FREEFIELD LTD.

Ottawa, Ontario, Canada

ENVIRONMENTAL NOISE IMPACT ASSESSMENT FOR THE PROPOSED HALO CAR WASH FACILITY AT 3555 BORRISOKANE ROAD

CITY OF OTTAWA

PEO License No. 90532110

Prepared for

Halo Car Wash Inc.

Prepared by

Freefield Ltd.

21st March 2023

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Environmental Noise Impact Assessment for Halo Car Wash 3555 Borrisokane	Submitted with initial site plan application	Freefield Ltd.	24th October 2022
Environmental Noise Impact Assessment for Halo Car Wash 3555 Borrisokane	Updated to address City of Ottawa comments received 23rd February 2023 relating to removal of POR 5	Freefield Ltd.	15th March 2023
Environmental Noise Impact Assessment for Halo Car Wash 3555 Borrisokane	Updated to address City of Ottawa comments received 21st March 2023 relating to requirement to build Barrier 1 as condition of site plan approval	Freefield Ltd.	21st March 2023 (This Version)

ENVIRONMENTAL NOISE IMPACT ASSESSMENT FOR THE PROPOSED HALO CAR WASH FACILITY AT 3555 BORRISOKANE ROAD, CITY OF OTTAWA

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Resumes, Dr. Hugh Williamson, Michael Wells

ENVIRONMENTAL NOISE IMPACT ASSESSMENT FOR THE PROPOSED HALO CAR WASH FACILITY AT 3555 BORRISOKANE ROAD, CITY OF OTTAWA

1.0 Introduction

Freefield Ltd. has been retained by Halo Car Wash Inc. to undertake an environmental noise impact assessment, in relation to satisfying the City of Ottawa Environmental Noise Control Guidelines (ENCG) requirements for stationary noise sources, for the proposed car wash facility to be located at 3555 Borrisokane Road, City of Ottawa, Ontario.

This report describes an assessment of noise impacts from the proposed mechanical equipment associated with the facility at noise sensitive points of reception in the surrounding urban environment with recommendations for noise mitigation, where necessary, to meet the City of Ottawa and Ministry of Environment, Conservation and Parks, MECP, requirements.

This assessment has been carried out in accordance with City of Ottawa *Environmental Noise Control Guidelines, January 2013* (ENCG)[1] *and* MECP Document: NPC-300, *Stationary and Transportation Sources – Approval and Planning*, August 2013.[2] by Freefield Ltd.

The analysis was based on information received electronically from Halo Car Wash Inc., LRL Engineering and McRobie Architects + Interior Designers.

The noise assessment methodology is summarised below:

- Identification of noise sensitive receptors in the vicinity of the facility. Potential noise sensitive receptors include residences, motels, places of worship, schools, hospitals and vacant land zoned for potential noise sensitive use.

- Determination of the City of Ottawa[1] and MECP[2] sound level limits which will apply at each of the noise sensitive receptors.

- Identification of the sources of noise that will arise from equipment operations. In the current study, the strengths of the various noise sources were obtained from noise measurements at the existing Halo Car Wash located at 3604 Innes Road.

- Based on the strengths of the individual noise sources, noise levels due to operations are predicted at nearby noise sensitive receptors using a prediction procedure which is favoured by the City of Ottawa[1] and MECP[2]. The City of Ottawa[1] and MECP[2] methodology requires that compliance be assessed under predictable "worst case" conditions for normal operations.

- Assessment of compliance of the noise impacts from the proposed equipment operations with City of Ottawa and MECP sound level limits. Where appropriate, mitigation measures are recommended such that compliance is achieved at all receptors.

Note that this assessment considers all noise sources on the site. The facility is not a significant source of vibration therefore a vibration assessment is not required.

Surrounding Lands, Acoustic Environment and Critical Receptors

Directions in this report correspond to site north as shown on Figure 1.

The proposed car wash facility is to be located on the east side of Borrisokane Road at the intersection with Flagstaff Drive, in the suburb of Barrhaven, now in the City of Ottawa, Ontario, as shown in Figure 1 and 2.

The legal description of the site is as follows:

3555 Borrisokane Road,
City of Ottawa, Ontario

A location plan showing the site with respect to the surrounding area is provided in Figure 1. A site layout plan showing the facility's detailed arrangement and source locations is provided in Figure 2. A land use zoning map is provided in Appendix 1.

The car wash facility is to be located on land zoned Light Industrial (IL) as shown on the Zoning Map, Appendix 1.

To the north of the site, the land is zoned Local Commercial (LC), Environmental Protection (EP) with land zoned Residential Third Density (R3) located to the northeast of the site. The R3 zoned land is currently being developed with two storey townhomes with access via Main Halyard Lane. The closest residences in this direction have been selected as noise sensitive receptors in the following assessment.

To the east of the site the land is zoned Environmental Protection (EP) and Open space (O1). Further east the land is zoned Residential Third Density (R3). The R3 zoned land is currently being developed with three storey townhomes with access via Flagstaff Drive and Parallax Private. The closest residences in this direction have been selected as noise sensitive receptors in the following assessment.

To the south of the site the land is zoned Environmental Protection (EP). This land consists of densely wood land referred as the Cambrian Road Woods. There are no noise sensitive points of reception impacted by noise from the proposed facility to the south of the site.

To the west of the site the land is zoned Development Reserve (DR) with a significant portion of this land located in a flood plain. This land is currently vacant. Based on information received from the City of Ottawa in email correspondence dated 23rd February 2023,[6] we understand that this location is not required to be included in this assessment as there are no current applications for the development of this parcel and no plans are registered, hence, when a future noise sensitive development is proposed at this location, the applicant of that site will have to assess the noise from the Halo Car Wash facility and other sources of environmental noise including road traffic noise and implement mitigation measures as required to ensure compliance with applicable City of Ottawa and provincial noise guidelines.

This guidance is in line with Ministry of Environment, Conservation and Parks, MECP, noise guideline, NPC-300, Section B11 - Development of Adjacent Land which states, *''Where a site in proximity to a stationary source is in the process of being developed or redeveloped for noise sensitive land uses (such as residential), it is considered the responsibility of the proponent/developer of the noise sensitive land use to ensure compliance with the applicable sound level limits and for this responsibility to be reflected in the land use planning decisions.''*[2]

Further west lies Highway 416 with land zoned RU located on the western side of Highway 416. Noise impacts from the proposed facility will be insignificant at this location.

Where receptors have been located on vacant lots zoned for potential noise sensitive use the location selected for assessment is consistent with the existing pattern of development in the area as per MECP requirements.

The noise sensitive receptors, which have been selected for detailed analysis, are shown in Figure 1. These were selected as being the receptors most likely impacted by noise from the proposed showroom facility. Other noise sensitive receptors are at greater distances and will be less affected by noise from the facility's operations. Table 1 lists the noise sensitive points of reception selected for analysis.

The site and surrounding land are relatively flat with no significant changes in elevation.

2.0 Facility Description

The proposed Halo Car Wash facility consists of a tunnel type car wash enclosure and a central vacuum system with 18 vacuum stands.

Vehicles enter the site via Flagstaff Drive as shown on Figure 1 and typically proceed directly to car wash entry toll gate.

During periods of maximum capacity up to 24 vehicles may be queuing to enter the car wash at this location with engines typically idling.

After passing through the toll gate, vehicles proceed to the car wash entry, located on the west of the building, and drive onto a conveyor which transfers the vehicle through the automatic wash cycle. Process equipment associated with the automatic wash cycle consists of pressure washers, roller brushes, cleaning foam spray applicators and air-dryer equipment. This equipment is located inside the tunnel car wash building.

After drying, vehicles exit through the car wash exit located on the east side of the building. An automatic roller door is located on both the car wash entry and car wash exit which opens to allow vehicles to enter and exit the car wash building.

After washing, vehicles typically proceed to one of the 18 vacuum stands, each containing a vacuum nozzle and vacuum hose connected to the central vacuum system located in the vacuum plant room in the tunnel building. Equipment located in the vacuum system plant room exhausts through an exhaust stack located on the roof of the building. It is assumed during periods of maximum capacity 9 of the 18 vacuum stands are in use concurrently with vacuum nozzles at each stand in operation for 30 minutes per hour taking into consideration time for drivers to park vehicles and carry out other vehicle maintenance tasks while parked in the vacuum stands.

At certain times vehicles proceed directly from the site entry to the vacuum stands or directly from the car wash exit to the site entry / exit onto Flagstaff Drive i.e. bypassing the vacuum stands.

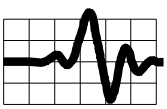
After washing and / or vacuuming vehicles exit the site via the site entry onto Flagstaff Drive.

Ancillary operations include two make-up air units located on the roof of the tunnel building.

Hours of Operation

Daytime and Early Evening Operations (07:00 – 20:00) - During the daytime and early evening period, all significant noise sources are assumed to be in operation.

Evening and Night Operations (20:00 – 07:00) – During the evening and nighttime period, the car wash facility is not in operation.



3.0 Noise Source Summary

The following noise sources have been used to model noise generated by on-site operations. In brackets are the shortened names of the noise sources as used in the acoustic model. The characteristics of these sources, as used in acoustic modelling, are summarized in Table A2.3 and Table A2.4.

- Twenty (24) vehicles in queue at the toll gate (Source: Vehicle_Idling),
- One Car Wash Tunnel Entry with roller door open (Source: Car_Wash_Entry),
- One Car Wash Tunnel Exit with roller door open (Source: Car_Wash_Exit),
- Nine (9) vacuum nozzles with one located at nine of the eighteen vacuum stands (Source: Vacuum_Nozzle),
- One Vacuum System Plant Room Exhaust Stack located on the roof of the building (Source: Vacuum_Plant_Room_Exhaust).
- Two Make-up Air Units located on the roof of the building (Source: MAU_1 and MAU_2)

The strengths of all noise sources, i.e. the sound powers shown in Table 1 and Table A2.3, and used in this analysis are taken from noise measurements carried out by Freefield Ltd. at the Halo Car Wash facility located in Orleans at 3604 Innes Road, Ottawa, Ontario, in December 2020.

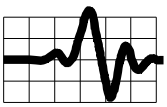
Noise measurements of the vacuum plant room exhaust included the attenuation provided by the acoustically lined duct extending from the vacuum motor to the exhaust stack located on the roof of the plant building.

Noise from the vacuum stands has been modelled as point sources representing the vacuum nozzles associated with each vacuum stand. For the purpose of assessing compliance, it has been assumed that 9 of the 18 vacuum stands are in use concurrently with the associated vacuum nozzles operating 30 minutes per hour.

Noise measurements of the Car_Wash_Exit included the attenuation provided by acoustically absorptive panels installed at the car wash exit and location of the dryers, setback from the opening by approximately 6 m. In the proposed facility the locations of the dryers are similar to the Orleans facility. In addition, recommendations for acoustical lining at the car wash exit have been recommended. Refer to Section 7.0.

Noise from the car wash entry and car wash exit has been modelled as vertical area sources representing the door opening in the tunnel at each end of the building. These doors open and close to allow vehicles to enter and exit the car wash tunnel. For the purpose of assessing compliance, it has been assumed that these doors are open 50 minutes per hour.

There are a number of insignificant noise sources including small vents and exhausts, as well as additional equipment located inside the insulated building. Due to the proposed size and / or internal location of this equipment, it was determined noise impacts from this equipment will



be insignificant at nearby receptors. This equipment will be similar to what is in use at the Orleans facility, which was running when noise measurements were carried out, hence, the cumulative noise from this equipment is included in this analysis.

The locations of the significant noise sources included in this assessment can be found on Figure 2 and 3.

Sound measurements were made with a Bruel and Kjaer sound level meter, Type 2270. The meter was field calibrated using a Bruel and Kjaer Type 4231 Field Calibrator before and after each series of measurements. The field calibration did not vary by more than 0.1 dB over the period of the measurements.

In addition, the meter and field calibrator are laboratory calibrated on an annual basis. Copies of the relevant calibration certificates are contained in Appendix 3.

Meteorological conditions during the measurement period were well suited to noise measurements, i.e. temperature between 0 and +10 °C, no precipitation, partly cloudy skies and the relative humidity below 95 %. Wind was moderate, however, less than 20 km/hour. All measurements were made with microphones mounted on tripods, min. 1.5 m above the ground.

4.0 Points of Reception

The critical noise sensitive points of reception, which have been selected for detailed analysis, are shown in Figure 1.

These were selected as being the points of reception in the surrounding environment most likely impacted by noise from the facility.

Other noise sensitive points of reception are at greater distances and will be less affected by noise from the operations of equipment. Table 1 lists the noise sensitive points of reception selected for analysis.

The four points of reception selected for analysis, POR 1 to POR 4, are listed in Table 2 and shown in Figure 1.

As per MECP Guideline NPC-300, two points of reception (POR) apply at each receptor.

> POW – Plane of window (POW) points of reception are located on the dwelling or noise sensitive building, typically 2 m above ground for single storey dwellings, and, 4.5 m above ground for two storey dwellings. For buildings above two stories the height of the upper floor plane of window location has been selected.
>
> OPR – Outdoor Point of Reception, an area on the property of the residence. For large properties, the OPR point of reception can be up to 30 m from the dwelling at a height of 1.5 m above ground.

Where receptors have been located on vacant land zoned for potential noise sensitive use i.e. a possible future residence located on land zoned Residential Third Density (R3) to the north, the location selected for assessment is consistent with the existing pattern of development in the area.

5.0 Assessment Criteria, Performance Limits

Sound level limits as specified in the City of Ottawa ENCG[1] and MECP guideline NPC-300[2], depend on the acoustical classification of the area as Class 1, 2, 3 or 4.

> **Class 1 area** 'an area with an acoustical environment typical of a major population centre, where the background sound level is dominated by the activities of people, usually road traffic, often referred to as urban hum.'
>
> **Class 2 area** 'an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 areas: sound levels characteristic of Class 1 during daytime (07:00 to 19:00 or to 23:00 hours); and, low evening and night background sound level defined by natural environment and infrequent human activity starting as early as 19:00 hours (19:00 or 23:00 to 07:00 hours).'
>
> **Class 3 area** 'a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as: a small community; agricultural area; a rural resort area such as a cottage or resort area; or, a wilderness area. '
>
> **Class 4 area** 'an area or specific site that would otherwise be defined as Class 1 or 2 and which: is an area intended for development with new noise sensitive land use(s) that are not yet built; is in proximity to existing, lawfully established stationary source(s); and, has formal confirmation from the land use planning authority with the Class 4 area classification which is determined during the land use planning process. Additionally, areas with existing noise sensitive land use(s) cannot be classified as Class 4 areas.'

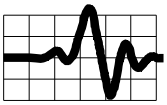
Due to the relatively high levels of road traffic on Borrisokane Road and urban character of the environment, background sound levels in the environment are dominated by traffic noise and other urban noise such as snow clearing and garden maintenance on a 24-hour basis. As such the area in which POR 1 to POR 4 are located is classified as Class 1 Area (Urban).

For a Class 1 Area (Urban) the applicable outdoor sound level limits at noise sensitive receptors, based on 1-hour equivalent sound levels, $L_{EQ,}$ are either the exclusion noise limits given in Table 3 and Table 4, or higher limits if established by an assessment of background noise.

A background noise assessment was not carried out, hence, the levels given in the Tables 3 and 4 are taken as the sound level limits at all points of reception for the purpose of this assessment according to their location in a Class 1 Area.

It is noted, in addition to the City of Ottawa ENCG and MECP noise guidelines, the City of Ottawa Noise By-law 2017-255 also address noise from a dryer associated with a commercial car wash facility.

The by-law states, "No person shall use or operate or cause to be used or operated any exhaust fan, exhaust system, intake fan, generators, dryer in a commercial car wash or similar device



which includes combustion exhaust of a high efficiency furnace, the noise from which has a level greater than 50 dB(A) when measured at the point of reception."

This is equivalent to the daytime exclusion sound level limit for a Class 1 Area as noted in Table 3 and Table 4, hence, compliance with the City of Ottawa ENCG and MECP noise guidelines ensures compliance with the City of Ottawa Noise By-law for all receptors.

For assessment of compliance to the City of Ottawa By-law 2017-255 at POR 3 the partial sound levels attributed to the dryers, located inside the car wash tunnel building near the Car Wash Exit, can be compared to this criterion. Refer Table A2.7.

Sound levels are assessed in terms of the 1-hour equivalent sound level, L_{eq}, effectively the average sound level over each hour. All sound levels are A-weighted, A-weighting being a frequency weighting with represents sensitivity of human hearing to sounds of differing frequencies.

6.0 Impact Assessment

Noise levels have been predicted at the critical receptors using "worst case" assumptions under normal operations and using the ISO sound propagation methodology[4], as implemented in the sound prediction software Cadna-A, version 2022. The ISO methodology, which is favored by the City of Ottawa and the MECP, provides a conservative (i.e. high) estimate of the noise level at each receptor taking into account adverse wind and meteorological conditions.

The estimation method includes the following.

- Distance attenuation is based on spherical spreading.
- Atmospheric attenuation.
- Ground attenuations, as appropriate.
- Barrier attenuation, as appropriate.

In order to consider cases of worst noise impacts, the following two scenarios have been modeled. In general, the worst-case impacts are those which occur when all equipment is in operation concurrently. The following two worst case scenarios are presented in this report.

Scenario 1: *Worst case, all equipment in operation concurrently* ***Before Mitigation*** *– Day and Evening operation (07:00 – 20:00). Refer to Figure 4 for predicted noise impacts.*

Scenario 2: *Worst case, all equipment in operation concurrently* ***After Mitigation*** *– Day and Evening operation (07:00 – 20:00). Refer to Figure 5 for predicted noise impacts.*

Noise impacts at critical points of reception have been completed for daytime and evening periods. The analyzed scenarios are for worst case conditions and modes of operation of equipment.

In Table 5 and Table 6, estimated noise levels at the points of reception for the worst-case scenarios are compared with the applicable sound level limits. The sound level limits applicable are the lowest sound level limits that apply at each point of reception for the period of operation.

More detailed estimates, for all sources are contained in Appendix 2, with Tables A2.5 and A2.6 providing a summary of predicted noise impacts at each receptor for the individual sources.

Statement of Compliance

It is concluded that, with the recommended mitigation measures detailed in Section 7.0, noise impacts from operations at the proposed Halo Car Wash facility will be in compliance with City of Ottawa ENCG[1] and MECP Environmental Noise Guidelines[3] for the proposed daytime and evening period of operation 7 am to 8 pm (07:00 to 20:00). For assessment of compliance to the City of Ottawa By-law 2017-255, the partial sound levels attributed to the Car_Wash_Exit, shown in Table A2.7, are below 50 dBA for all receptors, hence, are predicted to comply with the City of Ottawa Noise By-law.

7.0 Mitigation Measures

As shown in Table 5, it was found that noise impacts from the proposed equipment operations was critical at a nearby noise sensitive points of reception, POR 1 and POR 4. To achieve compliance the following mitigation measures, apply:

7.1 Noise Barriers:

7.1.1 Noise barriers are to be provided as per Table 7 and Figure 6.

7.1.2 Noise barriers shielding receptors on vacant lots zoned for potential noise sensitive use are only required following development of a new noise sensitive use on that or a represented vacant lot.

7.1.3 Noise barriers required to shield points of reception that also represent other nearby points of reception as noted in Table 2 are required to shield line of sight to the identified and represented locations.

7.1.4 Noise barriers shall be continuous and with no gaps. The barrier shall have a minimum surface density of 20 kg/m2, or alternatively be a commercial noise barrier which meets the requirements of CAN/CSA-Z107-9.00 (R2004) Standard for Certification of Noise Barriers (Reaffirmed 2004). Examples of suitable barriers are as follow:

i. Framed exterior walls with exterior cladding to meet the minimum surface density requirements as noted above. It is recommended the assembly of framed exterior walls with exterior cladding be reviewed by a qualified acoustical consultant prior to construction.
ii. Wood barriers constructed with tongue and groove joints or two layers of wood with joints overlapped. Overall thickness depends on density of wood. Based on an assumed density for pine and or spruce of 0.45 kg/m3 a noise barrier constructed of these materials would need to be 2" thick (finished) to meet the minimum surface density requirements as noted above. It is recommended the assembly of wood barriers be reviewed by a qualified acoustical consultant prior to construction.
iii. Concrete or brick walls;
iv. Commercial noise barriers.

7.2 The central vacuum system plant room exhaust stack is to be connected to the vacuum motor with an acoustically lined duct located inside the plant room. The thickness of the lining is to be a minimum 1" thick.

7.3 The walls and ceiling of the car wash exit building are to be acoustically lined with corrosion and moisture resistant acoustical panels, with a minimum noise reduction co-efficient (NRC) of 0.85. The acoustic lining is to extend back into the building from the opening at the car wash exit, to cover the walls and ceiling for the entire dryer area as shown in Figure 7. Panels to be mounted to facility drainage.

7.4 The roller doors located at each end of the car wash tunnel building, at the car wash entry and car wash exit, are to open to a maximum height of 2.4 m high to allow vehicles to enter and exit the car wash during periods the car wash is in operation. At other times, such as during routine maintenance, the roller doors may be opened to their full height.

7.5 The maximum outdoor sound power of the Make-up Air Units, MAU_1 and MAU_2, must not exceed the level given in Table 1.

7.6 If a new process is introduced to the site, then this process shall be assessed by a qualified acoustical consultant prior to commissioning. Noise mitigation measures shall be reviewed, and altered, if necessary, to ensure that City of Ottawa and MECP sound level limits are met at all points of reception.

8.0 Conclusion

A noise impact assessment of stationary noise source impacts has been conducted according to the City of Ottawa and MECP guidelines.

Noise generated from on-site equipment operations at the proposed Halo Car Wash facility have been predicted at critical noise sensitive locations in the surrounding environment.

Noise impacts have been estimated for worst case conditions according to City of Ottawa and MECP guidelines.

It has been found that noise levels at the proposed facility will be in compliance with the City of Ottawa and MECP sound level limits providing the recommendations as specified in this report are followed.

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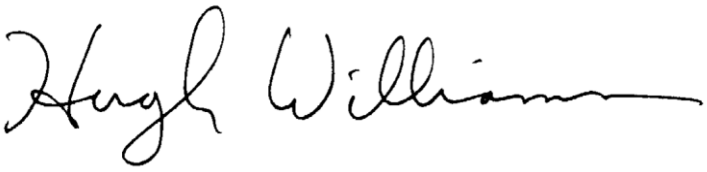


Hugh Williamson, Ph.D., P.Eng.
Member, Canadian Acoustical Society

References

1. City of Ottawa *Environmental Noise Control Guidelines, January 2016*.

2. Ministry of Environment Publication NPC-300, *Environmental Noise Guideline Stationary and Transportation Sources - Approval and Planning*, August 2013.

3. Ministry of Environment, *Sample Application Package, Basic Comprehensive Certificate of Approval (Air and Noise)*, July 2009.

4. International Standards Organization, *Acoustics - Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation*, ISO 9613-2: 1996(E).

5. City of Ottawa *"Official Plan - Annex 10*", 2011.

6. City of Ottawa email correspondence, *"Subject: RE: Noise study report for Halo car wash 3555 Borrisokane Rd. Ottawa (LRL#210691)",* dated 23rd February 2023.

TABLES

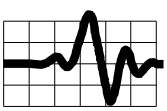


Table 1: Noise Source Summary Table

Name	Source ID	Sound Power (dBA)	Source Location Height (m)	Sound Character-istics	Noise Control Measures
Vehicles Idling in queue at toll gate (Eighteen in total)	Vehicle_Idling	82.8	0.8	Steady, non-tonal, non-directional	As noted in section 7.0
Car Wash Entry	Car_Wash_Entry	93.4	0 - 3	Steady, non-tonal, non-directional	As noted in section 7.0
Car Wash Exit	Car_Wash_Exit_Adj	97.3	0 - 3	Steady, non-tonal, non-directional	As noted in section 7.0
Vacuum Nozzle Located at each of the Vacuum Bays (Nineteen in total)	Vacuum_Nozzle	91.4	0.8	Steady, non-tonal, non-directional	As noted in section 7.0
Vacuum Plant Room Exhaust Stack	Vacuum_Plant_ Room_Exhaust	71.8	0.6*	Steady, non-tonal, non-directional	As noted in section 7.0
Make-up Air Unit	MAU_1/2	83.7	1.5	Steady, non-tonal, non-directional	As noted in section 7.0

*Height measured above roof level.

Table 2: Points of Reception

Point of Reception (POR)	Description
POR 1	Vacant land zoned for potential noise sensitive use Via Flagstaff Drive (2 storey) (Also represents adjacent vacant lots to the east zoned for potential noise sensitive development)
POR 2	Residence to the East via Parallax Private (3 storey)
POR 3	Residence to the East via Parallax Private (3 storey)
POR 4	Residence to the East via Parallax Private (3 storey)

For assessment purposes, points of reception, (POR), have been taken as upper floor windows, POW, (2 m above grade for single storey and 4.5 m above grade to represent two storey residences) and Outdoor Point of Reception, OPR, (1.5 m above grade) in acoustic calculations. POR's located on vacant land have been assessed at 2 stories in height.

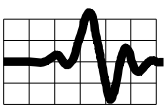


Table 3: Exclusion Limit Values for One-Hour Equivalent Sound Level (Leq, dBA) at Outdoor Points of Reception*

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 4: Exclusion Limit Values for One-Hour Equivalent Sound Level (Leq, dBA) at 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

*Sound level limits are based on 1-hour equivalent sound levels.

Table 5: Acoustic Assessment Summary Table – Before Mitigation

Point of Reception ID	POR Description	Location	Scenario 1 Estimated Sound Level Daytime / Early Evening Period[1,2] (Worst Case) (dBA)	Performance Limit* Daytime Period (dBA)	Compliance with Performance Limit (Yes/No)
POR 1	Vacant Lot	POW	52.5	50	**No[2]**
		OPR	50.7	50	**No[2]**
POR 2	Residence	POW	45.5	50	Yes
		OPR	44.8	50	Yes
POR 3	Residence	POW	45.4	50	Yes
		OPR	45.5	50	Yes
POR 4	Residence	POW	44.8	50	Yes
		OPR	44.9	50	Yes

1. Refer to Tables A2.6 and A2.7, Appendix 2 for detailed sound level estimates by source.
2. As shown in Table A2.7 noise from the dryers located near the car wash exit are 50 dBA or less, hence, comply with the City of Ottawa Noise By-law criteria of not exceeding Leq(1hr) 50 dBA at a point of reception.

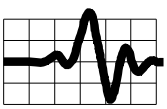


Table 6: Acoustic Assessment Summary Table – After Mitigation

Point of Reception ID	POR Description	Location	Scenario 2 Estimated Sound Level Daytime / Early Evening Period[1,2] (Worst Case) (dBA)	Performance Limit* Daytime Period (dBA)	Compliance with Performance Limit (Yes/No)
POR 1	Vacant Lot	POW	50.0	50	Yes
		OPR	48.1	50	Yes
POR 2	Residence	POW	41.2	50	Yes
		OPR	40.1	50	Yes
POR 3	Residence	POW	41.1	50	Yes
		OPR	41.1	50	Yes
POR 4	Residence	POW	41.2	50	Yes
		OPR	41.3	50	Yes

1. Refer to Tables A2.6 and A2.7, Appendix 2 for detailed sound level estimates by source.
2. As shown in Table A2.7 noise from the dryers located near the car wash exit are 50 dBA or less, hence, comply with the City of Ottawa Noise By-law criteria of not exceeding Leq(1hr) 50 dBA at a point of reception.

Table 7: Recommended Noise Barrier

Barrier	Minimum Height at Top of Barrier (m)	Minimum Length at Top of Barrier (m)	Maximum Distance from Source (m)	Location*	Required to shield Line of Sight from Identified Source ID	Required to shield Line of Sight to Identified Receptor/s	Description
Barrier_1	3.0	55 (full length of eastern boundary)	Not applicable	Eastern boundary of the site in location shown on Figure 6	• Car_Wash_Exit • Vacuum_Nozzles	• POR 1 (and represented lots).	New barrier

Notes:
1. Refer to Figure 6 for location of noise barrier.

Figures

Contents

Figure 1: Area Plan Showing Site Boundary and Points of Reception

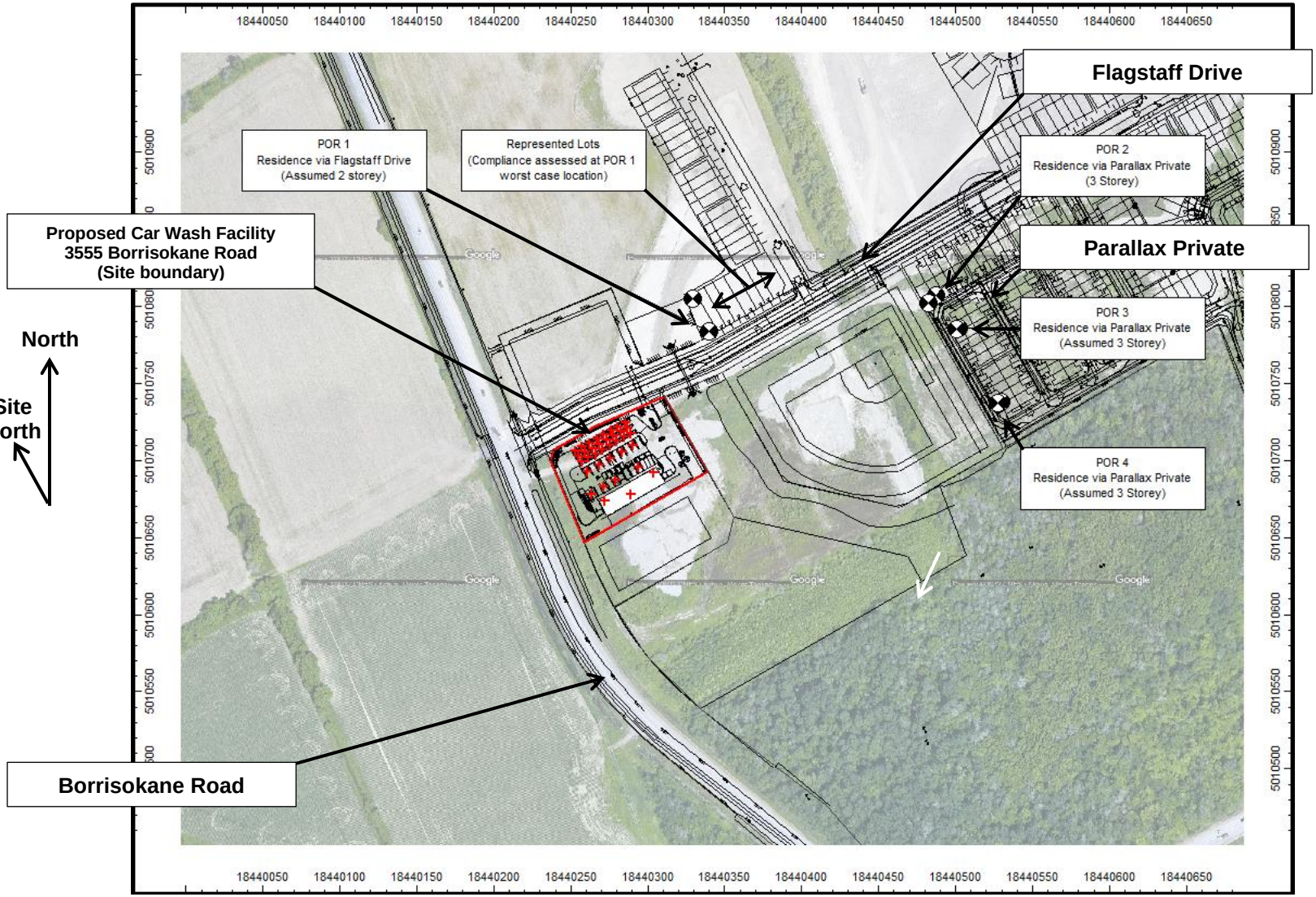


Figure 2: Site Plan

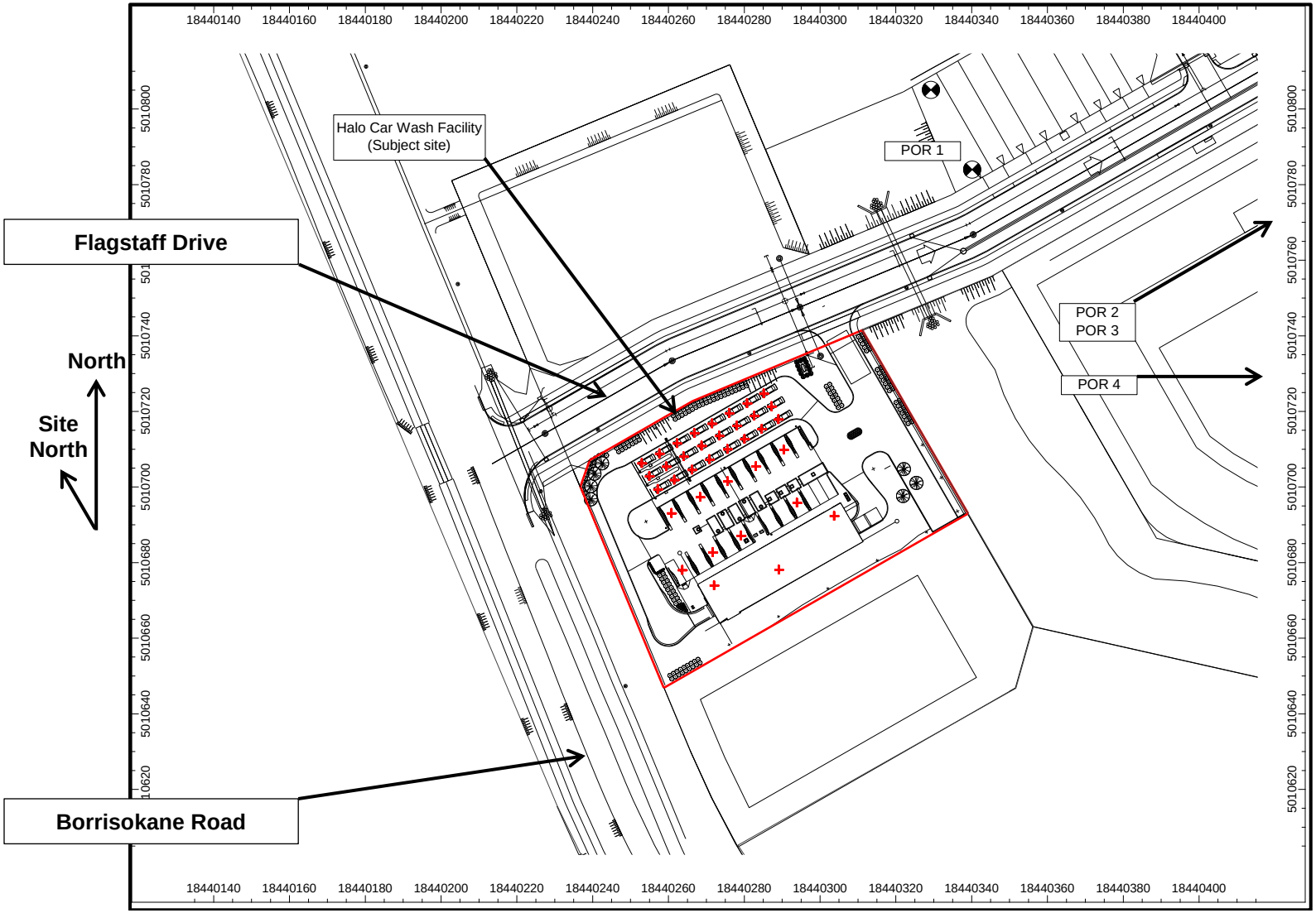


Figure 3: Detailed Plan at Car Wash facility showing Source Locations

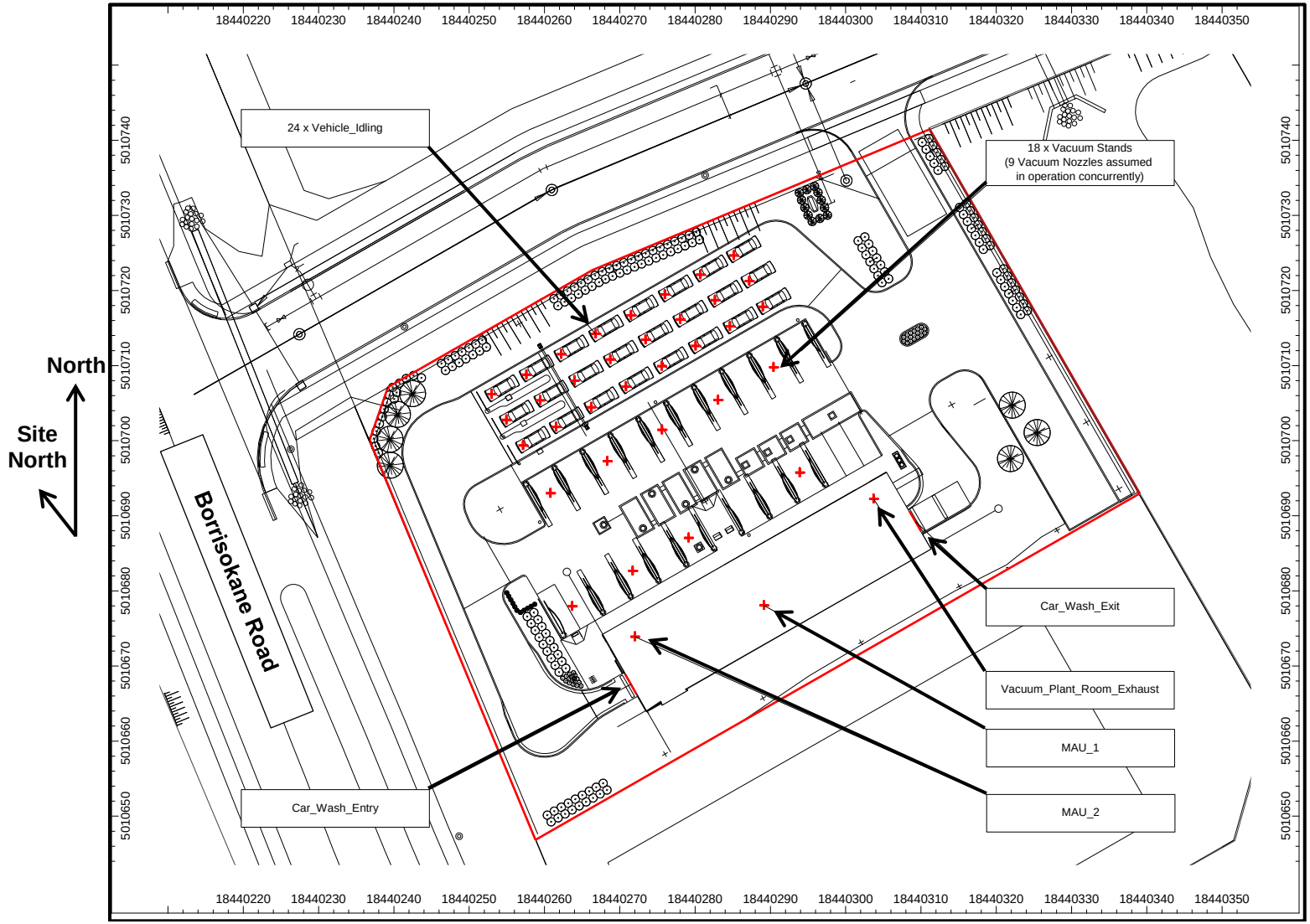


Figure 4: Scenario 1: Worst Case, All equipment in operation – Before Mitigation, Day and Evening only (07:00 – 23:00); Noise Contours: (Noise levels at 4.5 m)

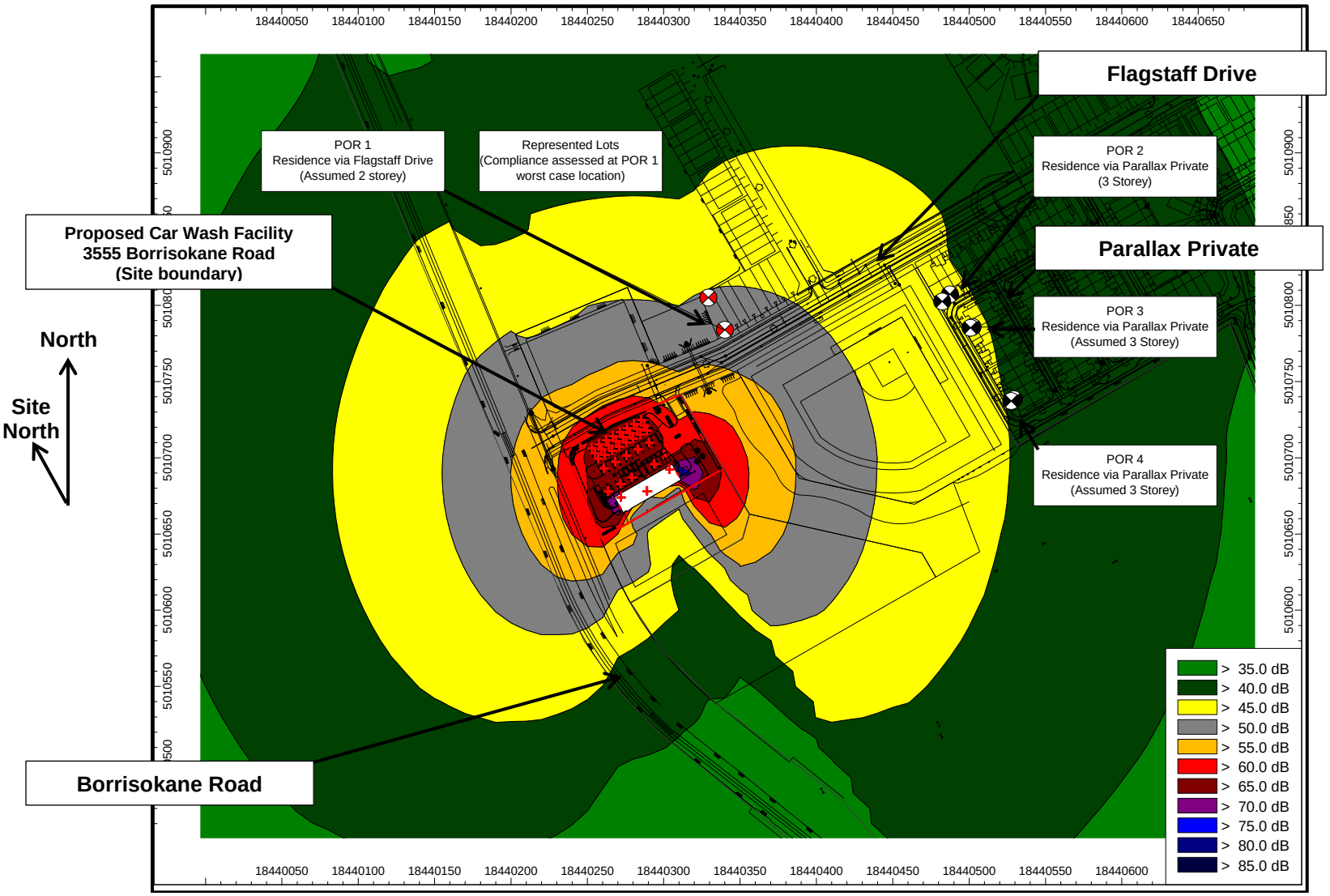


Figure 5: Scenario 2: Worst Case, All equipment in operation – After Mitigation, Day and Evening only (19:00 – 23:00); Noise Contours: (Noise levels at 4.5 m)

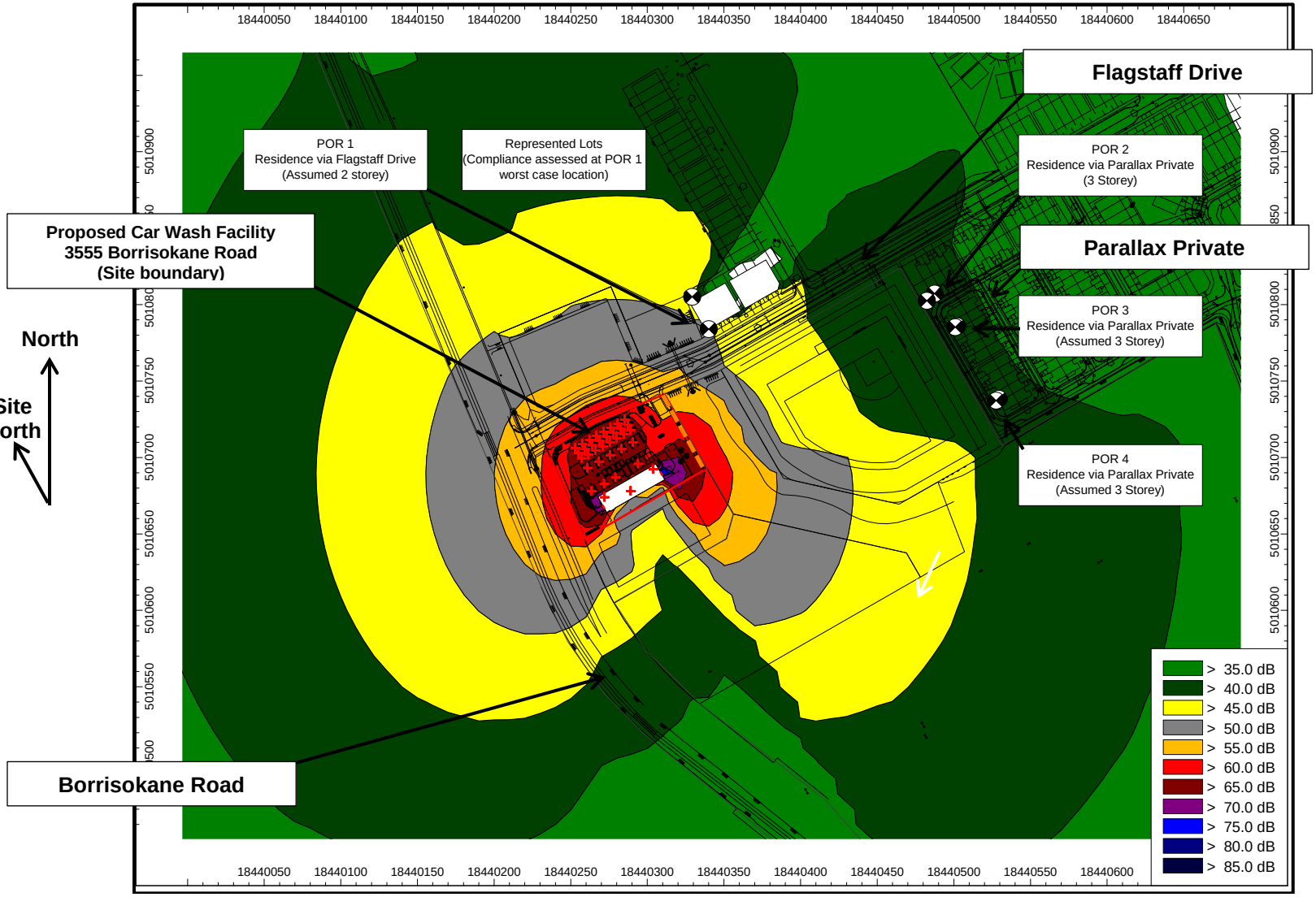


Figure 6: Detailed Site Plan at Car Wash facility showing Recommended Noise Barriers

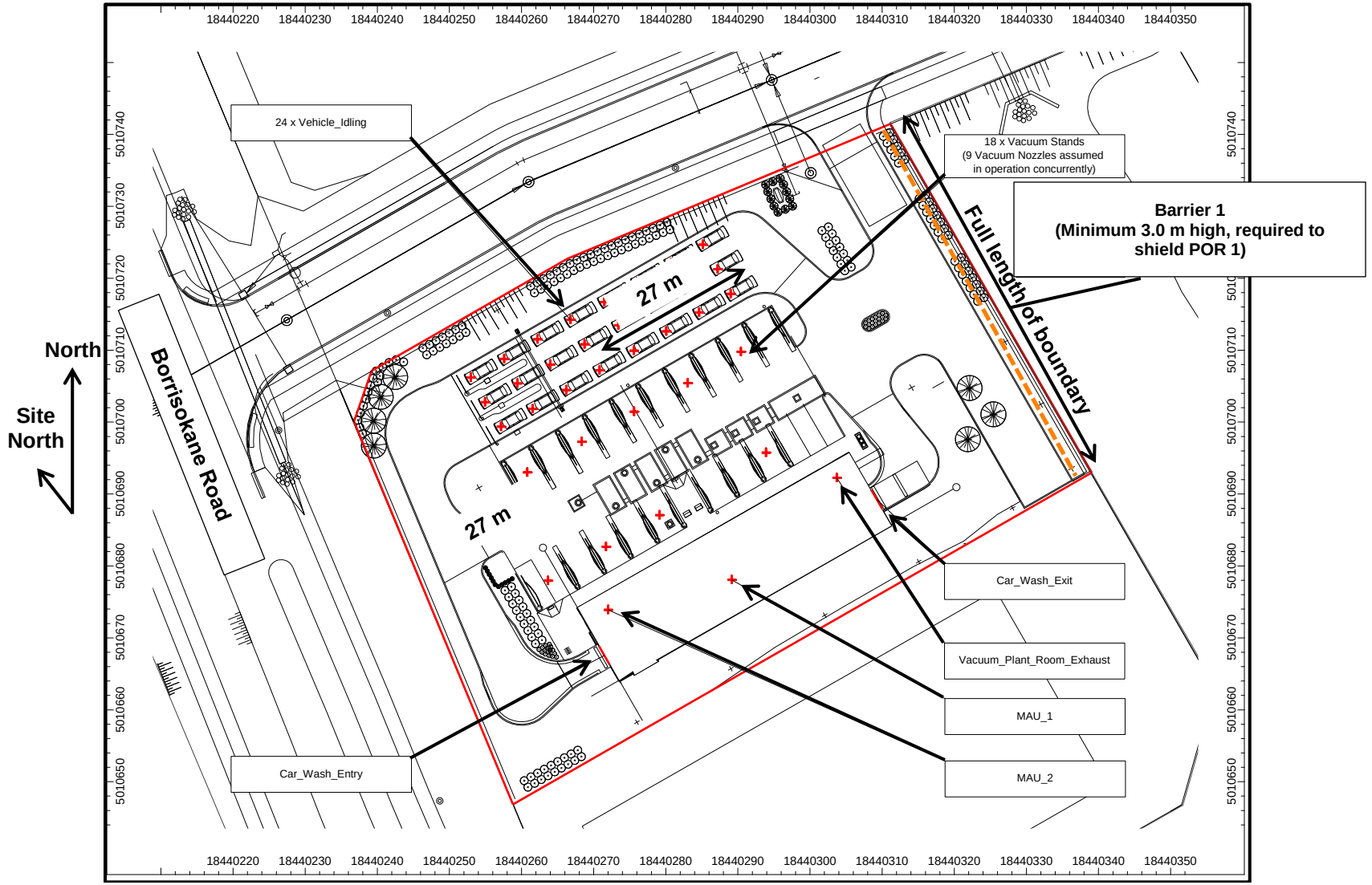
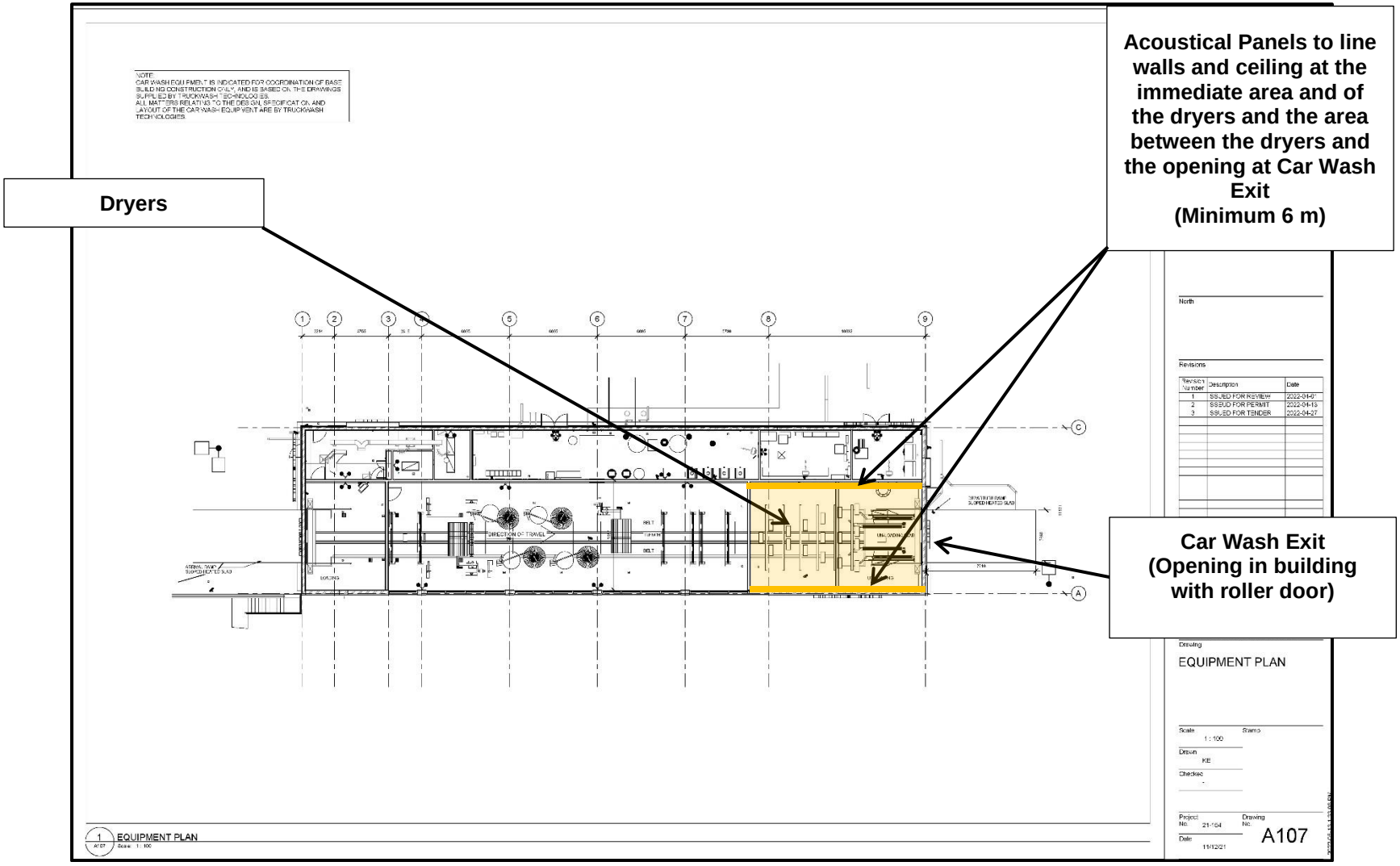


Figure 7: Detailed Interior Plan at similar Car Wash facility showing location of the Recommended Acoustical Lining



Appendix 1

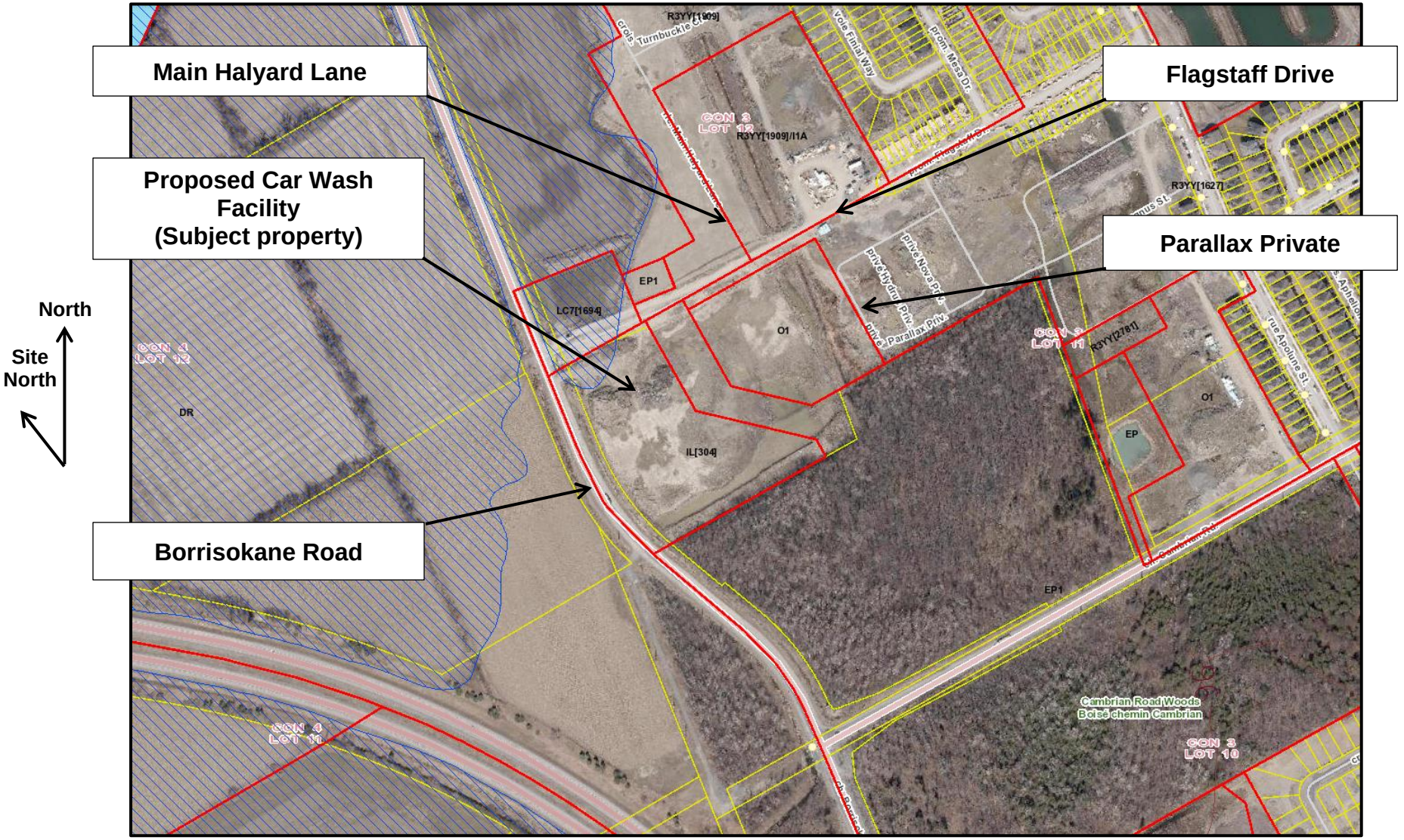
Zoning Plan and Land Use Designations

Contents:

Legend for Land Use Designations:

IL	-	Light Industrial Zone
LC	-	Local Commercial Zone
EP	-	Environmental Protection Zone
R3	-	Residential Third Density Zone
O1	-	Parks and Open Space Zone
DR	-	Development Reserve

Figure A1.1 - Zoning Plan - City of Ottawa Zoning Bylaw 2008 – 250 (source: geoOttawa)



Appendix 2

Acoustic Modelling Details

Modeling Notes:

1. Acoustic model developed uses Cadna-A software, Version 2022.
2. Sound propagation is modeled according to ISO 9613-2: 1996(E).
3. The whole of the site area and surrounding area consisting of hard surfaces is modelled as reflective with an absorption coefficient of 0.35. The fields to the east and west and the woodland to the south is modelled with an absorption co-efficient of 1.0.
4. MECP favoured conservative modelling assumptions are used, that is, 'no subtraction of negative ground attenuation' and 'no negative path differences'.

Contents:

Table A2.1 Calculation Configuration

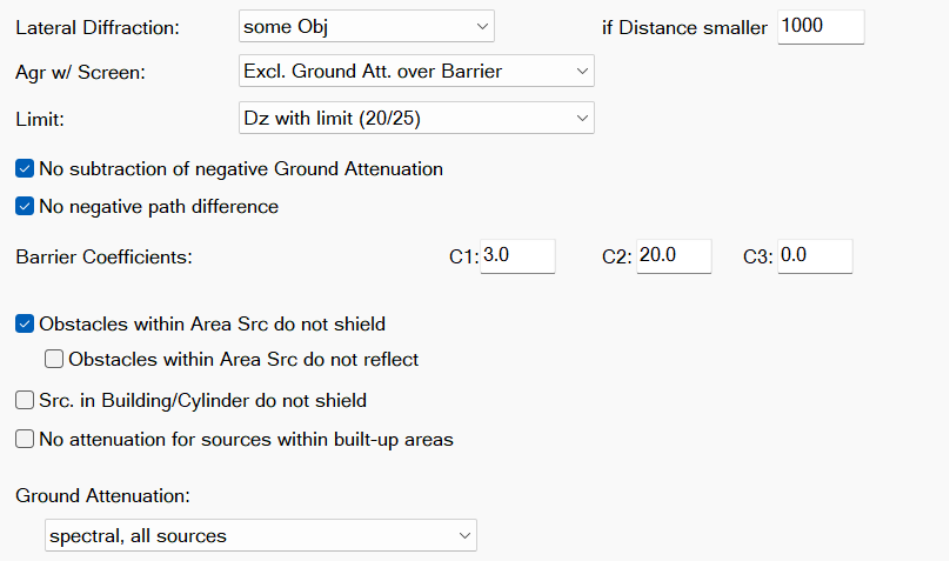


Table A2.2 Point of Reception Location Table

Name	ID	Height	Coordinates	
			X	Y
		(m)	(m)	(m)
POR_1_POW	POR_1_POW	4.5	18440340.1	5010784.0
POR_1_OPR	POR_1_OPR	1.5	18440329.3	5010805.0
POR_2_POW	POR_2_POW	7.5	18440487.4	5010807.1
POR_2_OPR	POR_2_OPR	1.5	18440482.4	5010802.4
POR_3_POW	POR_3_POW	7.5	18440502.2	5010785.8
POR_3_OPR	POR_3_OPR	7.0	18440500.9	5010785.2
POR_4_POW	POR_4_POW	7.5	18440529.4	5010738.3
POR_4_OPR	POR_4_OPR	7.0	18440527.6	5010737.2

Table A2.3 Point Sources

ID	Result. PWL			Lw / Li		Operating Time			Direct.	Height	Coordinates	
	Day	Evening	Night	Type	Value	Day	Special	Night			X	Y
	(dBA)	(dBA)	(dBA)			(min)	(min)	(min)		(m)	(m)	(m)
Vacuum_Plant_Room_Exhaust	71.8	71.8	71.8	Lw	Vacuum_Plant_Room_Exhaust				(none)	0.6	18440303.7	5010692.3
Vacuum_Nozzle	91.4	91.4	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440260.8	5010693.0
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440264.4	5010694.9
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440268.4	5010697.2
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440272.1	5010699.4
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440275.6	5010701.4
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440279.4	5010703.5
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440283.1	5010705.4
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440286.8	5010707.7
Vacuum_Nozzle	91.4	91	91.4	Lw	Vacuum_Nozzle	30.0	0.0	0.0	(none)	0.8	18440290.4	5010709.8
Vehicle_Idling	83	83	82.8	Lw	Vehicle_Idling				(none)	0.8	18440253.0	5010706.2
Vehicle_Idling	83	83	82.8	Lw	Vehicle_Idling				(none)	0.8	18440257.6	5010708.8
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440262.2	5010711.5
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440266.8	5010714.2
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440271.5	5010716.7
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440276.0	5010719.5
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440280.7	5010722.1
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440285.2	5010724.7
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440254.9	5010702.8
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440259.4	5010705.4
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440264.0	5010708.0
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440268.7	5010710.8
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440273.4	5010713.5
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440278.0	5010716.2
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440282.7	5010718.7
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440287.2	5010721.3
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440257.2	5010699.4
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440261.5	5010701.8
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440266.2	5010704.5
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440270.8	5010707.2
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440275.6	5010709.9
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440280.1	5010712.6
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440284.6	5010715.3
Vehicle_Idling	82.8	82.8	82.8	Lw	Vehicle_Idling				(none)	0.8	18440289.0	5010717.8
MAU_1	83.7	83.7	83.7	Lw	MAU_1				(none)	1.5	18440289.1	5010678.1

ID	Result. PWL			Lw / Li		Operating Time			Direct.	Height	Coordinates	
	Day	Evening	Night	Type	Value	Day	Special	Night			X	Y
	(dBA)	(dBA)	(dBA)			(min)	(min)	(min)		(m)	(m)	(m)
MAU_2	83.7	83.7	83.7	Lw	MAU_1				(none)	1.5	18440272.0	5010673.9

*Height measured from finished roof level.

Table A2.4 Vertical Area Sources

ID	Result. PWL			Lw / Li		Operating Time			Direct.
	Day	Evening	Night	Type	Value	Day	Special	Night	
	(dBA)	(dBA)	(dBA)			(min)	(min)	(min)	
Car_Wash_Entry	93.4	93.4	93.4	Lw	Car_Wash_Entry_Front	50.0	-	-	Opening (ÖAL28)
Car_Wash_Exit	97.3	97.3	97.3	Lw	Car_Wash_Exit_Front	50.0	-	-	Opening (ÖAL28)

Table A2.5 Noise Source Library

ID	Type	Octave Spectrum (dB)											Source
		31.5	63	125	250	500	1000	2000	4000	8000	A	lin	
Car_Wash_Exit_Front	Lw	94.3	101.4	94.2	90.5	95.3	92.1	89.8	85.2	82.8	97.3	104.3	Meas. Halo Car Wash Orleans at 9.5 m
Car_Wash_Entry_Front	Lw	94.6	96.9	92.1	88.5	90.4	88.3	86	82.5	79.5	93.4	101	Meas. Halo Car Wash Orleans at 7.9 m
Vacuum_Nozzle	Lw	87.6	87.2	78.4	75.5	75.7	79.9	85.2	85.8	86.6	91.4	94	Meas. Halo Car Wash Orleans at 2.2 m
Vacuum_Plant_Room_Exhaust	Lw	76.1	82.2	81.4	73.1	68.6	64.4	61	56	54.7	71.8	85.8	Meas. Halo Car Wash Orleans at 1 m
Vehicle_Idling	Lw	86.7	88.4	82.2	80	79	79.8	74.2	64.4	58.2	82.8	92.1	Meas. Halo Car Wash Orleans at 2.6 m
MAU_1	Lw	0	81	91.0	82.5	80.5	79.0	73.5	69.5	64.5	83.7	92.5	Manufactures Data (based on York Predator ZH061)
Meas_Car_Wash_Exit_45deg	Li	75	81.6	74.2	71.1	75.2	69.8	68.2	64.5	62.1	76.2	84.3	Meas. Halo Car Wash Orleans at 6.2 m
Meas_Car_Wash_Exit_Front	Li	73.6	80.7	73.5	69.8	74.6	71.4	69.1	64.5	62.1	76.6	83.6	Meas. Halo Car Wash Orleans at 9.5 m
Meas_Car_Wash_Exit_Side	Li	71	75.6	68.4	64.4	66.3	61.8	57.6	52.8	50.1	67.2	78.1	Meas. Halo Car Wash Orleans at 6.5 m
Meas_Car_Wash_Entry_Side	Li	72.3	72.2	66.6	62.8	62	62.3	59	53.3	49.9	66.3	76.5	Meas. Halo Car Wash Orleans at 6.4 m
Meas_Car_Wash_Entry_45deg	Li	73.9	77.6	71.8	68.1	69.4	66.8	64.3	60.7	57.8	72	80.9	Meas. Halo Car Wash Orleans at 6.5 m
Meas_Car_Wash_Entry_Front	Li	75.5	77.8	73	69.4	71.3	69.2	66.9	63.4	60.4	74.3	81.9	Meas. Halo Car Wash Orleans at 7.9 m
Meas_Vacuum_Nozzle	Li	72.7	72.3	63.5	60.6	60.8	65	70.3	70.9	71.7	76.5	79.1	Meas. Halo Car Wash Orleans at 2.2 m
Meas_Vacuum_Plant_Room_Exhaust	Li	68.1	74.2	73.4	65.1	60.6	56.4	53	48	46.7	63.8	77.8	Meas. Halo Car Wash Orleans at 1 m
Meas_Vehicle_Idling	Li	70.2	71.9	65.7	63.5	62.5	63.3	57.7	47.9	41.7	66.3	75.6	Meas. Halo Car Wash Orleans at 2.6 m

Table A2.6 Scenario 1 - Point of Reception Impacts by Source, Before Mitigation, Day and Early Evening (07:00 – 20:00)

	Partial Level Day and Early Evening (7 am to 8 pm)							
ID	POR_1 _POW	POR_1 _OPR	POR_2 _POW	POR_2 _OPR	POR_3 _POW	POR_3 _OPR	POR_4 _POW	POR_4_ OPR
Vacuum_Plant_Room_Exhaust_INS	21.6	20.0	13.2	11.4	13.1	13.1	12.6	12.6
Vacuum_Nozzle	34.3	34.2	25.1	25.4	24.9	25.0	24.3	24.4
Vacuum_Nozzle	35.0	35	25.5	25.8	25.2	25.3	24.6	24.8
Vacuum_Nozzle	35.8	35	25.9	26.2	25.6	25.7	24.9	25.1
Vacuum_Nozzle	36.6	36	26.3	26.6	26.0	26.0	25.2	25.4
Vacuum_Nozzle	37.5	37	26.7	26.9	26.5	26.5	25.6	25.7
Vacuum_Nozzle	33	33	24.9	25.3	24.8	24.9	10.2	10.2
Vacuum_Nozzle	34	34	25.3	25.7	25.1	25.3	11.1	11.1
Vacuum_Nozzle	35	35	25.7	26.0	25.5	25.6	13.1	13.0
Vacuum_Nozzle	36	36	26.6	26.8	26.4	26.4	25.7	25.8
Vehicle_Idling	31	31	22.4	21.9	22.2	22.3	21.7	21.8
Vehicle_Idling	31	31	22.6	22.1	22.4	22.5	21.8	21.9
Vehicle_Idling	32	31	22.8	22.3	22.6	22.7	22.0	22.1
Vehicle_Idling	32.0	31.6	23.0	22.5	22.7	22.8	22.1	22.2
Vehicle_Idling	32.5	32.0	23.2	22.7	23.0	23.0	22.3	22.4
Vehicle_Idling	33.0	32.3	23.5	22.9	23.2	23.2	22.4	22.5
Vehicle_Idling	33.6	32.7	23.7	23.1	23.4	23.4	22.6	22.7
Vehicle_Idling	34.1	33.1	23.9	23.2	23.6	23.6	22.7	22.8
Vehicle_Idling	30.6	30.4	22.5	21.9	22.3	22.4	21.7	21.8
Vehicle_Idling	31.0	30.8	22.6	22.1	22.4	22.5	21.9	22.0
Vehicle_Idling	31.4	31.1	22.8	22.3	22.6	22.7	22.0	22.1
Vehicle_Idling	31.9	31.5	23.0	22.5	22.8	22.8	22.2	22.3
Vehicle_Idling	32.4	31.8	23.3	22.7	23.0	23.0	22.3	22.4
Vehicle_Idling	32.9	32.2	23.5	22.9	23.2	23.2	22.5	22.6
Vehicle_Idling	33.5	32.6	23.7	23.1	23.4	23.4	22.6	22.7
Vehicle_Idling	34.0	32.9	23.9	23.3	23.6	23.6	22.8	22.9
Vehicle_Idling	30.5	30.3	22.5	22.0	22.3	22.4	21.8	21.9
Vehicle_Idling	30.9	30.6	22.6	22.1	22.4	22.5	21.9	22.0
Vehicle_Idling	31.4	31.0	22.8	22.3	22.6	22.7	22.1	22.2
Vehicle_Idling	31.8	31.3	23.1	22.5	22.8	22.9	22.2	22.3
Vehicle_Idling	32.3	31.7	23.3	22.7	23.0	23.1	22.4	22.5
Vehicle_Idling	32.8	32.0	23.5	22.9	23.2	23.2	22.5	22.6
Vehicle_Idling	33.3	32.4	23.7	23.1	23.5	23.5	22.7	22.8
Vehicle_Idling	33.8	32.7	23.9	23.3	23.7	23.7	22.9	22.9
MAU_1	32.2	30.7	24.3	22.7	24.3	24.2	23.9	23.9

ID	Partial Level Day and Early Evening (7 am to 8 pm)							
	POR_1 _POW	POR_1 _OPR	POR_2 _POW	POR_2 _OPR	POR_3 _POW	POR_3 _OPR	POR_4 _POW	POR_4_ OPR
MAU_2	31.5	30.0	23.8	22.1	23.7	23.6	23.3	23.3
Car_Wash_Entry_S1	17.6	17.6	12.9	10.0	12.9	12.9	13.2	13.3
Car_Wash_Exit_S1	50.0	47.1	44.3	43.4	44.2	44.2	43.8	43.8
Total	52.5	50.7	45.5	44.8	45.4	45.5	44.8	44.9

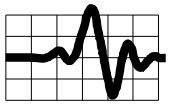


Table A2.7 Scenario 2 - Point of Reception Impacts by Source, After Mitigation, Day and Early Evening (07:00 – 20:00)

	Partial Level Day and Early Evening (7 am to 8 pm)							
ID	POR_1 _POW	POR_1 _OPR	POR_2 _POW	POR_2 _OPR	POR_3 _POW	POR_3 _OPR	POR_4 _POW	POR_4_ OPR
Vacuum_Plant_Room_Exhaust_INS	21.6	14.7	13.2	11.4	13.1	13.1	12.6	12.6
Vacuum_Nozzle	34.3	34.2	20.4	20.4	20.2	20.3	19.6	19.7
Vacuum_Nozzle	35.0	35	20.8	20.5	20.5	20.6	19.9	20.1
Vacuum_Nozzle	35.8	35	21.2	20.5	20.9	21.0	20.2	20.4
Vacuum_Nozzle	37	36	21.5	20.3	21.3	21.3	20.5	20.6
Vacuum_Nozzle	35	37	21.6	19.8	21.4	21.3	20.7	20.7
Vacuum_Nozzle	33	33	20.2	20.3	20.1	20.2	8.6	8.6
Vacuum_Nozzle	32.0	33.9	20.6	20.5	20.4	20.5	8.6	8.6
Vacuum_Nozzle	30.1	34.5	21.0	20.6	20.8	20.9	8.8	8.8
Vacuum_Nozzle	31.3	30.7	21.7	20.1	21.5	21.4	20.9	20.9
Vehicle_Idling	30.7	30.5	18.2	18.0	18.0	18.1	17.4	17.5
Vehicle_Idling	31.1	30.9	18.4	18.1	18.2	18.2	17.6	17.7
Vehicle_Idling	31.5	31.2	18.6	18.2	18.3	18.4	17.7	17.8
Vehicle_Idling	32.0	31.6	18.8	18.4	18.5	18.6	17.9	18.0
Vehicle_Idling	32.5	32.0	19.4	18.4	18.7	18.8	18.0	18.1
Vehicle_Idling	33.0	32.3	19.6	18.5	18.9	18.9	18.2	18.3
Vehicle_Idling	33.6	32.7	19.8	18.5	19.1	19.2	18.3	18.4
Vehicle_Idling	34.1	33.1	19.8	18.4	19.3	19.3	18.4	18.4
Vehicle_Idling	30.6	30.4	18.2	17.9	18.0	18.1	17.5	17.6
Vehicle_Idling	31.0	30.8	18.4	18.0	18.2	18.3	17.6	17.7
Vehicle_Idling	31.4	31.1	18.6	18.2	18.4	18.4	17.8	17.9
Vehicle_Idling	31.9	31.5	18.8	18.3	18.6	18.6	17.9	18.0
Vehicle_Idling	32.4	31.8	19.0	18.3	18.8	18.8	18.1	18.2
Vehicle_Idling	32.9	32.2	19.2	18.3	18.9	19.0	18.2	18.3
Vehicle_Idling	33.5	32.6	19.6	18.3	19.1	19.1	18.4	18.4
Vehicle_Idling	34.0	32.9	19.6	18.2	19.1	19.1	18.4	18.5
Vehicle_Idling	30.5	30.3	18.2	17.9	18.1	18.1	17.5	17.6
Vehicle_Idling	30.9	30.6	18.4	18.0	18.2	18.3	17.7	17.8
Vehicle_Idling	31.4	31.0	18.6	18.1	18.4	18.5	17.8	17.9
Vehicle_Idling	31.8	31.3	18.8	18.2	18.6	18.7	18.0	18.1
Vehicle_Idling	32.3	31.7	19.0	18.3	18.8	18.8	18.2	18.3
Vehicle_Idling	32.8	32.0	19.2	18.3	19.0	19.0	18.3	18.4
Vehicle_Idling	33.3	32.4	19.4	18.2	19.1	19.1	18.4	18.5
Vehicle_Idling	33.8	32.7	19.4	18.1	19.2	19.1	18.5	18.5
MAU_1	32.2	26.1	24.3	22.7	24.3	24.2	23.9	23.9

ID	Partial Level Day and Early Evening (7 am to 8 pm)							
	POR_1 _POW	POR_1 _OPR	POR_2 _POW	POR_2 _OPR	POR_3 _POW	POR_3 _OPR	POR_4 _POW	POR_4_ OPR
MAU_2	31.5	30.0	23.8	22.1	23.7	23.6	23.3	23.3
Car_Wash_Entry_S2	17.1	17.4	12.2	8.2	12.3	12.3	13.0	13.0
Car_Wash_Exit_S2	45.0	28.8	39.8	38.7	39.7	39.7	40.3	40.3
Total	50.0	48.1	41.2	40.1	41.1	41.1	41.2	41.3

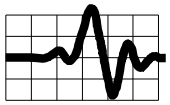


Table A2.8 Sample Calculations

Receiver
Name: POR_1_POW
ID: POR_1_POW
X: 18440340.14 m
Y: 5010783.97 m
Z: 4.50 m

vert. Area Source, ISO 9613, Name: "Car_Wash_Exit", ID: "Car_Wash_Exit_S1"

Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
1	18440309.26	5010689.25	2.50	0	D	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
1	18440309.26	5010689.25	2.50	0	D	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
1	18440309.26	5010689.25	2.50	0	D	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	25.4
1	18440309.26	5010689.25	2.50	0	D	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.7	0.0	0.0	0.0	0.0	0.0	28.1
1	18440309.26	5010689.25	2.50	0	D	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	-1.0	0.0	0.0	0.0	0.0	0.0	40.9
1	18440309.26	5010689.25	2.50	0	D	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.4	0.0	0.0	0.0	0.0	0.0	41.1
1	18440309.26	5010689.25	2.50	0	D	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.4	0.0	0.0	0.0	0.0	0.0	39.4
1	18440309.26	5010689.25	2.50	0	D	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.4	0.0	0.0	0.0	0.0	0.0	32.3
1	18440309.26	5010689.25	2.50	0	D	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.4	0.0	0.0	0.0	0.0	0.0	19.4
1	18440309.26	5010689.25	2.50	0	N	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
1	18440309.26	5010689.25	2.50	0	N	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
1	18440309.26	5010689.25	2.50	0	N	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	25.4
1	18440309.26	5010689.25	2.50	0	N	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.7	0.0	0.0	0.0	0.0	0.0	28.1
1	18440309.26	5010689.25	2.50	0	N	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	-1.0	0.0	0.0	0.0	0.0	0.0	40.9
1	18440309.26	5010689.25	2.50	0	N	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.4	0.0	0.0	0.0	0.0	0.0	41.1
1	18440309.26	5010689.25	2.50	0	N	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.4	0.0	0.0	0.0	0.0	0.0	39.4
1	18440309.26	5010689.25	2.50	0	N	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.4	0.0	0.0	0.0	0.0	0.0	32.3
1	18440309.26	5010689.25	2.50	0	N	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.4	0.0	0.0	0.0	0.0	0.0	19.4
1	18440309.26	5010689.25	2.50	0	E	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
1	18440309.26	5010689.25	2.50	0	E	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
1	18440309.26	5010689.25	2.50	0	E	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	25.4
1	18440309.26	5010689.25	2.50	0	E	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.7	0.0	0.0	0.0	0.0	0.0	28.1
1	18440309.26	5010689.25	2.50	0	E	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	-1.0	0.0	0.0	0.0	0.0	0.0	40.9
1	18440309.26	5010689.25	2.50	0	E	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.4	0.0	0.0	0.0	0.0	0.0	41.1
1	18440309.26	5010689.25	2.50	0	E	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.4	0.0	0.0	0.0	0.0	0.0	39.4
1	18440309.26	5010689.25	2.50	0	E	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.4	0.0	0.0	0.0	0.0	0.0	32.3
1	18440309.26	5010689.25	2.50	0	E	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.4	0.0	0.0	0.0	0.0	0.0	19.4
2	18440309.26	5010689.25	1.50	0	D	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
2	18440309.26	5010689.25	1.50	0	D	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
2	18440309.26	5010689.25	1.50	0	D	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	26.0
2	18440309.26	5010689.25	1.50	0	D	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.9	0.0	0.0	0.0	0.0	0.0	27.9
2	18440309.26	5010689.25	1.50	0	D	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	39.5
2	18440309.26	5010689.25	1.50	0	D	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.3	0.0	0.0	0.0	0.0	0.0	41.0
2	18440309.26	5010689.25	1.50	0	D	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.5	0.0	0.0	0.0	0.0	0.0	39.6
2	18440309.26	5010689.25	1.50	0	D	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.5	0.0	0.0	0.0	0.0	0.0	32.5
2	18440309.26	5010689.25	1.50	0	D	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.5	0.0	0.0	0.0	0.0	0.0	19.6
2	18440309.26	5010689.25	1.50	0	N	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
2	18440309.26	5010689.25	1.50	0	N	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
2	18440309.26	5010689.25	1.50	0	N	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	26.0
2	18440309.26	5010689.25	1.50	0	N	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.9	0.0	0.0	0.0	0.0	0.0	27.9
2	18440309.26	5010689.25	1.50	0	N	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	39.5
2	18440309.26	5010689.25	1.50	0	N	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.3	0.0	0.0	0.0	0.0	0.0	41.0
2	18440309.26	5010689.25	1.50	0	N	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.5	0.0	0.0	0.0	0.0	0.0	39.6
2	18440309.26	5010689.25	1.50	0	N	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.5	0.0	0.0	0.0	0.0	0.0	32.5
2	18440309.26	5010689.25	1.50	0	N	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.5	0.0	0.0	0.0	0.0	0.0	19.6
2	18440309.26	5010689.25	1.50	0	E	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9
2	18440309.26	5010689.25	1.50	0	E	63	65.6	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	26.2
2	18440309.26	5010689.25	1.50	0	E	125	68.5	4.8	-0.8	3.0	1.5	51.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	26.0
2	18440309.26	5010689.25	1.50	0	E	250	72.3	4.8	-0.8	3.0	1.5	51.0	0.1	1.9	0.0	0.0	0.0	0.0	0.0	27.9
2	18440309.26	5010689.25	1.50	0	E	500	82.5	4.8	-0.8	3.0	1.5	51.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	39.5
2	18440309.26	5010689.25	1.50	0	E	1000	82.5	4.8	-0.8	3.0	1.5	51.0	0.4	-1.3	0.0	0.0	0.0	0.0	0.0	41.0
2	18440309.26	5010689.25	1.50	0	E	2000	81.4	4.8	-0.8	3.0	1.5	51.0	1.0	-1.5	0.0	0.0	0.0	0.0	0.0	39.6
2	18440309.26	5010689.25	1.50	0	E	4000	76.6	4.8	-0.8	3.0	1.5	51.0	3.3	-1.5	0.0	0.0	0.0	0.0	0.0	32.5
2	18440309.26	5010689.25	1.50	0	E	8000	72.1	4.8	-0.8	3.0	1.5	51.0	11.6	-1.5	0.0	0.0	0.0	0.0	0.0	19.6
3	18440309.26	5010689.25	0.50	0	D	32	45.3	4.8	-0.8	3.0	1.5	51.0	0.0	-3.0	0.0	0.0	0.0	0.0	0.0	5.9

Appendix 3

Instrument Calibration Certificates

www.pylonelectronics.com

Pylon Electronics Inc.
147 Colonnade Road
Ottawa, ON K2E 7L9

CERTIFICATE OF CALIBRATION

Description	**SOUND LEVEL CALIBRATOR**	**Work Order**	**N0833134**
Model Number	**4231**	**Serial Number**	**2730374**
Instrument Id	**N/A**	**Cal Procedure**	**33K3-4-2871-1**
Manufacturer	**BRUEL & KJAER**	**Cal Date**	**30 Jan 2020**
Customer Name	**FREEFIELD LTD.**	**Recall Cycle**	**52 Weeks**
		Next Cal Date	**30 Jan 2021**
		Purchase Order	**Credit Card**

Calibration Environment: Temperature **23.0 °C** Relative Humidity **35.2 %RH**

Received Condition: **Within Tolerance**

Completed Condition: **Within Tolerance**

Remarks: **Optimized sound level.**

Standards Used to Establish Traceability

Instrument Type	Model	Asset #	Cal Due Date
4145 BRUEL&KJAER 1" MICROPHONE	4145	240-054	4 Dec 2020
1/2" MICROPHONE	4166	240-709	18 Jun 2020
PISTONPHONE	4220	354-017	1 Apr 2020
FFT SIGNAL ANALYZER SYSTEM	3550	354-759	10 Oct 2020
MICROPHONE PREAMP	2639T	355-164	27 Feb 2020

Pylon certifies that, at the time of calibration, the above listed instrument meets or exceeds all of the specifications defined on the Test Data Sheet (TDS), unless otherwise indicated. The Certificate received and completed conditions and the TDS specifications are based on the procedure(s) and/or specification(s) referenced on the TDS unless otherwise indicated. Any statement of compliance is made without taking measurement uncertainty into account and is based on the instrument's performance against the test limits documented on the test data sheet.

The above listed instrument has been calibrated using standards that are traceable to the International System of Units (SI) through a National Metrological Institute (such as NRC or NIST). Pylon's quality system meets the requirements of ISO/IEC 17025:2005. Unless otherwise specified, Pylon maintains a minimum of a 4:1 ratio between the equipment under test and the measurement system.

Test data As Found and Final (as left) results are the same unless reported otherwise. Certificate remarks identify if adjustments were performed.

pylcert1

Metrologist : *062* Quality Assurance: *301* Date of Issue: **30 Jan 2020** F083 Rev 15

HALIFAX MONTREAL OTTAWA TORONTO EDMONTON CALGARY

PYLON

Calibration Test Data

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Description:	**SOUND LEVEL CALIBRATOR**	Work order:	**N0833134**
Model:	**4231**	Serial:	**2730374**
Customer ID.:	**N/A**	Procedure:	**33K3-4-2871-1**
Manufacturer:	**BRUEL & KJAER**	Proc. Rev.:	**30-Oct-2006**
Customer:	**FREEFIELD LTD.**	Cal Date:	**30-Jan-2020**

TEST REF.	TEST DESCRIPTION	RESULTS MIN	AS FOUND	FINAL	MAX
4.1	**Sound Level Calibration:**				
	Nominal dB_{SPL}	dB_{SPL}	dB_{SPL}	dB_{SPL}	dB_{SPL}
	94.0	93.80	94.15	94.02	94.20
	(+20 dB Button) 114.0	113.80	114.13	114.01	114.20
4.2	**Frequency Calibration:**				
	Nominal (Hz)	Hz	Hz		Hz
	1 k	999.0	1000.0		1001.0
4.3	**Distortion Calibration :**				
	Measured Value	-	0.37 %		1.00 %
	ADDITIONAL TEST:				
	AUTO SHUT OFF	Pass / Fail	Pass		

www.pylonelectronics.com

Pylon Electronics Inc.
147 Colonnade Road
Ottawa, ON K2E 7L9

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CERTIFICATE OF CALIBRATION

Description	**SOUND ANALYZER**	**Work Order**	**N0833130**
Model Number	**2270**	**Serial Number**	**3008643**
Instrument Id	**N/A**	**Cal Procedure**	**BE1713-32**
Manufacturer	**BRUEL & KJAER**	**Cal Date**	**30 Jan 2020**
Customer Name	**FREEFIELD LTD.**	**Recall Cycle**	**52 Weeks**
		Next Cal Date	**30 Jan 2021**
		Purchase Order	**Credit Card**

Calibration Environment: Temperature **23.0 °C** Relative Humidity **35.2 %RH**

Received Condition: **Within Tolerance**

Completed Condition: **Within Tolerance**

Remarks: **Unit calibrated with Preamp ZC 0032 S/N 23073 AND MIC 4189 S/N 2985656**

Standards Used to Establish Traceability

Instrument Type	Model	Asset #	Cal Due Date
SOUND LEVEL CALIBRATOR	4231	240-1151	17 Sep 2020
PISTONPHONE	4220	354-017	1 Apr 2020

Pylon certifies that, at the time of calibration, the above listed instrument meets or exceeds all of the specifications defined on the Test Data Sheet (TDS), unless otherwise indicated. The Certificate received and completed conditions and the TDS specifications are based on the procedure(s) and/or specification(s) referenced on the TDS unless otherwise indicated. Any statement of compliance is made without taking measurement uncertainty into account and is based on the instrument's performance against the test limits documented on the test data sheet.

The above listed instrument has been calibrated using standards that are traceable to the International System of Units (SI) through a National Metrological Institute (such as NRC or NIST). Pylon's quality system meets the requirements of ISO/IEC 17025:2005. Unless otherwise specified, Pylon maintains a minimum of a 4:1 ratio between the equipment under test and the measurement system.

Test data As Found and Final (as left) results are the same unless reported otherwise. Certificate remarks identify if adjustments were performed.

pylcert1

Metrologist : *062* Quality Assurance: *301* Date of Issue: **30 Jan 2020** F083 Rev 15

HALIFAX MONTREAL OTTAWA TORONTO EDMONTON CALGARY

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PYLON

Calibration Test Data

Description:	**SOUND ANALYZER**	Work order:	**N0833130**
Model:	**2270**	Serial:	**3008643**
Customer ID.:	**N/A**	Procedure:	**BE1713-32**
Manufacturer:	**BRUEL & KJAER**	Proc. Rev.:	**23-Feb-2016**
Customer:	**FREEFIELD LTD.**	Cal Date:	**30-Jan-2020**

TEST REF.	TEST DESCRIPTION	RESULTS MIN	AS FOUND	FINAL	MAX
P. 52	**SOUND LEVEL CALIBRATION**				
	CONNECT TI TO SOUND CALIBRATOR MODEL 4231,				
	SWITCH ON THE CALIBRATOR, PRESS "START" ON TI,				
	NOTE THAT TI INDICATING "DETECTING LEVEL"	Pass / Fail	Pass		
	WHILE TI SEARCHING FOR SIGNAL & SIGNAL IS				
	STABILISING, THE "TRAFFIC LIGHT" INDICATES				
	SHORT GREEN FLASH EVERY SECOND	Pass / Fail	Pass		
	WHEN SIGNAL IS STABLE, THE GREEN LIGHT IS				
	STABLE	Pass / Fail	Pass		
	WHEN CALIBRATION IS COMPLETED SUCCESSFULLY				
	THE TRAFFIC LIGHT INDICATES A SHORT YELLOW				
	FLASH EVERY 5 SECONDS	Pass / Fail	Pass		
	Nominal SPL with 4189 Microphone attached	dB	dB		dB
	93.8 dB	92.8	93.8		94.8
	CALIBRATION COMPLETED	Pass / Fail	Pass		

RESUMÉ: Dr. HUGH WILLIAMSON, P.Eng.

QUALIFICATIONS:

Ph.D. Mechanical Engineering, University of New South Wales, 1972

B.Sc. Mechanical Engineering, (with Distinction), University of Alberta, 1967

Member, Professional Engineers, Ontario

Member, Canadian Acoustical Association

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.

PROFESSIONAL EXPERIENCE:

Hugh Williamson is a professional engineer with many years of experience in the measurement, analysis and control of noise and vibration. Freefield Ltd. was incorporated in 2017 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to joining Freefield Ltd. Hugh Williamson founded and directed Hugh Williamson Associates Inc. which specialized in consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. His career included extensive periods in industry as well as university level research and teaching. He is a former Director of the Acoustics and Vibration Unit at the Australian Defence Force Academy. He has published over 50 engineering and scientific papers and has been an invited speaker on noise and vibration at national and international conferences. He has more than 25 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson has provided consulting services to large and small clients including: National Research Council, J. L. Richards & Associates, Barry Padolsky Associates, Atkinson Schroeter Design Group, R. W. Tomlinson Limited, Geo. Tackaberry Construction, Miller Paving, City of Ottawa.

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RESUMÉ: MICHAEL WELLS

QUALIFICATIONS:

Registered Architect of NSW, Registration Number: 8111

B. Architecture (Hons), University of Sydney, 2002

B.Sc. Architecture, University of Sydney, 1999

Member, Canadian Acoustical Association

Member, Australian Acoustical Society

Associate Member, INCE-USA

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning.
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.
- Design services including sketch design, design development (development / permit applications), contract documents, tendering and contract administration.

PROFESSIONAL EXPERIENCE:

Michael Wells is a professional Architect registered in NSW, Australia, with many years of experience in the measurement, analysis and control of noise and vibration. Michael Wells is a founding Director of Freefield Ltd. which was incorporated in 2017, and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to establishing Freefield Ltd., his career included working for Hugh Williamson Associates Inc. specializing in acoustics, noise and vibration consulting services, and, the founding of Michael Wells Architect in Sydney, Australia, specializing in the design of institutional, commercial and residential projects. He is the former Director of Architectural Workshops Australia and Vision Blue Pty Ltd. He has more than 15 years of experience as a consultant.

CLIENT LIST:

Michael Wells has provided consulting services to large and small clients including: National Research Council, R. W. Tomlinson, G. Tackaberry & Sons Construction, Miller Paving, J. L. Richards & Associates, Barry Padolsky Associates, Atkinson Schroeter Design Group and Industry Canada.