

PRELIMINARY ENVIRONMENTAL NOISE REPORT

**PROPOSED RESIDENTIAL DEVELOPMENT
KENNEDY ROAD AND ANGUS GLEN BOULEVARD
YORK DOWNS EAST DRAFT PLAN
CITY OF MARKHAM
REGION OF YORK**



Prepared for
Sixteenth Land Holdings Inc.

October 4, 2016
File: 16-040

October 4, 2016

City of Markham
101 Town Centre Boulevard
Markham, Ontario
L3R 9W3

Attention: Mr. Binu Korah, P.Eng.
Senior Manager of Development
Engineering and Transportation

Gentlemen:

RE: Noise Study Requirements
Proposed Residential Development
Kennedy Road and Angus Glen Boulevard
York Downs East Draft Plan
AMANDA File No.: Not Available
Our File: 16-040



Jade Acoustics Inc. has prepared a noise study titled "Preliminary Environmental Noise Report" dated October 4, 2016, for the above mentioned proposed residential development.

I hereby certify that the noise study for the above mentioned proposed residential development meets all applicable guidelines as required by the Ministry of Environment and Climate Change related to noise mitigation and also meets the requirements of the City of Markham.

The City of Markham is hereby authorized to rely on this certificate for the purposes of approving the residential development of York Downs East Draft Plan pursuant to a condition of development approval.

Yours very truly,

JADE ACOUSTICS INC.

Per:


Davor Sikic, P.Eng.
Jade Acoustics Inc.
Tel: (905) 660-2444
Fax: (905) 660-4110
Email: davor@jadeacoustics.com



TABLE OF CONTENTS

	SUMMARY	1
1.0	INTRODUCTION	3
2.0	NOISE SOURCES	4
2.1	Transportation Sources	4
2.1.1	Road Traffic.....	4
2.1.2	Aircraft Traffic.....	4
2.2	Stationary Sources	5
3.0	ENVIRONMENTAL NOISE CRITERIA.....	6
3.1	Road Traffic	6
3.1.1	Indoors	6
3.1.2	Outdoors	7
3.2	City of Markham’s Noise By-law	8
3.3	Stationary Sources	8
3.4	Region of York’s Requirements	9
4.0	NOISE IMPACT ASSESSMENT	10
4.1	Road Traffic	10
4.2	Stationary Sources	11
5.0	NOISE ABATEMENT REQUIREMENTS.....	12
5.1	Indoor Living Areas and AC/Ventilation Requirements	12
5.2	Building Façade Construction.....	13
5.3	Outdoor Living Areas and Barrier Requirements	14
5.4	Stationary Sources	16
6.0	CONCLUSION.....	17
7.0	CONDITIONS TO BE INCORPORATED INTO THE SUBDIVISION/SITE PLAN AGREEMENTS	17
8.0	REFERENCES	18

LIST OF TABLES

TABLE 1	SUMMARY OF TRAFFIC DATA	19
TABLE 2	SUMMARY OF PREDICTED UNMITIGATED SOUND LEVELS	20
TABLE 3	SUMMARY OF MINIMUM NOISE ABATEMENT MEASURES	21
TABLE 4	SOUND BARRIER REQUIREMENTS TO ACHIEVE PREDICTED SOUND LEVELS BETWEEN 55 dBA AND 60 dBA.....	25

LIST OF FIGURES

FIGURE 1	KEY PLAN
FIGURE 2	PLAN OF SUBDIVISION SHOWING MINIMUM NOISE ABATEMENT MEASURES

LIST OF APPENDICES

APPENDIX A	CORRESPONDENCE REGARDING TRAFFIC DATA.....	A-1
APPENDIX B	ENVIRONMENTAL NOISE CRITERIA.....	B-1
APPENDIX C	SAMPLE CALCULATION OF PREDICTED UNMITIGATED SOUND LEVELS	C-1
APPENDIX D	SAMPLE CALCULATION OF ARCHITECTURAL COMPONENT SELECTION.....	D-1
APPENDIX E	SAMPLE CALCULATIONS OF SOUND BARRIER REQUIREMENTS.....	E-1

SUMMARY

The proposed residential development is located on the west side of Kennedy Road, north of 16th Avenue. The subject site includes the lands within the York Downs East Draft Plan and is subject to road traffic noise from Kennedy Road and the internal collector roads, Streets A, D and E.

The City of Markham and Region of York follow the environmental noise guidelines of the Ministry of the Environment and Climate Change (MOECC) for new residential developments. These guidelines set out sound level limits for both indoor and outdoor space. Sound levels due to Kennedy Road and Streets A, D, and E were determined using ORNAMENT, the MOECC noise prediction model for road traffic.

Using road traffic data obtained from the Region of York, Poulos and Chung Limited and Horizon Data Services Ltd., the sound levels for various locations in the residential development were determined.

The results of the road traffic noise predictions were used to determine the required mitigation measures. These measures include sound barriers, mandatory central air conditioning and provision for adding central air conditioning.

Sound barriers, central air conditioning and warning clauses are required for the lots and blocks (units) closest to Kennedy Road. Some other lots and blocks (units) require the provision for adding central air conditioning and warning clauses.

Better than standard window, exterior door and exterior wall construction is required for the dwellings immediately adjacent to Kennedy Road. Standard window, exterior door and exterior wall construction would be satisfactory for all other residential dwellings.

When final house plans are available, acoustical requirements should be re-evaluated to ensure that the applicable guidelines are met. Where minor excesses exist and noise mitigation measures are required, future occupants will be advised through the use of a warning clause.

The southeast corner of the proposed site is bordered by an existing church (St. Philip's on the Hill). An existing school (the Unionville Montessori Private School) and a grocery store (The Village Grocer) are found to the south. A commercial plaza, a high school (Pierre Elliott Trudeau High School) and an industrial/commercial facility (Industrial Property Services) are located on the east side of Kennedy Road, north of Bur Oak Avenue.

Due to proximity to the proposed site, the institutional/commercial/industrial facilities listed above were considered and, based on their proximity to the existing residential developments, all were determined to have no impact on the proposed development in terms of any noise mitigation measures required to be implemented by the proponent of the subject lands. Therefore, noise mitigation measures are not required.

1.0 INTRODUCTION

Jade Acoustics Inc. was retained by Sixteenth Land Holdings Inc. to prepare a Preliminary Environmental Noise Report to investigate the potential impact of noise on the proposed development to the satisfaction of the City of Markham and the Region of York.

The proposed site is identified as:

Part of Lots 16, 17 and 18, Concession 5
City of Markham
Regional Municipality of York

The proposed development is bounded by Kennedy Road to the east and existing and future residential developments to the north, west and south. The surrounding land uses include mainly existing and future residential developments. A Key Plan is attached as Figure 1.

This report is based on the draft plan prepared by Gatzios Planning and Development Consultants Inc. dated August 22, 2016.

The proposed residential development is comprised of detached dwellings, townhouse blocks, three park blocks, two stormwater management blocks, one open space (woodlot) block, one elementary school block and new internal roads. Dwellings are expected to be two-storey or three-storey residential units with typical rear yards or potential terraces above the garages for townhouse dwellings.

Stacked townhouses are proposed to be constructed within Block 9 along Kennedy Road. A separate environmental noise report will need to be prepared as part of a future site plan application for this block. Therefore, Block 9 was not addressed further in this report.

A residential reserve block (Block 10) is located at the southwest corner of Kennedy Road and Street C. Block 10 is expected to be included in the block plans for the lands to the south. A separate environmental noise report will need to be prepared at that time to assess the potential noise impacts and determine mitigation measures. As such, Block 10 was not addressed further in this report.

2.0 NOISE SOURCES

2.1 Transportation Sources

2.1.1 Road Traffic

The noise source of potential impact on the proposed development is the road traffic on Kennedy Road and the internal collector roads, Streets A, D and E.

The ultimate road traffic data for Kennedy Road was obtained from the Region of York on August 9, 2016 and is summarized in Table 1. Information regarding the 85th percentile vehicle speeds on Kennedy Road provided by Horizon Data Services Ltd. was also used in the analysis. Correspondence regarding the road traffic information is included in Appendix A.

The 85th percentile speed on Kennedy Road is 78 km/hr and 77 km/hr for northbound and southbound traffic respectively.

16th Avenue and Warden Avenue are located approximately 270 m and 850 m, respectively, from the proposed residential development. Due to the separation distances and intervening residential dwellings, 16th Avenue and Warden Avenue are acoustically insignificant; therefore, they were not analysed further in this report.

The 2021 horizon year a.m. and p.m. peak hour road traffic volumes for Street A, D and E were provided by Poulos and Chung Limited on August 30, 2016. An annual growth rate of 1% was used to calculate the 2026 a.m. and p.m. peak hour volumes which represent a 10 year projection. The 2026 AADT volumes were calculated by using the 2026 a.m. or 2026 p.m. volume, whichever is higher, and multiplying them by 10 (a.m. or p.m. peak hour volume taken to be 10% of AADT). This is the generally accepted method to determine AADT volumes using a.m. and p.m. peak road traffic volumes.

Other internal streets were also considered in the analysis. Based on forecasted road traffic volumes provided by Poulos and Chung Limited, all other internal streets are predicted to be acoustically insignificant and were not analyzed further.

The site is not affected by rail traffic.

2.1.2 Aircraft Traffic

Aircraft using Buttonville Airport and the future Pickering Airport are not deemed to impact the project adversely since there are no blocks within the NEF 25 contour (based on the 1991 and 2000 Noise Exposure Forecast map).

2.2 Stationary Sources

There are several institutional, commercial and industrial facilities located in the vicinity of the proposed development. The location of facilities is shown on Figure 1. The following is a list of the facilities:

- East side of Kennedy Road, north of Bur Oak Avenue:
 - Industrial Property Services (IPS);
 - Commercial Plaza; and
 - Pierre Elliott Trudeau High School.
- West side of Kennedy Road, south of the proposed development:
 - St. Phillip's on the Hill Church;
 - The Unionville Montessori Private School; and
 - Grocery Store (The Village Grocer).

All facilities listed above are required to meet the applicable MOECC guidelines for stationary source of noise at the existing residential dwellings which are located at similar separation distances or closer when compared with the proposed residential dwellings. Meeting the MOECC guidelines at the existing noise sensitive receptors will ensure compliance at the proposed residential developments; therefore, noise mitigation measures to be implemented by the proponent of the subject lands are not required. As such, no physical noise mitigation measures are proposed in this report.

A vacant land (lot) is located immediately north of the IPS facility. Based on the City of Markham Official Plan (2014), a mixed use/mid-rise use is assigned for the vacant lot. Once specific information regarding the development of this lot becomes available, an environmental noise analysis should be prepared by the proponent of this lot to ensure that the applicable MOECC/City of Markham noise guidelines are met at the proposed residential development.

A York Down Garden Centre Ltd. property is situated on the north side of the vacant lot. The garden centre is no longer in operation. Based on the City of Markham Official Plan (2014), a residential low rise use is planned for this property; therefore, no acoustic impact on the proposed development is expected from the future development within the garden centre property.

3.0 ENVIRONMENTAL NOISE CRITERIA

The most recent environmental noise guidelines (NPC-300) of the Ontario Ministry of the Environment and Climate Change (MOECC) were used for this report.

The MOECC document “Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning, Publication NPC-300”, dated August, 2013, released October 21, 2013 (updated final version # 22) replaces the MOECC documents LU-131 and NPC-205. NPC-300 introduced updates to the stationary and transportation source criteria. A brief summary of the NPC-300 guidelines is given in Appendix B. The guidelines are also summarized below.

The following documents were used to determine the City’s and Region’s procedures and environmental noise criteria:

- Section O – Noise Criteria of the Design Criteria document prepared by the City of Markham, Engineering Department dated August 2012; and
- Standard Operating Procedures (SOP’s) for Traffic Noise Mitigation on Regional Roads prepared by the Region of York, Transportation Services dated July, 2010.

The City of Markham’s, the Region of York’s and the Ministry of the Environment and Climate Change’s environmental noise criteria are summarized below.

3.1 Road Traffic

3.1.1 Indoors

If the nighttime (11:00 p.m. to 7:00 a.m.) sound level in terms of Leq at the exterior face of a bedroom or living/dining room window is greater than 60 dBA or if the daytime (7:00 a.m. to 11:00 p.m.) sound level in terms of Leq at the exterior face of a bedroom or living/dining room window is greater than 65 dBA, means must be provided so that windows can be kept closed for noise control purposes and central air conditioning is required. For nighttime sound levels (LeqNight) greater than 50 dBA to less than or equal to 60 dBA on the exterior face of a bedroom or living/dining room window or daytime sound levels (LeqDay) greater than 55 dBA to less than or equal to 65 dBA on the exterior face of a bedroom or living/dining room window, there need only be the provision for adding central air conditioning by the occupant at a later date. This typically involves a ducted heating system sized to accommodate the addition of central air conditioning by the occupant at a later date. A warning clause advising the occupant of the potential interference with some activities is also required.

The City of Markham requires in their Engineering Department Design Criteria – Section O Noise Criteria, that the air cooled condenser unit not exceed an AHRI sound rating of 7.6 bels and must comply with the City's Noise By-law.

It should be noted that the current City of Markham's Noise By-law No. 2003-137 consolidated May 30, 2005 refers to the MOECC Publication NPC-216 which regulates sound ratings and locations of installation of air cooled condenser units by setting sound level limits at adjacent residential properties. In certain situations, this may result in air cooled condenser units that have an AHRI sound rating of less than 7.6 bels.

As required by the MOECC, the indoor noise criteria for road traffic noise is 40 dBA (Leq8hour) for the bedrooms during nighttime hours, 45 dBA (Leq8hour) for the living/dining rooms during nighttime hours and 45 dBA (Leq16hours) for the living/dining rooms and bedrooms during daytime hours. These criteria are used to determine the architectural requirements.

3.1.2 Outdoors

For the outdoor amenity areas (Outdoor Living Areas – OLA), the daytime design guideline sound level for road and rail traffic is 55 dBA. If daytime sound level is less than or equal to 55 dBA, no control measures or warning clauses are required.

If the daytime sound level is greater than 55 dBA and less than or equal to 60 dBA, physical control measures (such as a noise barrier) are required to reduce the sound level to 55 dBA. If physical measures are proven not to be technically, economically, or administratively feasible, then a warning clause is required and must be included in offers of purchase and sale or lease agreements and included in the development agreement.

Amenity areas such as a balcony, ground floor patios, terraces, rooftop decks and decks/terraces above garages, etc. that are less than 4.0 m deep are not considered to be an OLA requiring acoustical protection.

The City of Markham generally requires that the acoustic fence portion of the sound barrier not exceed 2.0 m in height; however, to minimize the use of berms, acoustic fences of up to 2.5 m may be acceptable to the City, subject to site specific review and approval by the City staff. In addition, where feasible, the City of Markham limits the total sound barrier height to 4.5 m measured with respect to the road centreline.

For both the indoor and outdoor conditions, where the acoustical criteria are exceeded, warning clauses must be placed in offers of purchase and sale or lease agreements and included in the development agreement.

3.2 City of Markham's Noise By-law

The City of Markham has By-law No. 2003-137 consolidated May 30, 2005 to regulate noise likely to disturb the inhabitants of the City. It regulates sound ratings and locations of installation of air cooled condenser units by setting sound level limits at adjacent residential properties (MOECC Publication NPC-216). It also provides quantitative and qualitative information with respect to other noise sources. Prohibitions by time and place are also included in the by-law.

3.3 Stationary Sources

The guidelines of the Ontario Ministry of the Environment and Climate Change (MOECC) for stationary sources are to be used for the commercial/industrial facilities.

The MOECC has recently published the document NPC-300 titled "Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning".

The MOECC also has vibration guidelines with respect to stationary sources, NPC-207. These guidelines require that the peak vibration velocities not exceed 0.3 mm/s at the point of reception during the day or night.

The MOECC recognizes the need for back-up beepers/alarms as safety devices and as such does not have any guidelines or criteria to address these sources.

It should be noted that the MOECC guidelines do not require that the source be inaudible, but rather that specific sound level limits be achieved.

With respect to stationary sources of noise in urban areas, the MOECC guidelines require that the sound level due to the stationary source at the building façade and outdoor amenity spaces not exceed the sound level due to road traffic and in certain situations due to rail traffic in any hour of source operation, subject to specific exclusions. Tables C-5, C-6, C-7 and C-8 of NPC-300 included in Appendix B provide the exclusion limit values of one-hour equivalent sound level (Leq, dBA) and impulsive sound level (LIm, dBAI).

In addition, the MOECC guidelines require that most industries have a valid Environmental Compliance Approval (ECA) or its precursor, a Certificate of Approval (C of A) to operate.

In general, if the criteria for a stationary source of noise are exceeded, the MOECC recommends that control be implemented at the source rather than at the receiver. Alternatively, if the receiver is set back from the source or if a physical barrier is constructed so that the criteria can be met at the receiver, no additional mitigation measures are required. Treatment of the receptor building by the use of suitable wall and window construction and

central air conditioning to keep windows closed is not an acceptable solution to the MOECC in Class 1 and 2 areas (urban). In addition, a warning clause in offers of purchase and sale and/or lease agreement noting the proximity of dwellings to such a source should be considered.

3.4 Region of York's Requirements

The calculation procedures included in Scenario C – Development Planning Applications of the Region of York Publication titled “Standard Operating Procedures (SOP's) for Traffic Noise Mitigation on Regional Roads” were followed in the preparation of the noise calculations for the proposed residential receptors adjacent to Kennedy Road.

The 85th percentile speeds were compared with and found to be higher than the posted speed limits; therefore, as per the Region of York's requirements, the 85th percentile speeds were used for the analysis.

Also, as per the Region's procedures, multiple segments were used to model the existing 4 lane arterial roads.

4.0 NOISE IMPACT ASSESSMENT

4.1 Road Traffic

For road traffic noise, the sound levels in terms of Leq the energy equivalent continuous sound levels for both day (16 hours) and night (8 hours) were predicted using ORNAMENT, the MOECC Traffic Noise Prediction Model for road traffic.

Typical ground level outdoor amenity areas with the rear yard receiver assumed to be 3 m from the middle of the rear wall of the house have been taken into account. Shielding provided by the buildings has also been accounted for in the analysis.

Specific grading plans are not yet available; therefore, the scenario analyzed in this report was based on the following:

- the base of source elevation and the base of barrier elevation are equal: and
- the base of receiver elevation is 0.5 m higher with respect to the base of barrier elevation and the base of the source elevation.

For the lots and blocks (units) along Kennedy Road, the unmitigated daytime and nighttime sound levels at the buildings envelopes are predicted to be between 70 dBA and 72 dBA (daytime) and between 62 dBA and 64 dBA (nighttime).

For the lots directly flanking Kennedy Road and for the blocks (units) flanking Kennedy Road across laneways, the unmitigated daytime sound levels in the rear yards are predicted to be up to 69 dBA.

For the blocks (units) fronting Kennedy Road across single loaded roads, the unmitigated daytime sound levels in the rear yards are predicted to be up to 60 dBA for the end units.

All lots and blocks (units) where the unmitigated daytime sound levels in the rear yards are predicted to exceed 55 dBA require sound barriers and warning clauses.

For the lots and blocks (units) along Streets A, D and E, the unmitigated sound levels at the building envelopes are predicted to be up to 58 dBA (daytime) and up to 51 dBA (nighttime). The unmitigated daytime sound levels in the rear yards are predicted to be 55 dBA or less.

Table 2 provides a summary of predicted sound levels due to road traffic at selected locations without any mitigative measures. Appendix C gives sample calculations.

All lots and blocks (units) located within 43 m of the centreline of Kennedy Road would experience daytime sound levels of higher than 65 dBA at the building envelope. Therefore, all dwellings within 43 m of the centreline of Kennedy Road require mandatory central air conditioning and warning clauses.

All lots and blocks (units) located within 185 m of the centreline of Kennedy Road would experience daytime sound levels of higher than 55 dBA at the building façades. Therefore, all dwellings within 185 m of the centreline of Kennedy Road not requiring mandatory central air conditioning and all dwellings along Streets A, D and E require the provision for central air conditioning and warning clauses.

Where the sound level limits are expected to be exceeded, mitigative measures and warning clauses are required.

4.2 Stationary Sources

As discussed in Section 2.2, physical noise mitigation measures are not required.

5.0 NOISE ABATEMENT REQUIREMENTS

5.1 Indoor Living Areas and AC/Ventilation Requirements

Based on the City of Markham's noise criteria and the predicted sound levels, lots and blocks (units) adjacent to Kennedy Road require installation of central air conditioning and a warning clause. This includes the following lots and blocks (units):

- Lots 1, 2, 15, 16, 688 and 689 and Blocks 14 (two east units), 17 (all units), 18 (all units), 65 (two east units), 68 (two east units) and 71 (two east units)

All lots and blocks (units) within 185 m of the centreline of Kennedy Road not requiring mandatory central air conditioning and all lots and blocks (units) along Streets A, D and E require the provision for adding central air conditioning by the occupants at a later date and a warning clause. This includes the following lots and blocks (units):

- Lots 3 to 14, 17 to 31, 44 to 48, 128, 129, 169, 170, 233 to 237, 243 to 249, 252 to 256, 273 to 276, 298 to 303, 325, 468 to 470, 536 to 542, 549 to 557, 566 to 577, 582 to 605, 623 to 640 and 672 to 687 and Blocks 14 (all units except two east units), 15 (all units), 16 (all units), 19 to 24 (all units), 26 (south unit), 27 (south unit), 30 (south unit), 31 (south unit), 35 to 48 (all units), 51 (east unit), 54 (east unit), 56 (north unit), 57 (north unit), 60 (north unit), 61 (north unit), 63 (all units), 64 (all units), 65 (all units except two east units), 66 (all units), 67 (all units), 68 (all units except two east units), 69 (all units), 70 (all units) and 71 (all units except two east units)

Table 3 and Figure 2 summarize the ventilation requirements.

Warning clauses will also be required to be placed in offers of purchase and sale or lease agreements and in the development agreement for all relevant lots and blocks (units) to make future occupants aware of the potential noise situation.

The City of Markham requires that all air cooled condenser units not exceed an AHRI sound rating of 7.6 bels and must comply with the City's noise by-law. It should be noted that the current City of Markham's Noise By-law No. 2003-137 consolidated May 30, 2005 refers to the MOECC Publication NPC-216 which regulates sound ratings and locations of installation of air cooled condenser units by setting sound level limits at adjacent residential properties. In certain situations, this may result in air cooled condenser units that have an AHRI sound rating of less than 7.6 bels. With townhouse developments, 6.8 bel (or lower) units should be considered where compliance with NPC-216 is required.

5.2 Building Façade Construction

Generally, indoor sound level criteria for road traffic can be achieved in all cases by using appropriate architectural elements for external wall construction, roof construction, windows and external doors. MOECC and City of Markham indoor sound level criteria for road traffic noise are 40 dBA for the bedrooms during nighttime hours and 45 dBA for the living/dining rooms during daytime and nighttime hours, as well as the bedrooms during daytime hours. These criteria have been used in this report. The characteristic spectrum of the noise sources has been accounted for in the determination of the architectural components. Appendix D contains a sample calculation of architectural component selection.

In determining the architectural requirements, for the units adjacent to the roadways, it is assumed that the bedroom will be located on the upper level of a two-storey or three-storey dwelling and the worst case would involve a bedroom located at the corner of the dwelling. The exterior walls would be 55% of the associated floor area for the wall parallel and perpendicular to the roadway. The windows would be 25% of the associated floor area and located on the wall parallel and perpendicular to the roadway.

The day/night traffic split results in more than 5 dBA difference between the predicted daytime and nighttime sound levels. This difference is more than the difference between the MOECC/City of Markham indoor criteria for road traffic for daytime and nighttime hours; therefore, the bedroom with calculated daytime sound level was used for the analysis.

For the worst-case dwellings (along Kennedy Road), taking into account the ratios mentioned above, windows and exterior doors need to be STC 33 and exterior walls need to be STC 41.

An STC 33 rating for windows and exterior doors and an STC 41 rating for exterior walls are better than standard window, exterior door and exterior wall construction which complies with the minimum structural and safety requirements of standard construction. Better than standard window, exterior door and exterior wall construction is required for the dwellings on Lots 1, 15 and 689 and Blocks 14 (east unit), 17 (all units), 18 (all units), 65 (east unit), 68 (two east units) and 71 (two east units).

For all other lots and blocks (units), standard window, exterior door and exterior wall construction is acoustically acceptable.

Since house plans are not yet available, the final architectural choices cannot be made. Therefore, a preliminary analysis using assumed window and wall percentages has been conducted to provide an indication of the architectural requirements. Once house plans are available, the noise control requirements should be re-evaluated.

5.3 Outdoor Living Areas and Barrier Requirements

As stated in Section 4.1, the unmitigated sound levels in the rear yards of some lots and blocks (units) along Kennedy Road exceed 60 dBA; therefore, physical mitigation measures are required.

The City of Markham guidelines generally require a maximum predicted daytime sound level of 55 dBA in the outdoor amenity area. Sound levels between 55 dBA and 60 dBA have been accepted by the City of Markham for some developments in the past. In accordance with the MOECC guidelines, the maximum predicted sound level of 60 dBA is permissible in the outdoor amenity area.

In addition, the City of Markham generally requires that the acoustic fence portion of the sound barrier not exceed 2.0 m in height; however, to minimize the use of berms, acoustic fences of up to 2.5 m may be acceptable to the City subject to approval by the City staff.

Based on the analysis, 5.2 m to 5.6 m high sound barrier are required to achieve 55 dBA in the rear yards of Lots 1, 15 and 689 directly flanking Kennedy Road and Blocks 14 (east unit) and 65 (east unit) flanking Kennedy Road across Lanes B and N. These sound barrier heights are excessive.

A 2.5 m high acoustic fence and 1.0 m high berm combination is proposed in this report to minimize the height of the berm for the above mentioned lots and blocks (units). Using the 3.5 m high sound barrier, the sound levels in the rear yards are predicted to be between 59.5 dBA and 60.0 dBA. Table 4 includes the sound barrier heights to achieve sound levels between 55 dBA and 60 dBA.

For Lots 1, 15 and 689, a minimum 3.0 m wide buffer block would need to be provided along Kennedy Road to accommodate one side of the 1.0 m high berm with a 3:1 slope. Also, sufficient land would need to be provided within the lots to accommodate the other side of the berm.

For Blocks 14 (east unit) and 65 (east unit), sufficient land would need to be provided within the block to accommodate the entire 1.0 m high berm.

For Lots 1 and 689, a 3.5 m high sound barrier should be installed along the side property line and returned to the side wall of the dwelling and the side wall of the detached garage.

For Lots 15, a 3.5 m high sound barrier should be installed along the side and rear property lines and returned to the side wall of the dwelling. The 3.5 m high sound barrier should be extended along the rear property line of Lot 16 gradually tapering down to a 2.5 m high acoustic fence. The 2.5 m high acoustic fence should be extended along the rear property line of Lots 17 to 19.

For Blocks 14 (east unit) and 65 (east unit), a 3.5 m high acoustic fence should be installed along the side property line and returned to the side wall of the dwelling and the side wall of the detached garage.

As per Section O of the City of Markham Engineering Department Design Criteria, sound barriers are not required for dwellings with less than 4.0 m deep terraces above the garages since elevated outdoor amenity areas that are less than 4.0 m deep are not considered outdoor living areas which require acoustical protection. Therefore, if the ground level amenity areas associated with the above discussed lots and blocks (units) are eliminated and replaced with less than 4.0 m deep elevated (terrace above garage) outdoor amenity areas, sound barriers would not be required. In this scenario, a similar design would be needed for several lots and townhouse units to the west of the lots and townhouse units closest to Kennedy Road.

For Lots 571, 572 and 588 and Blocks 17 (south unit), 18 (north unit), 19 (north unit) and 20 (south unit), a 2.2 m high acoustic fence is predicted to achieve 55 dBA in the rear yards.

For Lot 571, the 2.2 m high acoustic fence should be installed along the side and rear property lines and returned to the side wall of the dwelling.

For Lots 572 and 588, the 2.2 high acoustic fence should be installed along the side property line and returned to the side wall of the dwellings.

For Block 17 (south unit), 18 (north unit), 19 (north unit) and 20 (south unit), a 2.2 m high acoustic fence should be installed along the side property line and returned to the side wall of the dwellings and the side wall of the detached garages.

Again, if the ground level amenity areas associated with Blocks 17, 18, 19 and 20 are eliminated and replaced with less than 4.0 m deep elevated (terrace above garage) outdoor amenity areas, acoustic fences would not be required.

Blocks 66 to 71 include back-to-back townhouse units. It is expected that the units will be designed with less than 4.0 m deep balconies and no ground level outdoor amenity areas; therefore, sound barriers are not required. It should be noted that any rooftop terrace (if applicable) should be less than 4.0 m deep to eliminate the need for sound barriers. Additional noise analyses should be prepared for more than 4.0 deep rooftop terraces, once specific information becomes available.

Table 3 of this report summarizes the recommended sound barrier heights. Figure 2 shows the locations and heights of the recommended sound barriers. Sample sound barrier analyses is provided in Appendix E.

Sound barrier heights to achieve the predicted sound levels between 55 dBA and 60 dBA are shown in Table 4.

As required by the City of Markham, if a sound barrier is to be used, the sound barrier may be an acoustic fence, berm, or a berm/acoustic fence combination. The acoustic fence must be solid with no gaps along its length and have a minimum surface density of 20 kg/m² (4 lb/ft²). It is generally made of wood but other equivalent materials accepted by the City of Markham's Director of Engineering could be used.

Appropriate treatment of the sound barrier at all discontinuities and points of termination would be required to ensure that the sound barrier is effective. This would involve extending the barrier to the front property line; returning to the side wall of the house or extending the sound barrier for a minimum of 3 times the distance between the side wall and barrier, past the rear wall of the house.

If gaps at the bottom of the acoustic fence are necessary for drainage, special design techniques to create interrupted line of sight under the acoustic fence are required. Any treatment of the drainage proposed for the subject site should be reviewed by Jade Acoustics Inc. prior to its implementation.

Warning clause requirements are listed in Table 3 and specific wording is included in the Notes to Table 3.

5.4 Stationary Sources

As discussed in Section 2.2 and mentioned in Section 4.2, physical noise mitigation measures are not required.

Lots 1, 15 and 689 and Blocks 14 (east unit), 17 (all units) and 18 (all units) should be provided with a proximity warning clause notifying the purchasers/tenants that the activities associated with the existing commercial/industrial facilities may at times be audible. See Table 3 and Notes to Table 3.

6.0 CONCLUSION

Based on the acoustical analysis, with the incorporation of noise warning clauses and attenuation requirements stipulated in Table 3 and shown on Figure 2, the sound levels for all proposed lots and blocks (units) will be within the applicable environmental noise criteria.

A detailed environmental noise report will need to be prepared once a final draft plan and final grading plans are available to ensure the appropriate noise criteria are achieved.

As required by the City of Markham, noise certifications should be prepared by Jade Acoustics Inc. prior to issuance of building permits, building occupancy and acceptance for maintenance.

7.0 CONDITIONS TO BE INCORPORATED INTO THE SUBDIVISION/SITE PLAN AGREEMENTS

The conditions will be included in the Detailed Environmental Noise Report.

Respectfully submitted,

JADE ACOUSTICS INC.

Per:


Davor Sikic, P.Eng.



Per:


Dalila C. Giusti, P.Eng.



DS/DCG/afo
J:\Reports\16-040 Oct 4-16 Kennedy & Angus Glen.doc

8.0 REFERENCES

1. "Model Municipal Noise Control By-Law", Final Report, by the Ontario Ministry of the Environment, August, 1978.
2. ORNAMENT – "Ontario Road Noise Analysis Method for Environment and Transportation", Ontario Ministry of the Environment, October, 1989.
3. "Building Practice Note No. 56: Controlling Sound Transmission into Buildings", by J.D. Quirt, Division of Building Research, National Research Council of Canada, September, 1985.
4. "Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning", Ontario Ministry of the Environment and Climate Change Publication NPC-300, August, 2013, released October 21, 2013, (updated final version # 22).
5. "Design Criteria, Section O – Noise Criteria", City of Markham, Engineering Department, April, 2014.
6. Noise By-law No. 2003-137, City of Markham, May 30, 2005.
7. "Standard Operating Procedures (SOP's) for Traffic Noise Mitigation on Regional Roads", Region of York, Transportation Services, July, 2010.

TABLE 1

PROPOSED RESIDENTIAL DEVELOPMENT

KENNEDY ROAD AND ANGUS GLEN BOULEVARD

YORK DOWNS EAST DRAFT PLAN

CITY OF MARKHAM

REGION OF YORK

SUMMARY OF TRAFFIC DATA

A. ROAD TRAFFIC

ROAD	KENNEDY ROAD	STREET A	STREET D	STREET E
AADT*	52,000 (Ultimate)	6,250 (2026)	4,700 (2026)	8,000 (2026)
No. of Lanes	4 (future 6)	2	2	2
Posted Speed Limit (km/hr)	60	50	50	50
Speed (km/hr)	78 (NB)**/77 (SB)**	--	--	--
Trucks (%)	4	1	1	1
Medium/Heavy Split (%)	50/50	100/0	100/0	100/0
Gradient (%)	Up to 8	2***	2***	2***
Day/Night Split (%)	93/7	90/10***	90/10***	90/10***
R.O.W. (m)	Up to 43	24.5	23.0	24.5

* AADT: Annual Average Daily Traffic.

** 85th percentile speed.

*** Assumed.

B. AIRCRAFT TRAFFIC

Buttonville Airport NEF <25 (1991 Noise Exposure Forecast)

Pickering Airport NEF <25 (2000 Noise Exposure Forecast)

TABLE 2

PROPOSED RESIDENTIAL DEVELOPMENT

KENNEDY ROAD AND ANGUS GLEN BOULEVARD

YORK DOWNS EAST DRAFT PLAN

CITY OF MARKHAM

REGION OF YORK

SUMMARY OF PREDICTED UNMITIGATED SOUND LEVELS

Lots and Blocks (Units)	Location*	Source	Distance (m)	Leq (dBA)			
				Day		Night	
				Separate	Combined	Separate	Combined
Lot 15	Rear Yard	Kennedy Road (SB)	25.0	67	69	--	--
		Kennedy Road (NB)	35.5	64		--	
	Side Wall	Kennedy Road (SB)	19.5	70	72	62	64
		Kennedy Road (NB)	30.0	67		59	
Lot 129	Rear Yard	Street A	19.5	54	--	--	--
	Side Wall	Street A	15.0	57	--	50	--
Lot 237	Rear Yard	Street E	19.5	55	--	--	--
	Side Wall	Street E	15.0	58	--	51	--
Lot 549	Rear Yard	Street D	20.5	52	--	--	--
	Side Wall	Street D	14.0	56	--	50	--
Lot 571	Rear Yard	Kennedy Road (SB)	112.0	56	59	--	--
		Kennedy Road (NB)	122.5	56		--	
	Side Wall	Kennedy Road (SB)	107.0	59	61	50	53
		Kennedy Road (NB)	117.5	58		50	
Block 14 (East Unit)	Rear Yard	Kennedy Road (SB)	33.5	67	69	--	--
		Kennedy Road (NB)	44.0	66		--	
	Side Wall	Kennedy Road (SB)	30.5	68	71	60	62
		Kennedy Road (NB)	41.0	67		59	
Block 17 (South Unit)	Front Wall	Kennedy Road (SB)	35.5	68	70	60	62
		Kennedy Road (NB)	46.0	66		58	
Block 20 (South Unit)	Rear Yard	Kennedy Road (SB)	74.5	57	60	--	--
		Kennedy Road (NB)	85.0	57		--	

* Wall receptor is second/third storey at a height of 4.5/7.5 m above ground. The outdoor amenity area receptor is taken at a height of 1.5 m above ground and 3.0 m from the middle of the rear wall.

TABLE 3
PROPOSED RESIDENTIAL DEVELOPMENT
KENNEDY ROAD AND ANGUS GLEN BOULEVARD
YORK DOWNS EAST DRAFT PLAN
CITY OF MARKHAM
REGION OF YORK

SUMMARY OF MINIMUM NOISE ABATEMENT MEASURES

Lots and Blocks (Units)	Air Conditioning (1)	Exterior Wall (2)	Window (2)	Sound Barrier (3)	Warning Clause (4)
Lots 1, 15 and 689 and Block 14 (east unit)	Mandatory	STC 41	STC 33	3.5 m*	A, B, C, D, G
Block 65 (east unit)	Mandatory	STC 41	STC 33	3.5 m*	A, B, C, D
Lot 16	Mandatory	Standard**	Standard**	3.5 m to 2.5 m***	A, B, C, D
Blocks 17 (south unit) and 18 (north unit)	Mandatory	STC 41	STC 33	2.2 m [#]	A, B, C, D, G
Blocks 17 (all units except south unit) and 18 (all units except north unit)	Mandatory	STC 41	STC 33	No	A, B, D, G
Lots 2 and 688 and Blocks 14 (second east unit), 65 (second east unit), 68 (two east units) and 69 (two east units)	Mandatory	Standard**	Standard**	No	A, B, D
Lots 17, 18 and 19	Provision for adding	Standard**	Standard**	2.5 m ^{##}	A, B, C, E
Lots 571, 572 and 588 and Blocks 19 (north unit) and 20 (south unit)	Provision for adding	Standard**	Standard**	2.2 m [#]	A, B, C, E

* 2.5 m high acoustic fence on top of 1.0 m high berm. See Section 5.3 and Figure 2 for details.

** Construction meeting the minimum structural and safety requirements provided by standard construction practices. See Section 5.2 for details.

*** 2.5 m high acoustic fence on top of 1.0 m high berm gradually tapering down to 4.5 m high acoustic fence. See Section 5.3 and Figure 2 for details.

[#] 2.2 m high acoustic fence. See Section 5.3 and Figure 2 for details.

^{##} 2.5 m high acoustic fence. See Section 5.3 and Figure 2 for details.

See Notes to Table 3 on the following page. Warning clauses included in Note 4 follow the format and numbering provided by the City of Markham in their document titled "Design Criteria, Section O – Noise Criteria", dated April, 2014.

TABLE 3 - Continued
PROPOSED RESIDENTIAL DEVELOPMENT
KENNEDY ROAD AND ANGUS GLEN BOULEVARD
YORK DOWNS EAST DRAFT PLAN
CITY OF MARKHAM
REGION OF YORK

SUMMARY OF MINIMUM NOISE ABATEMENT MEASURES

Lots and Blocks (Units)	Air Conditioning (1)	Exterior Wall (2)	Window (2)	Sound Barrier (3)	Warning Clause (4)
Lots 3 to 14, 20 to 31, 44 to 48, 128, 129, 169, 170, 233 to 237, 243 to 249, 252 to 256, 273 to 276, 298 to 303, 325, 468 to 470, 536 to 542, 549 to 557, 566 to 570, 573 to 577, 582 to 587, 589 to 605, 623 to 640 and 672 to 687 and Blocks 14 (all units except two east units), 15 (all units), 16 (all units), 19 (all units except north unit), 20 (all units except south unit), 21 to 24 (all units), 26 (south unit), 27 (south unit), 30 (south unit), 31 (south unit), 35 to 48 (all units), 51 (east unit), 54 (east unit), 56 (north unit), 57 (north unit), 60 (north unit), 61 (north unit), 63 (all units), 64 (all units), 65 (all units except two east units), 66 (all units), 67 (all units), 68 (all units except two east units), 69 (all units), 70 (all units) and 71 (all units except two east units)	Provision for Adding	Standard**	Standard**	No	A, B, E
All other lots and blocks (units)	No Special Requirements				

* 2.5 m high acoustic fence on top of 1.0 m high berm. See Section 5.3 and Figure 2 for details.

** Construction meeting the minimum structural and safety requirements provided by standard construction practices. See Section 5.2 for details.

*** 2.5 m high acoustic fence on top of 1.0 m high berm gradually tapering down to 4.5 m high acoustic fence. See Section 5.3 and Figure 2 for details.

2.2 m high acoustic fence. See Section 5.3 and Figure 2 for details.

2.5 m high acoustic fence. See Section 5.3 and Figure 2 for details.

See Notes to Table 3 on the following page. Warning clauses included in Note 4 follow the format and numbering provided by the City of Markham in their document titled "Design Criteria, Section O – Noise Criteria", dated April, 2014.

NOTES TO TABLE 3

1. Means must be provided to allow windows to remain closed for noise control purposes. The air-cooled unit must be located in compliance with NPC-216 and must not exceed an AHRI sound rating of 7.6 bels. With townhouse developments, 6.8 bel (or lower) units should be considered where compliance with NPC-216 is required.

Provision for adding central air conditioning would involve a ducted heating system sized to accommodate the addition of central air conditioning by the occupant at a later date. The air cooled condenser unit AHRI sound rating must not exceed 7.6 bels and should be placed in a noise insensitive location which complies with municipal by-laws. With townhouse developments, 6.8 bel (or lower) units should be considered where compliance with NPC-216 is required.

2. STC – Sound Transmission Class Rating (Reference ASTM-E413). See Section 5.1.1 for details.
3. Warning Clauses to be placed in the development agreement and to be included in offers of purchase and sale or lease agreements on designated blocks:

A. “Purchasers/tenants are advised that noise levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the noise criteria of the Ministry of the Environment and Climate Change and/or the Municipality”.

B. “Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the noise criteria of the Ministry of the Environment and Climate Change and/or the Municipality.”

C. “Purchasers/tenants are advised that a noise barrier (noise fence or berm + noise fence) is located inside the property line on the side and/or rear yard of this property and that it shall not be altered or removed. The owner of this property is responsible to maintain that part of the noise barrier situated on this property to the satisfaction of the Director of Engineering. Any maintenance, repair or replacement required shall be done with the same material, standards, colour and appearance as the original.”

D. “Purchasers/tenants are advised that this dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the noise criteria of the Municipality and the Ministry of the Environment and Climate Change. The air cooled condenser unit shall have an AHRI sound rating not exceeding 7.6 bels and shall comply with the City’s noise by-law.”

E. “Purchasers/tenants are advised that this dwelling unit has been supplied with forced air heating and ducting etc. with the provision for adding a central air conditioning system at the occupant’s discretion. The air cooled condenser unit, if installed by the occupant, shall have an AHRI sound rating not exceeding 7.6 bels and shall comply with the City’s noise by-law.”

G. “Purchasers/tenants are advised that due to the proximity to the existing commercial/industrial development, sound levels from their activities may at times be audible.”

TABLE 4

PROPOSED RESIDENTIAL DEVELOPMENT

KENNEDY ROAD AND ANGUS GLEN BOULEVARD

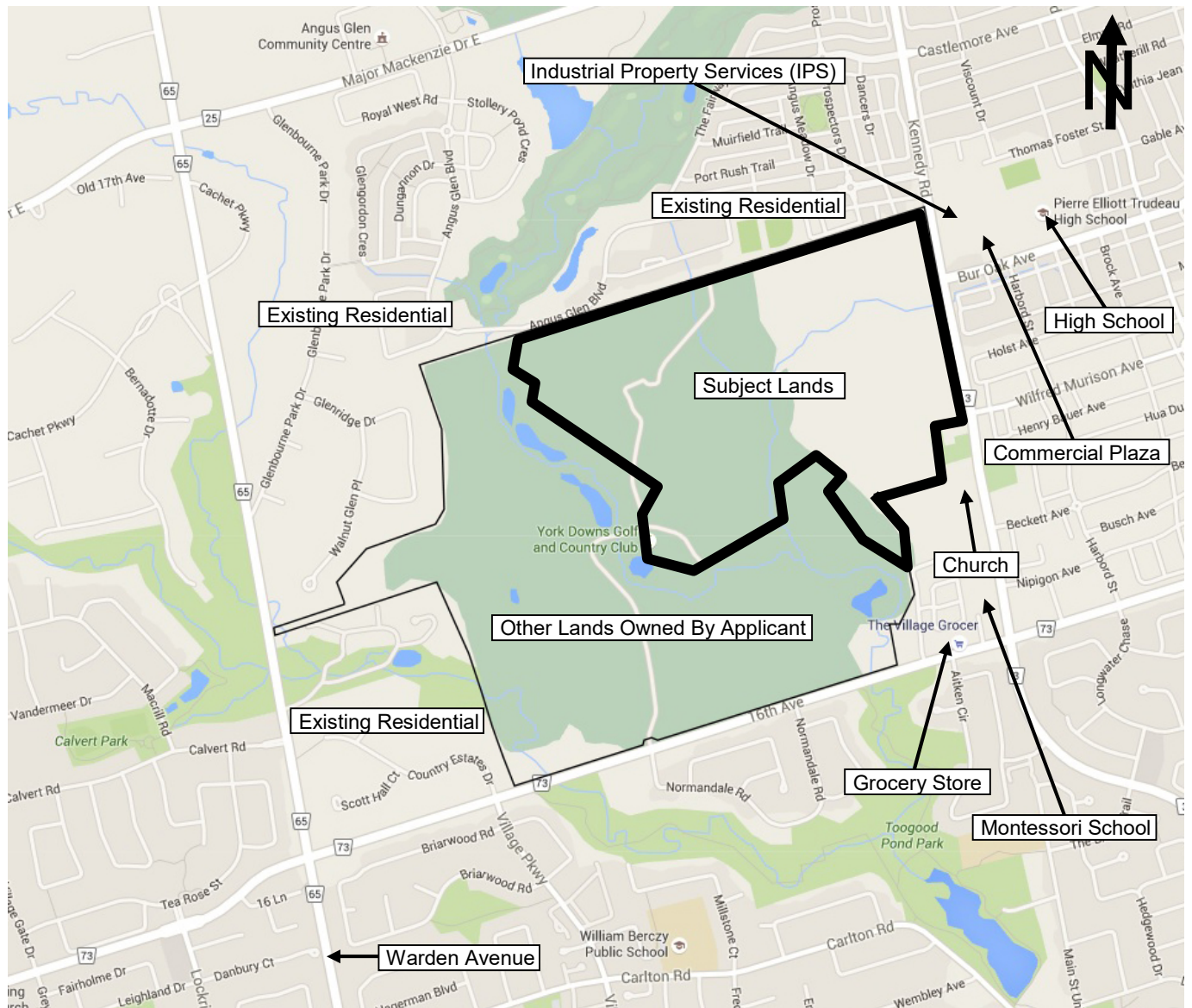
YORK DOWNS EAST DRAFT PLAN

CITY OF MARKHAM

REGION OF YORK

**SOUND BARRIER REQUIREMENTS TO ACHIEVE PREDICTED SOUND LEVELS
BETWEEN 55 dBA AND 60 dBA**

Lots and Blocks (Units)	Sound Barrier Heights (m)					
	55 dBA	56 dBA	57 dBA	58 dBA	59 dBA	60 dBA
Lots 1, 15 and 689	5.6	5.1	4.6	4.1	3.7	3.5
Blocks 14 (east unit) and 65 (east unit)	5.2	4.8	4.4	4.0	3.7	3.5



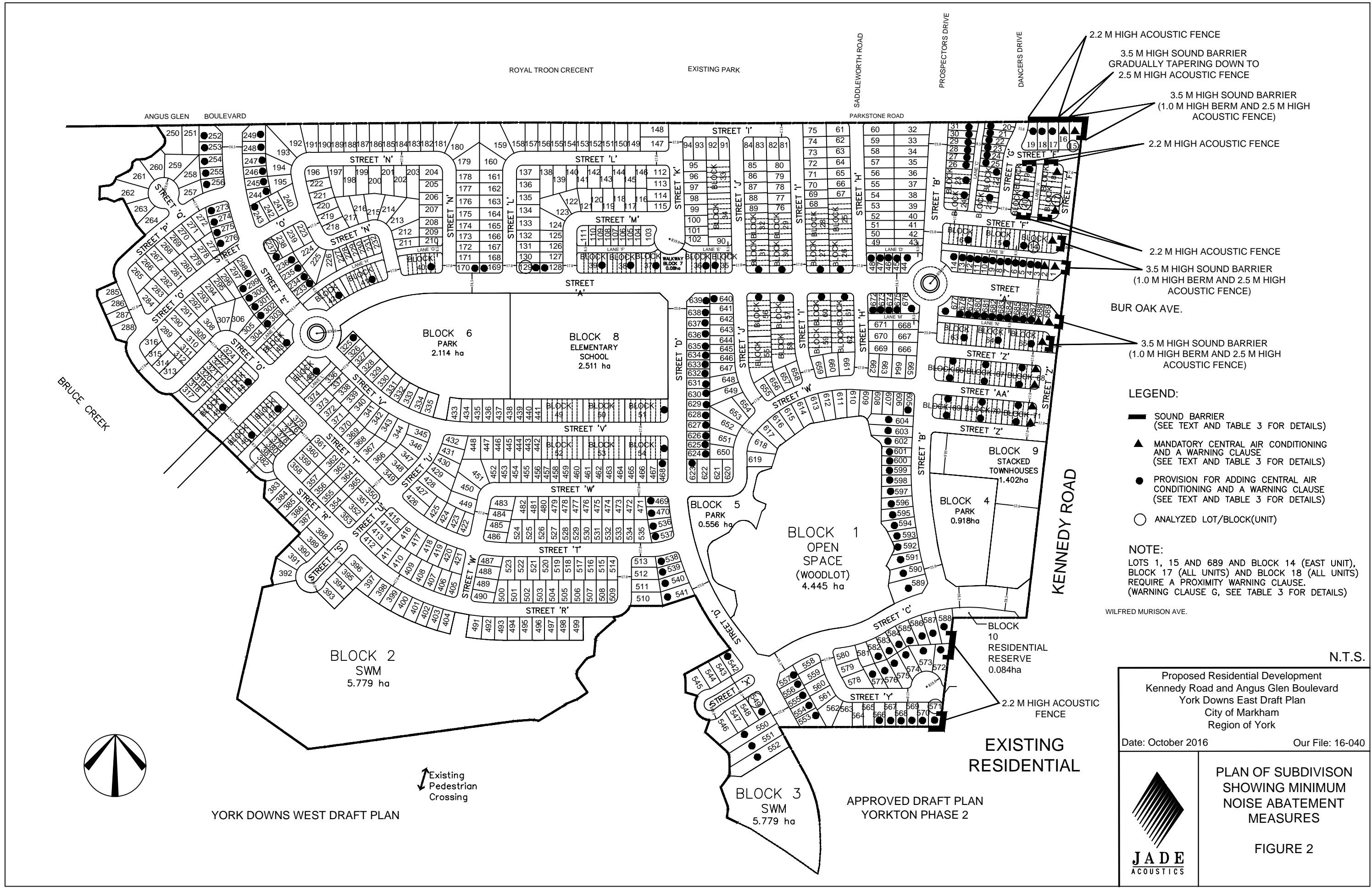
N.T.S.

**Proposed Residential Development
Kennedy Rd. and Angus Glen Blvd.
York Downs East Draft Plan
City of Markham
Region of York**

Date: October 2016 File: 16-040

**KEY PLAN
FIGURE 1**





Proposed Residential Development
Kennedy Road and Angus Glen Boulevard
York Downs East Draft Plan
City of Markham
Region of York

Date: October 2016 Our File: 16-040

JADE
ACOUSTICS

PLAN OF SUBDIVISION
SHOWING MINIMUM
NOISE ABATEMENT
MEASURES

FIGURE 2

APPENDIX A

CORRESPONDENCE REGARDING TRAFFIC DATA



Transportation Services Department
Transportation Planning

August 9, 2016

Mr. Aaron Charbonneau
Jade Acoustics Inc.
411 Confederation Parkway, Unit 19
Concord, ON L4K 0A8

Dear Mr. Charbonneau:

Re: Request for Traffic Data
File No. T09, Forecasts - Markham

As requested, the traffic data for your study are summarized below.

	<u>Warden Avenue</u>	<u>Kennedy Road</u>	<u>16th Avenue</u>
Section No.	65-08	03-08	73-34
Location	North of 16 th Avenue	North of 16 th Avenue	East of Warden Avenue
Existing AADT	13,300 (2013)	22,000 (2013)	42,300 (2013)
Ultimate AADT	49,000	52,000	60,000
No. of Lanes	4 (future 6)	4 (future 6)	4 (future 6)
Posted Speed	60 km/h	60 km/h	60 km/h
Trucks (Med/Heavy)	1% / 1%	2% / 2%	2% / 2%
Grade	Up to 7%	Up to 8%	Up to 7%
Day/Night Split	93/7	93/7	92/8
Planned ROW	Up to 43m	Up to 43m	Up to 43m

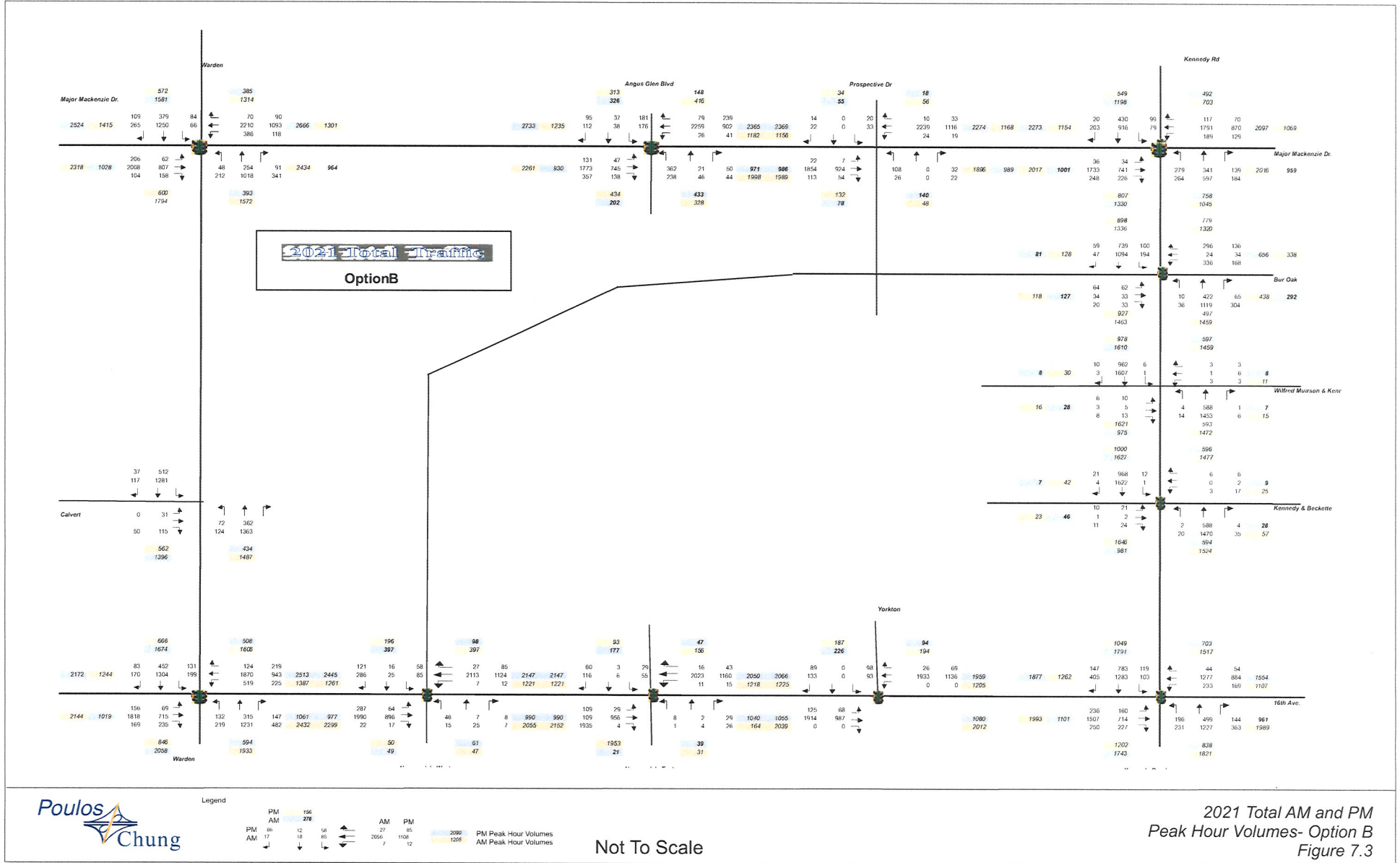
I trust that this will be satisfactory for your study. The invoice will be mailed to you separately.

Sincerely,

Kevin Ye
Transportation Planning, Forecasting

Ky/ky

YORK-#6889487-v1-160048-Charbonneau_16th-Warden-Kennedy.docx



Report-2.1		Location : JA-16-003NS Direction : North Dates : 8/23/2016															
Speeds,km/h ----->		41	51	61	71	81	91	101	111	121	131	141	151	160	Total	Pace Speed	Number in Pace
00:00	1:00			14	53	35	13	1							116	59.0-79.0	91
1:00	2:00	2		2	22	17	10								53	62.4-82.4	41
2:00	3:00				9	8	4	1							22	64.4-84.4	19
3:00	4:00			3	8	5	2								18	58.8-78.8	16
4:00	5:00			3	8	5	6	1							23	64.3-84.3	15
5:00	6:00	3	1	7	22	20	4	4							61	58.9-78.9	43
6:00	7:00	2	2	11	45	41	17	1							119	60.6-80.6	88
7:00	8:00	3	10	27	118	95	17	6	3						279	58.1-78.1	214
8:00	9:00	3	22	94	185	127	21								452	57.2-77.2	340
9:00	10:00	6	8	66	204	105	22	1							412	56.4-76.4	316
10:00	11:00	2	9	81	193	100	15	3							403	57.2-77.2	314
11:00	12:00	3	10	77	178	131	22								421	58.6-78.6	326
12:00	13:00		15	101	214	145	22	3							500	57.4-77.4	396
13:00	14:00	3	10	114	242	145	29	5							548	56.6-76.6	420
14:00	15:00	4	11	87	201	164	26	4							497	58.7-78.7	385
15:00	16:00	24	43	161	324	233	21	2	1						809	58.1-78.1	599
16:00	17:00	29	54	155	440	213	28		1						920	57.4-77.4	700
17:00	18:00	14	73	165	424	288	59	7							1030	58.8-78.8	727
18:00	19:00	27	63	173	421	290	45	5	2			1			1027	57.5-77.5	733
19:00	20:00	1	15	130	321	199	23	7							696	57.7-77.7	549
20:00	21:00	8	38	162	339	154	12	1							714	55.0-75.0	552
21:00	22:00	2	14	120	222	159	33	3	1						554	54.9-74.9	423
22:00	23:00	1	8	36	171	135	20	3	1		1				376	60.5-80.5	309
23:00	00:00	1	2	35	109	78	23	7							255	59.1-79.1	192
Total		136	410	1824	4473	2892	494	65	9	1		1			10305		
AM PEAK		1.3%	4.0%	17.7%	43.4%	28.1%	4.8%	0.6%	0.1%		0.0%		0.0%				
period		6	22	94	204	131	22	6	3						452		
% of class		9:00	8:00	8:00	9:00	11:00	9:00	7:00	7:00						8:00		
		4.4%	5.4%	5.2%	4.6%	4.5%	4.5%	9.2%	33.3%						4.4%		
PM PEAK		29	73	173	440	290	59	7	2	1		1			1030		
period		16:00	17:00	18:00	16:00	18:00	17:00	17:00	18:00	22:00		18:00			17:00		
% of class		21.3%	17.8%	9.5%	9.8%	10.0%	11.9%	10.8%	22.2%	100.0%		100.0%			10.0%		

15% Percentile :	56 KPH
50% Percentile :	67 KPH
85% Percentile :	78 KPH
95% Percentile :	82 KPH

20 KPH Pace Speed:	57.7-77.7 KPH
Number in Pace:	7713
Percent in Pace:	74.8 %
Number of Vehicles >60 KPH:	8117
Percent of Vehicles >60 KPH:	78.8 %
Mean Speed(average):	67 KPH

Report-2.2		Location : JA-16-003NS KENNEDY RD - north of 16th Ave															
		Direction : South															
		Dates : 1 8/23/2016															
Speeds,km/h ----->		41	51	61	71	81	91	101	111	121	131	141	151	160	Total	Pace Speed	Number in Pace
00:00 1:00		2	14	27	17	1									61	55.2-75.2	51
1:00 2:00			4	8	4			1							17	52.2-72.2	13
2:00 3:00		1	3	3	5		1								13	58.2-78.2	8
3:00 4:00			4	6	2	2									14	53.7-73.7	12
4:00 5:00		2	8	18	4	1									33	54.3-74.3	28
5:00 6:00		1	23	52	32	5	1	2							116	55.6-75.6	96
6:00 7:00	8	3	62	194	142	41	5								455	60.4-80.4	339
7:00 8:00	8	5	112	406	241	52	3								827	58.3-78.3	677
8:00 9:00	8	14	226	538	208	34	1								1029	55.8-75.8	870
9:00 10:00	5	3	165	426	181	24	3								807	56.2-76.2	687
10:00 11:00		10	124	325	148	15	2								624	57.1-77.1	535
11:00 12:00	2	4	121	325	146	19	3	1	1						622	56.6-76.6	534
12:00 13:00	1	5	113	312	159	14	3								607	57.2-77.2	507
13:00 14:00	2	4	104	258	120	24	2								514	57.1-77.1	422
14:00 15:00	3	6	77	259	132	15	2								494	58.2-78.2	408
15:00 16:00	3	4	82	274	156	34	2	2							557	55.5-75.5	451
16:00 17:00		7	66	333	221	41	1	1	1						671	60.5-80.5	555
17:00 18:00		2	72	291	240	40	3	1							649	59.0-79.0	537
18:00 19:00		5	79	320	216	35	4								659	59.7-79.7	552
19:00 20:00	4	5	86	283	169	27	1	1							576	57.6-77.6	463
20:00 21:00	3	10	97	198	87	15	2	1							413	55.4-75.4	332
21:00 22:00		2	70	140	77	15	3	1							308	57.1-77.1	245
22:00 23:00	3	8	35	99	31	9		2							187	53.4-73.4	147
23:00 00:00	1	2	25	59	24	5									116	56.7-76.7	99
Total		51	105	1772	5154	2762	468	42	13	2					10369		
AM PEAK		0.5%	1.0%	17.1%	49.7%	26.6%	4.5%	0.4%	0.1%	0.0%							
period		8	14	226	538	241	52	5	2	1					1029		
% of class		6:00	8:00	8:00	8:00	7:00	7:00	6:00	5:00	11:00					8:00		
		15.7%	13.3%	12.8%	10.4%	8.7%	11.1%	11.9%	15.4%	50.0%						9.9%	
PM PEAK		4	10	113	333	240	41	4	2	1					671		
period		19:00	20:00	12:00	16:00	17:00	16:00	18:00	15:00	16:00					16:00		
% of class		7.8%	9.5%	6.4%	6.5%	8.7%	8.8%	9.5%	15.4%	50.0%						6.5%	

15% Percentile : 59 KPH
50% Percentile : 67 KPH
85% Percentile : 77 KPH
95% Percentile : 81 KPH

20 KPH Pace Speed: 57.4-77.4 KPH
Number in Pace: 8428
Percent in Pace: 81.3 %
Number of Vehicles >60 KPH: 8618
Percent of Vehicles >60 KPH: 83.1 %
Mean Speed(average): 68 KPH

APPENDIX B

ENVIRONMENTAL NOISE CRITERIA

ONTARIO MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE (MOECC)

Reference: "Environmental Noise Guidelines Stationary and Transportation Sources – Approval and Planning", Publication NPC-300, August, 2013, released October 21, 2013 (updated final version # 22).

SOUND LEVEL CRITERIA FOR ROAD AND RAIL NOISE

TABLE C-1
Sound Level Limit for Outdoor Living Areas
Road and Rail

Time Period	L_{eq} (16) (dBA)
16 hr, 07:00 - 23:00	55

TABLE C-2
Indoor Sound Level Limits
Road and Rail

Type of Space	Time Period	L_{eq} (dBA)	
		Road	Rail
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	07:00 – 23:00	45	40
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	23:00 – 07:00	45	40
Sleeping quarters	07:00 – 23:00	45	40
	23:00 – 07:00	40	35

SOUND LEVEL CRITERIA FOR AIRCRAFT NOISE

TABLE C-3
Outdoor Aircraft Noise Limit

Time Period	NEF/NEP
24-hour	30

TABLE C-4
Indoor Aircraft Noise Limit
(Applicable over 24-hour period)

Type of Space	Indoor NEF/NEP*
Living/dining/den areas of residences, hospitals, nursing/retirement homes, schools, daycare centres, etc.	5
Sleeping Quarters	0

- * The indoor NEF/NEP values in Table C-4 are used to determine acoustical insulation requirements based on the NEF/NEP contour maps.

SOUND LEVEL CRITERIA FOR STATIONARY SOURCES

TABLE C-5

**Exclusion Limit Values of One-Hour Equivalent Sound Level (L_{eq} , dBA)
Outdoor Points of Reception**

Time of Day	Class 1 Area	Class 2 Area	Class 3 Area	Class 4 Area
07:00 – 19:00	50	50	45	55
19:00 – 23:00	50	45	40	55

TABLE C-6

**Exclusion Limit Values of One-Hour Equivalent Sound Level (L_{eq} , dBA)
Plane of Window of Noise Sensitive Spaces**

Time of Day	Class 1 Area	Class 2 Area	Class 3 Area	Class 4 Area
07:00 – 19:00	50	50	45	60
19:00 – 23:00	50	50	40	60
23:00 – 07:00	45	45	40	55

TABLE C-7
Exclusion Limit Values for Impulsive Sound Level (L_{LM} , dBAI)
Outdoor Points of Reception

Time of Day	Actual Number of Impulses in Period of One-Hour	Class 1 Area	Class 2 Area	Class 3 Area	Class 4 Area
07:00 – 23:00	9 or more	50	50	45	55
	7 to 8	55	55	50	60
	5 to 6	60	60	55	65
	4	65	65	60	70
	3	70	70	65	75
	2	75	75	70	80
	1	80	80	75	85

TABLE C-8
Exclusion Limit Values of Impulsive Sound Level (L_{LM} , dBAI)
Plane of Window - Noise Sensitive Spaces (Day/Night)

Actual Number of Impulses in Period of One-Hour	Class 1 Area (07:00-23:00) / (23:00-07:00)	Class 2 Area (07:00-23:00) / (23:00-07:00)	Class 3 Area (07:00-19:00) / (19:00-07:00)	Class 4 Area (07:00-23:00) / (23:00-07:00)
9 or more	50/45	50/45	45/40	60/55
7 to 8	55/50	55/50	50/45	65/60
5 to 6	60/55	60/55	55/50	70/65
4	65/60	65/60	60/55	75/70
3	70/65	70/65	65/60	80/75
2	75/70	75/70	70/65	85/80
1	80/75	80/75	75/70	90/85

SUPPLEMENTARY SOUND LEVEL LIMITS

Indoor limits for transportation sources applicable to noise sensitive land uses are specified in Table C-2 and Table C-4. Table C-9 and Table C-10 are expanded versions of Table C-2 and Table C-4, and present guidelines for acceptable indoor sound levels that are extended to land uses and developments which are not normally considered noise sensitive. The specified values are maximum sound levels and apply to the indicated indoor spaces with the windows and doors closed. The sound level limits in Table C-9 and Table C-10 are presented as information, for good-practice design objectives.

TABLE C-9
Supplementary Indoor Sound Level Limits
Road and Rail

Type of Space	Time Period	L _{eq} (Time Period) (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	16 hours between 07:00 – 23:00	50	45
Living/dining areas of residences, hospitals, schools, nursing/retirement homes, daycare centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, reading rooms, etc.	16 hours between 07:00 – 23:00	45	40
Sleeping quarters of hotels/motels	8 hours between 23:00 – 07:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	8 hours between 23:00 – 07:00	40	35

TABLE C-10
Supplementary Indoor Aircraft Noise Limit
(Applicable over 24-hour period)

Type of Space	Indoor NEF/NEP*
General offices, reception areas, retail stores, etc.	15
Individual or semi-private offices, conference rooms, etc.	10
Living/dining areas of residences, sleeping quarters of hotels/motels, theatres, libraries, schools, daycare centres, places of worship, etc.	5
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	0

* The indoor NEF/NEP values in Table C-10 are not obtained from NEF/NEP contour maps. The values are representative of the indoor sound levels and are used as assessment criteria for the evaluation of acoustical insulation requirements.

APPENDIX C

SAMPLE CALCULATION OF PREDICTED UNMITIGATED SOUND LEVELS

APPENDIX C-1

SAMPLE CALCULATION OF PREDICTED SOUND LEVELS

FILE: 16-040
 NAME: York Downs East Draft Plan
 REFERENCE DRAWINGS: Draft Plan
 LOCATION: Lot 15, 4.5 m above grade, side wall

Noise Source:	Kennedy Road (SB)	Kennedy Road (NB)
Angle of Exposure:	-90 to 90	-90 to 90
Time Period:	16 hr. (day)	16 hr. (day)
Distance (m):	19.25	29.75

CALCULATION OF PREDICTED SOUND LEVELS*

Reference Leq (dBA)*:	73.32	73.43
Height and/or Distance Correction (dBA):	-1.71	-4.70
Finite Element Correction (dBA):	-1.32	-1.32
Allowance for Screening (dBA):	0.00	0.00
Allowance for Future Growth (dBA):	incl.	incl.
Leq (dBA):	70.29	67.42
Combined LeqDay (dBA):	72.10	

* Leq determined using the computerized model of the Ontario Ministry of the Environment and Climate Change Noise Assessment Guidelines, STAMSON Version 5.04 (ORNAMENT). See attached printouts.

APPENDIX C-2

SAMPLE CALCULATION OF PREDICTED SOUND LEVELS

FILE: 16-040
 NAME: York Downs East Draft Plan
 REFERENCE DRAWINGS: Draft Plan
 LOCATION: Lot 15, 4.5 m above grade, side wall

Noise Source:	Kennedy Road (SB)	Kennedy Road (NB)
Angle of Exposure:	-90 to 90	-90 to 90
Time Period:	8 hr. (night)	8 hr. (night)
Distance (m):	19.25	29.75

CALCULATION OF PREDICTED SOUND LEVELS*

Reference Leq (dBA)*:	65.06	65.18
Height and/or Distance Correction (dBA):	-1.71	-4.70
Finite Element Correction (dBA):	-1.32	-1.32
Allowance for Screening (dBA):	0.00	0.00
Allowance for Future Growth (dBA):	incl.	incl.
Leq (dBA):	62.03	59.16
Combined LeqNight (dBA):	63.84	

* Leq determined using the computerized model of the Ontario Ministry of the Environment and Climate Change Noise Assessment Guidelines, STAMSON Version 5.04 (ORNAMENT). See attached printouts.

Filename: 15sw.te **Time Period:** Day/Night 16/8 hours
Description: Lot 15, side wall

Road data, segment # 1: Kennedy SB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 77 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 1: Kennedy SB (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 19.25 / 19.25 m
Receiver height : 4.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: Kennedy NB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 78 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 2: Kennedy NB (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 29.75 / 29.75 m
Receiver height : 4.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Kennedy SB (day)

Source height = 1.19 m

ROAD (0.00 + 70.29 + 0.00) = 70.29 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.58	73.32	0.00	-1.71	-1.32	0.00	0.00	0.00	70.29

Segment Leq : 70.29 dBA

Results segment # 2: Kennedy NB (day)

Source height = 1.19 m

ROAD (0.00 + 67.42 + 0.00) = 67.42 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.58	73.43	0.00	-4.70	-1.32	0.00	0.00	0.00	67.42

Segment Leq : 67.42 dBA

Total Leq All Segments: 72.10 dBA

Results segment # 1: Kennedy SB (night)

Source height = 1.19 m

ROAD (0.00 + 62.03 + 0.00) = 62.03 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.58	65.06	0.00	-1.71	-1.32	0.00	0.00	0.00	62.03

Segment Leq : 62.03 dBA

Results segment # 2: Kennedy NB (night)

Source height = 1.19 m

ROAD (0.00 + 59.16 + 0.00) = 59.16 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.58	65.18	0.00	-4.70	-1.32	0.00	0.00	0.00	59.16

Segment Leq : 59.16 dBA

Total Leq All Segments: 63.84 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 72.10
(NIGHT): 63.84

APPENDIX C-3 SAMPLE CALCULATION OF PREDICTED SOUND LEVELS

FILE: 16-040
NAME: York Downs East Draft Plan
REFERENCE DRAWINGS: Draft Plan
LOCATION: Lot 15, 1.5 m above grade, rear yard

Noise Source:	Kennedy Rd. (SB)	Kennedy Rd. (NB)
Time Period:	16 hr. (day)	16 hr. (day)
Segment Angle:	-90 to 30	-90 to 30
Distance (m):	24.75	35.25

CALCULATION OF PREDICTED SOUND LEVELS*

Reference Leq (dBA)*:	73.32	73.43
Height and/or Distance Correction (dBA):	-3.61	-6.16
Finite Element Correction (dBA):	-2.85	-2.85
Allowance for Screening (dBA):	0.00	0.00
Allowance for Future Growth (dBA):	incl.	incl.
LeqDay (dBA):	66.86	64.43
Combined LeqDay (dBA):	68.82	

* Leq determined using the computerized model of the Ontario Ministry of the Environment and Climate Change Noise Assessment Guidelines, STAMSON Version 5.04 (ORNAMENT and STEAM). See attached printouts.

Filename: 15ola.te Time Period: Day/Night 16/8 hours
Description: Lot 15, rear yard

Road data, segment # 1: Kennedy SB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 77 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 1: Kennedy SB (day)

Angle1 Angle2 : -90.00 deg 30.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 24.75 m
Receiver height : 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 30.00 deg
Barrier height : 0.00 m
Barrier receiver distance : 10.00 m
Source elevation : 0.00 m
Receiver elevation : 0.50 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Kennedy NB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 78 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 2: Kennedy NB (day)

```

-----
Angle1  Angle2      : -90.00 deg   30.00 deg
Wood depth      :      0          (No woods.)
No of house rows :      0
Surface         :      1          (Absorptive ground surface)
Receiver source distance : 35.25 m
Receiver height  :    1.50 m
Topography      :      2          (Flat/gentle slope; with barrier)
Barrier angle1   : -90.00 deg   Angle2 : 30.00 deg
Barrier height   :    0.00 m
Barrier receiver distance : 10.00 m
Source elevation :    0.00 m
Receiver elevation :    0.50 m
Barrier elevation :    0.00 m
Reference angle  :    0.00
  
```

Results segment # 1: Kennedy SB (day)

Source height = 1.19 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver    ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
      1.19 !      1.50 !      1.67 !      1.67
  
```

ROAD (0.00 + 66.86 + 0.00) = 66.86 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	30	0.66	73.32	0.00	-3.61	-2.85	0.00	0.00	-0.27	66.59*
-90	30	0.66	73.32	0.00	-3.61	-2.85	0.00	0.00	0.00	66.86

* Bright Zone !

Segment Leq : 66.86 dBA

Results segment # 2: Kennedy NB (day)

Source height = 1.19 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver    ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
      1.19 !      1.50 !      1.77 !      1.77
  
```

ROAD (0.00 + 64.43 + 0.00) = 64.43 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	30	0.66	73.43	0.00	-6.16	-2.85	0.00	0.00	-0.29	64.13*
-90	30	0.66	73.43	0.00	-6.16	-2.85	0.00	0.00	0.00	64.43

* Bright Zone !

Segment Leq : 64.43 dBA

Total Leq All Segments: 68.82 dBA

APPENDIX D

SAMPLE CALCULATION OF ARCHITECTURAL COMPONENT SELECTION

APPENDIX D-1
SAMPLE CALCULATION OF ARCHITECTURAL COMPONENT SELECTION*

FILE: 16-040
NAME: York Downs East Draft Plan
REFERENCE DRAWINGS: Draft Plan
LOCATION: Lot 15, second storey corner bedroom

ROAD

Wall area as a percentage of floor area:	Side: 55%	
	Front: 55%	
Window area as a percentage of floor area:	Side: 25%	
	Front: 25%	
Number of components:	4	
Outdoor Leq:	Side: 72 (+3 for reflections) = 75 dBA	
	Front: 69 (+3 for reflections) = 72 dBA	
Indoor Leq:	45	
Noise Reduction (dBA):	Side: 30	
	Front: 27	
Noise Spectrum:	Road/Distance Aircraft	Angle Correction: 0
Absorption:	Medium	

APPROPRIATE ELEMENTS

		STC Rating
Wall	Side	STC 41
	Front	STC 38
Window	Side	STC 33
	Front	STC 30

* Based upon "Controlling Sound Transmission into Buildings", Building Practice Note 56 by National Research Council of Canada, September, 1985.

APPENDIX E

SAMPLE CALCULATION OF SOUND BARRIER REQUIREMENTS

Filename: 15ola.te **Time Period:** Day/Night 16/8 hours
Description: Lot 15, rear yard

Road data, segment # 1: Kennedy SB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 77 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 1: Kennedy SB (day)

Angle1 Angle2 : -90.00 deg 30.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 24.75 m
Receiver height : 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 30.00 deg
Barrier height : 0.00 m
Barrier receiver distance : 10.00 m
Source elevation : 0.00 m
Receiver elevation : 0.50 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Road data, segment # 2: Kennedy NB (day/night)

Car traffic volume : 23213/1747 veh/TimePeriod *
Medium truck volume : 484/36 veh/TimePeriod *
Heavy truck volume : 484/36 veh/TimePeriod *
Posted speed limit : 78 km/h
Road gradient : 8 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 26000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 93.00

Data for Segment # 2: Kennedy NB (day)

```

-----
Angle1  Angle2      : -90.00 deg  30.00 deg
Wood depth      :      0      (No woods.)
No of house rows :      0
Surface         :      1      (Absorptive ground surface)
Receiver source distance : 35.25 m
Receiver height  : 1.50 m
Topography      :      2      (Flat/gentle slope; with barrier)
Barrier angle1   : -90.00 deg  Angle2 : 30.00 deg
Barrier height    : 0.00 m
Barrier receiver distance : 10.00 m
Source elevation  : 0.00 m
Receiver elevation : 0.50 m
Barrier elevation  : 0.00 m
Reference angle   : 0.00
  
```

Results segment # 1: Kennedy SB (day)

Source height = 1.19 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver    ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
      1.19 !      1.50 !      1.67 !      1.67
  
```

ROAD (0.00 + 66.86 + 0.00) = 66.86 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	30	0.66	73.32	0.00	-3.61	-2.85	0.00	0.00	-0.27	66.59*
-90	30	0.66	73.32	0.00	-3.61	-2.85	0.00	0.00	0.00	66.86

* Bright Zone !

Segment Leq : 66.86 dBA

Results segment # 2: Kennedy NB (day)

Source height = 1.19 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver    ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
      1.19 !      1.50 !      1.77 !      1.77
  
```

ROAD (0.00 + 64.43 + 0.00) = 64.43 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	30	0.66	73.43	0.00	-6.16	-2.85	0.00	0.00	-0.29	64.13*
-90	30	0.66	73.43	0.00	-6.16	-2.85	0.00	0.00	0.00	64.43

* Bright Zone !

Segment Leq : 64.43 dBA

Total Leq All Segments: 68.82 dBA

Barrier table for segment # 1: Kennedy SB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
1.50	1.50	66.86	66.86
1.60	1.60	66.86	66.86
1.70	1.70	62.18	62.18
1.80	1.80	62.15	62.15
1.90	1.90	62.06	62.06
2.00	2.00	61.91	61.91
2.10	2.10	61.72	61.72
2.20	2.20	61.48	61.48
2.30	2.30	61.21	61.21
2.40	2.40	60.91	60.91
2.50	2.50	60.59	60.59
2.60	2.60	60.26	60.26
2.70	2.70	59.92	59.92
2.80	2.80	59.58	59.58
2.90	2.90	59.25	59.25
3.00	3.00	58.91	58.91
3.10	3.10	58.59	58.59
3.20	3.20	58.27	58.27
3.30	3.30	57.95	57.95
3.40	3.40	57.65	57.65
3.50	3.50	57.36	57.36
3.60	3.60	57.07	57.07
3.70	3.70	56.80	56.80
3.80	3.80	56.53	56.53
3.90	3.90	56.28	56.28
4.00	4.00	56.03	56.03
4.10	4.10	55.79	55.79
4.20	4.20	55.56	55.56
4.30	4.30	55.33	55.33
4.40	4.40	55.12	55.12
4.50	4.50	54.91	54.91
4.60	4.60	54.70	54.70
4.70	4.70	54.51	54.51
4.80	4.80	54.32	54.32
4.90	4.90	54.13	54.13
5.00	5.00	53.95	53.95
5.10	5.10	53.78	53.78
5.20	5.20	53.61	53.61
5.30	5.30	53.44	53.44
5.40	5.40	53.28	53.28
5.50	5.50	53.13	53.13
5.60	5.60	52.97	52.97
5.70	5.70	52.82	52.82
5.80	5.80	52.68	52.68
5.90	5.90	52.54	52.54
6.00	6.00	52.40	52.40
6.10	6.10	52.27	52.27
6.20	6.20	52.13	52.13
6.30	6.30	52.03	52.03
6.40	6.40	51.93	51.93

Barrier table for segment # 2: Kennedy NB (day)

Barrier Height	Elev of Barr Top	Road dBA	Tot Leq dBA
1.50	1.50	64.43	64.43
1.60	1.60	64.43	64.43
1.70	1.70	64.43	64.43
1.80	1.80	59.92	59.92
1.90	1.90	59.90	59.90
2.00	2.00	59.84	59.84
2.10	2.10	59.73	59.73
2.20	2.20	59.57	59.57
2.30	2.30	59.38	59.38
2.40	2.40	59.16	59.16
2.50	2.50	58.91	58.91
2.60	2.60	58.64	58.64
2.70	2.70	58.36	58.36
2.80	2.80	58.07	58.07
2.90	2.90	57.77	57.77
3.00	3.00	57.47	57.47
3.10	3.10	57.18	57.18
3.20	3.20	56.88	56.88
3.30	3.30	56.59	56.59
3.40	3.40	56.31	56.31
3.50	3.50	56.03	56.03
3.60	3.60	55.76	55.76
3.70	3.70	55.50	55.50
3.80	3.80	55.25	55.25
3.90	3.90	55.00	55.00
4.00	4.00	54.76	54.76
4.10	4.10	54.53	54.53
4.20	4.20	54.31	54.31
4.30	4.30	54.09	54.09
4.40	4.40	53.88	53.88
4.50	4.50	53.68	53.68
4.60	4.60	53.49	53.49
4.70	4.70	53.30	53.30
4.80	4.80	53.11	53.11
4.90	4.90	52.94	52.94
5.00	5.00	52.76	52.76
5.10	5.10	52.60	52.60
5.20	5.20	52.44	52.44
5.30	5.30	52.28	52.28
5.40	5.40	52.13	52.13
5.50	5.50	51.98	51.98
5.60	5.60	51.83	51.83
5.70	5.70	51.69	51.69
5.80	5.80	51.56	51.56
5.90	5.90	51.42	51.42
6.00	6.00	51.29	51.29
6.10	6.10	51.17	51.17
6.20	6.20	51.05	51.05
6.30	6.30	50.93	50.93
6.40	6.40	50.81	50.81

Combined LeqDay = 59.76 dBA