BURNSIDE

Rail Safety Report and Development Viability Assessment
720, 735, 740 Oval Court and 5135, 5155 Fairview Street

Branthaven Development Corp.
720 Oval Court
Burlington ON L7L 6A9

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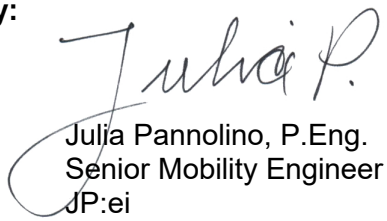
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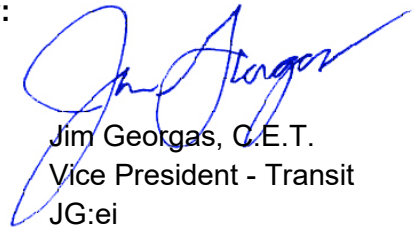
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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Branthaven Development Corporation (Branthaven) to provide a Development Viability Assessment and Rail Safety Report for the property at 720, 735, 740 Oval Court and 5135, 5155 Fairview Street in Burlington, Ontario. This site is located at approximately Mile 27.85 of the Metrolinx Oakville subdivision rail corridor.

Figure 1: Location of Site



The purpose of this report is to assess the risks associated with development near the adjacent rail corridor and summarize the mitigation measures that are proposed. This report does not address noise, vibration, stormwater, or drainage, all of which are reviewed separately.

This Rail Safety Report will act as a proof-of-concept for submission to the local Municipality and Rail Operator(s) for review and comment. It is the developer's responsibility to ensure the proposed mitigation measures are constructed and maintained.

2.0 Guidelines and Methodology

All new development proposals within proximity of railway lands should consider the rail safety requirements set out by governing authorities and the local Municipality. The guidelines reviewed for this report are outlined in the sections that follow.

2.1 FCM / RAC Guidelines

The Federation of Canadian Municipalities (FCM) and the Railway Association of Canada (RAC) entered into a partnership to develop common approaches to the prevention and resolution of issues arising from development occurring in close proximity to railway corridors and other rail operations. Through this partnership, the "Guidelines for New Development in Proximity to Rail Operations" (FCM / RAC Guidelines) was created; this document provides guidelines and best practices for development near rail corridors.

The following principles for mitigation design should be considered when applying the FAC / RAC Guidelines:

- Standard mitigation measures are desired as a minimum requirement.
- In instances where standard mitigation measures are not viable, alternative development solutions may be introduced.
- All mitigation measures should be designed to the highest possible urban design standards. Mitigation solutions should not create an onerous, highly engineered condition that overwhelms the aesthetic quality of an environment.

2.1.1 Setbacks

A setback from the railway corridor, or railway freight yard, is a highly desirable development condition. The FCM / RAC Guidelines recommend the following setbacks:

Table 1: Setback Recommendations

Classification	Setback
Freight Rail Yard	300 m
Principle Main Line	30 m
Secondary Main Line	30 m
Principle Branch Line	15 m
Secondary Branch Line	15 m
Spur Line	15 m

2.1.2 Berms

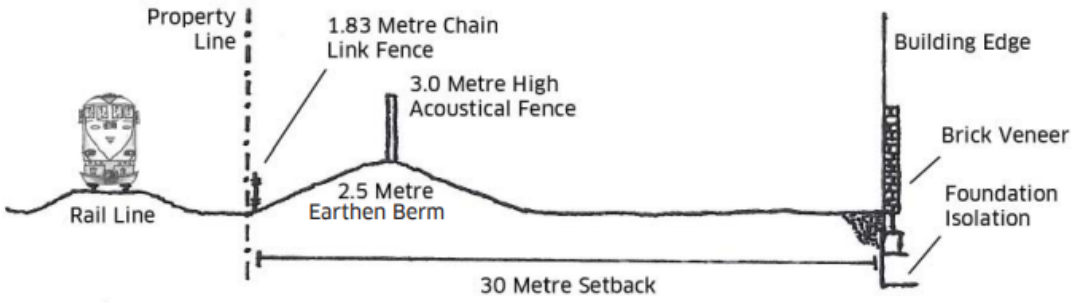
Safety barriers reduce the risks associated with railway incidents by intercepting or deflecting derailed trains and debris. The standard safety barrier is an earthen berm, which is intended to absorb the energy of derailed train cars, limiting the distance they travel outside of the railway right-of-way. Where full setbacks are provided, berms compacted to 95% modified proctor should be provided to afford a maximum level of risk mitigation. Berms should be constructed parallel to the rail corridor, with returns at the ends and to the following specifications:

Table 2: Berm Specifications

Classification	Berm Height (Measured at Grade of Property Line)	Berm Side Slopes
Principle Main Line	2.5 m above grade	Not steeper than 2.5 to 1
Secondary Main Line	2.0 m above grade	Not steeper than 2.5 to 1
Principle Branch Line	2.0 m above grade	Not steeper than 2.5 to 1
Secondary Branch Line	2.0 m above grade	Not steeper than 2.5 to 1
Spur Line	No requirement	

A typical berm design is pictured below:

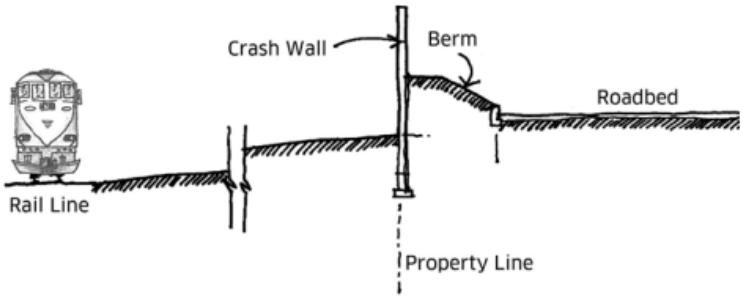
Figure 2: Example Berm Design



2.1.3 Crash Berms

Crash berms are reinforced berms that can be useful in spatially constrained sites where a full berm cannot be accommodated. Crash berms are typically concrete wall structures retaining more earth behind the wall which in-turn provides more energy absorption. A typical crash berm design is pictured below:

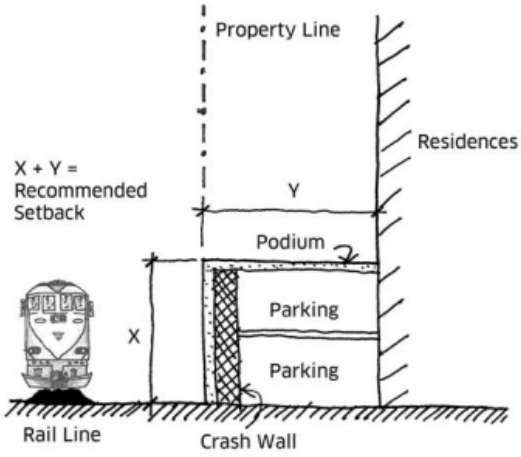
Figure 3: Example Crash Berm Design



2.1.4 Crash Walls

Crash walls are concrete structures that are designed to provide the equivalent resistance as the standard berm. The design of a crash wall is dependant on variables such as train speed, weight, and angle of impact. The crash wall design guidelines have been created by AECOM and will be explained further in this report. Horizontal setback requirements may be reduced with the construction of a crash wall. An example of a crash wall is shown below:

Figure 4: Example Crash Wall Design



2.1.5 Security Fencing

Trespassing onto a railway corridor can have dangerous consequences, and every effort should be made to discourage it. All new developments in proximity to railway corridors must include a 1.83 m high chain link fence along the mutual property line, at a minimum.

2.2 AECOM Crash Wall Guidelines

In 2014, AECOM produced the “Development of Crash Wall Design Loads from Theoretical Impact” (AECOM Crash Wall Guidelines). As noted in Section 2.1.4, the FCM / RAC Guidelines refer designers to the AECOM Crash Wall Guidelines to derive the appropriate load a crash wall is required to withstand.

The use of an earthen berm is not practical for every site, in those cases a reinforced crash wall may be used. There are two possible modes of impact that should be considered when designing a crash wall: a glancing blow from a derailed train running in the direction of the track; and a direct impact as a result of cars piling up in an accordion fashion.

For the design of a crash wall adjacent to a railway track, one of the following methods may be used. The simplified design approach of Method 1 may be used in many cases. Method 2 may be used to optimize the design, or where factors such as distance from the track to the wall, track speeds, side slopes along the track, and consequences of collision may justify a different load.

2.2.1 Method 1

The wall shall be designed for a minimum point load of 600 kip (2,700 kN) applied horizontally and normal to the face at any point along the wall. The point load shall be applied at a height of 6 ft (1.8 m) above the top of rail for walls up to 25 ft (7.6 m) from the centreline of track, or a height of 6 ft (1.8 m) above the groundline for walls farther than 25 ft (7.6 m) from the centreline of track. This method may be applied where track speeds do not exceed 50 mph (80 km/hr) for freight or 70 mph (112 km/hr) for passenger trains; where speeds exceed these limits, Method 2 shall be used.

2.2.2 Method 2

An energy balance approach considering collision by glancing blow and single car rotation may be used to determine the design load for a wall at a distance d_{CL} from the centreline of track. The closest existing or future / proposed track is to be used. The following four cases shall be considered:

Freight Train Load Case 1 – Glancing Blow: nine cars weighing 143 tons (129,700 kg) each, impacting the wall at an angle. The angle of impact will be a function of track curvature, and for tangent track may be taken as 3.5 degrees.

Freight Train Load Case 2 – Single Care Impact: single car weighing 143 tons (129,700 kg) impacting the wall as it undergoes rotation about its centre. Where d_{CL} is greater than 28 ft (8.5 m), this load case need not be considered.

Passenger Train Load Case 3 – Glancing Blow: eight cars weighing 74 tons (67,120 kg) each impacting the wall at an angle. The angle of impact will be a function of track curvature, and for tangent track ma be taken as 3.5 degrees.

Passenger Train Load Case 4 – Single Car Impact: single care weighing 74 tons (67,120 kg) impacting the wall as it undergoes rotation about its centre. Where d_{CL} is greater than 42'-6" (13 m), this load case need not be considered.

Regardless of the method selected, the following guidelines must be followed:

- Minimum thickness of:
  - 2'-6" (0.760 m) for crash walls up to 25 ft (7.6 m) from the centreline of track.
  - 18 inches (0.45 m) for crash walls farther than 25 ft (7.6 m) from the centreline of the track.
- Minimum height of:
  - 12 feet (3.6 m) above the top of rail for crash walls less than 12 ft (3.6 m) from the centreline of track.
  - 7 ft (2.135 m) above the top of rail for crash walls between 12 ft (3.6 m) and 25 ft (7.6 m) from the centreline of track.
  - 7 ft (2.135 m) above the adjacent groundline for crash walls greater than 25 ft (7.6 m) from the centreline of track.
- The face of the crash wall shall be smooth and continuous and shall extend a minimum of 6 inches (0.15 m) beyond the face of the structure (such as a building column or bridge pier) parallel to the track.
- The design must incorporate horizontal and vertical continuity to distribute the loads from the derailed train.
- The wall must be of solid, heavy construction, and separate precast blocks or stones will not be permitted.

2.3 Metrolinx Guidelines

Any party engaged with planning and development activities for lands within 300 m of Metrolinx heavy rail (GO Transit) corridors, should consider the "Metrolinx Adjacent Development Guidelines GO Transit Heavy Rail Corridors" (Metrolinx Guidelines) document. While Metrolinx reviews applications along corridors owned and operated by Canadian National (CN) and Canadian Pacific (CP) Railways where passenger train service operates, the corridor owners are the primary commenting agencies for those lines and development-oriented feedback must be obtained directly from those entities.

In addition to considering the FCM / RAC and AECOM Guidelines, the Metrolinx Guidelines describe the design considerations that follow.

2.3.1 Setbacks

Building setback requirements are established to provide a buffer zone that contains the impacts associated with a potential train derailment, and other safety considerations. The following provides and overview of typical building setback requirements by land use:

- Residential, Commercial, Institutional, Industrial (high occupancy), Programmed Open Space: 30 m
- Industrial (low occupancy): 15 m
- Limited occupancy / passively used spaces: no setback required.

2.3.2 Anti-Trespassing Measures

The current Metrolinx minimum fencing standard is a 2.4 m high security / anti-trespassing (non-cuttable / non-climbable) fence. Noise barriers and crash barriers are acceptable substitutes for standard fencing; however, if the selected fencing is a solid surface, Metrolinx requires an anti-graffiti silicone coating be applied to the railway side of the barrier.

2.3.3 Vegetation

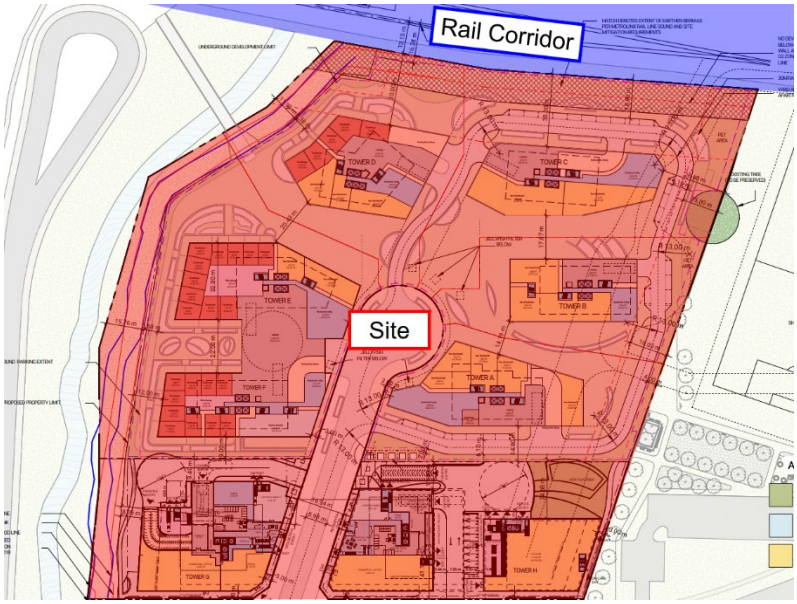
A 3.5 m low-vegetation buffer has been established as part of the Metrolinx GO Expansion program. The buffer is measured from the property line, and only low-lying vegetation are permitted in this area.

3.0 Site Description

3.1 Site Plan

The proposed development site is located immediately adjacent to Appleby GO Station and the Metrolinx-owned rail corridor, within the Oakville subdivision at Mile 27.85. The development is proposed as a large mainly residential subdivision, with eight towers ranging from 11 to 30 storeys high. The image below shows the site plan and its relationship to the rail corridor.

Figure 5: Site Plan



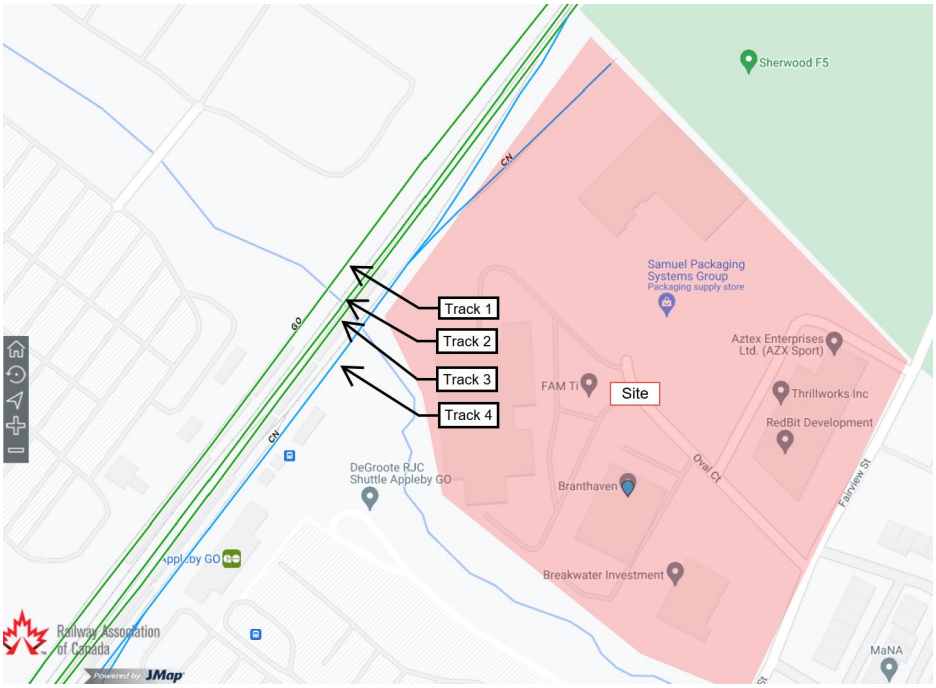
3.2 Rail Corridor

The following section provides a summary of the relationship between the site and rail corridor. Additional rail corridor information is presented in Appendix A.

Table 3: Rail Corridor Information

Category	Data / Information
Rail Corridor Subdivision	Oakville
Site Location Mile	27.85
Number of Tracks at Site Location	4 total (not including the line closest to property line which is out of service and to be removed by the developer).
Track Speed Track 1 (Freight and Passenger) Track 2 (Freight and Passenger) Track 3 (Freight and Passenger) Track 4 (Freight Only)	 Freight = 60 mph; Passenger = 95 mph. Freight = 60 mph; Passenger = 95 mph. Freight = 60 mph; Passenger = 95 mph. Freight = 60 mph.
Alignment	Straight in the immediate vicinity (in relation to the site's property line).
Elevation	The grade of the rail corridor is approximately 2.5 m higher than the grade of the site.
Other Characteristics to Note	The site is just east of the Appleby GO Station. In between the site and GO station is the Appleby Creek the deepest part of the creek is approximately 3 m below the grade of the site.

Figure 6: Track Location



3.3 Accident / Incident History

The following section assesses the rail corridor based on information published by the Transportation Safety Board (TSB). The TSB dataset has been filtered for information relevant to this site. The following data shows all accidents and incidents within the last 10 years and within 10 miles (16 km) of the proposed development site. This information will be used when performing the Risk Assessment in Section 5.0.

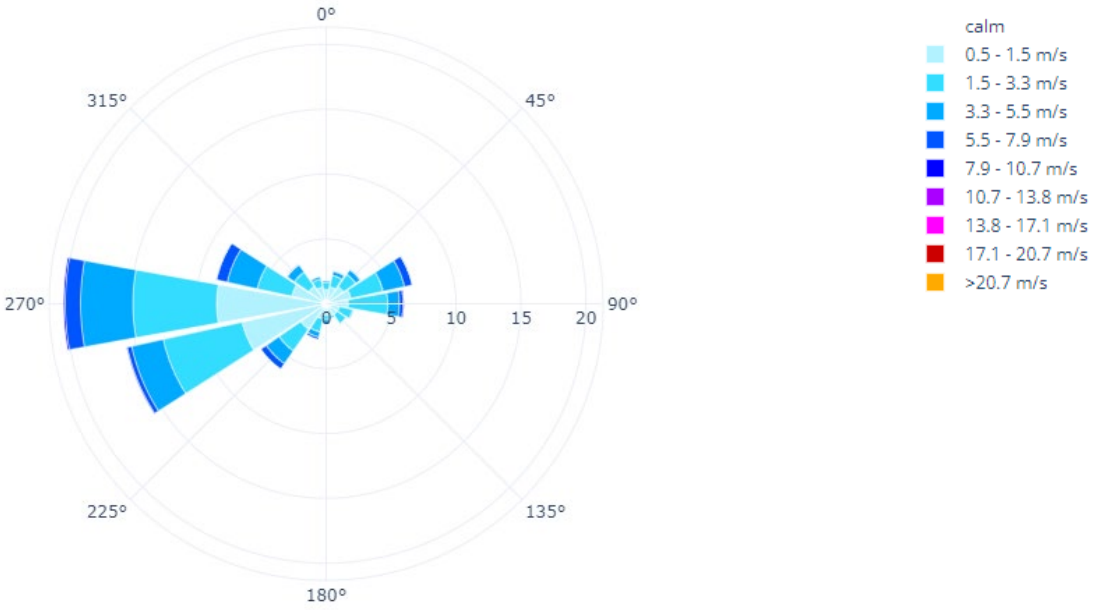
Table 4: Rail Accident / Incident History

Accident / Incident Type	Number of Accidents / Incidents
Main-Track Train Derailment	7
Main-Track Train Collision	1
Non-Main-Track Train Derailment	21
Non-Main-Track Train Derailment (No Damage)	6
Non-Main-Track Train Collision	1
Movement Exceeds Limits of Authority	13
Crossing	5
Trespasser	9
Fire On-Board Rolling Stock	1
Passenger	1

3.4 Local Winds

Based on the Wind Rose diagram for the years 2004-2021, the site location typically experiences winds from the west to east direction. The data shown in the diagram below was collected at the Hamilton Royal Botanical Gardens, approximately 16 kilometres away. This information will be used when performing the Risk Assessment in Section 5.0.

Figure 7: Wind Rose Diagram



4.0 Evaluation and Mitigation Measures

4.1 Setbacks

The setbacks to sensitive use space have been measured and are identified below. Measurements have only been made to Towers C and D since they are closest to the rail corridor. As shown in the setback measurements, all sensitive use space will be located at least 30 m from the property line shared by the rail corridor.

Table 5: Setback Measurements

Tower	Setback Description	Approximate Measurements
Tower C	Horizontal setback from building to property line	30 m
Tower D	Horizontal setback from building to property line	30 m

Figure 8: Tower Location

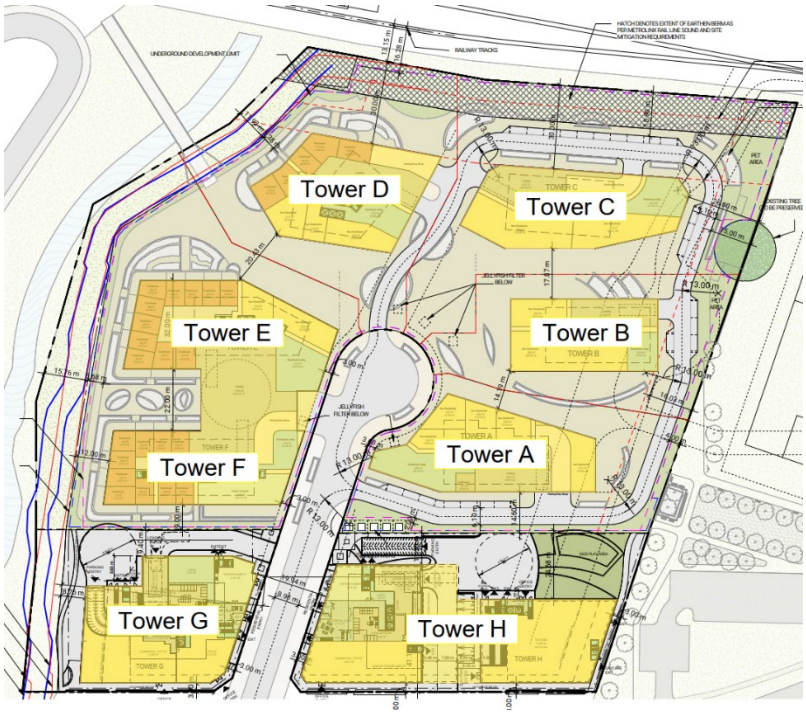


Figure 9: Plan View - Horizontal Setback Measurements

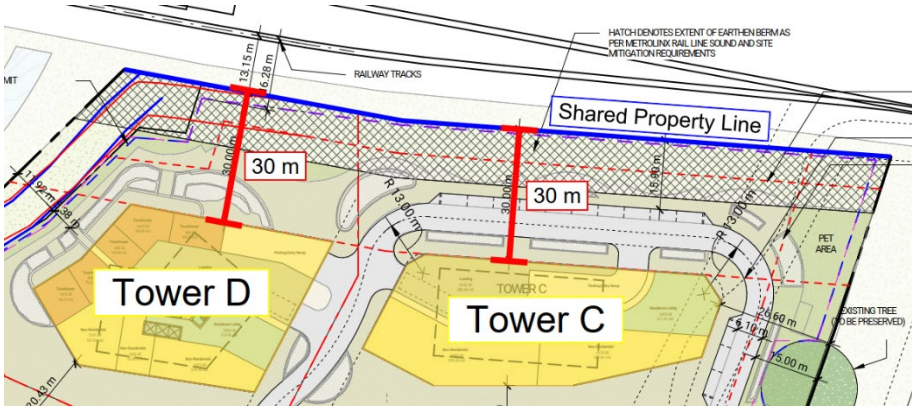
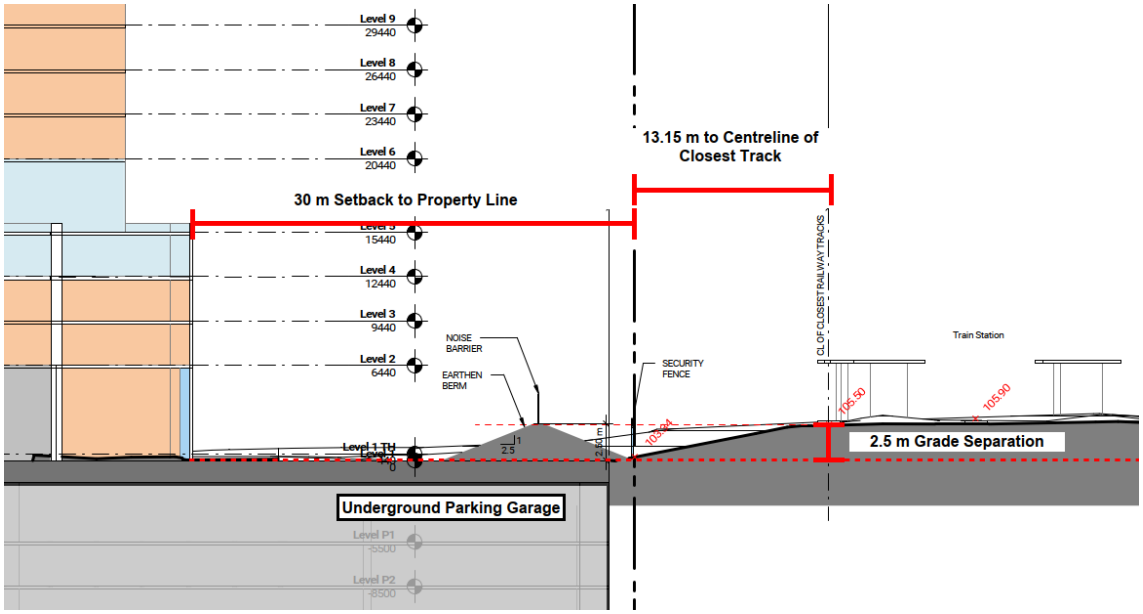


Figure 10: Section View - Setback Measurements



4.2 Derailment Calculations

The table below shows the derailment scenarios defined in the AECOM Guidelines and the maximum distance from the centreline of track where a derailed train would come to rest. The analysis included freight trains travelling at a speed of 60 mph and passenger trains travelling at a speed of 95 mph. A derailment angle of 3.5º was used, and a grade separation of 2.5 m (tracks higher than site). These calculations will be considered when performing the Risk Assessment in Section 5.0.

Table 6: Derailment Calculations

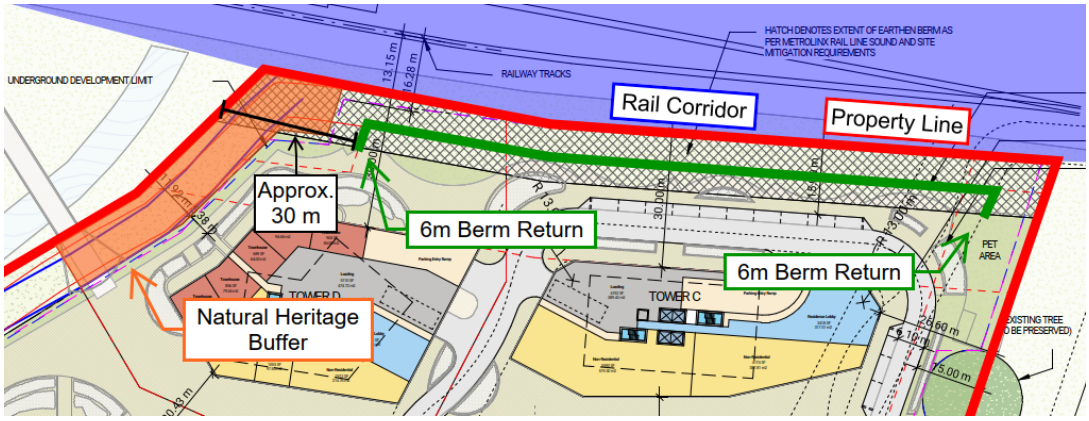
Derailment Scenario	Maximum distance from centreline of track where train comes to rest
Freight Train Glancing Blow	≤ 7.9 m
Freight Train Single Car	≤ 8.5 m
Passenger Train Glancing Blow	≤ 20.9 m
Passenger Train Single Car	≤ 13 m

4.3 Risk Mitigation

4.3.1 Berm

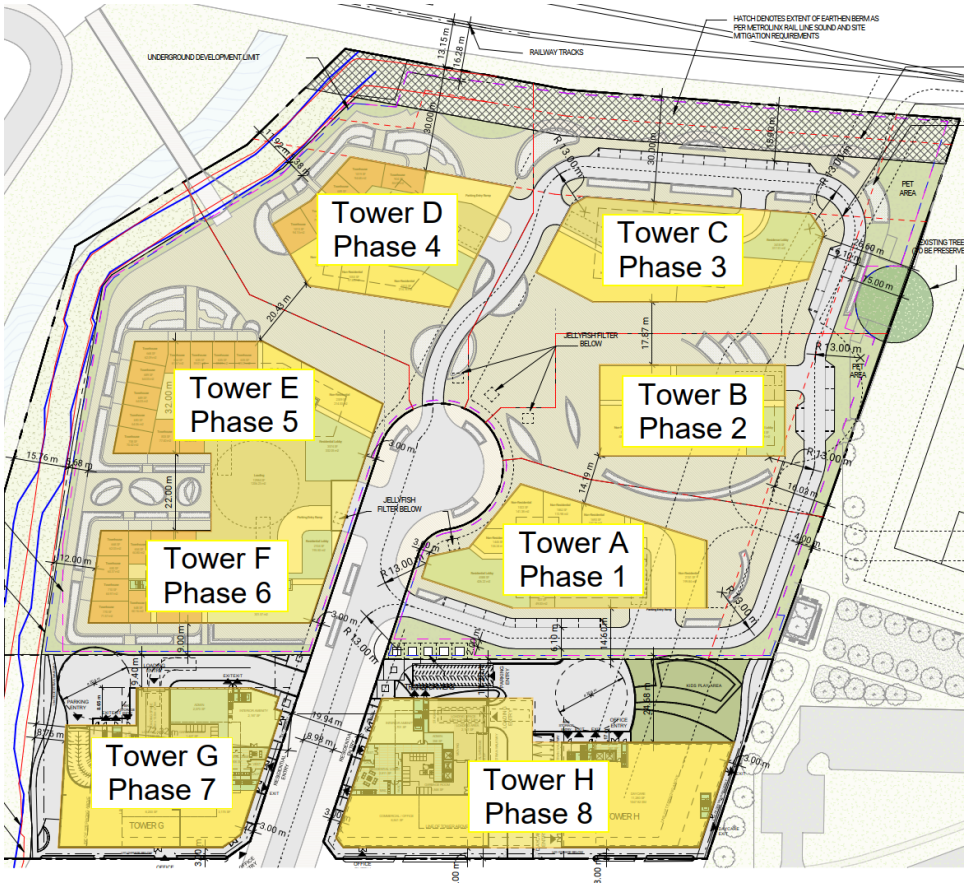
Since the proposed development has ample setback to the rail corridor, we recommend a standard 2.5 m high berm (per the FCM / RAC Guidelines) be located within the 30 m setback to mitigate the risks associated with the rail corridor. The suggested berm location and extent is shown below.

Figure 11: Berm Location and Extent



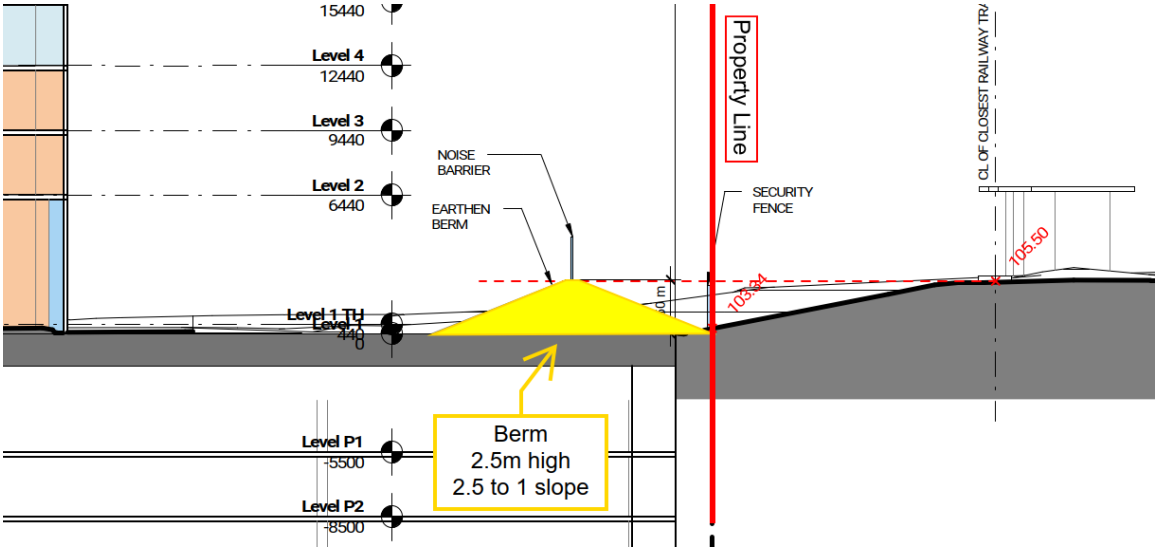
The berm is to be located within the 30 m setback and extend from the eastern property limit to approximately 28 m from the western property limit. The reason for reducing the length of the berm on the west side is to accommodate the Natural Heritage Buffer which has been established for Appleby Creek by the Local Conservation Authority. Both ends of the berm will include a 6 m extension. The proposed berm is to remain intact and maintained for the lifespan of the development. This site will be developed in phases, in alphabetic order of the Towers A to H. The berm must be constructed before the occupancy of Towers C and D; however, is not necessary for the occupancy of any other Towers, due to the ample setback distance from the rail corridor. A phasing diagram in shown in the figure that follows.

Figure 12: Phasing Plan



The highest point of the berm will be 2.5 m above the grade level taken at the property line and will have side slopes not steeper than 2.5 to 1. A section view of the berm is shown in the figure that follows.

Figure 13: Section View - Berm Location

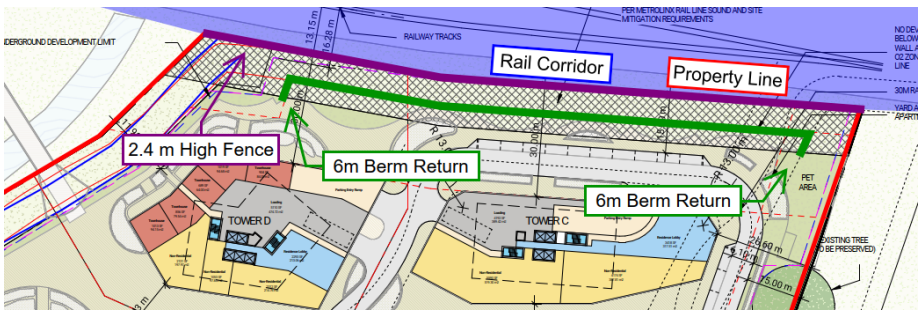


As mentioned earlier in this report, west of the site location is the Appleby Creek separating the site from the Appleby GO Station. The bottom of the creek is approximately 3 m below the proposed grade of the site. We believe the creek will provide further protection to the site in addition to the berm and extension should an eastbound train derail towards the site. If an eastbound train were to derail and travel toward the site, the train would first have to fall into the creek, which would slow or stop the derailed train. The creek would act as an inverse berm, mitigating the risk of a derailed train from entering the site. The site grading plan is provided in Appendix B.

4.3.2 Fencing

Since the site is adjacent to a Metrolinx-owned rail corridor, this development must adhere to Metrolinx's fencing requirements. A 2.4 m high security / anti-trespassing fence will be constructed along the site's property line to discourage any trespassing. The location of the fence is shown below.

Figure 14: Fence Location



5.0 Risk Assessment

Risk is a function of both frequency and severity. A Risk Assessment Matrix can be a useful tool to evaluate the magnitude of effort required to address the perceived risks. For the purposed of this report, we have reviewed the potential risks in accordance with Table 7 and Table 8 below.

Table 7: Risk Evaluation Matrix

Frequency of Event	Class	Severity of Event				
		Negligible	Marginal	Serious	Critical	Catastrophic
		1	2	3	4	5
Improbable	1	1	2	3	4	5
Remote	2	2	4	6	8	10
Occasional	3	3	6	9	12	15
Probably	4	4	8	12	16	20
Frequent	5	5	10	15	20	25

Table 8: Risk Factors

Risk (Frequency x Severity)		Risk Assessment Category	Mitigation Measures Approach
Low	1 to 5	Acceptable	No further mitigation is required.
Medium	6 to 10	Tolerable	Tolerable if risk is considered as low as reasonably possible.
High	11 to 25	Intolerable	Risk shall be eliminated / reduced.

Based on the analysis and mitigation measures proposed in this report, the following Risk Assessment has been created. The table below shows thirteen hazards associated with the rail corridor and the residual level of risk with the proposed mitigation measures. The detailed Risk Assessment, including the current risks are shown in Appendix C.

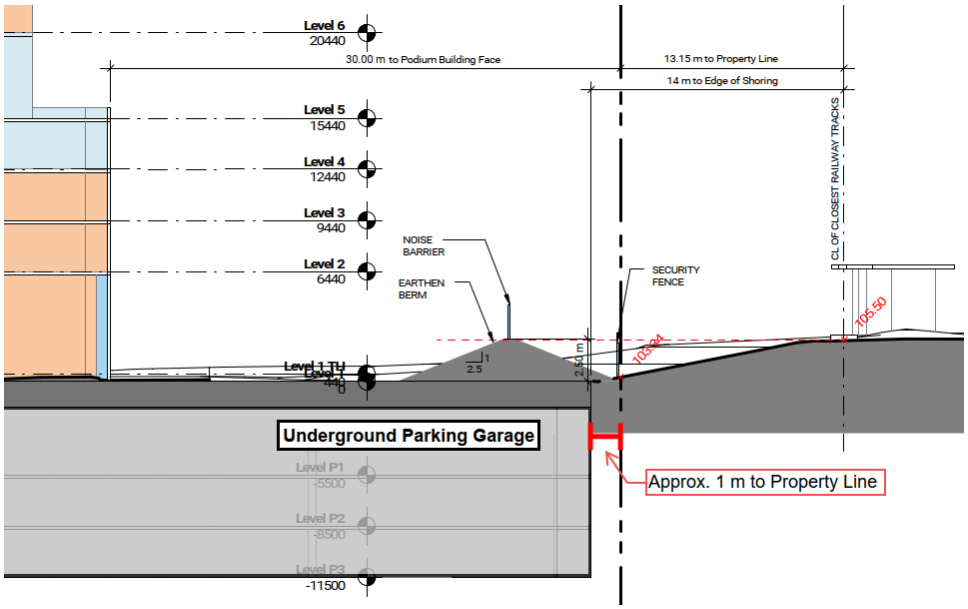
Table 9: Risk Assessment with Proposed Mitigation Measures

Hazard	Frequency	Severity	Residual Risk	Classification
Freight Train Derailment - Glancing Blow *Multi-car derailment of freight train*	2	2	4	Acceptable
Freight Train Derailment - Single Car *Single car derailment of freight train*	2	1	2	Acceptable
Freight Train Derailment - Above Speed Limit *Derailment of freight train travelling faster than the posted speed limit*	2	2	4	Acceptable
Passenger Train Derailment - Glancing Blow *Multi-car derailment of passenger train*	2	2	4	Acceptable
Passenger Train Derailment - Single Car *Single car derailment of passenger train*	2	1	2	Acceptable
Passenger Train Derailment - Above Speed Limit *Derailment of passenger train travelling faster than the posted speed limit*	2	2	4	Acceptable
Freight Train Derailment - Dangerous Goods *Derailment of freight train carrying dangerous goods*	1	3	3	Acceptable
Airborne Debris - Freight Train *Part of freight train becomes projectile during derailment*	1	3	3	Acceptable
Groundborne Debris - Freight Train *Part of freight train becomes rolling or sliding debris on ground*	1	3	3	Acceptable
Airborne Debris - Passenger Train *Part of passenger train becomes projectile during derailment*	1	3	3	Acceptable
Groundborne Debris - Passenger Train *Part of passenger train becomes rolling or sliding debris on ground*	1	3	3	Acceptable
Smoke / Exhaust *Ingestion of smoke or exhaust into development*	2	2	4	Acceptable
Trespassing *Unauthorized person enters rail corridor*	2	4	8	Tolerable

6.0 Constructability

The proposed development includes an underground parking garage for Tower C which is approximately setback 1 m from the shared property line. The underground parking garage in relation to the property line is shown below. A constructability report will be developed by Branthaven in future stages of the project to be able to detail and mitigate the risks associated with construction and shoring for the parking garage. Constructability is not covered in this report.

Figure 15: Location of Parking Garage



7.0 Conclusion

This Rail Safety Report has been developed to review the site-specific concerns in relation to developing adjacent to a rail corridor. The risk mitigation measures include:

- A 30 m setback from the property line to any sensitive-use space.
- A 2.5 m high earthen berm constructed within the 30 m setback area, with 6 m extensions on each end. The berm will be designed to satisfy the FCM / RAC Guidelines.
- The Appleby Creek west of the site will provide additional protection.
- A 2.4 m high anti-trespassing fence located along the shared property line. The anti-trespassing fence will follow the requirements set by the Metrolinx Guidelines.

The risks associated with train derailment have been assessed for the proposed development at 720, 735, 740 Oval Court, and 5135, 5155 Fairview Street. This assessment follows all applicable guidelines and proposes an appropriate solution for risk mitigation.

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Appendix A

Rail Corridor Details

RTC: CH8T1
*5-460#

Appleby
27.9

5111 Fairview St,
Burlington ON
L7L 4W8

No. 1 Track
No. 2 Track
No. 3 Track

N
W
E
S

Dominion Nickel
Alloy Ltd.

Harvester St.

NOTE: PSO **No. 1 Track**
Psgr Trains = 80 MPH between
Mile 22.2 and Mile 36.4

28.54
28.50
28.48
OC88
775'
Gate

28.25

GO
Station Parking

27.95
27.88
Psgr.
Tunnel

NOTE: PSO **No. 1 Track**
Psgr Trains = 80 MPH between
Mile 22.2 and Mile 36.4

27.45

287T1
286T1
287T2
286T2
287T3
286T3

PSO T1 = 80 MPH Psgr.
PSO T1 = 80 MPH Psgr.
PSO T1 = 80 MPH Psgr.

TUNNEL
R107 Fence

28.76
28.64
OC92
955'
Plibrico

Culvert
Culvert
(Appleby
Creek West)

Henderson Paper Products
(43655) OC81 3575'

OC82-1200'

TUNNEL
TUNNEL

27.83
(TEL 2783)

Approx. Site
Location

Mile 27.85

Appleby
Line

C.I.P.
St. Laurent
Paperboard Inc.

GO
Station Parking

Psgr.
Tunnel

Fairview St.

Sheldon
Creek
35 ft.

CURVE DATA

L
R

R2-27.30 - 28.85
Oakville Sub.
15\08\26dmm

28.85 28.75 28.50 28.25 28 27.75 27.50 27.30

95 95
60 60

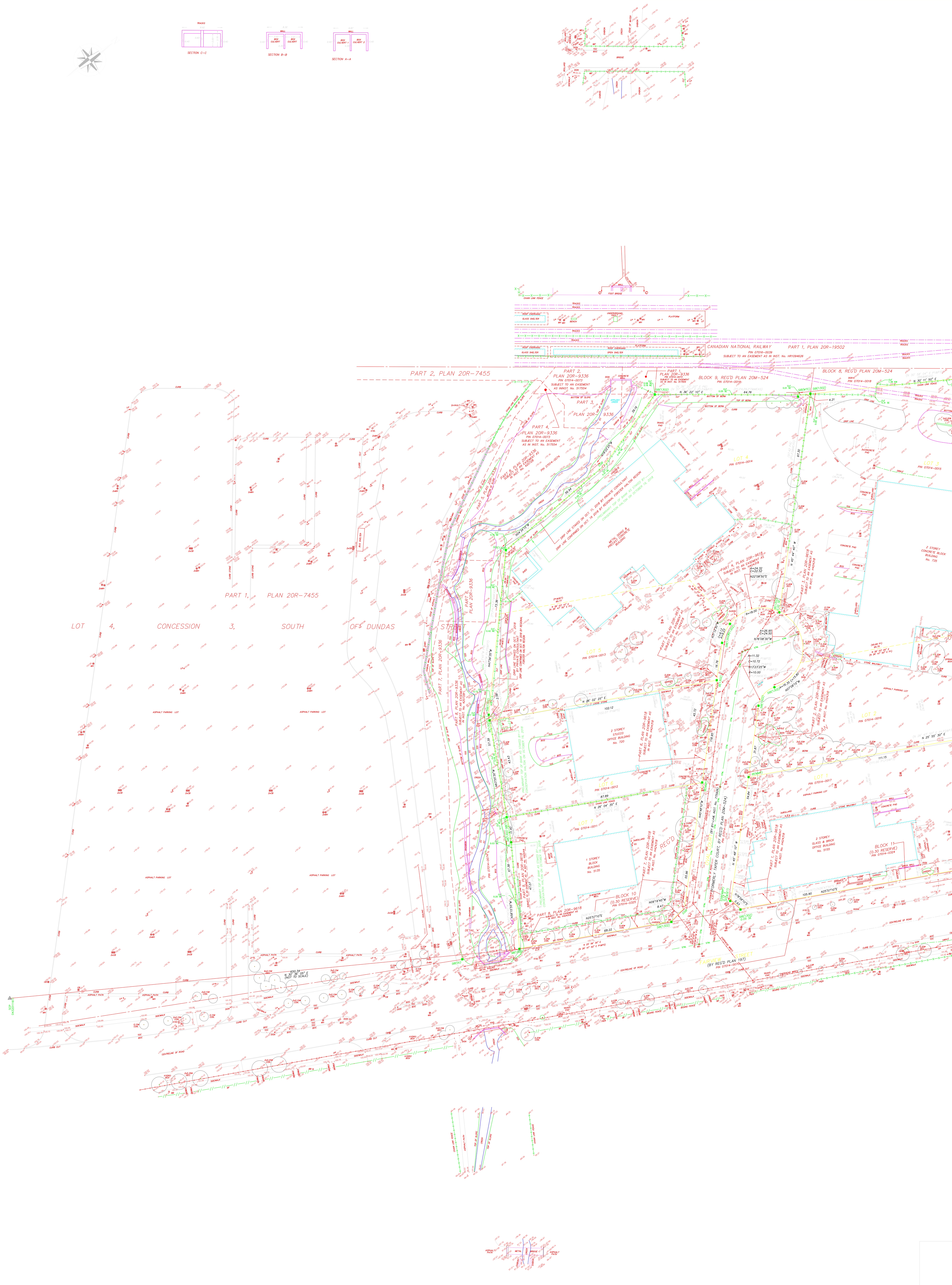
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Appendix B

Grading Plan



PLAN OF SURVEY AND TOPOGRAPHY OF
LOTS 1 TO 7
REGISTERED PLAN 20M–524
CITY OF BURLINGTON
REGIONAL MUNICIPALITY OF HALTON

0 5 10 20 30 40 m

SCALE 1 : 400

J. H. Gelbloom Surveying Limited
Ontario Land Surveyor 2 0 1 8

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REGISTERED EASEMENTS AND/OR RIGHT–OF–WAY
Subject to an Easement over Parts 1 to 9, Plan 20R–9618 as in Inst. No. H424318

NOTABLES
Note the Location of the Fences around the Subject Property.

LEGEND

■	Survey Monument Found
□	Survey Monument Set
SIB	Standard Iron Bar
SSIB	Short Standard Iron Bar
IB	Iron Bar
1302	A. Skranda Surveying Ltd., O.L.S.
(OU)	Origin Unknown
MTC	Ministry of Transportation & Communications
BURL	City of Burlington
P1	Registered Plan 20M–524
P2	Plan of Survey by Mackay, Mackay & Peters Ltd., O.L.S., dated June 7, 2017
P3	Plan of Survey by A. Skranda Surveying Ltd., O.L.S., dated June 17, 1998
P4	Plan of Survey by Mackay, Mackay & Peters Ltd., O.L.S., dated August 27, 2008
P5	Plan of Survey by Mackay, Mackay & Peters Ltd., O.L.S., dated July 15, 2005
P6	Plan 20R–19502
P7	Plan 20R–9336
CLF	Chain Link Fence
MH	Maintenance Hole
CB	Catch Basin
FF	Finished Floor
WV	Water Valve
BF	Board Fence
UP	Utility Pole
DEC.	Deciduous
CON.	Coniferous
HYD.	Hydrant
LP	Light Standard
BB	Bell Box
GW	Guy Wire
TOS	Top of Slope
BOS	Bottom of Slope
TOC	Top of Curb
BOC	Bottom of Curb
N	Denotes North
S	Denotes South
E	Denotes East
W	Denotes West
GS	Gas Service
INV.	Invert

– Short Standard Iron Bars were used instead of Standard Iron Bars due to the proximity of below grade services
—STM— Storm Locate

BENCHMARK
Elevations are Referred to the City of Burlington Benchmark No. 1090, ha an Elevation of 98.243 m.

NOTE
This REPORT can be updated by this office, however NO ADDITIONAL PRINTS of this ORIGINAL REPORT will be issued, subsequent to the DATE OF CERTIFICATION.
All building ties are perpendicular to property lines unless otherwise n

This REPORT was prepared for Branthaven Development Corp and the undersigned accepts no responsibility for use by other parties.

NOTE
Distances shown on this plan are in metres and can be converted feet by dividing by 0.3048.

BEARING NOTE
BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS LISTED IN THE FOLLOWING TABLE, AND ARE REFERENCED TO THE CENTRAL MERIDIAN 81° WEST LONGITUDE, ZONE 17, ONTARIO COORDINATE SYSTEM (6° UTM), NAD83 (ORIG).

SPECIFIED CONTROL POINTS: UTM ZONE 17, NAD83 (ORIG).
COORDINATES TO URBAN ACCURACY PER SEC. 14(2) OF O.REG. 216/10

POINT ID	NORTHING	EASTING
00819830473	4 805 184.760	600 868.174
04320111611	4 803 032.598	600 288.671

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE–ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN.

Distances shown on this plan are Ground Distances and can be conve to Grid Distances by Multiplying the Combined Scale Factor of 0.9997

SURVEYOR'S CERTIFICATE
I certify that:
1: This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act, and the Regulations made under them.
2: The survey was completed on the 29th day of November, 2018.

Date

Andrew Musil, O.L.S.

Party Chief:	Drawn By:	Checked By:	Project:
J.W.	M.K.	A.M.	18–150

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Appendix C

Risk Assessment

	Existing Conditions				Proposed Mitigating Measures					
Hazard	**Frequency**	**Severity**	**Residual Risk**	**Classification**	**Frequency**	**Severity**	**Residual Risk**	**Classification**	**Change in Risk**	**Comments**
Freight Train Derailment - Glancing Blow *Multi-car derailment of freight train*	2	5	10	Tolerable	2	2	4	Acceptable	-6	Berm and setback mitigates the risk associated with derailment.
Freight Train Derailment - Single Car *Single car derailment of freight train*	2	1	2	Acceptable	2	1	2	Acceptable	0	Berm and setback mitigates the risk associated with derailment.
Freight Train Derailment - Above Speed Limit *Derailment of freight train travelling faster than the posted speed limit*	2	5	10	Tolerable	2	2	4	Acceptable	-6	Berm and setback mitigates the risk associated with derailment.
Passenger Train Derailment - Glancing Blow *Multi-car derailment of passenger train*	2	5	10	Tolerable	2	2	4	Acceptable	-6	Berm and setback mitigates the risk associated with derailment.
Passenger Train Derailment - Single Car *Single car derailment of passenger train*	2	1	2	Acceptable	2	1	2	Acceptable	0	Berm and setback mitigates the risk associated with derailment.
Passenger Train Derailment - Above Speed Limit *Derailment of passenger train travelling faster than the posted speed limit*	2	5	10	Tolerable	2	2	4	Acceptable	-6	Berm and setback mitigates the risk associated with derailment.
Freight Train Derailment - Dangerous Goods *Derailment of freight train carrying dangerous goods*	1	5	5	Acceptable	1	3	3	Acceptable	-2	Berm and setback mitigates the risk of train derailment with dangerous goods.
Airborne Debris - Freight Train *Part of freight train becomes projectile during derailment*	1	5	5	Acceptable	1	3	3	Acceptable	-2	Berm and setback mitigates the risk of debris.
Groundborne Debris - Freight Train *Part of freight train becomes rolling or sliding debris on ground*	1	5	5	Acceptable	1	3	3	Acceptable	-2	Berm and setback mitigates the risk of debris.
Airborne Debris - Passenger Train *Part of passenger train becomes projectile during derailment*	1	5	5	Acceptable	1	3	3	Acceptable	-2	Berm and setback mitigates the risk of debris.
Groundborne Debris - Passenger Train *Part of passenger train becomes rolling or sliding debris on ground*	1	5	5	Acceptable	1	3	3	Acceptable	-2	Berm and setback mitigates the risk of debris.
Smoke / Exhaust *Ingestion of smoke or exhaust into development*	2	2	4	Acceptable	2	2	4	Acceptable	0	We recommend no air intakes on the side of the northwestern side of the development.
Trespassing *Unauthorized person enters rail corridor*	3	4	12	Intolerable	2	4	8	Tolerable	-4	Anti-trespassing fence will prevent trespassing onto rail corridor.

Frequency Rating	**Description**
1. Improbable	Extremely unlikely to occur
2. Remote	Unlikely to occur in rail lifecycle
3. Occasional	Likley to occur several times in rail lifecycle
4. Probable	Expected to occur
5. Frequent	Expected to occur continuous

Severity Rating	**Consequence to Person/Public**	**Consequence to Environment**
1. Negligible	Non-reportable injury	None
2. Marginal	Single minor injury	Reversible minor environmental impact
3. Serious	Single permanent partial or tempory total disabling injury; multiple minor injury	Reversible moderate environmental impact
4. Critical	Single fatality; Single permanent total disability; Multiple permanent partial or temporay total disabling injury	Reversible significant environmental impact
5. Catastrophic	Multiple fatalities; Multiple permanent total disabling injuries	Irreversible significant environmental impact

R.J. Burnside & Associates Limited