APPENDIX D

EXISTING ROADWAY NOISE, AIR QUALITY AND GROUND VIBRATION ANALYSIS

West Transitway Extension Project
Holly Acres Road to Moodie Drive

Environmental Noise, Air Quality & Ground Vibrations
Existing Conditions Report

REPORT: GmE 09-004-Existing

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EXECUTIVE SUMMARY

Planning is underway by the City of Ottawa to extend the West Transitway network from Holly Acres Road to Moodie Drive. This report summarizes the existing roadway traffic noise levels, air quality and ground vibrations in the study area, and provides a baseline condition to which future conditions will be compared. The roadways considered in this study include Highways 416 and 417, Moodie Drive, Holly Acres Road, Corkstown Road and Carling Avenue.

Within this report the existing conditions for noise, air quality and ground vibrations are compared to established local guidelines from the City of Ottawa, provincial guidelines set forth by the Ministry of the Environment of Ontario (MOE), and specifically for ground vibrations, criteria for human tolerances and structural damage thresholds.

With respect to roadway traffic noise, *GmE*'s calculations indicate that noise levels range between 48 and 63 dBA during the daytime period (0700-2300 hrs), and between 41 and 57 dBA during the nighttime period (2300-0700 hrs). Although some receptors experience noise levels that exceed 60 dBA (L_{EQ} 16 hour), the affected areas are not eligible for noise abatement under the City of Ottawa's Local Improvements policy, since the primary noise source is the provincial Highway 417[1].

Regarding air quality, the estimated pollutant levels produced by vehicle emissions fall significantly below the MOE recommended standards for all pollutants studied, which include carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_X) and suspended particulate matter (PM).

Field measurements of ground vibrations at three locations along Highway 417 indicate that vibration levels are low and decay quickly with increasing distance from the highway. The recorded vibration levels fall into the low end of the human perception tolerance range, and fall well below structural or cosmetic building damage thresholds.

[1] City of Ottawa Environmental Noise Control Guidelines, City of Ottawa, April 2006, Section 3.2.1.

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A copy of all appendices, including modelling input and output data, is on file with the City of Ottawa and is available upon request.

1. INTRODUCTION

Gradient Microclimate Engineering Inc. (*GmE*) was retained by McCormick Rankin Corporation (MRC) to conduct environmental studies for the proposed expansion of the West Transitway from Holly Acres Road to Moodie Drive. The scope of work within our mandate includes the assessment of traffic noise, air quality and ground vibrations for existing and future conditions. This report provides a summary of the existing conditions that will be used as a baseline for comparison to future conditions associated with the preferred route of the West Transitway between Holly Acres Road and Moodie Drive.

2. TERMS OF REFERENCE

The proposed expansion of the West Transitway network between Holly Acres Road and Moodie Drive has been identified by the City of Ottawa's Transportation Master Plan as a key project to accommodate population growth in west Ottawa. The proposed expansion will address the need for more public transit availability; and will improve traffic conditions along the adjacent section of Highway 417 by removing public transit traffic from that roadway.

Several route options are available for the future transitway alignment, the final selection of which will be decided based on many key factors including environmental impacts, budget availabilty, and community support.

3. OBJECTIVES

The main objective of this report is to summarize the existing environmental conditions relating to roadway noise, air quality and ground vibrations for the residential areas north of Highway 417, between Holly Acres Road and Moodie Drive. This work requires a combination of computational modelling based on current environmental data, physical site measurements, and interpretation of gathered data. This existing conditions data for noise, air quality and ground vibrations is compared to established local guidelines from the City of Ottawa, provincial guidelines set forth by the Ministry of the Environment of Ontario (MOE), and specifically for ground vibrations, criteria for human tolerances and structural damage thresholds.

4. METHODOLOGY

4.1 Roadway Noise Assessment Procedure

Using traffic information received from the City of Ottawa and MRC, noise levels have been calculated at 25 receptor locations within the area bounded by Highway 417 to the south, Holly Acres Road to the east, Carling Avenue to the north, and Moodie Drive to the west. Figure 1 illustrates the complete study area, while Figures 2A and 2B more closely illustrate the noise receptor locations (orange circles) within the study area. Receptor locations were selected to represent outdoor living spaces, to characterize noise dissipation with distance, and to determine the effects of local topography.

Vehicular traffic is the primary source of environmental noise within the study area. Roadway noise calculations were performed with the assistance of the Ministry of the Environment (MOE) road noise analysis program STAMSON 5.04. This program calculates noise levels based on: (i) Annual Average Daily Traffic (AADT) volumes and vehicle mix data for necessary roadways; (ii) source-receiver distance, exposure angles and intermediate ground surface characteristics; and (iii) source-receiver ground elevation data. The use of this program satisfies MOE[2] and City of Ottawa[3] requirements.

Vehicular traffic volumes for City roadways were obtained from the City of Ottawa through MRC, while traffic data for Highway 417 was determined by MRC through an independent study (Appendix C). AADT values are summarized in Table 1 on the following page. The 2010 AADT values for City roads have been calculated by applying an average annual growth rate of 3% to the most recent available counted traffic volumes. A daytime/nighttime split of 92% / 8% was used for each roadway segment, as well as a vehicle mix of 7% and 5% for medium sized and heavy vehicles, respectively, on surrounding streets. A vehicle mix of 1.3% medium trucks and 3.8% heavy trucks was used for Highway 417, as indicated in Appendix C.

[2] Noise Assessment Criteria in Land Use Planning, Publication LU131, Ministry of The Environment, Oct. 1997.
[3] City of Ottawa Environmental Noise Control Guidelines, City of Ottawa, April 2006.

TABLE 1: AADT VOLUMES FOR LOCAL ROADWAYS

ROADWAY	2010 TRAFFIC VOLUME
Highway 417 (East of Highway 416)	148,400
Highway 417 (West of Highway 416)	123,760
Existing Bus Traffic Along Highway 417	1,000
Holly Acres Road	9,801
Corkstown Road	4,050
Carling Avenue	21,186
Moodie Drive	22,643

Highway 416 was not included as an independent noise source for this study. Instead, since all of the vehicle traffic on Highway 416 either originates from or travels through the 417 / 416 interchange, the traffic volumes were combined and represented only by the Highway 417 geometry. This modelling approach provides a conservative representation of noise levels, since it places Highway 416 traffic noise in closer proximity to the study area.

The AADT traffic volume for Corkstown Road was artificially increased from 2,121 to 4,050. This increase is necessary to meet STAMSON's minimum AADT input requirement.

The Ministry of Transportation typically calculates noise levels along freeways based on a 24 hour L_{EQ}. This approach assumes that the average daily traffic volume is evenly distributed across a 24 hour period. The 16 hour L_{EQ} assumes that, in this case, 92% of the traffic flow occurs between 7am and 11pm, which results in a higher hourly averaged traffic value during that period. The resulting calculated $L_{EQ}16$ is typically 1 - 1.5 dBA higher than the $L_{EQ}24$ for the same daily average traffic value.

4.2 Air Quality Assessment Procedure

Using peak hour traffic volumes, an assessment of air quality was performed for common vehicle pollutants, including carbon monoxide (CO), nitrogen oxides (NO_X), total hydrocarbons (HC) and suspended particulate matter (PM). This information was input into a computer model of the study area, including all major intersections with significant vehicle traffic. Twenty-four receptors, all matching the noise measurement locations (Figures 2A and 2B), were selected to determine the worst-case one-hour concentrations during peak traffic hours of the morning and afternoon periods. Wind probabilities for the Ottawa area were then combined with the pollutant data to determine statistical levels of pollutant concentrations occurring along the corridor. The computer model used for the evaluation, CAL3QHC, incorporates vehicle counts, characteristics of signalized intersections, relevant atmospheric parameters and pollutant dispersion characteristics to calculate pollutant concentrations at specified points.

Current ambient concentration levels for the noted pollutants were obtained from the MOE permanent monitoring station at 940 Carling Avenue in Ottawa. These values represent conservative estimates of the 90th percentile ambient levels existing in the study area. The 90th percentile for each major vehicle emission is included along with the MOE's Ambient Air Quality Criteria (AAQC)[4] in Table 2. This data indicates that, for 90% of the time, the actual background concentrations will fall below the levels stated in Table 2. Unless noted otherwise, the concentration units are milli-grams per cubic meter (mg/m^3). The AAQC are based in part on research performed by Health Canada[5].

[4] Summary of Point of Impingement Standards, Point of Impingement Guidelines, and Ambient Air Quality Criteria (AAQCs). Standards Development Branch, Ontario Ministry of the Environment, March 1999.
[5] Cakmak, S., R. Burnett, and D. Krewski. Methods for Detecting and Estimating Population Threshold Concentrations of Air Pollution-Related Mortality with Exposure Measurement Factor, Risk Analysis, Vol. 19, No. 3, 1999.

TABLE 2: AMBIENT AIR QUALITY CRITERIA AND AMBIENT LEVELS

POLLUTANT	AAQC (mg/m^3)		BACKGROUND (mg/m^3)	LIMITING EFFECT
Carbon Monoxide (CO)	36.2 (1 hr)	15.7 (24 hr)	0.38	Health
Hydrocarbons (HC)	35.0 (1/2 hr)	12.0 (24 hr)	0.001*	Health
Oxides of Nitrogen (NO_x)	0.40 (1 hr)	0.20 (24 hr)	0.043	Health
Particulate Matter (PM, < 44μm)	0.10 (1/2 hr)	0.12 (24 hr)	Unavailable	Visibility
Particulate Matter (PM_{10}, < 10μm)	Unavailable	0.05 (24 hr)	Unavailable	Health
Particulate Matter ($PM_{2.5}$, < 2.5μm)	Unavailable	0.05 (24 hr)	0.013	Health

*Point of Impingement Limit (AAQC unavailable)

4.3 Ground Vibrations Measurement Procedure

Existing ground vibrations due to vehicle traffic were measured using an Instantel Minimate Plus seismograph capable of recording three components of ground velocity (one vertical and two horizontal). Three locations were selected to measure ground vibration magnitudes and to characterize the amplitude decay with distance. The locations selected for ground vibrations measurements are illustrated in Figure 2A (blue triangles). Measurements were performed during an off-peak period (approximately 10:30 AM) when the vehicle speeds on Highway 417 were high and the traffic flow was unrestricted. The seismograph was set to record peak particle velocity (ppv) data, in millimeters per second (mm/s), for multiple 10 second periods. The device was triggered manually to capture the passage of large vehicles, and the recorded data was subsequently analyzed to determine peak levels at each location.

5. RESULTS

5.1 Roadway Noise

The quantification of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which represents how noise is perceived by humans. With this scale, a doubling of sound power at the source results in a 3 dBA increase in measured noise at the receiver, and is just perceptible to most people. An increase of 10 dBA is usually perceived to be twice as loud.

The results of roadway noise calculations are expressed in terms of the equivalent sound level, L_{EQ}, for daytime and nighttime periods. The L_{EQ} provides a weighted measure of the time varying noise levels produced by vehicle traffic. It is defined as the continuous sound level that has the same energy as a time varying noise level over a selectable period of time. For roadways, the L_{EQ} is commonly calculated on the basis of a 16 hour daytime / 8 hour nighttime split. The detailed inputs, calculations and results from the STAMSON analysis for all 25 receptors are included in Appendix A.

The results of the analysis are summarized in Table 3 on the following page. Results of the analysis indicates that noise levels range between 48 dBA and 63 dBA for daytime periods and between 41 dBA and 57 dBA for nighttime periods. The highest noise levels occur at receptors closest to Highway 417, with levels diminishing with increasing distance from the noise source. Calculations also indicate that significant noise attenuation is provided by the existing earth berms along Highway 417.

TABLE 3: EXISTING NOISE LEVELS DUE TO ROADWAY TRAFFIC

Receptor	DAYTIME Leq (dBA)	NIGHTTIME Leq (dBA)
1	60.0	53.7
2	52.7	49.8
3	59.4	52.8
4	57.1	51.0
5	57.2	52.1
6	51.7	45.7
7	57.1	53.4
8	54.0	48.3
9	53.0	46.9
10	58.1	53.5
11	54.6	49.0
12	58.2	55.5
13	58.0	52.1
14	63.0	56.6
15	60.1	53.9
16	53.9	47.8
17	48.3	42.8
18	60.5	54.3
19	55.6	49.6
20	58.8	52.6
21	50.2	44.8
22	51.4	45.8
23	57.7	51.5
24	52.7	46.8
25	62.5	56.0

Although some receptors experience noise levels that exceed 60 dBA (L_{EQ} 16 hour), the affected areas are not eligible for noise abatement under the City of Ottawa's Local Improvements policy, since the primary noise source is the provincial Highway 417[6].

[6] City of Ottawa Environmental Noise Control Guidelines, City of Ottawa, April 2006, Section 3.2.1.

5.2 Air Quality

The results of existing conditions calculations for maximum pollutant concentrations in the study area, incorporating the effects of local wind statistics and existing ambient concentrations, are provided in Table 4. Details of input parameters and calculation results for CAL3QHC are provided in Appendix B. Tabulated results include ambient levels of pollutants and represent the reasonable worst-case concentrations expected to occur at the noted receptor locations.

TABLE 4: POLLUTANT CONCENTRATIONS WITH WIND PROBABILITIES CONSIDERED

RECEPTOR	CONCENTRATION (mg/m^3)			
	CO	HC	NO_X	PM
1	0.480	0.009	0.054	0.014
2	0.476	0.009	0.053	0.014
3	0.477	0.009	0.054	0.014
4	0.476	0.009	0.054	0.014
5	0.486	0.010	0.056	0.014
6	0.482	0.010	0.055	0.014
7	0.522	0.013	0.062	0.014
8	0.492	0.011	0.057	0.014
9	0.481	0.009	0.055	0.014
10	0.520	0.013	0.062	0.014
11	0.488	0.010	0.056	0.014
12	0.517	0.013	0.061	0.014
13	0.488	0.010	0.056	0.014
14	0.510	0.012	0.060	0.014
15	0.498	0.011	0.057	0.014
16	0.473	0.009	0.053	0.014
17	0.469	0.008	0.052	0.014
18	0.505	0.011	0.058	0.014
19	0.494	0.010	0.055	0.014
20	0.505	0.011	0.056	0.014
21	0.483	0.009	0.053	0.014
22	0.489	0.009	0.053	0.014
23	0.504	0.011	0.055	0.014
24	0.491	0.009	0.052	0.014

Table 4 summarizes the result of combining the maximum calculated pollutions levels for each receptor, for all calculated wind directions, with a statistical model of the Ottawa climate. Statistically speaking, the tabulated atmospheric pollutant concentration levels are expected to occur often on an annual basis. These results fall significantly below the allowable limits for CO, HC, NO_X and PM including the 90^{th} percentile ambient levels.

5.3 Ground Vibrations

Peak recorded ground vibrations included: 0.284 mm/s at location 1; 0.198 mm/s at location 2; and 0.087 mm/s at location 3. Research indicates that ground vibration levels of 0.1 – 0.2 mm/s are just perceptible to most humans, and that 1.0 – 2.0 mm/s is generally considered to be annoying. Measured vibration levels are considered to be low and of no consequence with respect to human perception and structural or cosmetic damage thresholds for buildings and other structures.

Experience and published literature indicate that intermittent peak vibrations transmitted to people are acceptable without complaints up to 1 mm/s or more, and that old buildings on poor soil can withstand vibrations of 30 mm/s or more without triggering new damage[7].

[7] C.H. Dowding, Blast Vibration Monitoring & Control, Prentice Hall, 1985.

6. SUMMARY AND CONCLUSIONS

The work summarized in this report establishes the existing environmental conditions for noise, air quality and ground vibrations for residences along the north side of Highway 417 between Holly Acres Road and Moodie Drive.

With respect to roadway traffic noise, *GmE*'s calculations indicate that noise levels range between 48 and 63 dBA during the daytime period (0700-2300 hrs), and between 41 and 57 dBA during the nighttime period (2300-0700 hrs). Although some receptors experience noise levels that exceed 60 dBA (L_{EQ} 16 hour), the affected areas are not eligible for noise abatement under the City of Ottawa's Local Improvements policy, since the primary noise source the provincial Highway 417.

Statistically calculated pollutant levels produced by existing vehicle traffic in the study area, including estimates of ambient concentrations, fall significantly below the MOE recommended standards for all pollutants studied, including carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_X) and suspended particulate matter (PM).

Seismograph measurements of ground vibration levels due to roadway traffic along Highway 417 in the study area are low, and although ground-borne vibrations are expected to be perceptible, they are generally acceptable with respect to human perception. In addition, these levels will be too low to cause any cosmetic or structural problems for buildings or other structures.

This concludes our assessment of existing conditions. As indicated previously, the information summarized in this report will form the basis for comparison to future conditions as affected by the Holly Acres Road to Moodie Drive Transitway expansion project.

If you have any questions or wish to discuss our findings please advise us.

Yours truly,

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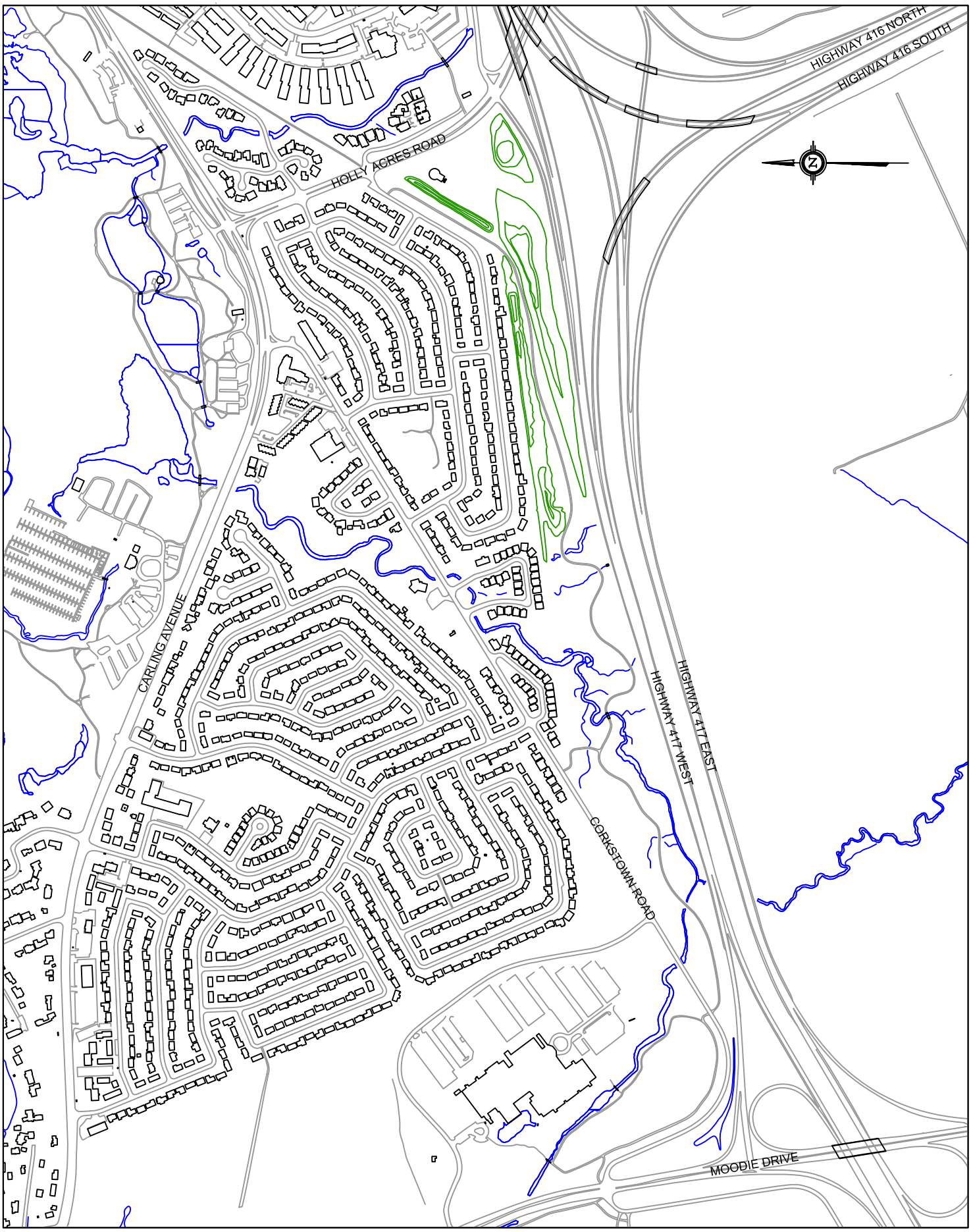

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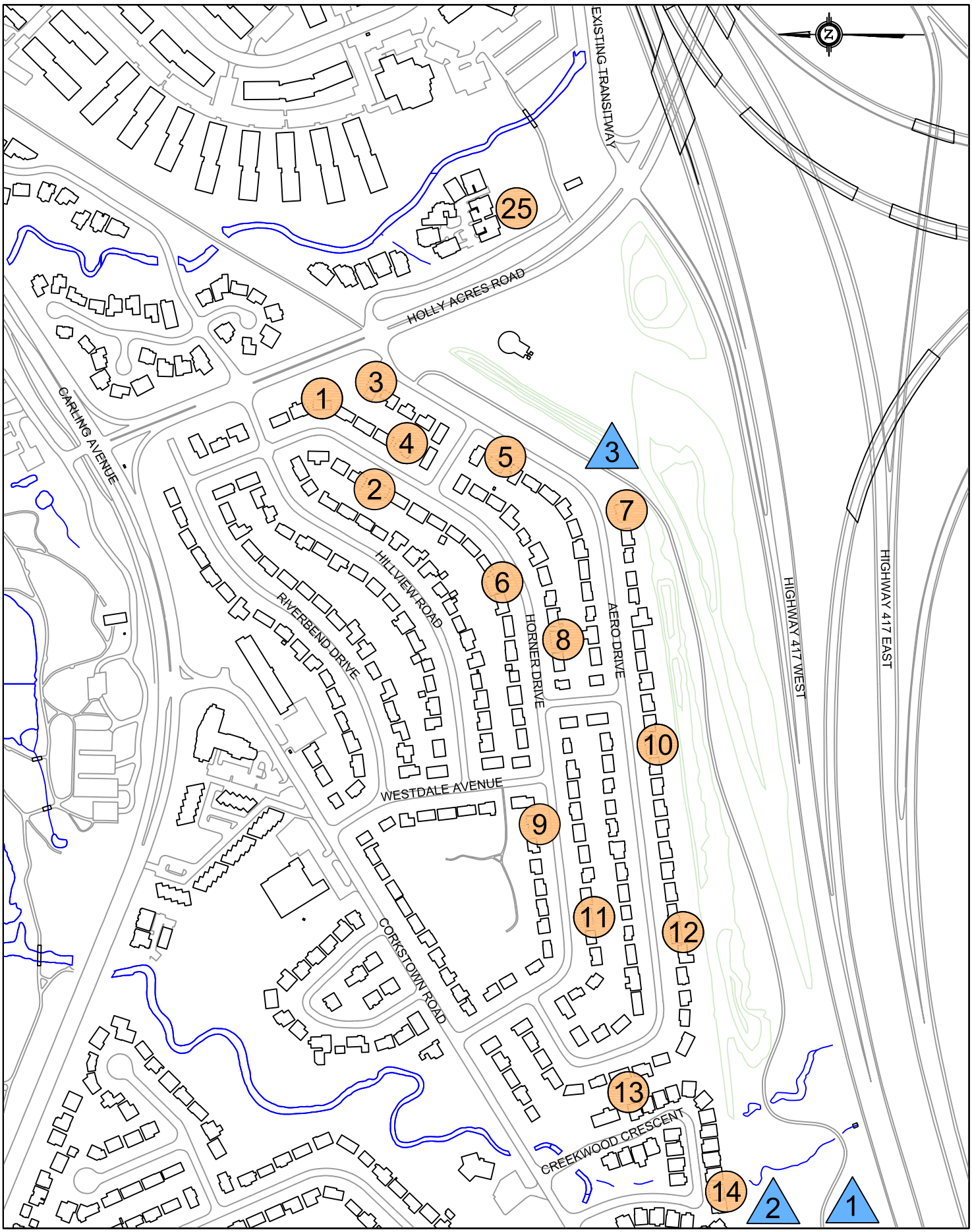
PROJECT	TRANSITWAY EXPANSION - HOLLY ACRES ROAD TO MOODIE DRIVE		
SCALE	1:10,000 (APPROX.)	DRAWING NO.	GME09-004-1
DATE	FEBRUARY 3, 2010	DRAWN BY	A.D.W.

DESCRIPTION

FIGURE 1:
SITE LOCATION AND
RELEVEANT SURROUNDING CONTEXT



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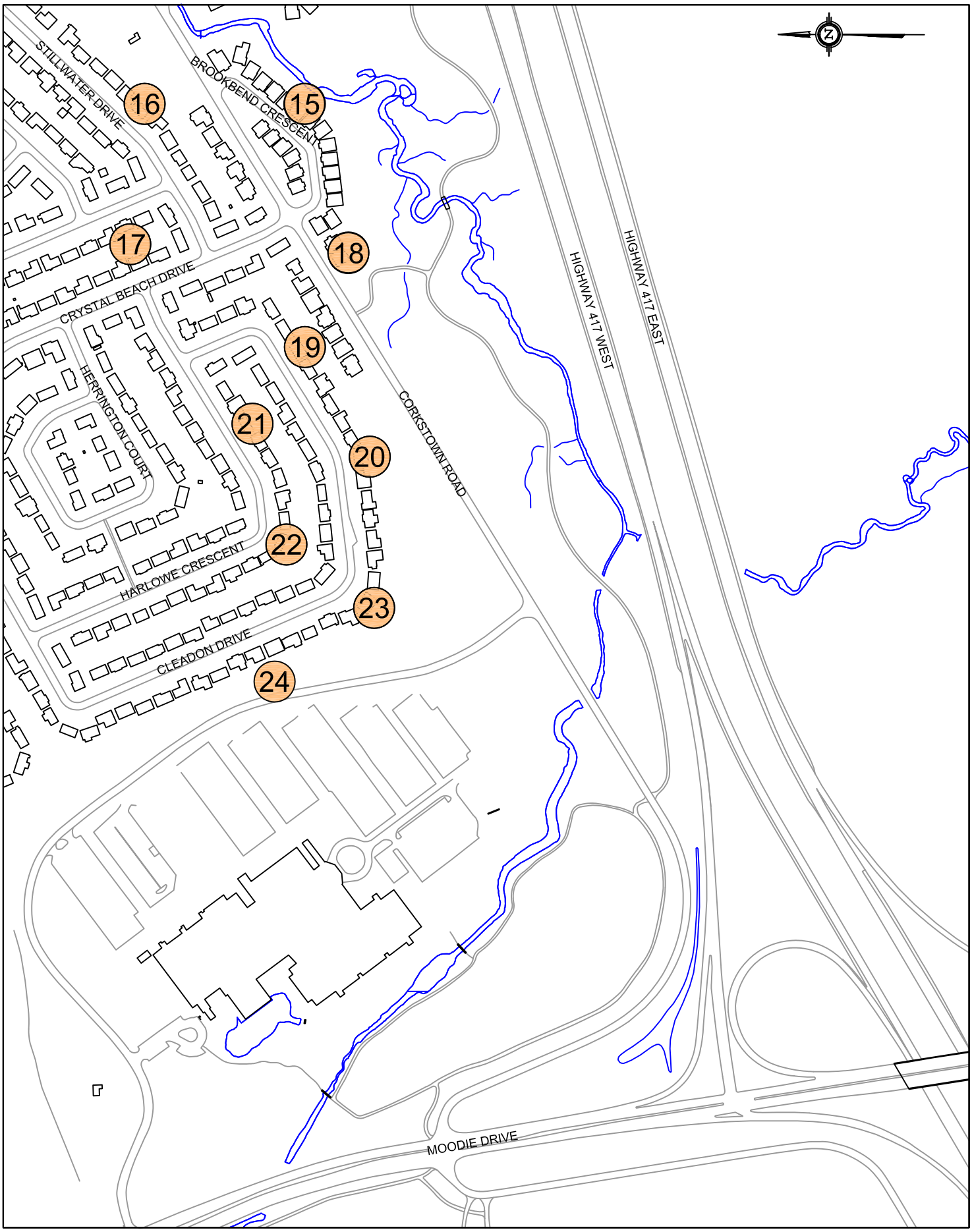
DESCRIPTION

FIGURE 2A:
NOISE RECEPTOR AND VIBRATION MEASUREMENT LOCATIONS



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DESCRIPTION

FIGURE 2B:
NOISE RECEPTOR AND VIBRATION MEASUREMENT LOCATIONS