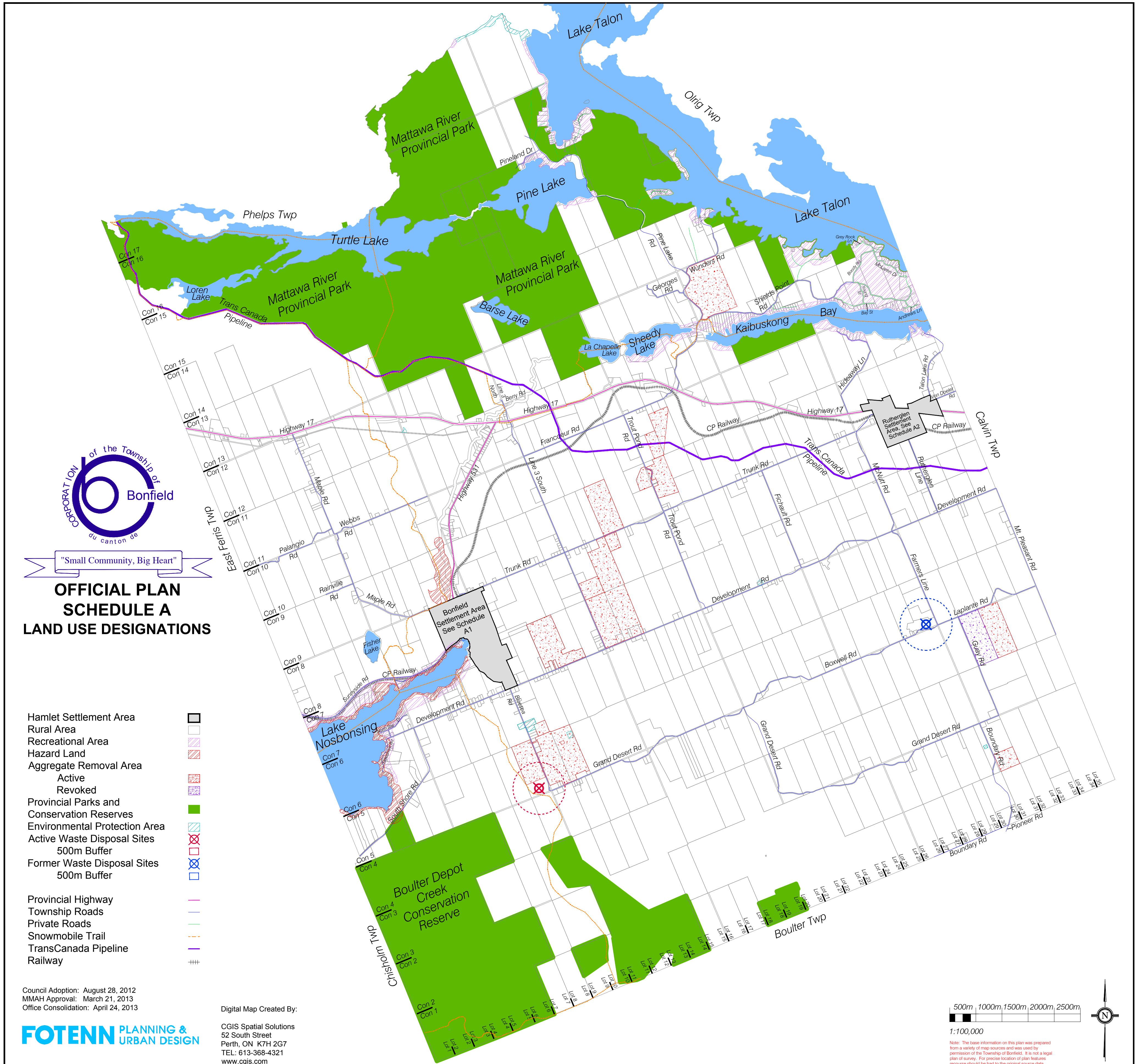
March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps\MPMXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

Appendix D

Appendix D: Zoning Plan



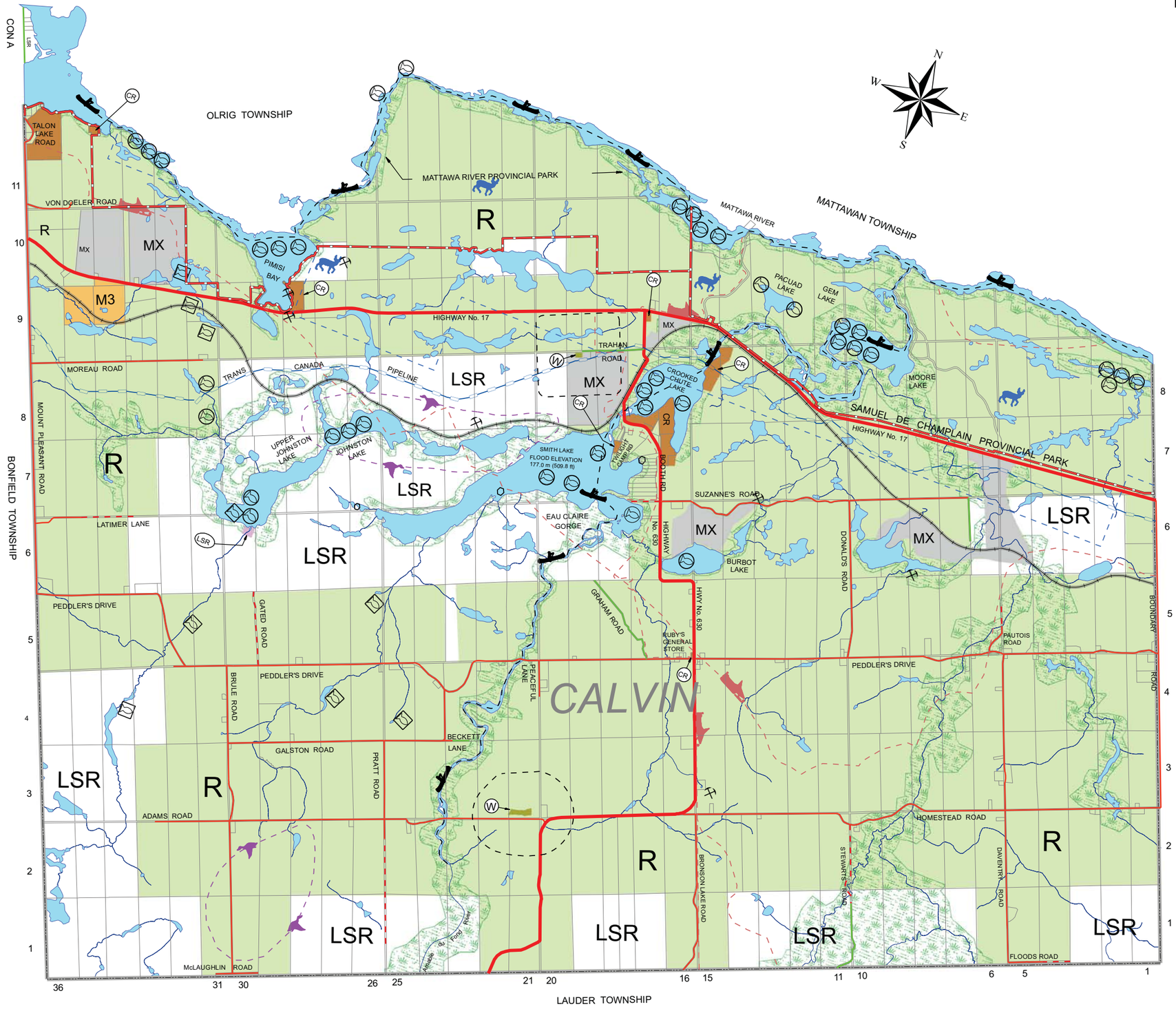
Corporation of the Township of Bonfield
du canton de
"Small Community, Big Heart"
OFFICIAL PLAN
SCHEDULE A
LAND USE DESIGNATIONS
Hamlet Settlement Area
Rural Area
Recreational Area
Hazard Land
Aggregate Removal Area
Active
Revoked
Provincial Parks and Conservation Reserves
Environmental Protection Area
Active Waste Disposal Sites
500m Buffer
Former Waste Disposal Sites
500m Buffer
Provincial Highway
Township Roads
Private Roads
Snowmobile Trail
TransCanada Pipeline
Railway
Council Adoption: August 28, 2012
MMAH Approval: March 21, 2013
Office Consolidation: April 24, 2013
FOTENN PLANNING & URBAN DESIGN
Digital Map Created By:
CGIS Spatial Solutions
52 South Street
Perth, ON K7H 2G7
TEL: 613-368-4321
www.cgis.com
Lake Talon
Olrig Twp
Mattawa River Provincial Park
Pineland Dr
Pine Lake
Phelps Twp
Turtle Lake
Loren Lake
Trans Canada Pipeline
Barse Lake
Sheedy Lake
La Chapelle Lake
Kaibuskong Bay
Wunders Rd
Georges Rd
Pine Lake Rd
Shields Point Rd
Hideaway Ln
Highway 17
CP Railway
Calvin Twp
Rutherglen Settlement Area, See Schedule A2
Francoeur Rd
Trout Pond Rd
Trunk Rd
Fichault Rd
McNutt Rd
Rutherglen Line
Development Rd
Highway 531
Lane 3 South
Maple Rd
Webbs Rd
Palangio Rd
Rainville Rd
East Ferris Twp
Mt. Pleasant Rd
Farmers Line
Laplante Rd
Guay Rd
Boxwell Rd
Bonfield Settlement Area See Schedule A1
Fisher Lake
Sunnyside Rd
Lake Nosbonsing
Grand Desert Rd
Boundary Rd
South Shore Rd
Pioneer Rd
Boulter Depot Creek Conservation Reserve
Chisholm Twp
Boulter Twp
500m 1000m 1500m 2000m 2500m
1:100,000
N
Note: The base information on this plan was prepared from a variety of map sources and was used by permission of the Township of Bonfield. It is not a legal plan of survey. For precise location of plan features recourse should be had to the original source data.

ZONING BY-LAW FOR THE
EAST NIPISSING PLANNING AREA
TOWNSHIP OF CALVIN

SCHEDULE "A" TO
BY-LAW No. 2000-011

October 20, 2009

SCALE
0 1000 3000 metres



LEGEND

NATURAL HERITAGE FEATURES
- WATERFOWL CONCENTRATION AREA
- DEER YARD
- MOOSE WINTERING AREA
- MOOSE AQUATIC FEEDING AREA
- WARM WATER HABITAT
- LARGEMOUTH BASS
- MUSKELLUNGE
- PIKE
- SMALLMOUTH BASS
- WALLEYE
- STURGEON
- COLD WATER HABITAT
- ATLANTIC SALMON
- BROOK TROUT
- LAKE TROUT
- RAINBOW TROUT
- SPLAKE
- BROOK TROUT SPAWNING AREA
- HERONRY
- OSPREY
- LOON

TRANSPORTATION AND INFRASTRUCTURE CORRIDORS
- PROVINCIAL HIGHWAY
- TOWNSHIP ROADS (Yearly Maintained)
- TOWNSHIP ROADS (Seasonally Maintained)
- PRIVATE ROADS
- RESOURCE ACCESS ROADS
- RAIL LINE
- TRANS CANADA PIPELINE
- SNOWMOBILE TRAIL

ZONES
- R — RURAL
- LSR — LIMITED SERVICES RURAL
- CR — COMMERCIAL / RECREATIONAL
- M1 — GENERAL INDUSTRIAL
- M3 — HEAVY INDUSTRIAL
- MX — MINERAL AGGREGATE RESOURCE
- W — WASTE MANAGEMENT FACILITY
- 500m INFLUENCE AREA
- ENVIRONMENTAL PROTECTION

NATURAL AND HUMAN MADE HAZARDS
- MINE HAZARD

FLOOD ELEVATIONS: SPECIFIC ELEVATIONS SHOWN ON SCHEDULE

OTHER FEATURES
- CANOE TRAIL
- TOWNSHIP BOUNDARY

Tunnock Consulting Ltd.

PAUL H. TORRANCE SURVEYING LTD.
GEOMATICS SERVICES

Appendix E

Appendix E: Proposed Noise Barriers

Base mapping produced by AECOM under licence from the Ontario Ministry of Natural Resources (MNR), Copyright© Queens Printer 2011. This licence does not constitute endorsement of this product by MNR or the Ontario Government.

N
W E
S

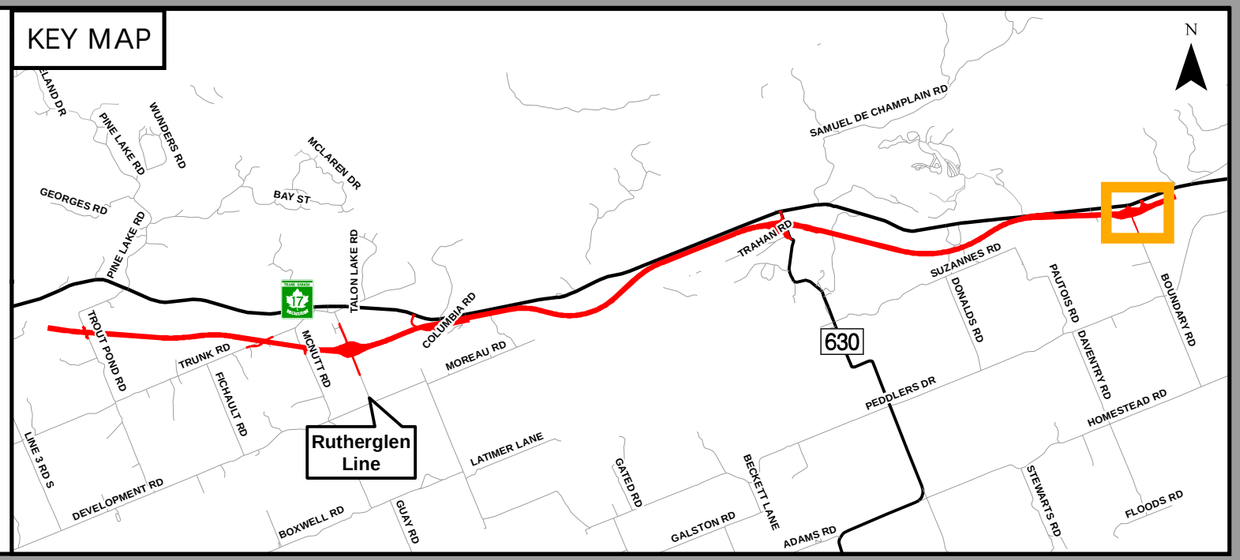
0 25 50 100
Metres

NAD 1983 UTM Zone 17N

LEGEND

- Municipal Boundary
- Route Footprint
- Railway
- TransCanada Pipeline
- Waterbody
- Provincial Park
- Noise Assessment Receptors
- Recommended Barrier

KEY MAP



Highway 17
Environmental Assessment

Noise Receptor Barrier Map

Figure: 2

March, 2014
Project #: 60241599

AECOM

Path: P:\60241599\400-Technical Information & Discipline Work In Progress\404-Socio-Economic-Land Use Maps WIP\MXDs\Rev_18-03-2014_60241599_01v1_Noise Impact Figure1.mxd

Appendix F

Appendix F: Traffic Data

	No Project		With Project					Road Only Parameters		
Source	Year	SADT	Year	SADT	%M.T. or #MT or #Loc	%H.T. or #HT or #Cars	Speed Limit (kph)	Grade %	Pavement Type	Day/Night Split
Old Alignment	2035	10200			5.77	9.23	90	<2	1	85/15
New Alignment EB			2035	5100	5.77	9.23	100	<2	1	66/33
New Alignment WB			2035	5100	5.77	9.23	100	<2	1	66/33

Appendix G

Appendix G: Traffic Noise Calculations

Base Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly

PAGE 1 OF 8

PROJECT NUMBER: 60241569

ENGINEER: Brian Baines

BASE DRAWING:

DATE: March 13, 2014

		No Project																		With Project																	
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (24hr) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Tr) (dBA)	Leq (Night) (dBA)
R01	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	260	-	45	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	397	-	-	-	-	2	258	260	-	45.43	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	435	-	-	-	-	2	258	260	-	44.79	-
	Total																		45	-																	48.132785	-
																																				Impact	3.1330785	-
R02	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	295	-	45	-																	
	New Alignment WB1																				-90	45	3	-	-	-	1	1.2	318	-	-	-	-	5	249	254	-	47.42	-
	New Alignment EB1																				-90	45	3	-	-	-	1	1.2	280	-	-	-	-	5	249	254	-	48.26	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2																				45	90	4	-	-	-	1	1.2	318	45	90	0	215	3	251	254	262	30.27	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2																				45	90	4	-	-	-	1	1.2	280	45	90	0	215	3	251	254	262	30.1	-
	Total																		45	-																	50.944.1397	-
																																				Impact	5.944.1967	-
R03	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	260	-	45	-																	
	New Alignment WB1																				-90	-20	3	-	-	-	1	1.2	385	-	-	-	-	12	248	260	-	46.11	-
	New Alignment EB1																				-90	-20	3	-	-	-	1	1.2	348	-	-	-	-	12	248	260	-	46.68	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2																				-20	30	4	-	-	-	1	1.2	385	-20	30	0	182	10	250	260	262	34.98	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2																				-20	30	4	-	-	-	1	1.2	348	-20	30	0	182	10	250	260	262	34.66	-
	New Alignment WB3																				30	90	3	-	-	-	1	1.2	385	-	-	-	-	11	249	260	-	44.75	-
	New Alignment EB3																				30	90	3	-	-	-	1	1.2	348	-	-	-	-	11	249	260	-	45.33	-
	Total																		45	-																	51.971.0285	-
																																				Impact	6.971.0285	-
R04	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	260	-	45	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	144	-	-	-	-	8	252	260	-	54.58	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	108	-	-	-	-	8	252	260	-	56.36	-
	Total																		45	-																	58.5708626	-
																																				Impact	13.570.8626	-

Base Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly — PAGE 2 OF 8

PROJECT NUMBER: 60241569 — ENGINEER: Brian Bulmers

BASE DRAWING: — DATE: March 13, 2014

		No Project																		With Project																	
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (24hr) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Trn) (dBA)	Leq (Night) (dBA)
R05	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	252	-	45	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	283	-	-	-	-	1	253	252	-	47.35	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	246	-	-	-	-	1	253	252	-	48.34	-
	Total																		45	-																	50.8834486	-
																																				Impact	5.88344863	-
R06	Old Alignment	-90	90	3	-	-	-	1	1.2	407	-	-	-	-	8	245	253	-	50.31	-																	
	New Alignment WB																				-90	90	1	-	-	-	1	1.2	182	-	-	-	-	-	253	253	-	50.12	-
	New Alignment EB																				-90	90	1	-	-	-	1	1.2	219	-	-	-	-	-	253	253	-	48.79	-
	Total																		50.31	-																	52.51601153	-
																																				Impact	2.20601527	-
R07	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	248	-	45	-																	
	New Alignment WB1																				-90	-45	4	-	-	-	1	1.2	89	-90	-45	0	53	5	253	248	254	43.53	-
	New Alignment EB1																				-90	-45	4	-	-	-	1	1.2	126	-90	-45	0	53	5	253	248	254	40.6	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2																				-45	45	4	-	-	-	1	1.2	89	-45	45	0	53	2	250	248	256	38.62	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2																				-45	45	4	-	-	-	1	1.2	126	-45	45	0	53	2	250	248	256	37.04	-
	New Alignment WB3																				45	90	4	-	-	-	1	1.2	89	45	90	0	53	2	246	248	253	45.82	-
	New Alignment EB3																				45	90	4	-	-	-	1	1.2	126	45	90	0	53	2	246	248	253	43.5	-
	Total																		45	-																	50.2914672	-
																																				Impact	5.29144734	-
R08	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	245	-	45	-																	
	New Alignment WB																				-90	90	1	-	-	-	1	1.2	112	-	-	-	-	-	245	245	-	53.62	-
	New Alignment EB																				-90	90	1	-	-	-	1	1.2	75	-	-	-	-	-	245	245	-	56.51	-
	Total																		45	-																	58.31.1384	-
																																				Impact	13.31.1384	-

Base Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly — PAGE 3 OF 8

PROJECT NUMBER: 60241569 — ENGINEER: Brian Bulners

BASE DRAWING: — DATE: March 13, 2014

		No Project																			With Project																					
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (Day) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Pri) (dBA)	Leq (Night) (dBA)
R09	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	237	-	45	-																					
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	277	-	-	-	-	1	238	237	-	47.5	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	240	-	-	-	-	1	238	237	-	48.52	-
	Total																		45	-																		51.0501785	-
																																					Impact	6.0501765	-
R10	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	241	-	45	-																					
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	185	-	-	-	-	5	246	241	-	51.88	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	147	-	-	-	-	5	246	241	-	53.39	-
	Total																		45	-																		55.7109986	-
																																					Impact	10.7109986	-
R11	Old Alignment	-90	90	3	-	-	-	1	1.2	76	-	-	-	-	2	255	257	-	59.07	-																					
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	45	-	-	-	-	22	235	257	-	64.79	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	82	-	-	-	-	22	235	257	-	62.18	-
	Total																		59.07	-																		66.6864865	-
																																					Impact	7.6184852	-
R12	Old Alignment	-90	90	3	-	-	-	1	1.2	35	-	-	-	-	1	220	221	-	64.3	-																					
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	97	-	-	-	-	2	219	221	-	55.23	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	134	-	-	-	-	2	219	221	-	52.98	-
	Total																		64.3	-																		57.2984094	-
																																					Impact	-7.0405906	-

Base Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly — PAGE 4 OF 8

PROJECT NUMBER: 60241569 — ENGINEER: Brian Bulmers

BASE DRAWING: — DATE: March 13, 2014

		No Project																		With Project																	
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (24hr) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Hr) (dBA)	Leq (Night) (dBA)
R13	Old Alignment	-90	90	3	-	-	-	1	1.2	112	-	-	-	-	3	221	218	-	56.68	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	181	-	-	-	-	2	220	218	-	50.89	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	218	-	-	-	-	2	220	218	-	49.6	-
	Total																		56.68	-																	53.3030216	-
																																					Impact	-3.3769784	-
R14	Old Alignment	-90	90	3	-	-	-	1	1.2	393	-	-	-	-	3	190	187	-	48.11	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	94	-	-	-	-	6	193	187	-	56.62	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	64	-	-	-	-	6	193	187	-	59.1	-
	Total																		48.11	-																	61.0449685	-
																																					Impact	12.9349685	-
R15	Old Alignment	-90	90	1	-	-	-	1	1.2	>500	-	-	-	-	-	-	191	-	45	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	441	-	-	-	-	7	198	191	-	47.17	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	409	-	-	-	-	7	198	191	-	47.65	-
	Total																		45	-																	50.428928	-
																																					Impact	5.4289283	-
R16	Old Alignment	-90	90	3	-	-	-	1	1.2	318	-	-	-	-	1	186	187	-	48.66	-																	
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	193	-	-	-	-	11	198	187	-	53.96	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	226	-	-	-	-	11	198	187	-	53.05	-
	Total																		48.66	-																	56.5380911	-
																																					Impact	7.8790912	-

Base Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly | PAGE 5 OF 8

PROJECT NUMBER: 60241569 | ENGINEER: Brian Bukles

BASE DRAWING: | DATE: March 13, 2014

		No Project																			With Project																			
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (Day) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Dn) (dBA)	Leq (Night) (dBA)
R17	Old Alignment	-90	90	3	-	-	-	1	1.2	296	-	-	-	-	2	186	188	-	49.61	-																			
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	182	-	-	-	-	13	201	188	-	55.08	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	217	-	-	-	-	13	201	188	-	54.11	-
	Total																		49.61	-																		57.632351	-
																																					Impact	8.0223513	-
R18	Old Alignment	-90	90	3	-	-	-	1	1.2	106	-	-	-	-	1	219	218	-	56.44	-																			
	New Alignment WB																				-90	90	3	-	-	-	1	1.2	44	-	-	-	-	1	219	218	-	60.54	-
	New Alignment EB																				-90	90	3	-	-	-	1	1.2	82	-	-	-	-	1	219	218	-	56.13	-
	Total																		56.44	-																		61.882549	-
																																					Impact	5.4425494	-

Mitigation Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly | PAGE 6 OF 8

PROJECT NUMBER: 60241599 | ENGINEER: Brian Bulmes

BASE DRAWING: | DATE: March 13, 2014

		Unmitigated																			Mitigated																	
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (Day) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Pri) (dBA)	Leq (Night) (dBA)
R02	Old Alignment																																						
	New Alignment WB1	-90	45	3	-	-	-	1	1.2	318	-	-	-	-	5	249	254	-	47.42	-	-90	45	4	-	-	-	1	1.2	318	-60	45	5	245	5	249	254	252	42.26	-
	New Alignment EB1	-90	45	3	-	-	-	1	1.2	280	-	-	-	-	5	249	254	-	48.26	-	-90	45	4	-	-	-	1	1.2	280	-60	45	5	245	5	249	254	252	41.53	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2	45	90	4	-	-	-	1	1.2	318	45	90	0	215	3	251	254	262	30.27	-	45	90	4	-	-	-	1	1.2	318	45	90	0	215	3	251	254	262	30.27	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2	45	90	4	-	-	-	1	1.2	280	45	90	0	215	3	251	254	262	30.1	-	45	90	4	-	-	-	1	1.2	280	45	90	0	215	3	251	254	262	30.1	-
	Total																		50.94413971	-																		45.20315928	-
																																					Noise Reduction	5.74094692	-
R03	Old Alignment																																						
	New Alignment WB1	-90	-20	3	-	-	-	1	1.2	385	-	-	-	-	12	248	260	-	46.11	-	-90	-20	4	-	-	-	1	1.2	385	-90	-20	5	340	12	248	260	252	40.95	-
	New Alignment EB1	-90	-20	3	-	-	-	1	1.2	348	-	-	-	-	12	248	260	-	46.68	-	-90	-20	4	-	-	-	1	1.2	348	-90	-20	5	340	12	248	260	252	35.86	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2	-20	30	4	-	-	-	1	1.2	385	-20	30	0	182	10	250	260	262	34.98	-	-20	30	4	-	-	-	1	1.2	385	-20	30	0	182	10	250	260	262	34.98	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2	-20	30	4	-	-	-	1	1.2	348	-20	30	0	182	10	250	260	262	34.66	-	-20	30	4	-	-	-	1	1.2	348	-20	30	0	182	10	250	260	262	34.66	-
	New Alignment WB3	30	90	3	-	-	-	1	1.2	385	-	-	-	-	11	249	260	-	44.75	-	30	90	4	-	-	-	1	1.2	385	30	90	5	344	11	249	260	249	43.81	-
	New Alignment EB3	30	90	3	-	-	-	1	1.2	348	-	-	-	-	11	249	260	-	45.33	-	30	90	4	-	-	-	1	1.2	348	30	90	5	344	11	249	260	249	37.92	-
	Total																		51.97103851	-																		47.21067722	-
																																					Noise Reduction	4.76035628	-
R04	Old Alignment																																						
	New Alignment WB	-90	90	3	-	-	-	1	1.2	144	-	-	-	-	8	252	260	-	54.58	-	-90	90	4	-	-	-	1	1.2	144	-60	60	5	73	9	251	260	257	49.86	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	108	-	-	-	-	8	252	260	-	56.36	-	-90	90	4	-	-	-	1	1.2	108	-60	60	5	73	9	251	260	257	50.67	-
	Total																		58.57086626	-																		53.2941567	-
																																					Noise Reduction	5.27670697	-
R05	Old Alignment																																						
	New Alignment WB	-90	90	3	-	-	-	1	1.2	283	-	-	-	-	1	253	252	-	47.35	-	-90	90	4	-	-	-	1	1.2	283	-90	90	5	212	1	253	252	254	42.83	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	246	-	-	-	-	1	253	252	-	48.34	-	-90	90	4	-	-	-	1	1.2	246	-90	90	5	212	1	253	252	254	42.29	-
	Total																		50.88344816	-																		45.57868675	-
																																					Noise Reduction	5.30476116	-
R07	Old Alignment																																						
	New Alignment WB1	-90	-45	4	-	-	-	1	1.2	89	-90	-45	0	53	5	253	248	254	43.53	-	-90	-45	4	-	-	-	1	1.2	89	-90	-45	5	53	5	253	248	254	41.55	-
	New Alignment EB1	-90	-45	4	-	-	-	1	1.2	126	-90	-45	0	53	5	253	248	254	40.6	-	-90	-45	4	-	-	-	1	1.2	126	-90	-45	5	53	5	253	248	254	39.95	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment WB2	-45	45	4	-	-	-	1	1.2	89	-45	45	0	53	2	250	248	256	38.62	-	-45	45	4	-	-	-	1	1.2	89	-45	45	5	53	2	250	248	256	36.36	-
Used average height across viewing angle for Barrier Base Elevation	New Alignment EB2	-45	45	4	-	-	-	1	1.2	126	-45	45	0	53	2	250	248	256	37.04	-	-45	45	4	-	-	-	1	1.2	126	-45	45	5	53	2	250	248	256	34.67	-
	New Alignment WB3	45	90	4	-	-	-	1	1.2	89	45	90	0	53	2	246	248	253	45.82	-	45	90	4	-	-	-	1	1.2	89	45	60	5	53	2	246	248	253	45.72	-
	New Alignment EB3	45	90	4	-	-	-	1	1.2	126	45	90	0	53	2	246	248	253	43.5	-	45	90	4	-	-	-	1	1.2	126	45	60	5	53	2	246	248	253	43.36	-
	Total																		50.29146772	-																		48.56324182	-
																																					Noise Reduction	0.72821904	-

Mitigation Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly | PAGE 7 OF 8

PROJECT NUMBER: 60241569 | ENGINEER: Brian Baines

BASE DRAWING: | DATE: March 13, 2014

		Unmitigated																			Mitigated																		
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (Day) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Pri) (dBA)	Leq (Night) (dBA)
R08	Old Alignment																																							
	New Alignment WB	-90	90	1	-	-	-	1	1.2	112	-	-	-	-	-	245	245	-	53.62	-	-90	90	2	-	-	-	1	1.2	112	-90	90	5	39	-	245	245	243	50.36	-
	New Alignment EB	-90	90	1	-	-	-	1	1.2	75	-	-	-	-	-	245	245	-	56.51	-	-90	90	2	-	-	-	1	1.2	75	-90	90	5	39	-	245	245	243	52.49	-
	Total																		58.311384	-																		54.564994	-
																																					Noise Reduction	3.7467899	-
R09	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	277	-	-	-	-	1	238	237	-	47.5	-	-90	90	4	-	-	-	1	1.2	277	-90	90	5	204	1	238	237	234	47.5	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	240	-	-	-	-	1	238	237	-	48.52	-	-90	90	4	-	-	-	1	1.2	240	-90	90	5	204	1	238	237	234	48.52	-
	Total																		51.050176	-																		51.050176	-
																																					Noise Reduction	0	-
R10	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	185	-	-	-	-	5	246	241	-	51.88	-	-90	90	4	-	-	-	1	1.2	185	-60	60	5	17	5	246	241	241	46.84	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	147	-	-	-	-	5	246	241	-	53.39	-	-90	90	4	-	-	-	1	1.2	147	-60	60	5	17	5	246	241	241	48.32	-
	Total																		55.710986	-																		50.653042	-
																																					Noise Reduction	5.0575957	-
R11	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	45	-	-	-	-	22	235	257	-	64.79	-	-90	90	4	-	-	-	1	1.2	45	-90	90	5	9	12	235	257	242	64.79	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	82	-	-	-	-	22	235	257	-	62.18	-	-90	90	4	-	-	-	1	1.2	82	-90	90	5	9	12	235	257	242	62.18	-
	Total																		66.688486	-																		66.688486	-
																																					Noise Reduction	0	-
R14	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	94	-	-	-	-	6	193	187	-	56.62	-	-90	90	4	-	-	-	1	1.2	94	-90	90	5	20	6	193	187	185	54.49	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	64	-	-	-	-	6	193	187	-	59.1	-	-90	90	4	-	-	-	1	1.2	64	-90	90	5	20	6	193	187	185	59.1	-
	Total																		61.049685	-																		60.390295	-
																																					Noise Reduction	0.6547352	-

Mitigation Calculations

PROJECT NAME: Highway 17 - Route Planning Bonfield Easterly | PAGE 8 OF 8

PROJECT NUMBER: 60241569 | ENGINEER: Brian Baines

BASE DRAWING: | DATE: March 13, 2014

		Unmitigated																			Mitigated																		
RECEIVER	SOURCE	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq (Day) (dBA)	Leq (Night) (dBA)	θ1	θ2	TOPO	WOODS	No. Rows	@ Density	Ground Surface Type	Receiver Height (r) (m)	Source Receiver Dist (m)	Barr θ1	Barr θ2	Barrier Height (m)	Barrier Receiver Distance (m)	Elevation Change (e) (m)	Source Ground Elevation (m)	Receiver Ground Elevation (m)	Base of Barrier Elevation (m)	Leq(Day) or Leq(Dn) (dBA)	Leq (Night) (dBA)
R15	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	441	-	-	-	-	7	198	191	-	47.17	-	-90	90	4	-	-	-	1	1.2	441	-90	90	5	370	7	198	191	188	47.17	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	409	-	-	-	-	7	198	191	-	47.65	-	-90	90	4	-	-	-	1	1.2	409	-90	90	5	370	7	198	191	188	47.65	-
	Total																		50.426928	-																		50.426928	-
																																					Noise Reduction	0	-
R16	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	193	-	-	-	-	11	198	187	-	53.96	-	-90	90	4	-	-	-	1	1.2	193	-90	90	5	156	11	198	187	187	53.96	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	226	-	-	-	-	11	198	187	-	53.05	-	-90	90	4	-	-	-	1	1.2	226	-90	90	5	156	11	198	187	187	53.05	-
	Total																		56.539091	-																		56.539091	-
																																					Noise Reduction	0	-
R17	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	182	-	-	-	-	13	201	188	-	55.08	-	-90	90	4	-	-	-	1	1.2	182	-90	90	5	147	13	201	188	189	55.08	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	217	-	-	-	-	13	201	188	-	54.11	-	-90	90	4	-	-	-	1	1.2	217	-90	90	5	147	13	201	188	189	54.11	-
	Total																		57.632351	-																		57.632351	-
																																					Noise Reduction	0	-
R18	Old Alignment																																							
	New Alignment WB	-90	90	3	-	-	-	1	1.2	44	-	-	-	-	1	219	218	-	60.54	-	-90	90	4	-	-	-	1	1.2	44	-60	60	5	8	1	219	218	216	55.45	-
	New Alignment EB	-90	90	3	-	-	-	1	1.2	82	-	-	-	-	1	219	218	-	56.13	-	-90	90	4	-	-	-	1	1.2	82	-60	60	5	8	1	219	218	216	51.29	-
	Total																		61.882545	-																		56.860442	-
																																					Noise Reduction	5.0221039	-