Ontario

Ministry of Transportation

407 East Environmental Assessment

Alternative Methods Technical Report (Noise)

FINAL DRAFT

August 2007

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1. Introduction

This report documents the assessment and evaluation of the short-listed alternative routes identified for the 407 East Environmental Assessment (EA) from the Noise perspective. Following completion of the screening phase, alternative routes were short-listed for detailed assessment and/or comparative evaluation. The short-listed routes were broken down into 5 sections:

- West Mainline
  - Brock Road to Audley Road – 1 route
  - Audley Road to Ashburn Road – 2 route alternatives
- Central Mainline
  - Ashburn Road to Simcoe Street – 1 route
  - Simcoe Street to Enfield Road – 2 route alternatives
- East Mainline
  - Enfield Road to Highway 35/115 – 12 route alternatives
- West Link
  - West Durham Link – 9 route alternatives
- East Link
  - East Durham Link – 13 route alternatives

This report is one of nine stand-alone documents that outline the evaluation of the alternative routes process from the perspective of each discipline. These reports will be used in concert with one another as supporting documents to the Alternative Methods Report. The following 9 discipline specific reports have been prepared and made available for comment:

- Natural Environment
- Noise
- Socio-economic
- Air Quality
- Agricultural
- Waste Contamination
- Archaeology
- Cultural Heritage
- Technical

The evaluation of alternative routes was a three-step process. The first step entailed a detailed field inventory of conditions associated with each alternative route. Each environmental feature was examined to determine the extent of impact and the findings of these were outlined within each of the disciplines Field Investigations Reports. The second step was to assess the findings of the field investigations against the established Criteria and Indicators listed in Table 1 (Appendix A of Alternative Methods Report) for each of the 5 Factor Areas (Natural, Social, Economic, Cultural and Technical). After determining the initial potential effects, standard mitigation, avoidance, enhancement and compensation measures were applied in order to determine the Net Effects.

The third step was the evaluation itself. This step involved a comparative analysis of the alternative routes considered to select a preferred alternative. At this stage, the relative importance of the environmental features was determined.

1.1 Noise Study Team

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

- ***Scott Penton, P.Eng., Project Director:*** *Supervised all technical aspects of the study and was responsible for ensuring that all work conformed to RWDI's standards for quality assurance.*

- ***Scott Shayko, Hon.B.Comm, B.Sc., Project Manager:*** *Provided technical direction and was responsible for the day-to-day communication with the 407 East Project Team.*

- ***Kyle Hellewell, B.Sc.Eng., EIT, Technical Coordinator:*** *Conducted the technical work under the direction of the Project Manager and Project Director.*

2. Assessment and Evaluation of the Alternative Routes

2.1 Methodology

The assessment and evaluation of the alternative routes was conducted in three steps:

Step 1: Confirm Evaluation Criteria and Indicators/Measures

The approved 407 East EA Terms of Reference (ToR) set out the draft criteria and indicators in **Table 5.2** for evaluating the 'alternative methods' in the EA. In addition, **Supporting Document C** of the 407 East EA ToR provided proposed data sources and measures for each of the indicators. As a result, the draft criteria, indicators, and measures provided for in the ToR were reviewed and modified appropriately to suit the evaluation of the alternative routes.

Specifically, the criteria, indicators and measures were modified in consultation with review agencies and the public to ensure that an appropriate level of scrutiny and rigour was applied in evaluating the "short listed" routes. By doing so, the results of the evaluation phase consist of clearly defined net effects for each "short listed" route that were suitable for comparison.

Step 2: Undertake the Net Effects Analysis

With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the "short-listed" alternative routes was carried out consisting of the following activities:

- Identify potential effects (based on measures) on the environment;
- Develop and apply avoidance/ mitigation/ compensation/ enhancement measures; and
- Determine net effects on the environment.

The following summarizes the methodology used for determining the net effects. This methodology includes estimates of future no-build and future build sound levels.

Future No-Build Sound Levels

Since no highway or other dominant noise sources exist, future no-build sound levels were established based on existing ambient (background) sound levels. Ambient sound levels were estimated using guidance from the Ontario Ministry of Transportation (MTO) "Environmental Guide for Noise", which is based on the Ontario Ministry of Environment (MOE) NPC-205 "Sound Level Limits for Stationary Sources in Class 1 and 2 Areas (Urban)" and NPC-232 "Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)". These recommended sound levels were verified using short-term measurements previously taken by RWDI in the study area. The MTO guidelines specify that a L_{eq} (24h) background sound level of 45 dBA be applied for rural areas, 50 dBA be applied for semi-rural / suburban areas, and 55 dBA be applied for urban areas. Based on direction provided by this guideline, it was determined that a L_{eq} (24h) background sound level of 50 dBA for semi-rural / suburban areas was most applicable to the 407 East study area.

Future Build Sound Levels

Future build sound level computer modelling was conducted to determine the distance from the centreline of the highway where a change in sound level of 0 to < 5 dB, 5 to < 10 dB, and > 10 dB would occur over future no-build sound levels. A change in sound level is determined by subtracting the predicted sound level contributed by the project from the future no-build sound level. These changes in sound levels were selected because they align with Ontario Ministry of Transportation (MTO) Guideline QST A-1, where a change in sound level of up to 5 dB is considered a noticeable difference, 6 to < 10 dB is considered a substantial difference, and > 10 dB is considered a very substantial difference. Additionally, increases of more than 5 dB require an investigation for the implementation of mitigation measures. The investigation of changes in sound levels was limited to 600 m from the centreline of the highway, as per QST A-1.

Computer modelling using the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) algorithms was conducted to determine where the above changes in sound levels would occur. ORNAMENT is a widely used numerical model designed specifically for predicting sound levels of roadway sources. The key parameters entered into the model are presented in the following two tables.

Table 2.1.1: Traffic Parameters

Route Alternative	% Medium Duty Vehicles	% Heavy Duty Vehicles	AADT
Highway Vehicles			
West Mainline	4	8	119,150
Central Mainline	3	6	78,550
East Mainline	1	1	39,200
West Link	4	8	52,800
East Link	5	9	46,490
Transitway Buses	0	100	2,400

All traffic parameters were provided by TSH and summarized in a memorandum dated March 26, 2007.

Table 2.1.2: ORNAMENT Key Input Parameters

Parameter	Input
Road Gradient	0 %
Vehicle Speed	100 km/hr
Pavement Type	Normal Asphalt
Ground Type	Hard
Topography	Flat / Gently Sloping

Based on the computer modelling, the distance ranges at which the 0 to < 5 dB, 5 to < 10 dB, and > 10 dB changes in sound level occurred from the centreline of the highway are summarized below.

Table 2.1.3: Calculated Change in Sound Level Ranges

Route Alternative	Ranges (m)		
	0 to < 5 dB	5 to < 10 dB	> 10 dB
West Mainline	500 to 600 m	250 to 500 m	ROW to 250 m
Central Mainline	400 to 600 m	200 to 400 m	ROW to 200 m
East Mainline	350 to 600 m	175 to 350 m	ROW to 175 m
West Link	350 to 600 m	175 to 350 m	ROW to 175 m
East Link	350 to 600 m	175 to 350 m	ROW to 175 m

In general, NSAs located closer to the highway alignment will have higher predicted sound levels due to traffic noise, and therefore greater changes in sound levels when compared to existing ambient levels. Additionally, traffic volumes also affect the amount of noise generated by the highway, with greater traffic volumes producing higher sound levels. These two effects can augment or cancel each other, depending on the particular NSA under consideration. For example, the West Mainline has the highest predicted traffic volume resulting in a > 10 dB change in sound level at a distance of 250 m from the ROW. The East Mainline has the lowest predicted traffic volume resulting in a > 10 dB change in sound level at a distance of 175 m from the ROW.

Step 3: Carry Out the Comparative Evaluation

In Step 3, the net effects identified for each “short-listed” route segment in Step 2 were compared to one another in order to identify a “recommended route segment”. The comparison of net effects was completed using a “Reasoned Argument” or “Trade-off” method, as provided for in the approved 407 East EA ToR.

A scoring system was developed in order to assist in the comparative evaluation of the route alternatives. This system was based on the noise modelling results presented above and the number and type of noise sensitive areas (NSA’s) that could potentially be impacted.

The number of NSA’s impacted within the different ranges were determined by (1) identifying the sensitive receptors using land-use information provided by Meridian Planning Consultants Inc. and (2) tallying the number of sensitive receptors within the different setbacks using GIS Software. A NSA was defined as a residence, church, school, daycare or senior housing facility with an outdoor living area (OLA).

The number of NSA’s impacted within the different ranges was multiplied by a factor for the 0 to < 5 dB, 5 to < 10 dB, and > 10 dB ranges in order to derive a weighted score. A factor of +1 was assigned to NSA’s within the 0 to < 5 dB range, +3 to NSA’s within the 5 to < 10 dB range, and +6 to NSA’s within the > 10 dB range. These factors were derived based on professional experience and on the general human perception of changes in sound levels.

According to QST-A1, if a change in sound level at a NSA increases by 5 dB or more, then investigation for the implementation of mitigation measures needs to occur. The scoring system took this into account by estimating the cost of a highway barrier at $190 per square meter, based on a 5 m tall barrier. Implementing mitigation at a NSA was considered feasible if the cost per NSA would be less than or equal to $50,000. If mitigating a NSA was considered to be feasible, then that NSA was given a reduced factor. The reduced factors applied were -1 to NSA’s within the 0 to < 5 dB range, -2 to NSA’s within the 5 to < 10 dB range, and -3 to NSA’s within the > 10 dB range. Only a reduced factor was applied to these NSA’s because these NSA’s would still have some impacts due to the project.

A score for each range was established by multiplying the number of impacted NSA’s within each range by the applicable factor. The total score for the route alternative was then established by summing the scores for each range together. A lower score indicates that a route alternative is better from a noise perspective.

Finally, special consideration was given to the critical NSA’s consisting of churches, schools, daycares or senior housing facilities. If a route alternative had the potential to impact a critical NSA, a penalty was assigned to the final score after it was calculated as described below. A penalty of 50 was assigned to a church and 100 to schools, daycares, and senior housing facilities. These penalties were assigned based on a number of factors such as, professional experience, number of people potentially exposed, anticipated age of people and potential duration of exposure.

An example calculation of this scoring system is provided under the heading “Example - West Mainline Route WM2”.

Technical Rational for Factors

The score weightings of (+1, +3, +6) for sound levels and (-1, -2, -3) for mitigation are based on professional experience and on the general human perception of changes in sound levels. Changes in sound levels can be ranked as follows:

Table 2.1.4: Scoring of Changes in Sound Levels

Changes in Sound Level (dBA)	Human Perception	Typical Ranking	Sound Level Factor Used in Analysis
0 to 3	Imperceptible	Insignificant	+1
> 3 to 5	Just noticeable	Noticeable	
> 5 to 10	Clearly noticeable	Substantial	+3
> 10	More than twice as loud	Very Substantial	+6
> 20	More than 4 times as loud	Very Substantial	

An increase of up to 5 dB over the existing semi-rural / suburban background (which includes existing (faint) traffic noise) would generally be considered “just noticeable”. A factor of +1 for this range is appropriate, both as a starting point and because it corresponds well with the ability to mitigate noise (a noise barrier just breaking the line of site between a road and NSA will provide at least 5 dB of attenuation). The ability to add a noise barrier at this NSA (giving a 5 dB reduction), effectively returns the NSA back to the original sound level. As an example, using the factors, a mitigated NSA in this category would see +1 for the 5 dB increase in noise level, and -1 for mitigation, yielding no net impact at this NSA location.

As can be seen from the previous table, human perception of changes in sound is non-linear. While a change up to 5 dB is just noticeable, a change of 10 dB would be perceived as twice as loud. To account for this non-linear change in perception a factor of +3 has been selected. The corresponding mitigation factor is -2. It is unlikely that a noise barrier will be able to provide a 10 dB reduction and return the sound level back to near the original level. As an example, a mitigated NSA in this category would see a factor of +3 for the up to 10 dB increase in noise level, and -2 for mitigation, yielding essentially +1 level of impact at this NSA location. A mitigated NSA would therefore move from a substantial change in sound environment to a just noticeable change.

Similarly, increasing the change in noise level to > 10 dB yields a greater potential for impacts. A +6 factor has been selected to again account for the non-linear human response to changes in sound level. It is unlikely that a barrier will provide much more than 5 dB of attenuation, so the mitigation factor is -3. As an example, a mitigated NSA in this category would see +6 for the greater than 10 dB increase in noise level, and -3 for mitigation, yielding essentially +3 level of impact at this NSA location. A mitigated NSA would therefore move from a very substantial change down a category to a substantial change.

Example - West Mainline Route WM2

1. The number of sensitive receptors are tallied using GIS Software.

Route	Number of Impacted Sensitive Receptors (Unmitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	28	50	12

2. The following factors are used for the different ranges.

Route	Factors (Unmitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	+6	+3	+1

3. The unmitigated score is established for each range by multiplying the number of sensitive receptors by the factor.

WM2	Scores (Unmitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	28 x 6 = 168	50 x 3 = 150	12 x 1 = 12

4. Sensitive receptors are analyzed to see if mitigation is considered feasible. In this example, it was determined that mitigation was feasible for eight sensitive receptors.

Route	Number of Mitigated Sensitive Receptors		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	8	0	0

5. The following factors are used for the different ranges.

Route	Factors (Mitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	-3	-2	-1

6. The mitigated score is established for each range by multiplying the number of mitigated sensitive receptors by the mitigated factor.

WM2	Scores (Unmitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	8 x -3 = -24	0	0

7. A total score is calculated by summing the mitigated and unmitigated scores together. These numbers are shaded grey in the above tables.

WM2	Scores (Unmitigated)		
	ROW to 250 m (> 10 dB)	250 to 500 m (> 5 to 10 dB)	500 to 600 m (0 to < 5 dB)
WM2	168 – 24 = 144	150 – 0 = 150	12 – 0 = 12
Total Score			144 + 150 + 12 = **306**

8. The final step is to determine if any critical receptors could potentially be impacted. In this situation, only one critical receptor (a daycare facility) resides within the area of influence and a penalty of 100 is added to the total score. Therefore, the final score is 306 + 100 = 406.

2.2 West Mainline – Brock Road to Audley Road

Although there was only one route alternative for this section of highway, a score was calculated to understand any potential impacts.

For the West Mainline, the modelling was conducted for the year 2031 using a ten-lane rural highway with an AADT of 119,150, and a bus transitway with a traffic volume of 100 buses per hour. Based on the computer modelling, the distances range at which 0 to < 5 dB change in sound level is measured as 500 to 600m. For a change of 5 to < 10 dB, the distance range is 250 to 500 m and for a change of > 10 dB, the distance range is ROW 250 m.

2.2.1 Net Effects Analysis

Total score for this route alternative is 205. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WM** for more detail.

2.3 West Mainline – Audley Road to Ashburn Road

The modelling for this section was identical to that for the section from Brock Road to Audley Road, as presented in Section 2.2.

2.3.1 Net Effects Analysis

WM1

Total score for this route alternative is 281. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WM1** for more detail.

WM2

Total score for this route alternative is 406. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a daycare facility in the area of influence. Refer to **Table 2a** and **Figure WM2** for more detail.

2.3.2 Evaluation Results

The following table summarizes the evaluation results for the West Mainline alternatives.

Table 2.3.1: Summary of Evaluation Results for the West Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 250 m	250 to 500 m	500 to 600 m		
WM1	18	53	17	No	281
WM2	28	50	12	Yes (1)	406

- Refer Step 2 for an explanation of the scoring system

2.4 Central Mainline – Ashburn Road to Simcoe Street

Although there was only one route alternative for this section of highway, a score was calculated to understand any potential impacts.

For the Central Mainline, the modelling was conducted for the year 2031 using a six-lane rural highway with an AADT of 78,500, and a bus transitway with a traffic volume of 100 buses per hour.

Based on the computer modelling, the distances range at which 0 to < 5 dB change in sound level is measured as 400 to 600 m. For a change of 5dB to < 10 dB, the distance range is 200 to 400 m and for a change of > 10 dB, the distance range is ROW to 250 m.

2.4.1 Net Effects Analysis

Total score for this route alternative is 283. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure CM** for more detail.

2.5 Central Mainline – Simcoe Street to Enfield Road

The modelling for this section was identical to that for the section from Ashburn Road to Simcoe Street, as presented in Section 2.4.

2.5.1 Net Effects Analysis

CM1

- Total score for this route alternative is 245. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure CM1** for more detail.

CM2

- Total score for this route alternative is 155. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure CM2** for more detail.

2.5.2 Evaluation Results

The following table summarizes the evaluation results for the Central Mainline Alternatives.

Table 2.5.1: Summary of Evaluation Results for the Central Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 200 m	200 to 400 m	400 to 600 m		
CM1	13	48	41	No	245
CM2	9	23	38	No	155

- Refer to Step 2 for an explanation of the scoring system

2.6 East Mainline – Enfield Road to Hwy 35/115

For the East Mainline the modelling was conducted for the year 2031 using a four-lane rural highway with an AADT of 39,200, and a bus transitway with a traffic volume of 100 buses per hour. The following summarizes the results for each of the East Mainline route alternatives.

Based on the computer modelling, the distances range at which 0 to < 5 dB change in sound level is measured as 350 to 600 m. For a change of 5 dB to < 10 dB, the distance range is 175 to 350 m and for a change of > 10 dB, the distance range is ROW to 175 m.

2.6.1 Net Effects Analysis

EM1

Total score for this route alternative is 139. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM1** for more detail.

EM2

Total score for this route alternative is 132. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM2** for more detail.

EM3

Total score for this route alternative is 130. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM3** for more detail.

EM4

Total score for this route alternative is 160. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM4** for more detail.

EM5

Total score for this route alternative is 156. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM5** for more detail.

EM6

Total score for this route alternative is 155. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM6** for more detail.

EM7

Total score for this route alternative is 160. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM7** for more detail.

EM8

Total score for this route alternative is 186. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM8** for more detail.

EM9

Total score for this route alternative is 173. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM9** for more detail.

EM10

Total score for this route alternative is 162. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM10** for more detail.

EM11

Total score for this route alternative is 170. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM11** for more detail.

EM12

Total score for this route alternative is 178. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EM12** for more detail.

2.6.2 Evaluation Results

The following table summarizes the evaluation results for the East Mainline Alternatives.

Table 2.6.1: Summary of Evaluation Results for the East Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 90 m	91 to 175 m	176 to 350 m		
EM1	0	20	91	No	139
EM2	2	24	66	No	132
EM3	1	23	65	No	130
EM4	2	26	84	No	160
EM5	5	20	82	No	156
EM6	3	26	78	No	155
EM7	1	27	81	No	160
EM8	3	25	102	No	186
EM9	3	22	101	No	173
EM10	1	27	93	No	162
EM11	3	27	89	No	170
EM12	0	29	105	No	178

- Refer to Step 2 for an explanation of the scoring system

2.7 West Link

For the West Link the modelling was conducted for the year 2031 using a four-lane rural highway with an AADT of 39,300, and a bus transitway with a traffic volume of 100 buses per hour. The following summarizes the results for each of the West Link route alternatives.

Based on computer modelling, the distances range at which 0 to < 5 dB change in sound level is measured as 350 to 600 m. For a change of 5 dB to < 10 dB, the distance range is 175 to 350 m, and for a change of > 10 dB, the distance range is ROW to 175 m.

2.7.1 Net Effects Analysis

WL1

Total score for this route alternative is 223. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL1** for more detail.

WL2

Total score for this route alternative is 230. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL2** for more detail.

WL3

Total score for this route alternative is 256. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL3** for more detail.

WL4

Total score for this route alternative is 254. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL4** for more detail.

WL5

Total score for this route alternative is 269. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL5** for more detail.

WL6

Total score for this route alternative is 325. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a daycare facility in the area of influence. Refer to **Table 2a** and **Figure WL6** for more detail.

WL7

Total score for this route alternative is 250. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL7** for more detail.

WL8

Total score for this route alternative is 237. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL8** for more detail.

WL9

Total score for this route alternative is 283. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure WL9** for more detail.

2.7.2 Evaluation Results

The following table summarizes the evaluation results for the West Link alternatives.

Table 2.7.1: Summary of Evaluation Results for the West Link

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 175 m	176 to 350 m	351 to 600 m		
WL1	7	32	94	No	223
WL2	7	35	92	No	230
WL3	12	29	109	No	256
WL4	12	30	101	No	254
WL5	16	35	86	No	269
WL6	17	36	130	Yes	325
WL7	8	31	118	No	250
WL8	5	33	114	No	237
WL9	7	46	109	No	283

- Refer to Step 2 for an explanation of the scoring system

2.8 East Link

For the East Link the modelling was conducted for the year 2031 using a four-lane rural highway with an AADT of 46,490, and a bus transitway with a traffic volume of 100 buses per hour. The following summarizes the results for each of the East Link route alternatives.

Based on computer modelling, the distance range at which 0 to < 5 dB change in sound level is measured is 350 to 600 m. For a change of 5 to < 10 dB, the distance range is 175 to 350 m, and for a change of > 10 dB, the distance range is ROW to 175 m.

2.8.1 Net Effects Analysis

EL1

Total score for this route alternative is 325. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL1** for more detail.

EL2

Total score for this route alternative is 398. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL2** for more detail.

EL3

Total score for this route alternative is 395. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL3** for more detail.

EL4

Total score for this route alternative is 356. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL4** for more detail.

EL5

Total score for this route alternative is 389. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL5** for more detail.

EL6

Total score for this route alternative is 407. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL6** for more detail.

EL7

Total score for this route alternative is 364. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL7** for more detail.

EL8

Total score for this route alternative is 363. This is based on the assumption that one sensitive receptor can be mitigated. Refer to **Table 2a** and **Figure EL8** for more detail.

EL9

Total score for this route alternative is 605. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a school in the area of influence. Refer to **Table 2a** and **Figure EL9** for more detail.

EL10

Total score for this route alternative is 592. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a school in the area of influence. Refer to **Table 2a** and **Figure EL10** for more detail.

EL11

Total score for this route alternative is 582. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a school in the area of influence. Refer to **Table 2a** and **Figure EL11** for more detail.

EL12

Total score for this route alternative is 498. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a school in the area of influence. Refer to **Table 2a** and **Figure EL12** for more detail.

EL13

Total score for this route alternative is 503. This is based on the assumption that eight sensitive receptors can be mitigated. An additional penalty of 100 was assessed because this route alternative could potentially impact a critical receptor, a school in the area of influence. Refer to **Table 2a** and **Figure EL13** for more detail.

2.8.2 Evaluation Results

The following table summarizes the evaluation results for the East Link alternatives.

Table 2.8.1: Summary of Evaluation Results for the East Link

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 175 m	176 to 350 m	351 to 600 m		
EL1	17	22	184	No	325
EL2	20	40	185	No	398
EL3	20	36	194	No	395
EL4	19	26	184	No	356
EL5	17	41	197	No	389
EL6	21	39	197	No	407
EL7	21	32	193	No	364
EL8	24	26	195	No	363
EL9	15	73	208	Yes	605
EL10	12	76	201	Yes	592
EL11	15	70	203	Yes	582
EL12	13	43	229	Yes	498
EL13	11	48	230	Yes	503

- Refer to Step 2 for an explanation of the scoring system

3. Summary

The results of this evaluation are best characterized by looking at the total scores for each set of route alternatives. The lower the score, the better the route is from a noise perspective.

The following tables are replicated from their applicable sections within the report for convenience to view a summary of the -noise comparative evaluation results.

West Mainline

Table 2.3.1: Summary of Evaluation Results for the West Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 250 m	250 to 500 m	500 to 600 m		
WM1	18	53	17	No	281
WM2	28	50	12	Yes (1)	406

- Refer Step 2 for an explanation of the scoring system

Route Alternative WM1 is preferred as it has the least net effects, impacting the fewest sensitive receptors.

Central Mainline

Table 2.5.1: Summary of Evaluation Results for the Central Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 200 m	200 to 400 m	400 to 600 m		
CM1	13	48	41	No	245
CM2	9	23	38	No	155

- Refer to Step 2 for an explanation of the scoring system

Route Alternative CM2 is preferred as it has the least net effects, impacting the fewest sensitive receptors.

East Mainline

Table 2.6.1: Summary of Evaluation Results for the East Mainline

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 90 m	91 to 175 m	176 to 350 m		
EM1	0	20	91	No	139
EM2	2	24	66	No	132
EM3	1	23	65	No	130
EM4	2	26	84	No	160
EM5	5	20	82	No	156
EM6	3	26	78	No	155
EM7	1	27	81	No	160
EM8	3	25	102	No	186
EM9	3	22	101	No	173
EM10	1	27	93	No	162
EM11	3	27	89	No	170
EM12	0	29	105	No	178

- Refer to Step 2 for an explanation of the scoring system

Route Alternatives EM1 – EM3 are preferred as they have least net effects, impacting the fewest sensitive receptors.

West Link

Table 2.7.1: Summary of Evaluation Results for the West Link

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 175 m	176 to 350 m	351 to 600 m		
WL1	7	32	94	No	223
WL2	7	35	92	No	230
WL3	12	29	109	No	256
WL4	12	30	101	No	254
WL5	16	35	86	No	269
WL6	17	36	130	Yes	325
WL7	8	31	118	No	250
WL8	5	33	114	No	237
WL9	7	46	109	No	283

- Refer to Step 2 for an explanation of the scoring system

Route Alternative WL1 is preferred as it has the least net effects, impacting the fewest sensitive receptors.

East Link

Table 2.8.1: Summary of Evaluation Results for the East Link

Route	Number of Impacted Sensitive Receptors (Mitigated)			Critical Receptor	Total Score
	ROW to 175 m	176 to 350 m	351 to 600 m		
EL1	17	22	184	No	325
EL2	20	40	185	No	398
EL3	20	36	194	No	395
EL4	19	26	184	No	356
EL5	17	41	197	No	389
EL6	21	39	197	No	407
EL7	21	32	193	No	364
EL8	24	26	195	No	363
EL9	15	73	208	Yes	605
EL10	12	76	201	Yes	592
EL11	15	70	203	Yes	582
EL12	13	43	229	Yes	498
EL13	11	48	230	Yes	503

- Refer to Step 2 for an explanation of the scoring system

Route Alternative EL1 and EL4 are preferred as they have least net effects, impacting the fewest sensitive receptors.

Glossary of Terms

Ambient (background) sound levels: The ambient noise from all sources other than the sound of interest (i.e. sound other than that being measured).

L_{eq}: An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (i.e., $L_{eq}(24)$ for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. An L_{eq} value expressed in dBA is a good, single value descriptor of the annoyance of noise.

dB - Decibel: The logarithmic units associated with sound pressure level, sound power level, or acceleration level.

dBA - Decibel, A-Weighted: The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to quiet sound levels. The resultant sound pressure level is therefore representative of the subjective response of the human ear. A-weighted sound pressure levels are denoted by the suffix 'A' (ie. dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).

Heavy Duty Vehicles: All vehicles having three or more axles and designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 12,000 kg. Intercity buses are also included in this category.

AADT: Average Annual Daily Traffic count, representing vehicle volumes for an average 24 hour period within a year.

Road Gradient: The slope of the road, typically affecting noise levels when 2% or greater, and traveled by heavy trucks.

Noise sensitive areas (NSA's): Any of the following land uses, with an Outdoor Living Area (OLA) associated with them:

- Private homes such as single family residences (owned or rental)
- Townhouses (owned or rental)
- Multiple unit buildings, such as apartments with OLA's for use by all occupants
- Hospitals, nursing homes for the aged, where there are OLA's for the patients
- Educational facilities and day care centres, where there are OLA's for students
- Campgrounds that provide overnight accommodation
- Hotels / motels where there are OLA's (i.e. swimming pool area, etc.) for visitors