MOREY ASSOCIATES LTD.
CONSULTING ENGINEERS

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May 7, 2021
Updated April 23, 2025

File: 021311

Bergeron Construction 2010
287 St-Thomas Road
Vars, Ontario
K0A 3H0

Attention: Carole Bergeron

RE: GLOBAL STABILITY ASSESSMENT
PROPOSED UNDERGROUND PARKING RAMP RETAINING WALLS
12 UNIT APARTMENT BUILDING
5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD, CITY OF OTTAWA, ONTARIO

Dear Carole:

This letter provides the results of a global stability assessment carried out for the proposed underground parking ramp retaining walls at the above noted proposed two storey, 12 unit apartment building site. The purpose of the assessment was to demonstrate that the proposed retaining walls at the site, extending up to a conservatively rounded up maximum height of some 2.1 metres, will have a factor of safety against global instability/failure of at least 1.5 for static conditions and at least 1.1 for seismic conditions.

The above mentioned proposed retaining walls and the finished grades for the subject site are indicated on the grading plan drawing prepared by and provided to us by email by Kollaard Associates Inc. (KAI) and is titled “Proposed Grading Plan”, for project “Proposed 12 Unit Apartment Building”, drawing No. 220863-GR, revision 1 dated Dec 21, 2023. That grading plan drawing should be read in conjunction with this letter.

PROPOSED DEVELOPMENT AND SITE BACKGROUND

For discussion purposes Rockdale Road is considered to exist at the east side of the subject site (see Key Plan, Figure 1). The site consists of an irregular shaped parcel of land some 1.8 hectares in plan area located on the west side of Rockdale Road, Vars, in the City of Ottawa, Ontario. It is understood that plans are being prepared to construct a two storey, 12 unit apartment building with underground parking at the site. The above mentioned KAI grading plan drawing indicates proposed retaining walls on either side (and extending out beyond) of the proposed driveway ramp that leads to the underground basement parking area within the proposed building and that the proposed retaining walls are aligned to follow the plan area shape of the driveway ramp. Based on the proposed finished grades and the retaining wall design details shown on the above mentioned KAI grading plan drawing the highest top of retaining walls elevation is indicated to be 79.72 metres and the lowest proposed finished grade elevation at the bottom of the retaining walls is indicated to be 77.71 metres, resulting in a maximum retained height of 2.01 metres. The KAI grading plan drawing further indicates that the proposed finished grades back of the retaining walls is relatively flat and, in general, do not significantly increase in elevation relative to the proposed top of retaining wall elevations.

For the purposes of this letter and for a conservative approach, the maximum retained height of the proposed retaining walls is considered to be 2.1 metres.

The results of previous test pits put down by Morey Associates Ltd. at the site in close proximity to the proposed retaining walls indicate that the area of the proposed retaining walls is underlain by a layer of fine to medium sand with a trace to some silt followed by a deposit of silty sand glacial till. A review of several available MOE Water Well Records for wells in the area of the site, obtained from the Province of Ontario map-based search website, indicates that between some 3 to 5 metres of overburden followed by shale and limestone bedrock was encountered by the well drillers.

PROPOSED RETAINING WALLS GLOBAL STABILITY ANALYSES

Computer stability analyses were carried out for the above mentioned 2.1 metre high retaining wall using GeoStudio 2012 Slope/W software package produced by GEO-SLOPE International Ltd., in order to determine a factor of safety against global failure for the retaining walls. The slope/retaining wall section used in the analyses was chosen by Morey Associates Ltd. to represent the highest section of proposed retaining wall (as described above). The above mentioned slope/retaining wall section used in the analyses is considered to represent the portion of the proposed retaining walls with the highest potential for global instability.

The soil and bedrock conditions used in the analyses were based on the above described subsurface information and the proposed finished grades/grade raises and structure locations indicated on the above mentioned KAI grading plan drawing. Based on our interpretation of the KAI grading plan drawing no surcharge loads are considered likely adjacent to the top of the highest portions of the proposed retaining walls. However, for a conservative approach a live load surcharge (i.e.: vehicle load) back of the top of the retaining walls of 4.8 kPa (~100 psf) has been considered in the analyses.

The stability analyses parameters used for the retaining wall backfill material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 32 degrees
Unit Weight, γ = 22.0 kilonewtons per cubic metre

The stability analyses parameters used for the native fine to medium sand with a trace to some silt material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 30 degrees
Unit Weight, γ = 18.0 kilonewtons per cubic metre

The stability analyses parameters used for the native silty sand glacial till material are:

Cohesion, c' = 0.5 kilopascals
Internal Friction Angle, ϕ' = 35 degrees
Unit Weight, γ = 20.5 kilonewtons per cubic metre

The stability analyses parameters used for the bedrock material are:

Cohesion, c' = 550 kilopascals
Internal Friction Angle, ϕ' = 24 degrees
Unit Weight, γ = 26.0 kilonewtons per cubic metre

The above parameters used in the analyses are based on experience with similar soil types in the Ottawa and surrounding area as well as information published by the Ministry of Natural Resources (MNR) and City of Ottawa relating to the subsurface conditions described above. It is pointed out that the above indicated bedrock parameters represent what is considered a very poor quality rock mass of disintegrated, poorly interlocked, heavily broken rock with a mixture of angular and rounded rock pieces. These bedrock parameters have been selected as a conservative approach. Further, for a conservative approach, the soil was assumed to be nearly fully saturated with the groundwater level within 0.1 to 0.3 metres from the ground surface.

Global stability analyses for the subject retaining wall were carried out for both static conditions and pseudo-static (seismic) conditions. Based on the subsurface conditions at the site, the subject site setting and proposed height of the subject retaining wall, it is considered that a pseudo-static analysis is adequate for the purposes of this present global stability assessment. For a conservation approach a conventional pseudo-static analysis was carried out as opposed to a two stage pseudo-static analysis since typically a two stage pseudo-static analysis will result in a higher factor of safety.

The peak (horizontal) ground acceleration (PGA) for the subject site was obtained from the 2015 National Building Code Seismic Hazard calculation (website), see Appendix A. The PGA for the subject site is indicated to be about 0.35 for a 2 percent probability of exceedance in 50 years. A seismic coefficient, k, was used for the above mentioned pseudo-static analysis, where k is equal to 0.5PGA.

For the purposes of assessing the results of the computer stability analyses for static conditions, a factor of safety against global failure of 1.5 or greater is considered to indicate long term stability. For the purposes of assessing the results of the computer stability analyses for pseudo-static conditions, a factor of safety against global failure of 1.1 or greater is considered to indicate adequate stability.

The results of the global stability analyses (see Appendix A) indicate that the calculated factors of safety against global failure for the maximum 2.1 metre high retaining walls is 3.2 and 1.6 for static conditions and pseudo-static (seismic) conditions, respectively. The above factors of safety against global failure for static and seismic conditions are above of 1.5 and 1.1, respectively, and are considered to indicate adequate long term stability against global failure of the proposed retaining walls.

CONCLUSION

Based on the above calculated factors of safety against global instability/failure, it is considered that the above mentioned proposed maximum 2.1 metre high retaining walls are in no danger of a global instability/failure.

We trust the above information is sufficient for your present purposes. If you have any questions concerning this letter, please do not hesitate to contact our office.

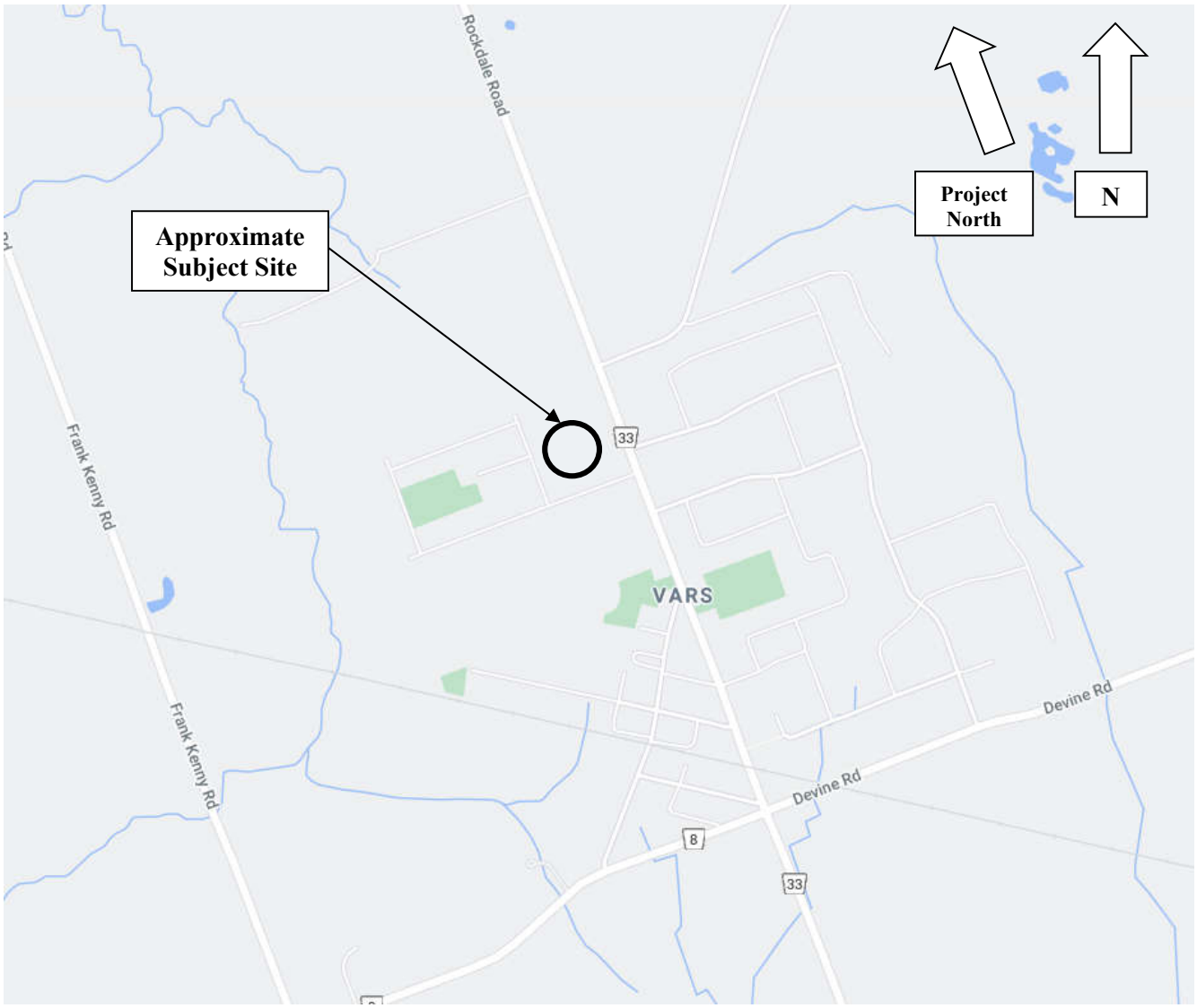
Yours truly,
Morey Associates Ltd.

D. G. Morey, P.Eng.
Principal | Consulting Engineer

Attachments: Figure 1
Appendices A and B

File: 021311

KEY PLAN	FIGURE 1



NOT TO SCALE

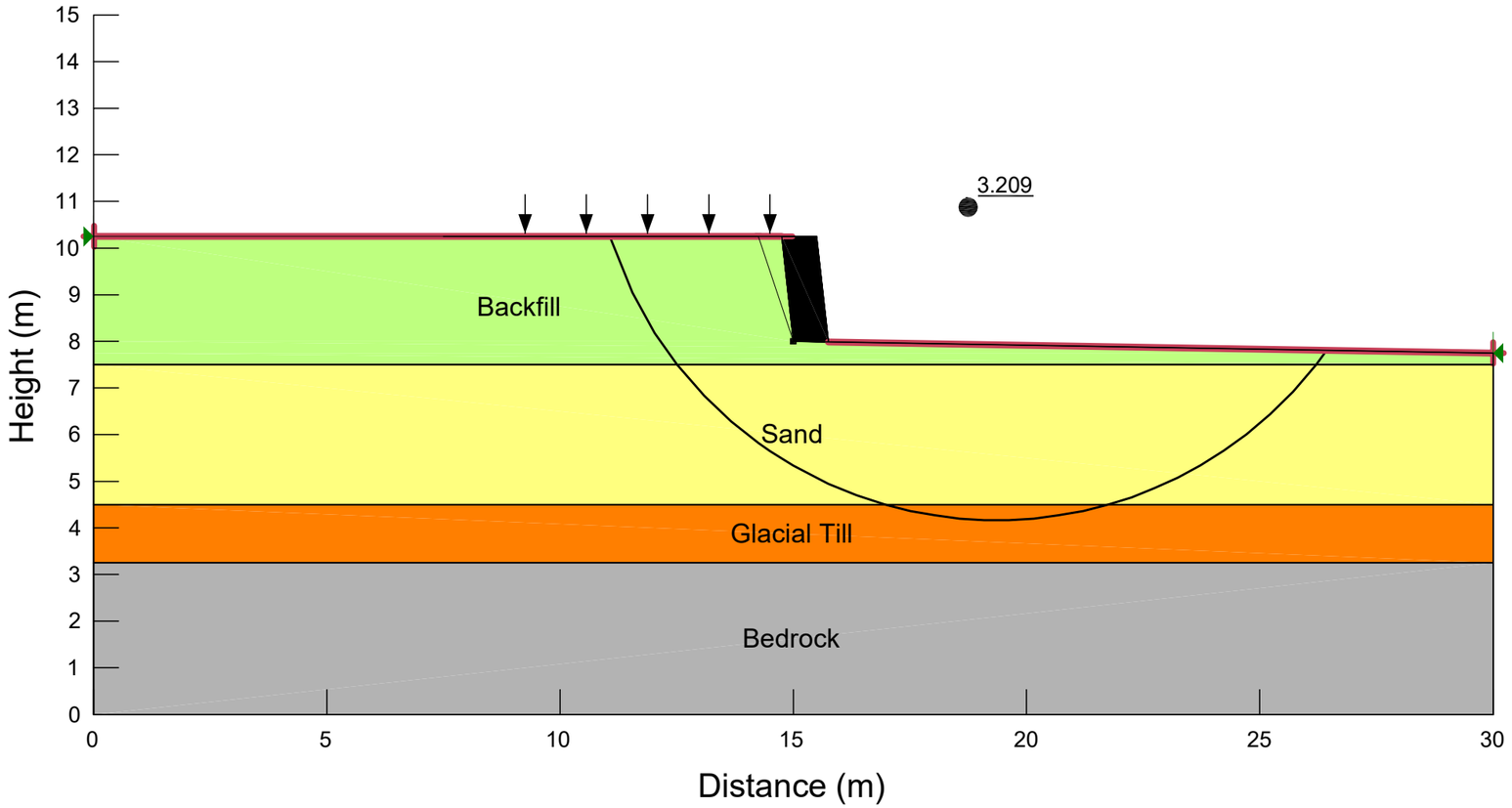
MOREY ASSOCIATES LTD.
CONSULTING ENGINEERS

Project No. 021311

Date May 2021

APPENDIX A

COMPUTER GLOBAL STABILITY ANALYSES RESULTS
STATIC AND PSEUDO-STATIC CONDITIONS



ANALYSIS NAME

STATIC CONDITIONS
2.1m HIGH RETAINING WALL

LOCATION

5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD
CITY OF OTTAWA, ONTARIO

PROJECT

SLOPE STABILITY ANALYSIS
PROPOSED RETAINING WALL

CLIENT

BERGERON CONSTRUCTION 2010

DATE	DRAWING No.	DRAWN BY	SCALE	FILE NO.
May 2021	1 of 2	DGM	As Shown	021311

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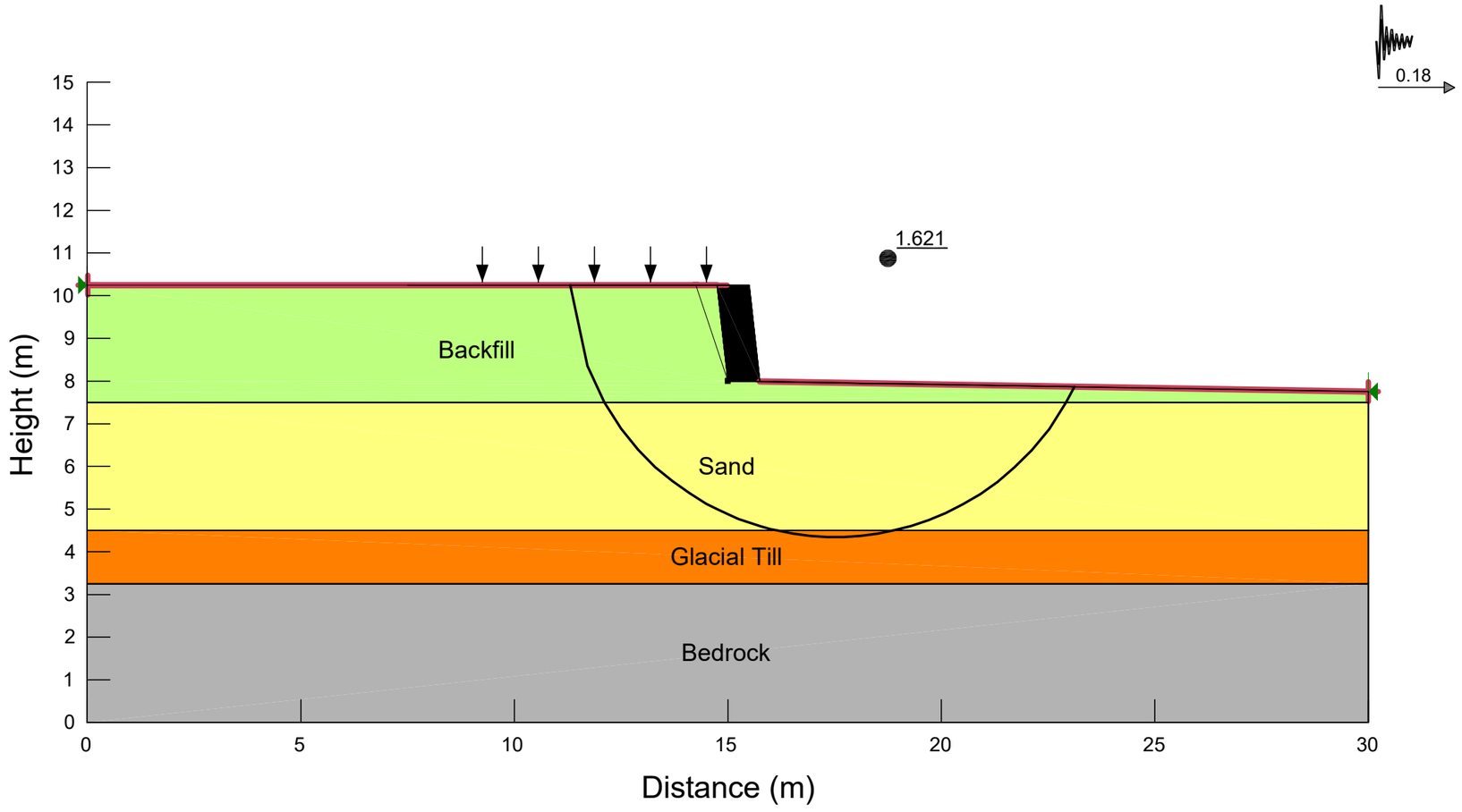

ANALYSIS NAME

PSEUDO-STATIC
2.1m HIGH RETAINING WALL

LOCATION

5574 ROCKDALE ROAD, VARS
CUMBERLAND WARD
CITY OF OTTAWA, ONTARIO

PROJECT

SLOPE STABILITY ANALYSIS
PROPOSED RETAINING WALLS

CLIENT

BERGERON CONSTRUCTION 2010

DATE	DRAWING No.	DRAWN BY	SCALE	FILE NO.
May 2021	2 of 2	DGM	As shown	021311

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APPENDIX B

2015 NATIONAL BUILDING CODE SEISMIC HAZARD CALCULATION

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.361N 75.355W

2025-04-24 18:05 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.579	0.313	0.182	0.050
Sa (0.1)	0.664	0.371	0.224	0.068
Sa (0.2)	0.544	0.308	0.189	0.061
Sa (0.3)	0.407	0.232	0.143	0.047
Sa (0.5)	0.282	0.160	0.100	0.033
Sa (1.0)	0.135	0.077	0.049	0.016
Sa (2.0)	0.062	0.035	0.022	0.006
Sa (5.0)	0.016	0.009	0.005	0.001
Sa (10.0)	0.006	0.003	0.002	0.001
PGA (g)	0.348	0.199	0.121	0.036
PGV (m/s)	0.233	0.128	0.077	0.023

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information