

Railway Vibration Study

Humberking Lands – Macville East

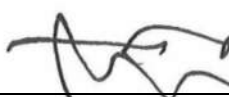

Proposed Mixed-Use Development Town of Caledon

June 21, 2024
Project: 123-0278

Prepared for

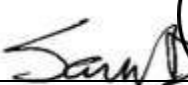

Humberking Developments Ltd.

Prepared by

Richard Qiang Li, Ph.D., P.Eng.

Reviewed by

Guangsheng (Sam) Du, M.Sc., P.Eng.

VALCOUSTICS

Canada Ltd.

Version History

Version #	Date	Comments
1.0	June 21, 2024	Final – Issued to Client

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION.....	1
1.1 THE SITE AND THE SURROUNDING AREA.....	1
1.2 THE PROPOSED DEVELOPMENT.....	2
1.3 SOURCES OF VIBRATION.....	2
2.0 VIBRATION GUIDELINES.....	3
3.0 METHOD.....	3
3.1 MEASUREMENT LOCATIONS.....	3
3.2 TRANSDUCER PLACEMENT	3
3.3 DATA ACQUISITION	3
3.4 DATA ANALYSIS.....	4
4.0 RESULTS.....	4
5.0 MITIGATION MEASURES.....	5
6.0 CONCLUSIONS	5
7.0 REFERENCES.....	5

LIST OF TABLES

TABLE 1 CPR FREIGHT TRAIN PASS-BYS MEASURED ON 2024-04-25.....	3
---	---

LIST OF FIGURES

FIGURE 1 KEY PLAN

FIGURE 2 RAILWAY VIBRATION MEASUREMENT LOCATIONS

LIST OF APPENDICES

APPENDIX A DRAFT PLAN

APPENDIX B SITE AND LANDSCAPE PLAN

APPENDIX C 3D MASSING

APPENDIX D VIBRATION VELOCITY TIME HISTORIES DUE TO TRAIN PASS-BYS

Humberking Lands – Macville East

Proposed Mixed-Use Development Town of Caledon

EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) was retained to prepare a Railway Vibration Study to support the Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) application submissions to the Town of Caledon. The proposed development will consist of a mixed-use block (Block 1) and a natural heritage system (NHS) block (Block 2). The specific building types, locations and configurations within the mixed-use block will be determined at the time of the future Site Plan Approval (SPA) application. For the purpose of this assessment, the preliminary conceptual site layout shown in the Site and Landscape Plan were used. Building numbers were added to the Site and Landscape Plan by VCL for ease of reference.

The significant source of ground-borne vibration with potential for impact at the proposed development is rail traffic on Canadian Pacific Railway (CPR) Mactier Subdivision. Measurements of ground-borne vibration were done on site near the rail line. The rail traffic induced vibration velocity magnitudes are measured to exceed the applicable vibration guideline limits at the proposed buildings.

Vibration mitigation measures are required for the proposed development.

1.0 INTRODUCTION

VCL was retained to prepare a Railway Vibration Study to support the OPA and ZBA application submissions to the Town of Caledon. The ground-borne vibration on site due to the train pass-bys was measured and compared with the vibration guidelines to determine the need for mitigation. The results are outlined herein.

1.1 THE SITE AND THE SURROUNDING AREA

The site is located to the north of the intersection of Humber Station Road and King Street, on the east side of Humber Station Road in the Town of Caledon. The site is bounded by:

- The Canadian Pacific Railway (CPR) Mactier Subdivision, with existing agricultural land and industrial developments beyond, to the east;
- Existing agricultural land to the north (proposed for future mixed-use development);
- Humber Station Road, with existing agricultural land (proposed for future residential development) beyond, to the west; and

- Existing agricultural land (proposed for future development), with existing industrial developments beyond, to the south.

A Key Plan is included as Figure 1. This report was prepared using:

- the Draft Plan of Subdivision, prepared by Humphries Planning Group Inc., last revised December 1, 2023.
- the Site and Landscape Plan, prepared by NAK Design Strategies, dated December 21, 2023. Note that the building forms shown on this drawing represent a preliminary conceptual site layout only and are subject to change.
- the 3D Massing, prepared by NAK Design Strategies, dated December 21, 2023. As noted above, the building forms shown on this drawing represent a preliminary conceptual layout only.

The Draft Plan of Subdivision is included as Appendix A. The Site and Landscape Plan is included as Appendix B. The 3D Massing is included as Appendix C.

Note, the building numbering was added to the Site and Landscape Plan by VCL for ease of reference.

1.2 THE PROPOSED DEVELOPMENT

The proposed development will consist of a mixed-use block (Block 1) and a natural heritage system (NHS) block (Block 2). The natural heritage system is intended to remain in its current state and will not be redeveloped.

The specific building types, locations and orientations within the mixed-use block will be determined at the time of the future SPA application. For the purpose of this analysis, the preliminary site concept shown in the Site and Landscape Plan was used.

The site concept consists of four buildings:

- Southwest building (Building 1): 14-storeys with a 6 and 7-storey podium;
- Northwest building (Building 2): 6-storeys with a 3-storey podium;
- Northeast building (Building 3): 14-storeys with a 6-storey podium; and
- Southeast building (Building 4): 14-storeys with a 6-storey podium.

The 3D Massing drawing indicates that the buildings will be primarily residential, with employment/retail uses on the ground floors of Buildings 1, 2 and 3.

1.3 SOURCES OF VIBRATION

The anticipated vibration source with potential to impact the development is the rail traffic on the CPR Mactier Subdivision.

Ground-borne vibration due to vehicular movements on surrounding roadways is not expected to create significant impact on the proposed development and thus, has not been considered further in the analysis. There are no other sources of vibration in the vicinity of the site.

2.0 VIBRATION GUIDELINES

The Federation of Canadian Municipalities and the Railway Association of Canada jointly developed “Guidelines for New Development in Proximity to Railway Operations”, dated May 2013 (herein referred to as the FCM/RAC guidelines). For residential developments, the FCM/RAC Guideline recommends a maximum vibration threshold of 0.14 mm/s root mean square (RMS, using a 1 second averaging time) between 4 Hz and 200 Hz (Reference 1).

Vibration mitigation is needed when the threshold is exceeded.

3.0 METHOD

3.1 MEASUREMENT LOCATIONS

Railway induced ground-borne vibration was measured at five (5) locations. Figure 2 shows the measurement locations on aerial imagery from Google Maps, overlaid with the conceptual site layout shown on the Site and Landscape Plan (Appendix B).

Locations A and C are located at, respectively, the northeast corner of Building 3 and the southeast corner of Building 4, approximately 30 m from the east property line [i.e., the rail right of way (ROW)], corresponding to the proposed building facades closest to the railway.

As a reference, Location B is located approximately 30 m to the east of Location C, along the rail ROW.

Locations D and E, along the south façade of Building 4, are located approximately 15 m and 30 m, respectively, to the west of Location C, approximately 45 m and 60 m respectively from the rail ROW.

3.2 TRANSDUCER PLACEMENT

Geophones were used to measure the vibration velocity produced by the train pass-bys. At each location, the geophone was placed into a small hole dug into the ground, approximately 50 mm below grade. The geophones were resting on compacted soil and were securely anchored with metal ground spikes.

3.3 DATA ACQUISITION

A total of five (5) CPR freight train pass-bys were monitored on April 25, 2024. Detailed information for the trains is summarized in Table 1.

The vibration signals were recorded simultaneously at all 5 locations for each train pass-by. The vertical axis signal from each geophone was recorded digitally, using a MetricPro Model MPV3C21 vibration data acquisition and analysis system at each location. The monitors recorded vibration velocity, in mm/s.

At each location the vibration data acquisition system recorded the ground-borne vibration continuously throughout the monitoring period. The system was set to record vibration at a sampling rate of 1000 samples per second.

TABLE 1: CPR FREIGHT TRAIN PASS-BYS MEASURED ON 2024-04-25

Pass-by #	Time/Period	Direction	# of Locos	# of Cars	Maximum Vibration Velocity ⁽¹⁾ (mm/s) at each Location ⁽²⁾				
					A	B	C	D	E
1	13:03 – 13:08	Northbound	3	130	0.07	0.31	0.07	0.05	0.04
2	15:21 – 15:23	Northbound	1	70	0.08	0.27	0.11	0.08	0.06
3	15:55 – 16:07	Southbound	2	110	0.08	0.25	0.06	0.05	0.04
4	16:18 – 16:21	Westbound	2	123	0.09	0.31	0.10	0.07	0.05
5	18:11 – 18:16	Southbound	3	103	0.11	0.41	0.16	0.11	0.09

Notes:

- (1) Maximum overall vibration velocity occurring for the entire pass-by, one second RMS averaging.
- (2) See Figure 2.

3.4 DATA ANALYSIS

Time histories of the vibration velocity produced by each train pass-by were plotted using an RMS (root-mean-square) averaging routine with a time constant of one second. The analysis procedure conforms with the FCM/RAC guidelines.

4.0 RESULTS

Table 1 also summarizes the maximum measured overall vibration velocity (1-second RMS) for each of the train pass-bys measured at each location.

Appendix D contains recorded time histories for each railway train pass-by measured at each location.

The maximum overall vibration velocity magnitudes were:

- Location A: 0.11 mm/s;
- Location B: 0.41 mm/s.
- Location C: 0.16 mm/s;
- Location D: 0.11 mm/s; and
- Location E: 0.09 mm/s.

The measured maximum vibration velocity magnitude of 0.16 mm/s at the proposed building structures, due to the freight trains, exceeded the 0.14 mm/s FCM/RAC Guideline limit for residential uses at the closest residential unit façade. Thus, vibration mitigation is required for the proposed development.

5.0 MITIGATION MEASURES

Since the measured maximum vibration velocities exceeded the FCM/RAC Guideline limit, vibration mitigation will be required for the proposed development. To be conservative, it is recommended that vibration mitigation measures be implemented for all the underground structure portions located within a setback distance of 40 m from the east property line (i.e., the rail ROW).

The vibration mitigation measures should be developed during the detailed design of the buildings. It is premature to develop the vibration mitigation design at this stage when the detailed design of the buildings has not been completed. However, mitigation options that could be implemented include perimeter and/or footing isolation of the underground structure; acoustic isolation joints between the residential portion of the building and part of the underground structure; increased setback to the underground structure; or a combination of these and other vibration isolation strategies.

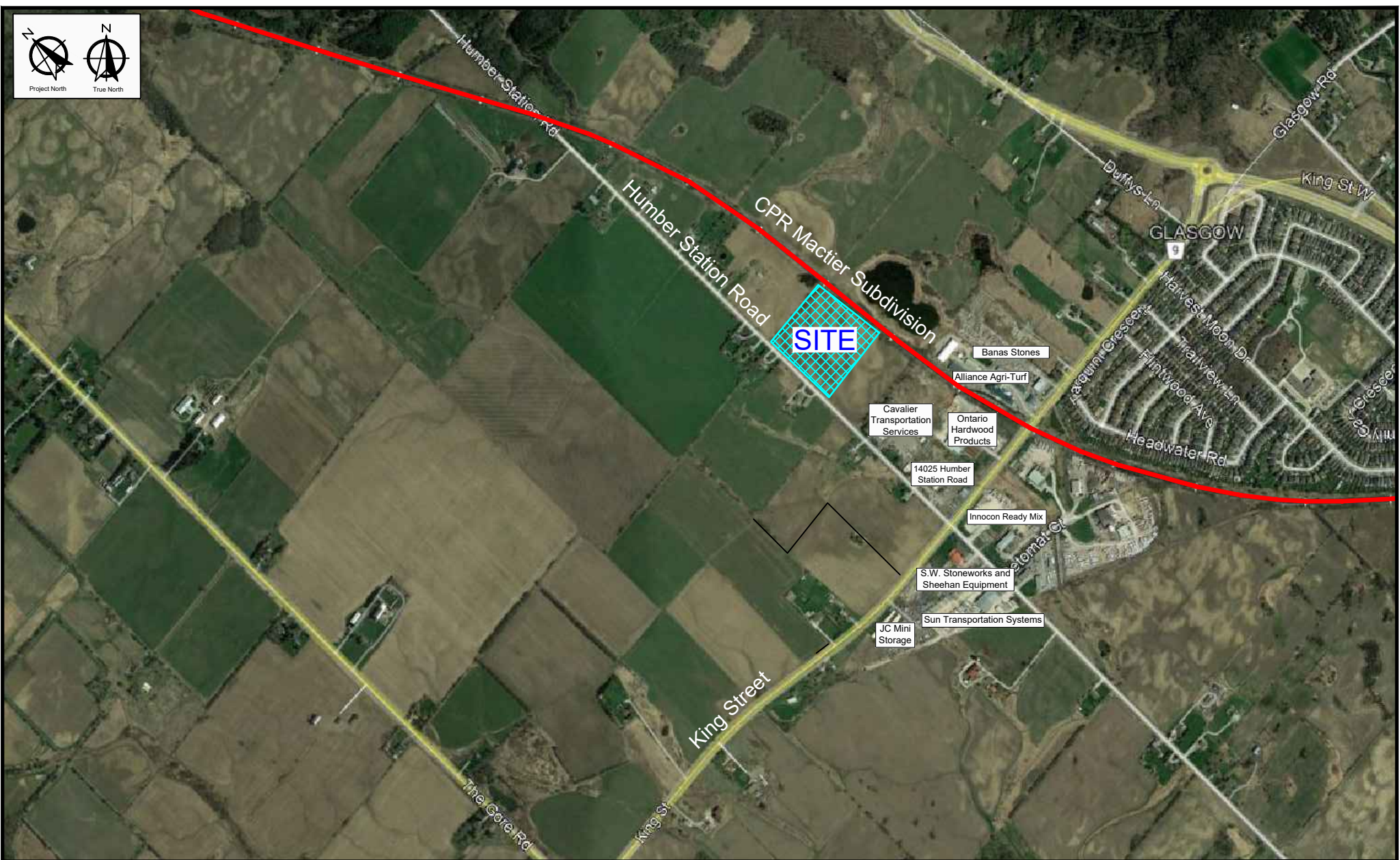
6.0 CONCLUSIONS


The measured ground-borne vibration velocity magnitudes at the proposed development, due to railway traffic on the CPR Mactier Subdivision, exceeded the FCM/RAC Guideline residential vibration limits. Therefore, vibration mitigation measures are required for this development and should be considered as part of the detailed design.

7.0 REFERENCES

1. “Guidelines for New Development in Proximity to Railway Operations”, Prepared for The Federation of Canadian Municipalities and the Railway Association of Canada, May 2013.

RL\SD\mv
J:\2023\1230278\000\Reports\Macville East\Vibration\Humber Station Development_Vibration v1_0 FnI.docx



		 <p>30 Wertheim Court, Unit 25 Richmond Hill, Ontario Canada L4B 1B9 solutions@valcoustics.com Phone: (905) 764-5223 Fax: (905) 764-6813</p>	<p>Title</p> <p>Key Plan</p>	<p>Project No.</p> <p>123-0278</p>	<p>Date</p> <p>March 21, 2024</p>
<p>No.</p>	<p>Revision/Issue</p>		<p>Date</p>	<p>Project Name</p> <p>Humberking Lands- Macville East, Caledon</p>	<p>Scale</p> <p>N.T.S.</p>

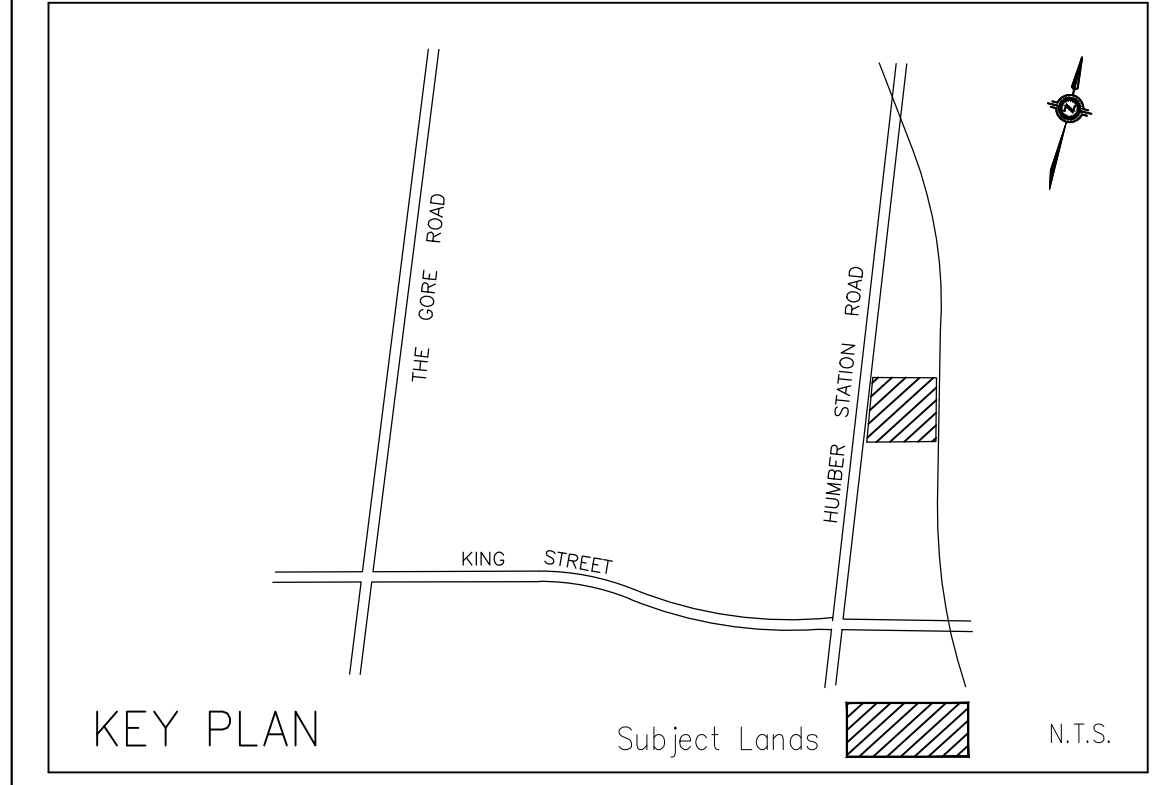
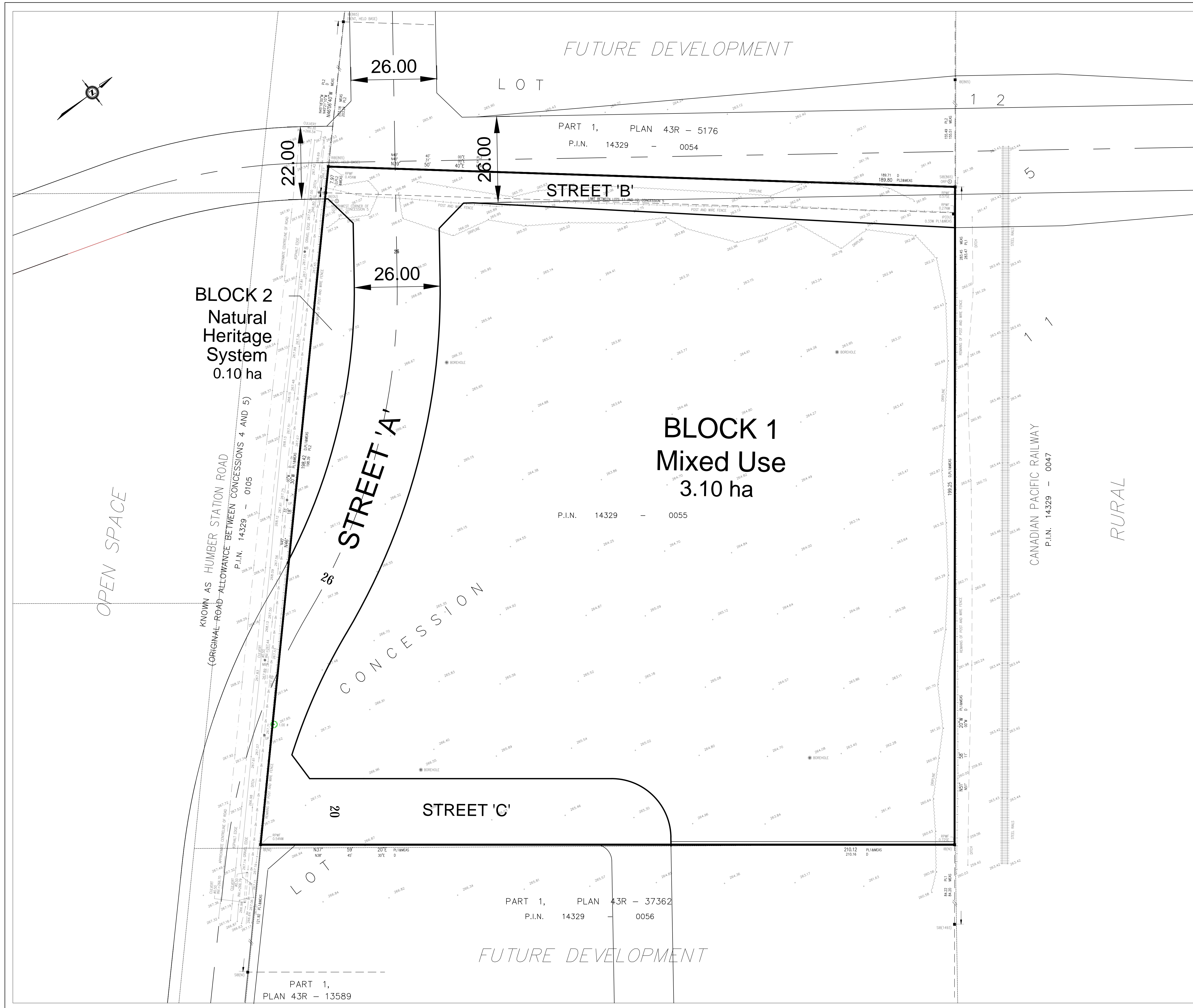


Title Railway Vibration Measurement Locations		Measurement Date April 25, 2024
Project Name Humberking Lands – Macville East, Caledon		Project No. 1230278.000

Figure 2

APPENDIX A

DRAFT PLAN



HUMPHRIES PLANNING GROUP INC.
190 PIPPIN ROAD, SUITE A, VAUGHAN, ONTARIO, L4K 4X9
TEL (905)264-7678, FAX (905)264-8073
www.humphriesplanning.com

DEVELOPMENT STATISTICS:

LAND USE	BLOCK #	AREA (ha)
Mixed Use	1	3.10
Natural Heritage System	2	0.10
Roads		0.85
TOTAL		4.05

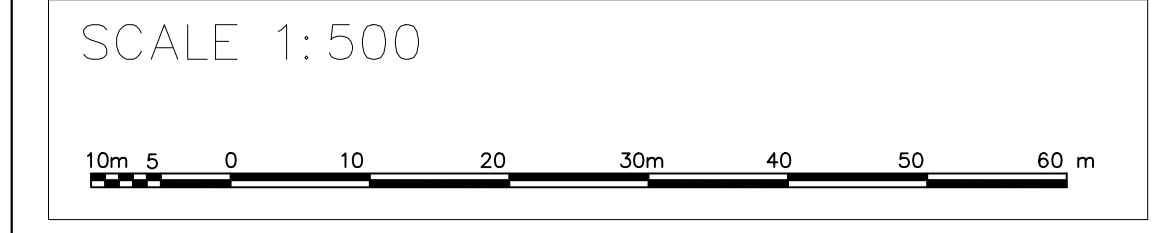
OWNER'S CERTIFICATE:
I authorize Humphries Planning Group Inc. to prepare and submit this plan for draft approval.
Date: _____

SURVEYOR'S CERTIFICATE:
I hereby certify that the boundaries of the lands being subdivided and their correct relationship to the adjacent lands are accurately and correctly shown on this plan.
Date: _____

WAHBA SURVEYING
285 Vaughan Valley Blvd.
Woodbridge ON L4H3B5 Tel. 905.851.1300
Tel. 905.851.1300 www.wahbasurveying.com
www.wahbasurveying.com

ADDITIONAL INFORMATION:
[Section 51(17) of the Planning Act, R.S.O. 1990, c. P. 13, as amended to April 11, 1997]
a), b), e), f), g), & j) - on plan.
c) - on key plan
d) - see statistics
h) - piped water to be installed by developer
i) - loam, sandy loam
k) - all services to be made available by developer
l) - none

DRAFT PLAN OF SUBDIVISION
PART OF LOTS 11 AND 12,
CONCESSION 5,
(GEOGRAPHIC TOWNSHIP OF ALBION)
TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL



HUMPHRIES PLANNING GROUP INC.
190 PIPPIN ROAD, SUITE A, VAUGHAN, ONTARIO, L4K 4X9
TEL (905)264-7678, FAX (905)264-8073
www.humphriesplanning.com

File Number:	Drawing Number:
Date Drawn: 6 FEB 23	A1
Drawn By: BT	
Checked By: R.H.	
Date Revised: 1 DEC 23	
CAD File No. :	

APPENDIX B

SITE AND LANDSCAPE PLAN



1 COMPACT STREET THAT PROMOTES SHARED SPACES IN WHICH PEOPLE, CYCLISTS AND VEHICLES SAFELY COEXIST.



2 EFFICIENT RAINWATER HARVESTING AND LOW-MAINTENANCE LANDSCAPING THAT HELP ACHIEVE SUSTAINABILITY OBJECTIVES.



6 ROOFTOP TERRACES THAT OFFER ADDITIONAL OUTDOOR AMENITY SPACES.

3 UTILIZING PAVED AREAS AND ARTISTIC ELEMENTS, FOSTERING LIVELY COMMUNAL SPOTS AND ENHANCING SENSE OF PLACE.



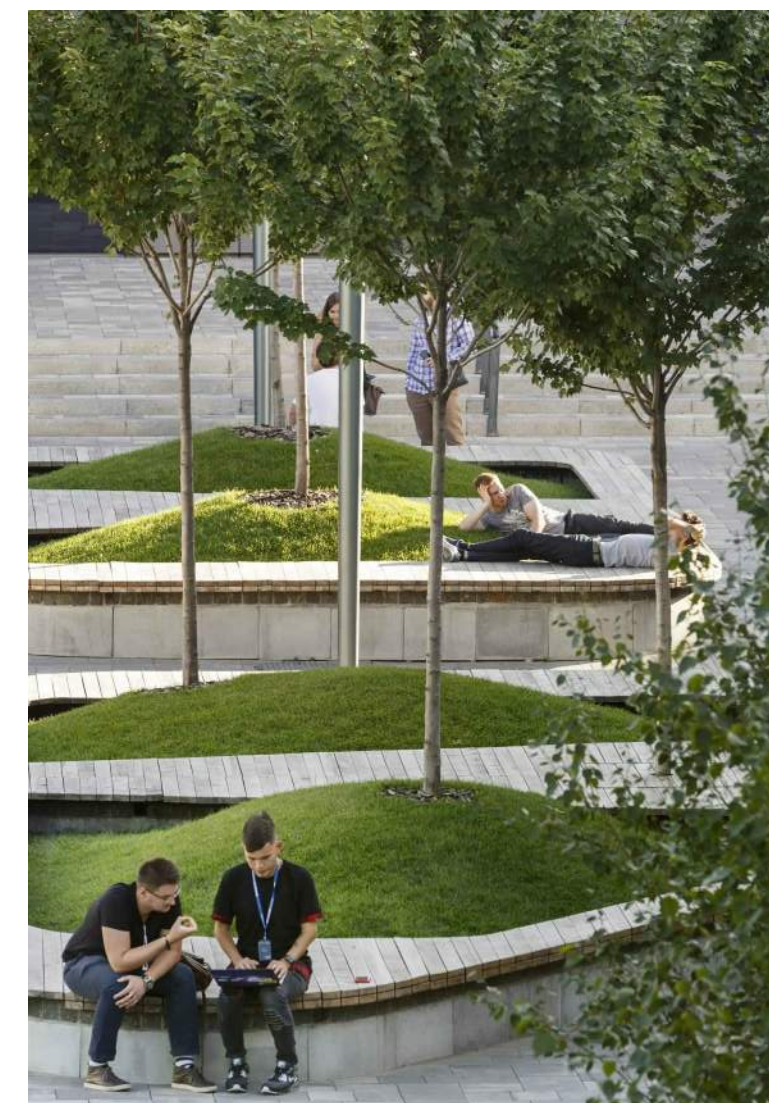
4 OUTDOOR ACTIVITIES FOR ALL AGES TO PROMOTE AN ACTIVE AND HEALTHY LIFESTYLE.



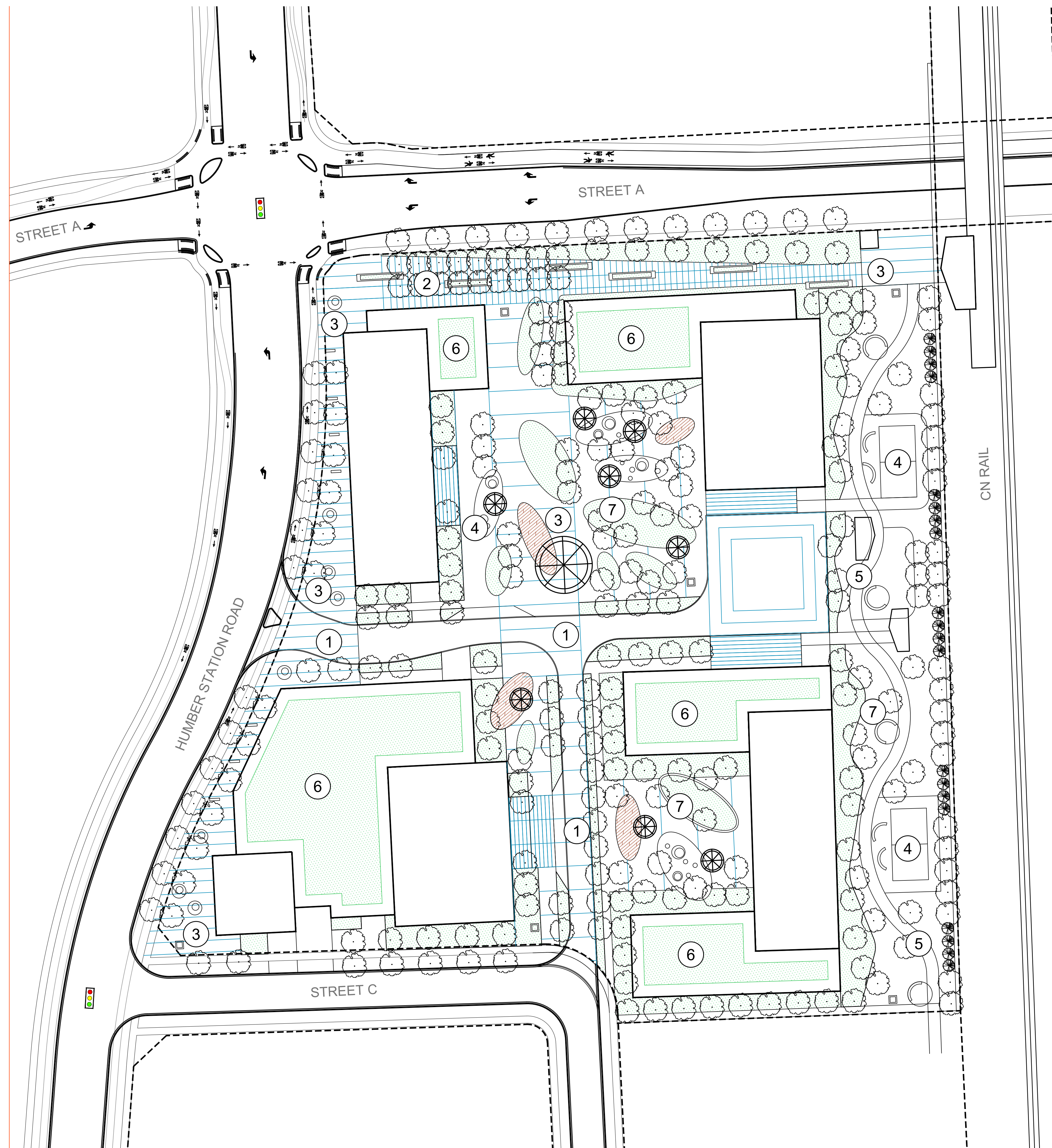
5 SAFE AND EASILY NAVIGABLE PATHWAYS THAT CONNECT TO DIVERSE PROGRAMMING OPTIONS AND ACTIVITIES.



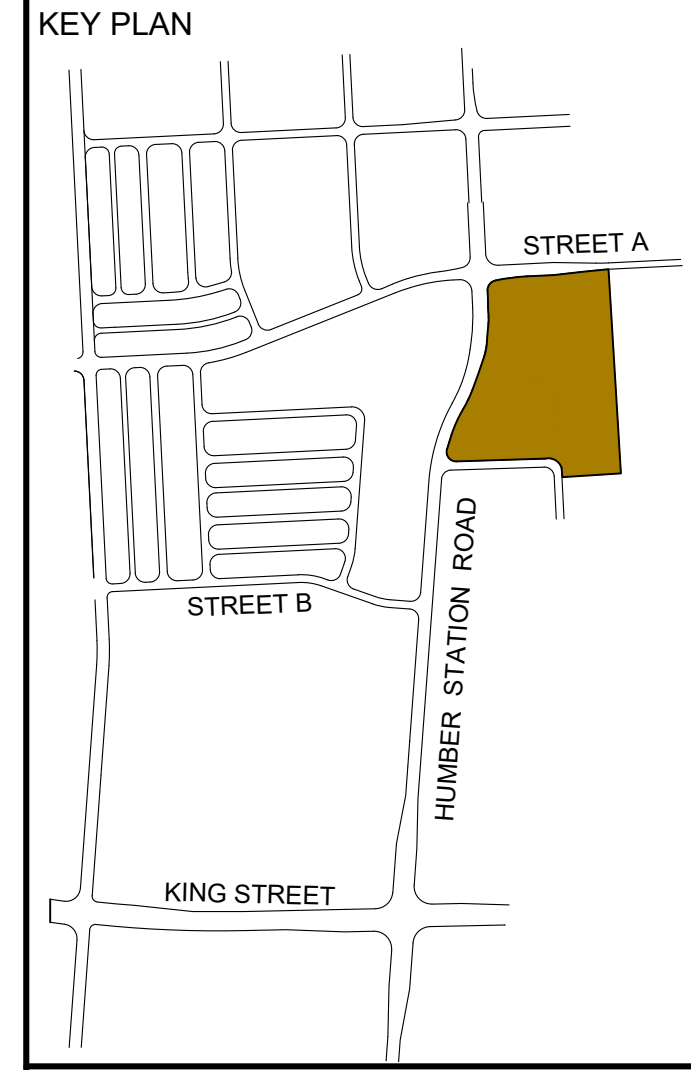
6 ROOFTOP TERRACES THAT OFFER ADDITIONAL OUTDOOR AMENITY SPACES.



7 SECLUDED GREEN SPACES WITH INTEGRATED SEATING, PERFECT FOR SHADE AND CONTEMPLATION.

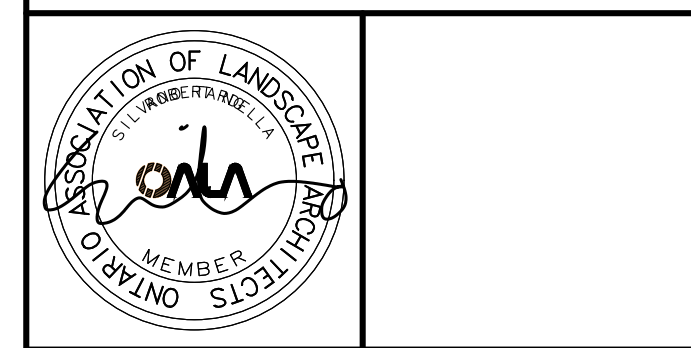


CONTRACTOR SHALL CHECK ALL DIMENSIONS ON THE WORK AND REPORT ANY DISCREPANCY TO THE LANDSCAPE ARCHITECT BEFORE PROCEEDING. ALL DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF THE LANDSCAPE ARCHITECT AND MUST BE RETURNED AT THE COMPLETION OF THE WORK. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.



REVISIONS		
No.	Description	Date

CITY APPROVAL STAMP



NAK
design strategies
421 RONCESVALLES AVENUE, TORONTO, ON M4R 2N1 CANADA
T 416.340.8700 F 416.340.7100 NAKDESIGNSTRATEGIES.COM

PROJECT
**Humberking - East Parcel
Macville Community**
Caledon, Ontario

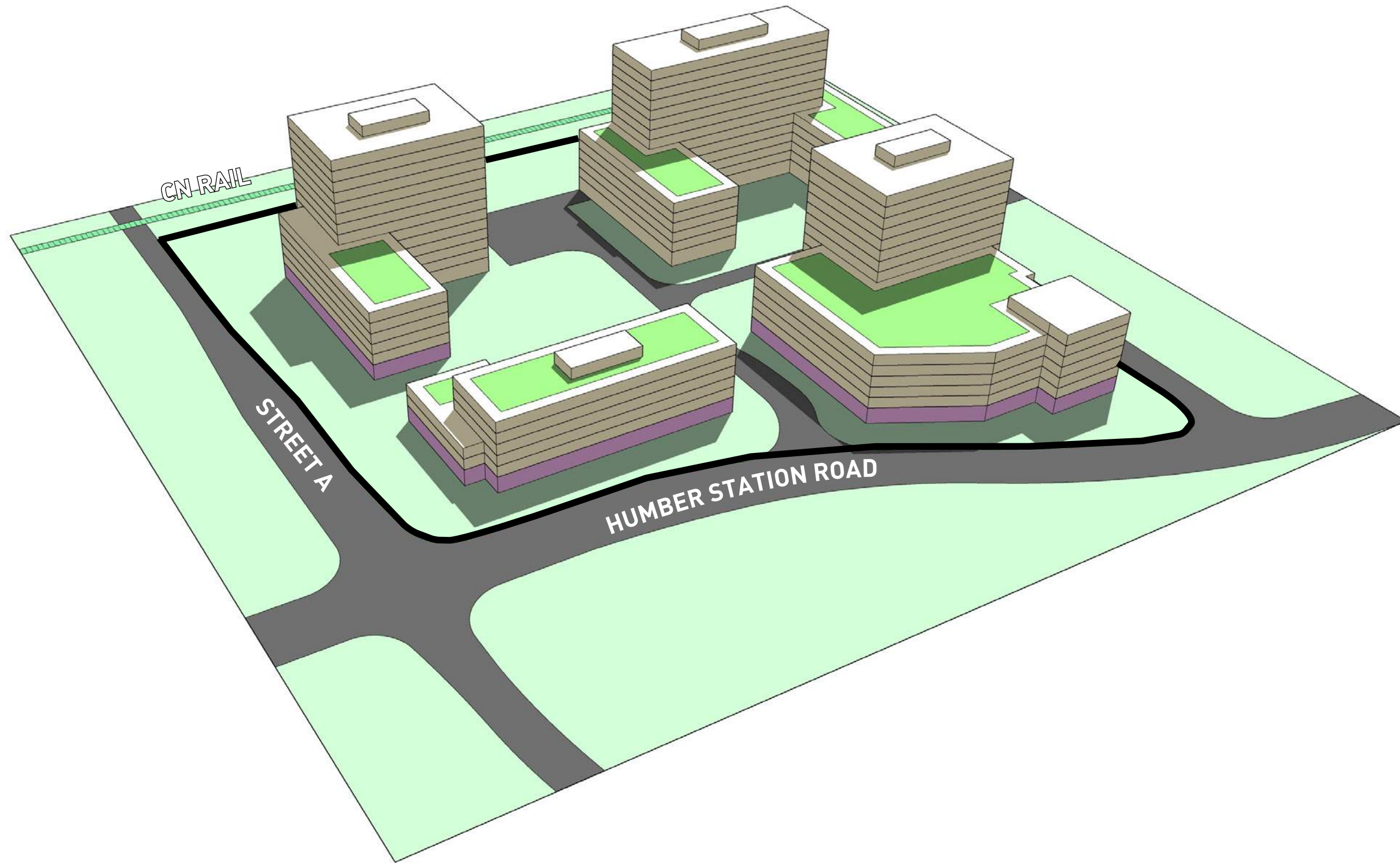
TITLE

DATE: Dec.21/23
SCALE: 1-500
DRAWN: AC
CHECKED: KK
JOB NO.: 23178

SHEET

APPENDIX C




3D MASSING



KEY MAP



LEGEND





-  PROPERTY LINE
-  EMPLOYMENT/
RETAIL
-  RESIDENTIAL
-  OUTDOOR
AMENITY

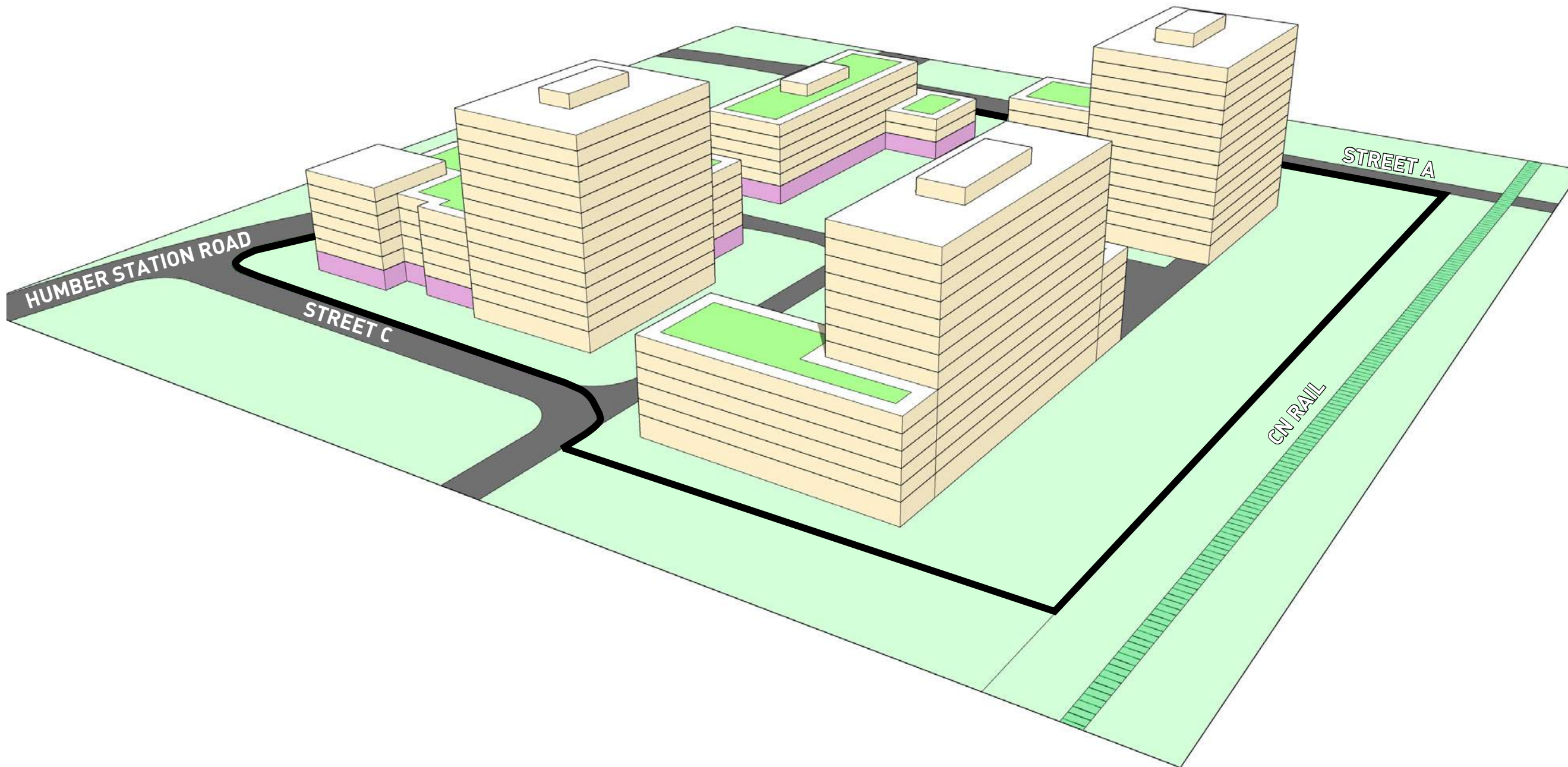


KEY MAP



LEGEND

-  PROPERTY LINE
-  EMPLOYMENT/
RETAIL
-  RESIDENTIAL
-  OUTDOOR
AMENITY








KEY MAP



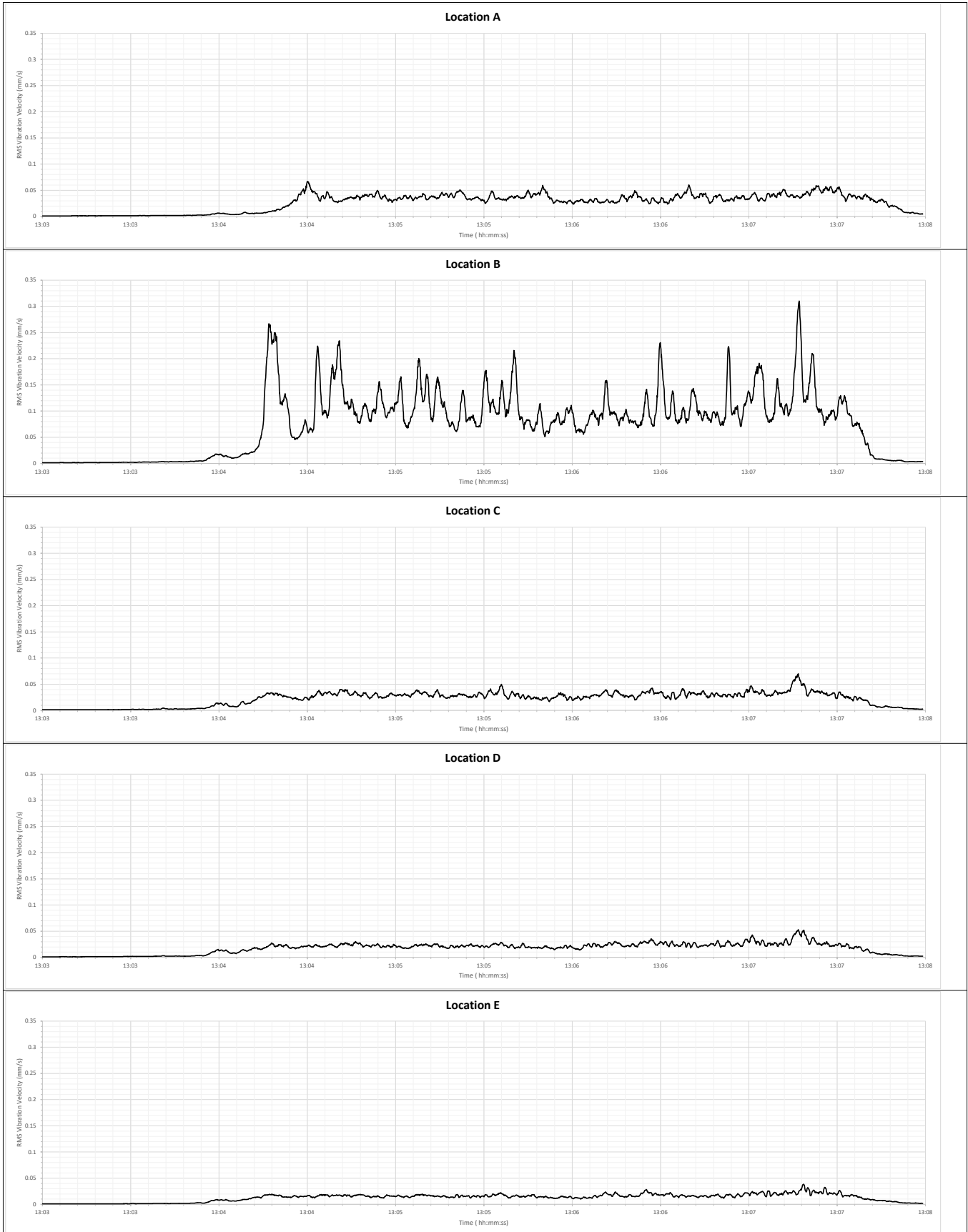
LEGEND

-  PROPERTY LINE
-  EMPLOYMENT/
RETAIL
-  RESIDENTIAL
-  OUTDOOR
AMENITY

APPENDIX D

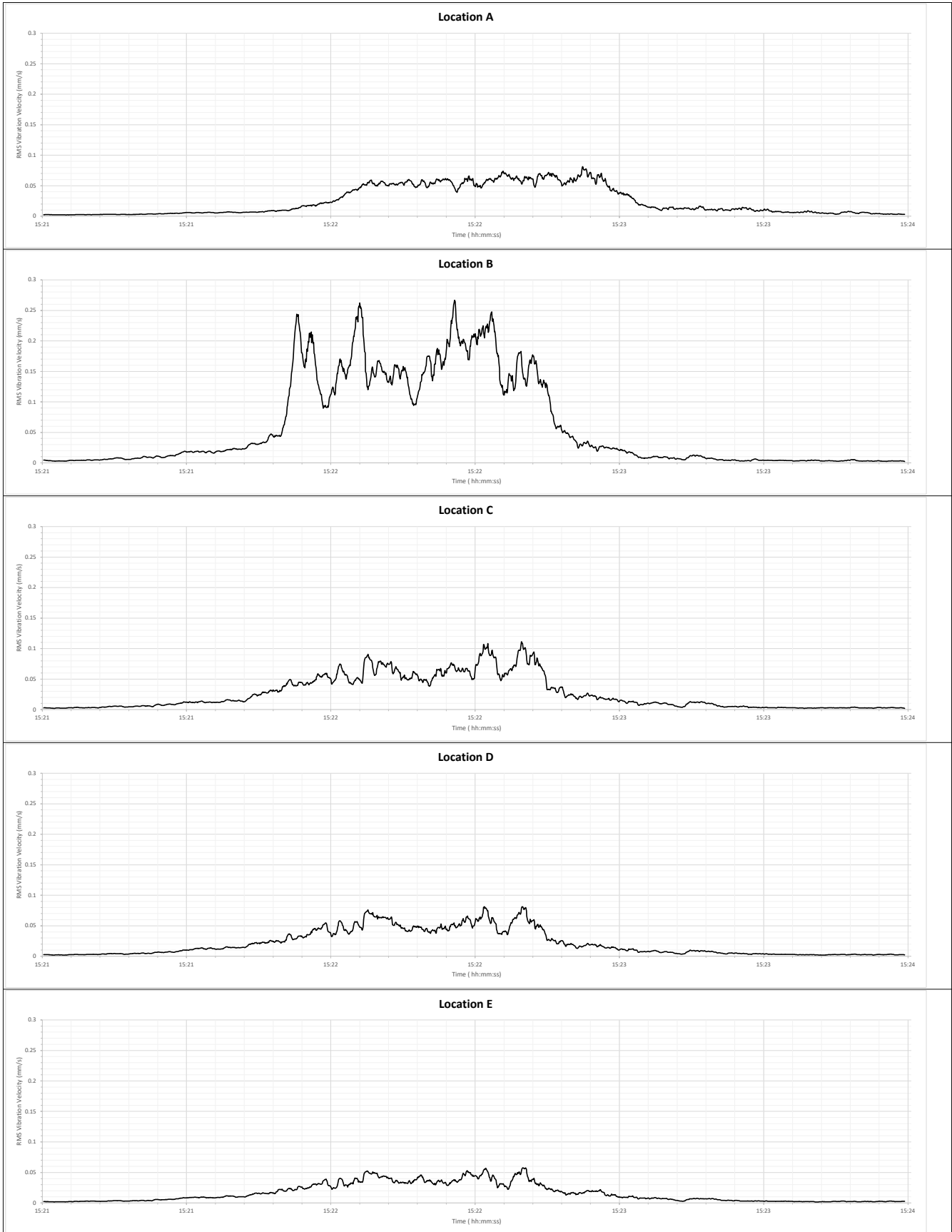
VIBRATION VELOCITY TIME HISTORIES DUE TO TRAIN PASS-BYS

Time History - Train Pass-by #1



© 2023, 1230278.000 Measurements (Vibration) (RMS) Time Histories (Z) Only, Humber Station Development, 01_0101

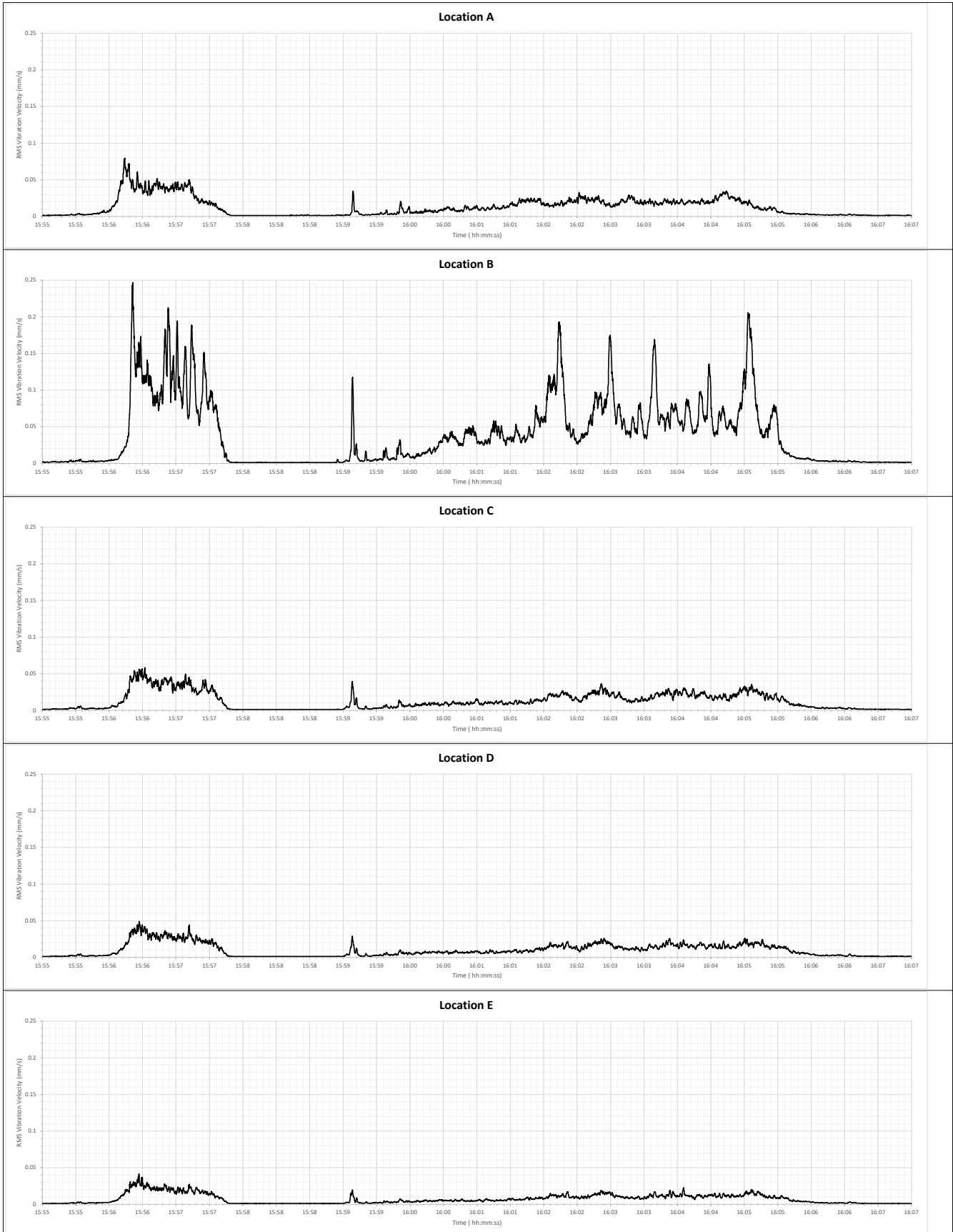
Time History - Train Pass-by #2



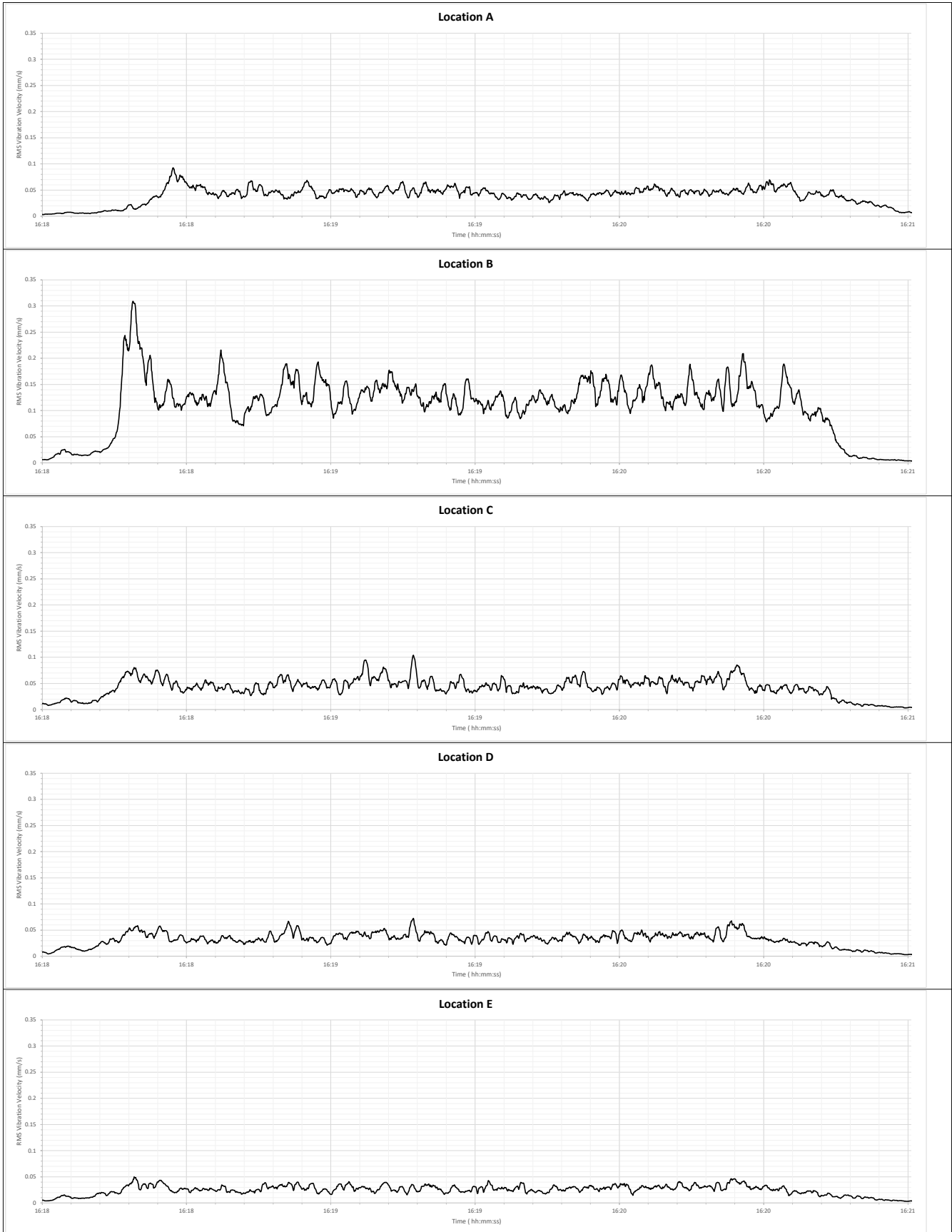
	Title Railway Vibration Measurements - Vertical (Z) RMS Velocity Time History	Measurement Date Apr 25, 2024	Figure 2
	Project Name Humber Station Development	Project No. 1230278.000	

© 2023, 1230278.000 Measurements (Vibration) RMS (Time History) (Z) Only, Humber Station Development, 01_0413

Time History - Train Pass-by #3



Time History - Train Pass-by #4



	Title Railway Vibration Measurements - Vertical (Z) RMS Velocity Time History	Measurement Date Apr 25, 2024	Figure 4
	Project Name Humber Station Development	Project No. 1230278.000	

© 2023, 1230278.000\Measurements\Vibration\RMS\Time Histories\Z Only_Humber Station Development_RL_0413

Time History - Train Pass-by #5

