

CAWTHRA PHASE 3 TRUNK SEWER

MISSISSAUGA, ONTARIO

CONSTRUCTION VIBRATION ZONE OF INFLUENCE

RWDI # 2300735

May 14, 2024

SUBMITTED TO

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VERSION HISTORY

Index	Date	Pages	Author
1	5/14/2024	All	Jacque Kelton



1 INTRODUCTION

RWDI AIR Inc. was previously retained to develop a Construction Monitoring Plan (CMP) with respect to noise and vibration for the construction work associated with the Cawthra Phase 3 Trunk Sewer project in Mississauga, Ontario. This plan titled “Cawthra Phase 3 Trunk Sewer- Construction Monitoring Plan” dated April 26th 2024, contains details about noise and vibration impacts from the construction work along the project’s path. The construction activities will take place along Burnhamthorpe Road, Wilcox Road and Tomken Road. There is a designated heritage property located at 1050 Burnhamthorpe Road which is within the boundary of the construction path. During the development of the CMP, it was determined that vibration from construction work may impact the heritage property and should have further investigation completed to determine these impacts. The scope of this review is limited to the potential for ground-borne vibrations, produced during construction activities, to impact the heritage building at 1050 Burnhamthorpe Road. All other noise and vibration impacts are covered in the CMP.

2 CRITERIA

Vibration limits for building damage are measured in peak particle velocity (PPV). In the absence of specific criteria from the Province or Municipality, guidance was drawn from the City of Toronto Construction Vibration Guideline which are consistent with best practices in other regions. In the guidelines, the overall building damage vibration criteria is divided based on the frequency of the vibration level. For this assessment, the strictest frequency criteria is conservatively applied for PPV limit. The CMP provides limits for annoyance due to vibration which is not covered in this assessment.

As the 5 mm/s PPV criteria may not be appropriate for heritage buildings, a stricter 3 mm/s criteria from the Swiss Association Standard¹ was used for the ZOI criteria for heritage buildings, as indicated in Table 1.

Table 1: Prohibited Construction Vibration Levels

Target Guidance/Criteria	Source of Guidance/Criteria	Description of Criteria
Potential Impact/	FTA - Building Category IV and Swiss Association Standard (Heritage Buildings)	3 mm/s PPV
	City of Toronto Construction Vibration Guideline (General Buildings)	5 mm/s PPV
	City of Toronto Construction Vibration Guideline (Prohibited Levels)	8 mm/s PPV

¹ Swiss Association of Standardization, Effects of Vibration on Construction, as cited in Amick H. and Gendreau M. 2000. Construction Vibrations and Their Impact on Vibration Sensitive Facilities, ASCE Construction Congress 6.

3 DEMOLITION AND CONSTRUCTION EQUIPMENT

Damage due to vibration from construction activities is a concern given the proximity of the construction activities to the existing buildings near the site.

The significant equipment that will be employed during construction potentially include the following:

- Microtunnel boring machine
- Backhoes, bulldozers, cranes and excavators
- Jackhammers
- Pavement breakers/Hoe Rams
- Slurry separation plant (settlement tanks/centrifuges/etc.)
- Dump trucks, Concrete trucks
- Concrete saws
- Hand tools
- Compactor
- Asphalt Spreader
- Road Roller

A hammer-type or vibratory-type pile driver will not be used.

4 ZONE OF INFLUENCE

A vibration damage Zone of Influence surrounding the construction area has been predicted and is included in **Figure 1**. Using data provided in the Journal of Geotechnical Engineering Division ² for the various construction activities, the damage ZOI has been determined to extend outward from the construction area by approximately 11.5 m. It is predicted that PPV greater than or equal to 3 mm/sec could be expected at any point within the ZOI.

The ZOI does not extend into the legal boundaries of the heritage property.

5 CONCLUSION

The ZOI does not extend into the legal boundaries of the heritage property at 1050 Burnhamthorpe Road and therefore vibration from the construction work associated with the Cawthra Phase 3 Trunk Sewer is not expected to impact the heritage property at all. We trust that this information meets your present needs.

² Journal of the Geotechnical Engineering Division, Construction Vibrations: State-of-the-Art, J. Wiss Feb 1981.



6 STATEMENT OF LIMITATION

This report entitled Cawthra Phase 3 Trunk Sewer Construction Vibration Zone of Influence was prepared by RWDI AIR Inc. ("RWDI") for IBI GROUP ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein to understand the different factors which may impact the conclusions and recommendations provided.

A large decorative graphic on the left side of the page. It features a blue triangular shape in the top-left corner, a white curved line separating it from a large grey circular area, and a thin white border around the grey area.

FIGURE



Construction Vibration ZOI

Map Projection: NAD 1983 UTM Zone 17N
 Sanitary Sewer Replacement - Cawthra Phase 3 Trunk Sewer - Mississauga, Ontario



Drawn by: JKK	Figure: 1
Approx. Scale: 1:1,000	
Date Revised: May 8, 2024	



Project #: 2300735

Map Document: \\gve-nrslf-01\volam-jobs-cfs\jobs\2023\2300735\03\WorkItems\20\Environmental\Vibration\Figures\Ontario\LUP ArcGIS Template\Ontario\LUP.aprx

REPORT



CAWTHRA PHASE 3 TRUNK SEWER

MISSISSAUGA, ONTARIO

CONSTRUCTION MONITORING PLAN

RWDI # 2300735

April 26, 2024

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VERSION HISTORY

Index	Date	Author	Reviewed By
1	April 22, 2024	Jacquie Kelton	Marcus Li



1 PURPOSE AND TARGET AUDIENCE

This Construction Noise and Vibration Management Plan has been developed to help manage the project's noise and vibration impacts. The plan is based on the project team's prior experience with managing noise and vibration issues encountered with other projects of a similar nature. This document has been prepared with the intent to be a simple guide for the project team. It provides the recommended monitoring methodology and relevant noise and vibration limits as well as additional resources that can be accessed in events of unique issues associated with the project's construction.

2 LIST OF NOISE AND VIBRATION REFERENCE DOCUMENTS AND PERFORMANCE LIMITS

2.1 Applicable Reference Documents

This is the full list of applicable noise and vibration criteria considered for this project. Limits for noise and vibration are based on these references.

- Ministry of Environment, Conservation and Parks (MECP) Publication NPC-101, Technical Definitions;
- MECP Publication NPC-102, Instrumentation;
- MECP Publication NPC-103, Procedures;
- MECP Publication NPC-104, Sound Level Adjustments;
- MECP Publication NPC-115, Construction Equipment;
- MECP Publication NPC-118, Motorized Conveyances;
- Ministry of Municipal Affairs and Housing (2012) Ontario Building Code;
- IEC Standard 61672; and
- ISO Standard 2631-2:2003, Mechanical vibration and shock – Evaluation of human exposure to whole body vibration.

The following list, although not direct criteria for this project, was used as supporting information for this project.

- U.S. Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual, FTA Report No. 0123, September 2018 (FTA Manual);
- Toronto Municipal Code Chapter 363, Building Construction and Demolition, Article 5 (City of Toronto Construction Vibration Guideline); and
- U.S. Federal Highway Administration's Construction Noise Handbook, FHWA-HEP-06-015, August 2006 (FHWA Handbook).
- Construction noise control program and mitigation strategy at the Central Artery/Tunnel Project, Erich Thalheimer, Noise Control Engineering Journal, Sep-Oct 2000 (Central Artery/Tunnel Noise Specification).

2.2 Noise and Vibration Limits

A review was completed regarding criteria applied to a point of reception, based on the provincial and applicable municipal noise and vibration limits related to roadway construction work.

- The City of Mississauga Noise By-Law 93-84 prohibits construction activities from “7 pm of one day to 7 am of the next day”.
- MECP maintains publications NPC-115 and NPC-118 which specify sound level criteria for specific types of construction equipment, but not their cumulative sound levels at receptors. It is the responsibility of the Construction Contractor’s on-site environmental inspector to ensure equipment on the construction site meets the criteria set out in NPC-115 and NPC-118 through equipment datasheets or sound level measurements.

As the above provincial and municipal criteria are not receptor-based, the following is a summary of the guideline limits applied.

2.2.1 Environmental Noise

Using guidance from the City of Mississauga Noise By-Law and in the absence of specific noise guidance within the Province of Ontario, a review of best practices from other regions was conducted. The documents reviewed included the FTA Manual, the FHWA Guide, and the Central Artery/Tunnel Noise Specification. Noise limits presented in **Table 1** were based primarily on the Central Artery/Tunnel Noise Specification with modifications based RWDI’s local experience.

The Central Artery/Tunnel Noise Specification provides 20-minute sound level limits. Based on RWDI’s experience, complaints associated with construction activities more closely align to shorter averaging periods, such as 10 minutes. Longer averaging times would permit excessive sounds, such as those from use of a hoe-ram, to be allowable for longer periods when they are followed by quiet periods; and hence may still cause complaints despite meeting a limit. The 20-minute limits used for the Central Artery/Tunnel were adjusted to be reflective for a 10-minute averaging period.

Many jurisdictions rely on the equivalent energy-average sound exposure (L_{EQ}) parameter as the basis for assessment. The L_{EQ} parameter is representative for long-term exposures to sound or sounds that are relatively steady in nature. However, sounds that are highly variable, such as many construction activities, tend to relate better to the 10-percentile sound level (L_{10} or sound level exceeded 10% of the time) parameter. As a result, the L_{10} parameter has been maintained here, consistent with the Central Artery/Tunnel Noise Specification.

Instantaneous (or L_{MAX}) limits are intended to capture peak short-term events, such as hammering, that have potential to disturb residents. The implementation of this type of limit helps to capture construction activities that can cause an adverse effect but would not otherwise trigger an exceedance under the sound level limit due to their extremely short duration.

Based on the results of the baseline monitoring, the sound level limits may be adjusted based on the metrics outlined in **Table 1**. Further details about baseline monitoring have been provided in Section 4.



Table 1: Construction Noise Limits

Noise Receptor Type	Daytime (7am to 7pm)		Nighttime (7pm to 7am) ^[1]	
	L _{10,10-min} (dBA)	L _{MAX} (dBA)	L _{10,10-min} (dBA)	L _{MAX} (dBA)
Noise-Sensitive (i.e. Residences, Institutions, etc.)	78 or Baseline + 5 (whichever is louder)	85 90 (impact) ^[2]	73 or Baseline + 3 (whichever is louder)	80
Commercial (i.e. Businesses, Stores, etc.)	83 or Baseline + 5 (whichever is louder)	-	78 or Baseline + 3 (whichever is louder)	-
Industrial Areas (i.e. Manufacturing, etc.)	88 or Baseline + 5 (whichever is louder)	-	-	-

Note 1 - Nighttime limits have been provided in the event that an exemption for the construction work is granted by the City of Mississauga to allow construction to occur between 7 pm of one day and 7 am of the next day.
2 - Applicable to Impact sources, such as Jackhammers.

2.2.2 Vibration

Vibration limits are provided for two different scenarios: public annoyance and building damage. The annoyance criterion is based on the ISO 2631-2:2003 standard and a threshold of perception of approximately 0.1 mm/s root-mean-square (RMS). The proposed criterion is equivalent to 72 VdB (referenced to 25.4 x 10⁻⁶ mm/sec) which is recommended in other standards, such as the FTA Manual, as a public annoyance criterion.

Vibration limits for building damage are generally higher than those for annoyance and are measured in peak particle velocity (PPV). In the absence of specific criteria from the Province or Municipality, guidance was drawn from the City of Toronto Construction Vibration Guideline which are consistent with best practices in other regions. In the guidelines, the overall building damage vibration criteria is divided based on the frequency of the vibration level. For this assessment, the strictest frequency criteria is conservatively applied for PPV limit.

As the 5 mm/s PPV criteria may not be appropriate for heritage buildings, a stricter 3 mm/s criteria from the Swiss Association Standard¹ was used for the ZOI criteria for heritage buildings.

The criteria for annoyance and potential impact are presented in **Table 2**.

Table 2: Vibration Exposure Limits Regarding Public Annoyance and Building Damage

Target Guidance/Criteria	Source of Guidance/Criteria	Description of Criteria
Annoyance	ISO 2631-2:2003	0.1 mm/s RMS
Potential Impact/	FTA - Building Category IV and Swiss Association Standard (Heritage Buildings)	3 mm/s PPV
	City of Toronto Construction Vibration Guideline (General Buildings)	5 mm/s PPV
	City of Toronto Construction Vibration Guideline (Prohibited Levels)	8 mm/s PPV

¹ Swiss Association of Standardization, Effects of Vibration on Construction, as cited in Amick H. and Gendreau M. 2000. Construction Vibrations and Their Impact on Vibration Sensitive Facilities, ASCE Construction Congress 6.

3 PREDICTED CONSTRUCTION NOISE AND VIBRATION

The construction activities will take place along Burnhamthorpe Road, Wilcox Road and Tomken Road in Mississauga, Ontario as shown in **Figure 1**.

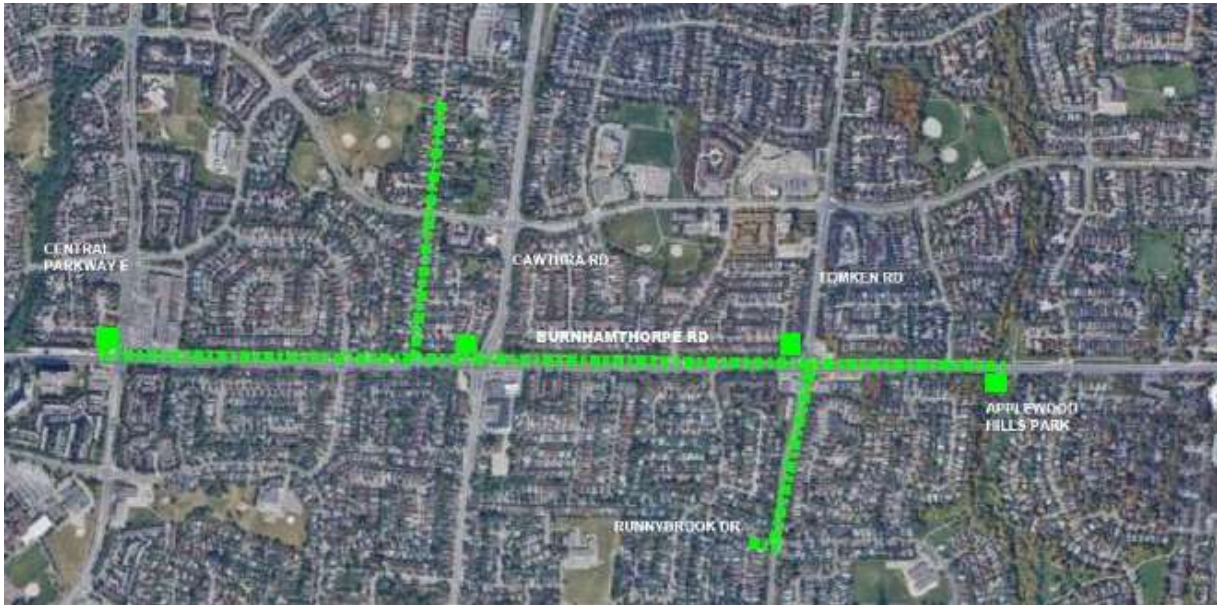


Figure 1: Construction Location

The expected list of equipment to be used during the construction includes the following:

- Microtunnel boring machine
- Backhoes, bulldozers, cranes and excavators
- Jackhammers
- Pavement breakers/Hoe Rams
- Slurry separation plant (settlement tanks/centrifuges/etc.)
- Dump trucks, Concrete trucks
- Concrete saws
- Hand tools
- Compactor
- Asphalt Spreader
- Road Roller

The potential impacts for both noise and vibration were estimated based on the best data available to inform the monitoring requirements for the project. At this time, details regarding the specific construction methodology are not available. Conservative approximations regarding equipment duty cycles and quantities based on RWDI's previous experience were implemented into the screening-level modelling. The noise and vibration criteria from Section 2 were used to estimate the extents of the potential impacts on surrounding sensitive receptors.

Zones of Influence (ZOIs) were developed for both potential noise and vibration impacts. ZOIs are used to visually identify areas that are likely to be potentially impacted and inform the monitoring methodology.

As the construction plans and methodologies are finalized, it is necessary to confirm that the ZOIs noted here still represent the predicted noise and vibration impacts at the surrounding communities.

3.1 Environmental Noise

To estimate the Zone of Influence (ZOI), a screening-level noise assessment was completed assuming equipment was operating up to the outer-most edge of an approximate construction area. In the absence of specific construction details, conservative assumptions regarding equipment duty cycles and quantities were implemented into the screening-level modelling. Zones of Influence were developed for each land-use type (e.g., sensitive receptors, commercial uses, and industrial uses) for the construction. The noise ZOIs are presented in **Appendix A**.

The ZOIs show residential sensitive receptors have the potential to be impacted. Consequently, noise monitoring is required and discussed further in Section 4.

3.2 Vibration

To estimate the Zone of Influence (ZOI), a screening-level vibration assessment was completed assuming equipment was operating up to the outer-most edge of an approximate construction area.

The vibration ZOI was determined by selecting the construction activity with the highest predicted vibration level, as only 1 activity is assumed to occur at a given time. For this work it is assumed the pavement breaker and compactor will generate the most onsite vibration during the entirety of the construction work. Reference vibration levels for the construction equipment were obtained from the FTA Manual.

Typical soil conditions were assumed for vibration propagation for all equipment. This approach is expected to be conservative, and the assumption can be re-visited if more information is available as vibration propagation is highly dependent on soil type.

Two different setbacks were calculated: one for annoyance and one for building damage. The annoyance ZOI is based on the criteria in

Table 2 of 0.1 mm/s RMS which results in a setback of 22 m from the vibration activity to the nearest sensitive receptor. The ZOI is based on the "caution" criteria of 5 mm/s PPV as recommended in the City of Toronto Construction Vibration Guidelines, which results in a setback of 8 m. For Heritage Buildings, a setback of 11.5 m was determined for the ZOI based on the "caution" criteria of 3 mm/s. The ZOIs are included in **Appendix B**.

There is a designated heritage property located at 1050 Burnhamthorpe Road which is along the path of construction. The extent of the property is located within the heritage ZOI and therefore a detailed ZOI study should be completed for that property.

The ZOIs indicate that vibration monitoring will be required within several areas. Additional discussion on vibration monitoring is included in Section 4.



4 MONITORING REQUIREMENTS

Based on the resulting predicted ZOIs for construction noise and vibration, monitoring is required. Monitoring requirements have been developed based on MECP guidelines and previous monitoring experience.

The Contractor is responsible for ensuring that the construction work is carried out in compliance with Applicable Construction Noise and Vibration Requirements.

4.1 Baseline Noise and Vibration Monitoring

Where monitoring is required, baseline noise and vibration measurements will be conducted immediately prior to the beginning of the construction by the Construction Contractor's Noise and Vibration Consultant. Noise monitoring equipment shall be deployed prior to start of major construction. Activities related to staging and clearing are not considered major construction however baseline levels should not be determined while these activities are occurring.

Baseline noise levels must be established using at least 48-hours of recorded data. High-level anomalous events, such as aircraft or trains, should be excluded from the calculation of the baseline. Caution alerts are not required to be enabled during baseline measurements. The goal is to collect sufficient data to understand the ambient sound and vibration conditions and the diurnal patterns in the area.

A baseline conditions report should be issued within two weeks of completion of baseline measurements by the Construction Contractor's Noise and Vibration Consultant. The report should compare sound level and/or vibration level measurements to the criteria provided in **Table 1 and 2**. If the results of the noise monitoring are higher than the sound or vibration criteria levels, the resulting changes to the sound criteria should be included in the report.

4.2 Construction Noise Monitoring

Sound level monitoring shall be carried out by the Construction Contractor's Noise and Vibration Consultant for the duration of the work that encroaches on the ZOI.

4.2.1 Monitoring Locations

Noise monitoring will be required to capture the highest construction noise levels for each sensitive neighborhood. Construction is expected to progress linearly along the construction area. There are residential land uses along the whole path of the construction work. When work is progressing along these areas one monitor on each side of the work area is required to capture the worst-case impacts in each direction. The monitor should be located near residences in closest proximity to the work. The monitor may be required to be relocated throughout the construction process to different locations along the construction area to capture the loudest activities at the closest residences.



It is understood that monitoring locations will be subject to permissions by owners and should be sited in the best available location given work, security, and access concerns. These monitoring locations may need to be altered depending on the detailed construction plans and methodologies or if complaints are received as construction progresses. Where monitors may be required to be located removed from the nearest residences due to access or security concerns, corresponding adjustments to the applicable limits may be required.

4.2.2 Noise Monitoring Procedures

The intent of the noise monitoring program is to limit the adverse effects from construction noise on adjacent communities. The monitoring program has been designed to flag exceedances before they happen, working in a pro-active manner to prevent adverse effects from occurring.

Previous experience has concluded that the caution alert levels should be set lower than the limits to allow some time for action to be taken, if required. If the alert level is set the same as the limit, then noise management becomes reactive rather than proactive and can result in more complaints. In general, the caution alert level should be set 3-5 dB lower than the limit. However, depending on the response in the area (i.e., complaints) once construction starts, the caution alert levels may be adjusted to best suit the area.

Sound level monitoring shall be carried out by the Construction Contractor's Noise and Vibration Consultant throughout all construction activities. The following actions are required to pro-actively manage construction noise throughout the project:

- If caution levels are exceeded an instantaneous, automatically generated message shall be sent to the Construction Contractor and the City Representative.
- Upon receipt of an automatically generated message, the Construction Contractor's on-site environmental inspector shall confirm and record the cause for the caution alert immediately and take action to adjust activities to prevent continued alerts (including consideration of altering construction techniques).
- If the construction noise limits are exceeded an instantaneous, automatically generated message shall be sent to the Construction Contractor's on-site environmental inspector, the City Representative and other persons to be named at the City.
- Upon generation of an automatically generated message, the cause of each exceedance shall be identified within one (1) hour, when requested by City Representative, and included in each Weekly Construction Noise Measurement Report.
- Within twenty-four (24) hours, a communication (letter or email) explaining the cause of the exceedance and the remedial actions taken to prevent future similar exceedances will be generated for the Construction Contractor and be available to the City Representative when requested.

Weekly Construction Noise Measurement reports will be generated and submitted to the Construction Contractor and be available to the City at their request. Weekly Construction Noise Measurement reports will include:

- A summary of noise measurement data collected during the reporting period (detailed data must be made available on request);
- A comparison of noise data to the applicable sound level limits;
- A summary of exceedances of the noise limits including the location of the exceedance; date and time of the exceedance; probable cause of the exceedance and list of construction work occurring at the time of the exceedance;
- Remedial actions taken to prevent future similar exceedances; and
- A summary of any complaints received during the reporting period.

4.2.3 Noise Equipment Specifications

Sound level monitors (SLMs) must be equipped with wireless telemetry allowing data to be retrieved in real-time. They must also be capable of taking audio recordings before and after trigger limits (as stipulated in **Table 1** **Error! Reference source not found.**) have been exceeded. In addition, the following requirements apply:

- Audio recording shall be taken a minimum 15 second before and 30 seconds after trigger limits are exceeded or as required to determine source of noise;
- Sound level meters must have a sufficient portable power source, and suitably sized data storage;
- Record baseline noise data for 10-minute periods;
- Record at a minimum L_{MAX} and L_{10} construction sound levels;
- Data logging system is to conform to ANSI S1.4-1983 (R2006) standard "Specification for Sound Level Meters" for Type 1 SLMs;
- SLMs to be field calibrated before each data collection period as well as anytime the equipment is moved or, if not moved, every three months; and
- Baseline readings shall be representative of the normal ambient conditions and shall take into account abnormal noise emitting activities (e.g., aircraft overflights).

Equipment shall be calibrated in accordance with NPC-103.

4.3 Construction Vibration Monitoring

Vibration monitoring shall be carried out by the Construction Contractor's Noise and Vibration Consultant for the duration of the work.

4.3.1 Monitoring Locations

To assess the potential for building damage and annoyance from construction vibration, the Construction Contractor's Vibration Noise and Consultant may conduct both attended and unattended vibration monitoring. Based on the results of the ZOI assessment and the proximity of the construction activities to nearby sensitive receptors and structures, unattended monitors will also be deployed prior to commencement of construction activities that have the potential to generate high vibration levels, e.g., pavement breaking, excavation and compaction. The vibration monitoring shall be carried out by the Construction Contractor's Noise and Vibration Consultant as follows. The construction area can be seen above in **Figure 1** with the ZOIs in **Appendix B**.

Construction is expected to progress linearly along the construction area. As construction progresses a monitor will be required near the residences along Wilcox Road, and the north side of Tomken Road. Monitoring may be required along some areas on the south side of Burnhamthorpe Road and may be required for the heritage property at 1050 Burnhamthorpe Road. Monitoring for these locations may be achieved with one monitor on either side of the work area that are moved as work progresses or with multiple monitors simultaneously placed throughout the construction path. The monitors may be required to be relocated throughout the construction process to different locations along the construction area to capture the most significant vibration activities at the closest residences. Additional monitors may be required if complaints from residences are received.



4.3.2 Vibration Monitoring Procedures

The intent of the vibration monitoring program is to limit the adverse effects from construction vibration on adjacent communities. The monitoring program has been designed to flag exceedances before they happen, working in a pro-active manner to prevent adverse effects from occurring.

Previous experience has concluded that the caution alert levels should be set lower than the limits to allow some time for action to be taken, if required. If the alert level is set the same as the limit, then vibration management becomes reactive rather than proactive and can result in more complaints or structural damage. In general, the caution alert level should be set at 0.08 mm/s RMS for annoyance (80% of limit) and 5 mm/s (as per City of Toronto Construction Vibration Guideline). However, depending on the response in the area (i.e., complaints) once construction starts, the caution alert levels may be adjusted to best suit the area.

Vibration monitoring shall be carried out by the Construction Contractor's Noise and Vibration Consultant throughout all construction activities. The following actions are required to pro-actively manage construction vibration throughout the project:

- For structures of concern within the vibration ZOI the following should be completed if possible and if not possible, documentation of attempts to conduct an inspection should be retained.
 - pre-construction consultation and record of comments provided to the applicant by the owners and occupants;
 - pre-construction measurement of background vibration; and
 - pre-construction inspection of adjacent buildings and structures within the ZOIs.
- If caution levels are exceeded an instantaneous, automatically generated message shall be sent to the Construction Contractor and the City Representative.
- Upon receipt of an automatically generated message, the Construction Contractor's on-site environmental inspector shall confirm and record the cause for the caution alert immediately and take action to adjust activities to prevent continued alerts (including consideration of altering construction techniques).
- If the construction vibration limits are exceeded an instantaneous, automatically generated message shall be sent to the Construction Contractor's on-site environmental inspector, the City Representative, and other persons to be named at the City.
- If the building damage construction limits are exceeded, work must cease immediately. Actions must be taken to reduce the vibration levels from the activity before proceeding.
- Upon generation of an automatically generated message, the cause of each exceedance shall be identified within one (1) hour, when requested by City Representative, and included in each Weekly Construction Vibration Measurement Report.
- Within twenty-four (24) hours, a letter explaining the cause of the exceedance and the remedial actions taken to prevent future similar exceedances will be generated for the Construction Contractor and be available to the City Representative when requested.



Weekly Construction Vibration Measurement reports will be generated and submitted to the Construction Contractor and be available to the City at their request. Weekly Construction Vibration Measurement reports will include:

- A summary of vibration measurement data collected during the reporting period (detailed data must be made available on request);
- A comparison of vibration data to the applicable vibration limits;
- A summary of exceedances of the vibration limits including the location of the exceedance; date and time of the exceedance; frequency and PPV level of the exceedance; probable cause of the exceedance and list of construction work occurring at the time of the exceedance;
- Remedial actions taken to prevent future similar exceedances; and
- A summary of any complaints received during the reporting period.

4.3.3 Vibration Equipment Specifications

Vibration monitors must be equipped with wireless telemetry allowing data to be retrieved in real-time. In addition, the following requirements apply:

- Vibration monitors must be capable of capturing the frequency, the RMS level (annoyance) and the PPV level (building damage);
- Vibration monitors must have a sufficient portable power source, and suitably sized data storage;
- Baseline readings shall be representative of the normal ambient conditions.

If a monitor records a vibration event at or above the limit, an email will automatically be issued by the Construction Contractor's Vibration Consultant and to the Construction Contractor's on-site environmental inspector of a vibration event. The email will contain the time of the exceedance as well as the vibration level of the exceedance.

5 MITIGATION OF POTENTIAL IMPACTS

During construction work, there is the potential for construction activities to exceed noise and vibration limits in the surrounding communities. These exceedances will trigger alerts from the monitoring equipment and may result in complaints from the public. Mitigation measures can be implemented to reduce noise and vibration levels in surrounding communities. Before implementing noise and vibration control measures, the most efficient way to reduce impacts at receivers is to increase the separation distance between source and receiver. Where this is not possible, noise and vibration control can include altering construction methodology, mitigating the source of noise or vibration or interrupting the path of noise or vibration between source and receiver. Noise and vibration control can also be implemented at the receiver, but in the case on managing construction noise and vibration, this is not practical.

5.1 Noise

Where complaints are received or sound levels exceed the limits, steps shall be taken to meet the limit or, if this is deemed impractical by the Construction Contractor's Noise and Vibration Consultant, communication with the City and the complainant be introduced to determine a solution to the exceedances.

Noise emissions can be reduced through altering the construction methodology. Examples of measures that would reduce noise levels include:

- Selection of low-noise construction equipment such as electric powered machinery in lieu of diesel-powered machinery, where possible;
- Switching equipment off when not in use, with idling kept to a minimum;
- Reducing equipment use during sensitive time periods, such as during early morning or evening hours;
- If possible, siting any construction staging or storage areas away from sensitive receivers; and
- Ensure equipment is properly maintained and operated in an appropriate manner. A documented, regular inspection and maintenance program must be implemented.
- Vehicle on-site speed limits must be met and will be enforced.
- In the presence of persistent noise complaints, all construction equipment should be verified to comply with MOE NPC-115 guidelines.

Noise emissions can also be reduced at source to reduce the sound emitted, including measures such as:

- All backup alarms within the Site shall be low frequency broadband alarms, with the exception of delivery vehicles that access the construction site infrequently;
- Construction Contractor shall demonstrate that they are using the quietest equipment reasonably available and at a minimum they must have effective silencers on their blowers or be fitted with them externally;
- Construction Contractor shall provide efficient intake and exhaust silencers on air equipment; and
- Construction Contractor shall provide efficient intake and exhaust mufflers on internal combustion engines.

Where sound levels cannot be reduced at source, the path between source and receiver can be interrupted with a temporary barrier or enclosure to prevent sound from reaching sensitive receivers. Noise barriers and enclosures are the most common method for interrupting the path. The Construction Contractor shall use noise-reducing enclosures, shrouds, or curtains to reduce noise levels where there are measured or anticipated exceedances, based on alerts from monitoring equipment. For example, concrete cutting and jack hammering shall whenever reasonably possible be undertaken in an enclosure. An example of a temporary curtain is provided in **Figure 2**.



Figure 2: Example of a Temporary Noise Curtain

5.2 Vibration

Where complaints are received or vibration levels exceed the limits, steps shall be taken to meet the limit. In the case of the building damage vibration limit, work must be stopped until a mitigation solution is implemented. For the annoyance vibration limit, if meeting the limit is deemed impractical by the Construction Contractor's Noise and Vibration Consultant, communication with the City and the complainant be introduced to determine a solution to the exceedances.

Vibration emissions are most efficiently reduced through altering the construction methodology. As an example using alternate boring methods, removal of rocks from the excavating area, or using smaller equipment can help to reduce the vibration emitted from construction activities. Whenever possible, construction activities which produce higher levels of vibration should consider alternative construction methods.

One method to help resolve complicated construction vibration control issues is to work collaboratively on-site with the Noise and Vibration Consultant. The Construction Contractor can arrange for the Consultant to attend the site for in-person vibration monitoring to facilitate trial and implementation of mitigation measures if warranted based on frequency and level.



6 COMPLAINT REPORTING

City staff should forward complaints to the Construction Contactor when they are received. Complaints from either the City, or directly from the public, should be formally logged by the Construction Contractor's Environmental Manager or other designated person on-site within 24 hours of receipt. Construction Contractor contact information and a complaint submission procedure should be clearly displayed at key entrances or locations easily accessible to the public.

A complaint form, or a procedure for recording complaints, should be developed and completed for each complaint. At a minimum the form, or procedure, should contain:

- Date and time of complaint and when complainant observed the event(s);
- Complainant name and contact information, including the address of the complainant or a general complainant location;
- Details of the complaint and observed events;
- Description of the construction activities that occurred during the complaint;
- Sound or vibration levels at an associated monitoring station at the time of complaint (where applicable);
- Actions taken by the liaison(s) (i.e., Construction Contactor's on-site environmental inspector);
- Acknowledgement if construction activities were responsible for complaint, or if it was due to an activity outside of the Construction Contractor's control; and
- Confirmation of liaison(s) following up with complainant.

In the event of noise complaints, Construction Contractor shall refer to the completed baseline noise monitoring program for receptor-specific noise limits outside of the provided construction noise action limits in **Table 1** to review potentially lower action limits or caution alert levels and subsequent complaint response protocols. Should a noise complaint be received, the City reserves the right to request the Construction Contractor provide noise data.

In the presence of persistent noise or vibration complaints, alternative control measures may be implemented. Any initial noise and vibration complaint will trigger verification that the general noise and vibration control measures are functioning effectively.



7 RESPONSIBLE PERSONNEL

7.1 Equipment Set up and Maintenance

The City and the Construction Contractor are responsible for obtaining permissions from landowners to deploy instrumentation at the recommended locations. The Construction Contractor's Noise and Vibration Consultant will be responsible for scheduling deployment once permission is granted. The Construction Contractor's Noise and Vibration Consultant will be responsible for maintaining monitoring equipment for the duration of the measurement campaign and obtaining permission to access properties when necessary.

7.2 Equipment Sound Levels

Construction Contractor's on-site environmental inspector is responsible for ensuring equipment meets NPC-115 and NPC-118 requirements through manufacturer certificates or sound level measurements conducted in accordance with NPC-103. The Noise and Vibration Consultant may assist with the noise verification measurements, if necessary.

7.3 Alerts

Monitoring equipment will issue an alert to a common e-mail account that the Construction Contractor's on-site environmental inspectors have access to. It is the responsibility of the Contractor to ensure that on-site inspectors receive, review the alert and create a log of the cause and action taken. The Construction Contractor's Noise and Vibration Consultant can provide support in the form of audio recordings and confirm if construction is the likely cause of the alert. However, it is preferred for the Construction Contractor's on-site environmental inspectors provide this information as they are present on-site and can more easily identify the cause and implement an action.

7.4 Complaints

It is expected that complaints would be received by the City. Given the importance the complaints have, it is important for the complaints to be relayed to the Construction Contractor in a timely manner (i.e., within an hour or less) so they can be dealt with as soon as possible.

7.5 Mitigation

It is the responsibility of the Construction Contractor's on-site environmental inspectors to investigate and/or verify the cause for any alerts and action limit exceedances. If mitigation measures are required, it is the Construction Contractor's responsibility to determine and implement the mitigation measures and indicate the timeline of the implementation in records.



7.6 Changes to Construction

It is the Construction Contractor's responsibility to inform the Contractor's Noise and Vibration Consultant of the construction schedules and construction locations.

7.7 Reporting Data

The Construction Contractor's Noise and Vibration Consultant will be responsible for providing weekly and monthly Noise and Vibration Reports. If requested, it is the responsibility of the Construction Contractor to provide the City with all necessary reports as well as information on the alerts and actions taken.

8 STATEMENT OF LIMITATIONS

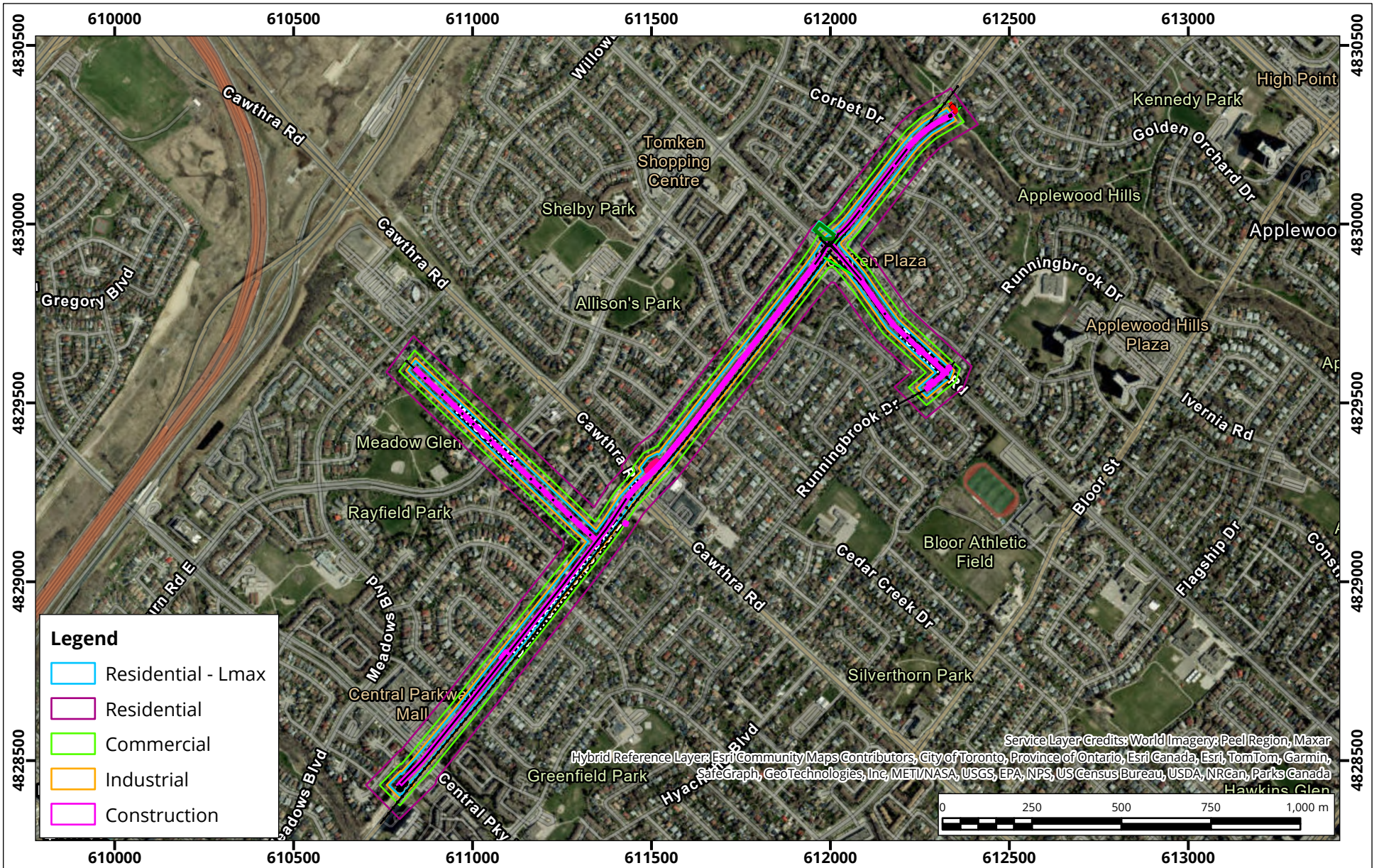
This document entitled "Cawthra Phase 3 Trunk Sewer – Construction Monitoring Plan" was prepared by RWDI AIR Inc. ("RWDI") for IBI GROUP ("Client"). The findings and conclusions presented in this document have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this document are based on the information available to RWDI when it was prepared. Since the contents of this document may not reflect the final design or operations of the Project or subsequent changes made after the date of this document, it is recommended that RWDI be retained by the Client during the final stages of the project to verify that the results and recommendations provided in this document have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this document have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the document and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this document carefully review the stated assumptions contained herein to understand the different factors which may impact the conclusions and recommendations provided.

APPENDIX A





Construction Noise ZOI

Map Projection: NAD 1983 UTM Zone 17N

Sanitary Sewer Replacement - Cawthra Phase 3 Trunk Sewer - Mississauga, Ontario

True North



Drawn by: JKK | Figure: A.1

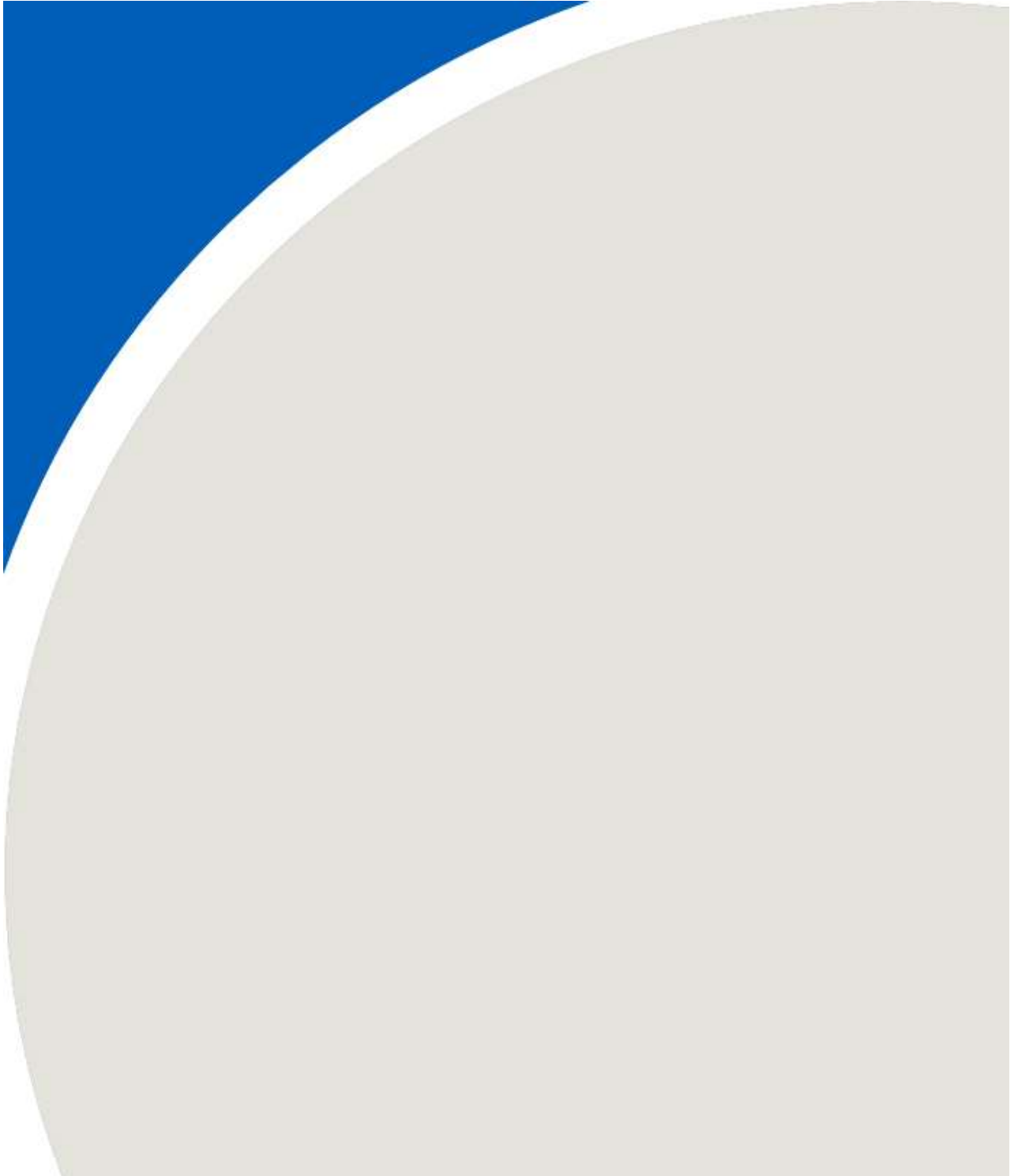
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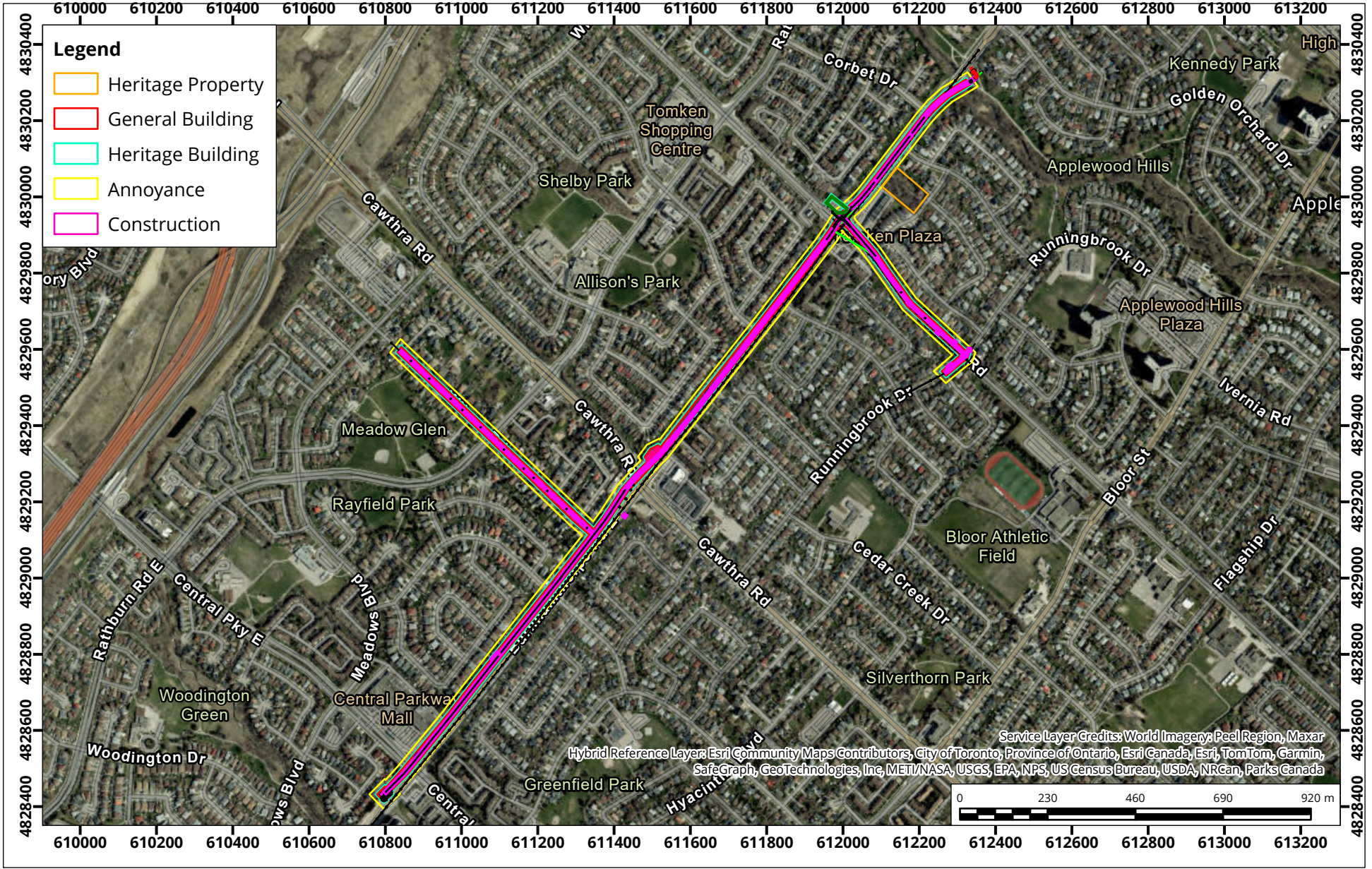
Date Revised: Apr 26, 2024



Project #: 2300735

APPENDIX B





Construction Vibration ZOI

Map Projection: NAD 1983 UTM Zone 17N
 Sanitary Sewer Replacement - Cawthra Phase 3 Trunk Sewer - Mississauga, Ontario



Drawn by: JKK	Figure: B.1
Approx. Scale: 1:14,000	
Date Revised: Apr 26, 2024	



Project #: 2300735

Map Document: \\gve-nrsif-01\volam-jobs-cdfs\jobs\2023\2300735\03\WorkItems\2023\Environmental\Vibration\Figures\Ontario\LP ArcGIS Templates\Ontario\LP.aprx

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FINAL REPORT



CAWTHRA PHASE 3 TRUNK SEWER ALONG BURNHAMTHORPE ROAD, PROJECTS:

18-2252, 20-2453 & 22-2254

MISSISSAUGA, ONTARIO

DUST BEST MANAGEMENT PRACTICES PLAN

RWDI # 2300735

April 26, 2024

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1 INTRODUCTION

1.1 Overview

RWDI Air Inc. (RWDI) was retained by IBI Group to provide air quality and noise and vibration consulting services in support of the engineering services for trunk sewer installation along Burnhamthorpe Road between Central Parkway and Little Etobicoke Creek in Mississauga. The work involves two components, with the first being the new 1500mm Trunk Sewer installation along Burnhamthorpe Road and the second being sanitary sewer improvements on Wilcox Road, Tomken Road and Runningbrook Drive.

Construction activities that are likely to generate nuisance dust with this work includes:

- Demolition and removal of roadways and sidewalks with heavy equipment such as jackhammers, excavators, backhoes, loaders, and haul trucks,
- Movement of trucks and heavy equipment on temporary or permanent road surfaces,
- Tailpipe emissions from vehicles, heavy equipment, power tools, generators, and stationary combustion equipment,
- Delivery and handling of clean bulk materials,
- Concrete forming, pouring and cutting,
- Delivery and placement of prefabricated concrete or steel structures, and
- Installation of asphalt.

This Best Management Practices Plan (BMPP) identifies the potential sources of air quality emissions and recommends measures to control emissions from construction activities that meet and/or exceed the current industry standards. Implementation of these measures will ensure that air emissions are effectively controlled and impacts to neighbouring residents are minimized.

1.2 Components of a Best Management Practices Plan

A BMPP is a detailed document that outlines the fugitive dust sources at a given site and describes the measures that shall be used to control emissions from these sources. The Ontario Ministry of the Environment Conservation and Parks (MECP) recommends that the BMPP be based on a process of “Plan, Do, Check, Act”, as described in the Technical Bulletin: Management Approaches for Industrial Fugitive Dust Sources. While not specific to construction sites, this guidance does provide a reasonable starting point for development of a BMPP specific to construction operations. Another document of reference is ‘Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities’ prepared by Cheminfo Services Inc. This BMPP is designed to meet the recommendations of the MECP in a form that provides clear and concise procedures for site personnel.

1.3 Air Emissions at Construction Sites

Typically, the dust at a construction site has the following characteristics:

- Primarily composed of calcium carbonate, magnesium carbonate, oxides of iron, magnesium and aluminum and/or silicon.
- SPM, representing total dust emissions.
- PM₁₀, comprising 19-55% of suspended particulate emissions¹.
- PM_{2.5}, comprising 3-14% of suspended particulate emissions².
- Crystalline silica content of onsite material, estimated at less than 20%.

Gaseous contaminants associated with tailpipe emissions from vehicles and heavy equipment consist of:

- Carbon monoxide (CO).
- Nitrogen oxides (NO_x in the form of NO₂).
- SPM, PM₁₀ and PM_{2.5}, although generally all tailpipe particulate emissions are PM_{2.5} or smaller.
- Sulphur dioxide (SO₂).
- Organic compounds including benzene, benzo(a)pyrene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein.

1.4 Overview of the Best Management Practices Plan

This document provides a separate section for each activity that results in emissions, including a description of the activity, complete with control measures applicable to each particular source.

2 DEMOLITION, SITE CLEARING & EXCAVATION

2.1 Activities Included

- Demolition and removal of asphalt and sidewalks.
- Fugitive dust emissions from clearing and excavation of the site using excavators, backhoes, loaders, and haul trucks, including the handling of potentially contaminated fill that may exist at the site.
- Decommissioning and replacing sanitary sewer mainlines, sanitary laterals, and manhole chambers.

¹ Standards Development Branch, Local Air Quality Section, Ontario Ministry of the Environment Conservation and Parks (MECP)

² Based on data from the AP-42 Compilation of Air Pollutant Emission Factors, published by the United States Environmental Protection Agency.



2.2 Controls

- Minimize drop heights for debris.
- Enclose chutes and cover any bins to store material.
- Vacuum up debris where possible and avoid long term storage of debris onsite.
- Operational controls, such as conducting work in phases to limit emissions, or restricting work under dry, windy conditions.
- Application of water to disturbed surfaces or stockpiles.
- Covering of disturbed surfaces with vegetation, stones or geotextiles as soon as practicable.
- Use of wind fencing around material stockpiles or excavation areas when feasible, especially near water bodies.
- Limit the number of vehicles and heavy equipment operating on-site to the lowest number possible to maintain optimal operating schedule.

3 BULK MATERIAL HANDLING

3.1 Activities Included

- Delivery and handling of clean bulk materials such as fill, topsoil or aggregates.

3.2 Controls

- Operational controls, such as spacing out deliveries throughout the day instead of multiple deliveries in rapid succession, and restricting deliveries and handling under dry, windy conditions.
- Minimize material drop heights into trucks or onto storage piles.
- Properly shape storage piles and minimize disturbance when possible.
- Use of wind fencing around material stockpiles or truck loading areas when feasible.
- Cover or wet down dry materials to prevent blowing dust and debris.
- Secure loads on haul trucks, including covering cargo beds when feasible.

4 FABRICATION PROCESSES

4.1 Activities Included

- Concrete forming and pouring.
- Delivery and placement of prefabricated concrete or steel structures.
- Cutting, drilling or grinding of concrete or steel structures.



4.2 Dust Controls

- Limit the time that ready-mix concrete trucks are on-site by optimizing the pour volume to limit the number of pours from each truck.
- Use prefabricated concrete structures where possible to limit the number of ready-mix truck deliveries required.
- Use prefabricated structural steel components to limit the requirement to weld and grind at the site.
- Use correctly sized pre-cast sections to limit any cutting or drilling.
- When cutting or grinding concrete, or grinding or welding steel components, use shrouds and fume extraction systems where possible.

5 VEHICLE & HEAVY EQUIPMENT MOVEMENT

5.1 Activities Included

- Movement of trucks and heavy equipment on temporary or permanent road surfaces.
- Tailpipe emissions from vehicles, heavy equipment and stationary combustion equipment.

5.2 Controls

- Apply water or provincially approved chemical dust suppressant to travelled unpaved areas under dry conditions, with the capacity to apply water multiple times per day.
- Clean paved road surfaces near the site regularly through wet or vacuum (or wet-vacuum) sweeping to prevent track-out of silt onto public roads.
- Contractor shall establish truck-staging zones for vehicles waiting to load or unload material at the Site. Such zones shall be located where diesel emissions have the least impact on abutting properties and the general public.
- Idling time for delivery trucks, dump trucks and all other internal combustion powered equipment shall be reduced as appropriate.
- Contractor shall ensure that internal combustion powered engines are located away from fresh air intakes, air conditioners and windows.
- Limit speed of on-site vehicles to 20 km/h.
- Limit the number of vehicles and heavy equipment operating on-site to the lowest number possible to maintaining optimal operating schedule.
- Where possible, ensure that all diesel-fired heavy equipment or stationary combustion equipment used at the site meets the Tier 3 emission standards, at a minimum. Tier 4 equipment is preferred.



6 ADMINISTRATION

6.1 Implementation Schedule

- All control measures should be in a state of readiness before activities at the site commence.

6.2 Implementation Plan

- Formal training on new and existing operating procedures shall be provided to relevant staff before activities at the site commence.
- The Contract Administrator shall communicate the BMPP to responsible supervisors, who shall ensure personnel are following operating procedures defined in the BMPP.
- The Site Manager shall be responsible for ensuring the BMPP is followed.
- A copy of the BMPP shall be kept on file at the site office.

7 INSPECTION & MONITORING

7.1 Inspection and Maintenance

- The public roadways near the site shall be inspected at least 3 times per day, to ensure that there is no track-out of silt onto the public roads, and a physical record shall be kept of the inspections with initials of responsible person, date and time.

7.2 Monitoring

- Visual inspection of the entire site for dusty conditions shall occur at a minimum of twice daily, and a physical record shall be kept of the inspections with initials of responsible person, date and time.
- The Site Manager or their delegate will be responsible for monitoring current conditions and weather forecasts from Environment Canada, to subsequently help plan for current and next day watering needs and other measures.

7.3 Record Keeping

- Records shall be kept of daily inspections of track out on public roadways and dusty site conditions.
- Records shall be kept of when and how dust control measures are implemented and when complaints are received, if any.
- These records shall be kept at the site office, at a minimum, and shall be available for inspection.



8 COMPLAINT TRACKING AND RESOLUTION

8.1 Complaint Tracking

Complaints regarding air emissions from construction activities are normally associated with fugitive dust. Odours may also be a source of complaint due to the operation of diesel-fired vehicles or heavy equipment, however these are typically less likely. The process outlined here can be applied in either case.

A sign posted at the site entrance shall include the Site Manager or on-site designates phone number for neighbours or members of the public to call if they have concerns.

The Contract Administrator shall request that The City of Mississauga or the Region of Peel notify them immediately if they receive a complaint, to allow for prompt response and follow-up.

Complainants should be requested to identify the location of the incident as well as the time of day that it was detected and any other information that they feel is relevant.

8.2 Complaint Resolution

When a complaint is received, the Site Manager shall ensure the following steps are undertaken:

1. Inspect the site and surrounding area to identify possible sources of visible dust or odour.
2. Obtain weather data for the time of the event.
3. Note all on-site activities at the time that the complaint was made.
4. If the information indicates that the facility is not the source of the dust complaint, the complainant shall be notified of this finding unless the complainant was anonymous or chose not to leave a contact number.

If it is determined that the complaint may, in fact, have been related to the facility operations, the following response procedures shall be followed, in the order provided below:

Level 1 – Correction of operations as soon as practical. The Site Manager shall ensure that dust control measures are being followed. Control measures shall be stepped up or operations may be curtailed, as required.

Level 2 – Re-review of Best Management Practice Plan. If the Level 1 response does not adequately resolve the problem, the BMPP shall be re-reviewed to look for additional control measures to address the source of the dust complaint.

Level 3 – Operational modifications. If the Level 2 response does not adequately resolve the problem, the construction contractor shall commit to making physical changes to the facility to address the source of the dust complaint, such as additional enclosures, relocation of equipment, or additional paving.



9 GENERAL STATEMENT OF LIMITATIONS

This report entitled 'Cawthra Phase 3 Trunk Sewer Along Burnhamthorpe Road, Projects: 18-2252, 20-2453 & 22-2254 - Dust Best Management Practices Plan', dated April 26, 2024 was prepared by RWDI AIR Inc. ("RWDI") for IBI Group ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). This report was prepared using published methodologies, literature and professional judgment. The plan presented within this document is based on available information for the project. The conclusions contained in this report are based on the information available to RWDI when this report was prepared; subsequent changes made by the Client after the date of this report have not been reflected in the conclusions.

This report was prepared for the exclusive use of IBI Group as part of the Cawthra Phase 3 Trunk Sewer Along Burnhamthorpe Road, Projects: 18-2252, 20-2453 & 22-2254. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. RWDI accepts no responsibility for damages, if any, suffered by any third party as result of decisions made or actions based on this report.