TETRA TECH

350 Indiana Street, Suite 500
Golden, CO 80401
Tel (303) 217-5700 **Fax** (303) 217-5705
www.tetratech.com

Technical Memorandum

To:	File	**From:**	Diana Cook, Justin Knudsen
Company:	Victoria Gold Corp.	**Date:**	May 3, 2011
Re:	Dublin Gulch – Seismic Peak Ground Accelerations for Design	**Project #:**	114-201045x
CC:	Troy Meyer		

EXECUTIVE SUMMARY

This document provides a summary of the seismic hazard analysis performed for Victoria Gold Corporation's Dublin Gulch property. This seismic hazard analysis includes results from both deterministic and probabilistic methods. Deterministic analyses were performed using five equally weighted attenuation relationships to evaluate seismic hazards for the Dublin Gulch Property resulting from a maximum credible earthquake (MCE). A MCE, by definition, has no specific recurrence interval and is the largest reasonably conceivable earthquake that appears possible along a recognized fault or within a geographically defined tectonic province, under the presently known or presumed tectonic framework. Theoretically, no ground motion should occur which exceeds that of the MCE. A deterministic analysis therefore allows for a more conservative approach to the determination of risks associated with identified seismic hazards. Data published by Natural Resources Canada (NRCAN) were used in the probabilistic analysis to estimate the probability of exceedance of peak ground accelerations (PGA) at the site for various return periods.

Considering the level of conservatism inherent in a deterministic analysis, and the added conservatism discussed in Section 3.1.5, Tetra Tech recommends a design PGA of 0.27g for high hazard facilities, based on an MCE of moment magnitude 7.0 generated in the Ogilvie Mountains area. This PGA is anticipated to reflect the current tectonic environment with greater accuracy than a low probability value based on the very short historic seismic record available, such as a 5,000-year event would produce. For facilities requiring a PGA based on a return period of 1,000 years or less, the mean National Building Code of Canada (NBCC) values from Table 3 may be used.

1.0 Introduction

This document provides a summary of a seismic hazard analysis for the Eagle Gold Project at Dublin Gulch, located approximately 85 km by road north of Mayo, and 20km northwest of Elsa in the Yukon Territory of Canada. For the purposes of this seismic hazard study, the site is assumed to be centered at approximately 64.0° N Latitude and 135.9° W Longitude. Access to the site is by way of

Silver Trail Highway from Mayo, and South McQuesten River Road, which connects to the highway approximately 39 km northeast of Mayo. The purpose of this document is to provide ground motions that may be used in design procedures for facilities on the mine site. This updated seismic hazard analysis includes results from both deterministic and probabilistic analyses.

2.0 Tectonic Setting and Seismicity

Regionally, the site is contained within the northern Canadian Cordillera, which encompasses an area stretching between approximately Latitudes 55 to 70 N, and Longitudes 110 to 150 W. More specifically, the site is located in the Selwyn Basin and lies within the Tombstone Thrust and Robert Service Thrust fault zones (Figure 1), where more than 100 km of structural overlap was accommodated during the Cretaceous (Mair et al., 2006). Indeed, much of the mineralization present in the Selwyn Basin is related to collision-related deformation of the Yukon Tanana terrane onto the ancient continental margin before 100 Ma, followed by the intrusion of granitic magma around 93 Ma. This new assembly experienced lateral displacement along the Tintina fault (located south of the site) during the Late Cretaceous (post-85 Ma). During recent geologic history, however, the Dublin Gulch area has generally been categorized as an area of low seismicity (Colpron, 2011), compared to other areas in Yukon Territory. These more seismically active areas include, but are not limited to, the Wernecke and Mackenzie Mountains to the east-northeast, the Ogilvie Mountains to the west-northwest, the Richardson Mountains to the north, and the Denali Fault zone to the southwest.

According to Natural Resources Canada (NRCAN), the northern Rocky Mountains region, which runs along the border of the Yukon and Northwestern Territory before extending westward, is one of the most seismically active areas in Canada. Earthquakes along the mountain front north and east of the Ogilvie, Wernecke, and Mackenzie Mountains are related to the northeastward push by the Yakutat microplate against the St. Elias Mountains in the south.

The largest earthquake recorded in the northern Rocky Mountains area was a magnitude 6.9 earthquake that occurred on December 23, 1985 in the Mackenzie Mountains of the Northwest Territories, at a distance of approximately 622 km from the site, according to the available records. Other 6-plus magnitude earthquakes have occurred in the Richardson Mountains of the Yukon Territory and include: M=6.2 in May, 1940; M=6.5 in June, 1940, and M=6.6 in March, 1955.)

3.0 Seismic Hazard Analysis

Seismic hazard analyses are typically conducted using one of two readily available methods: (1) deterministic analysis or (2) probabilistic analysis. Evaluating potential ground motions from a maximum credible earthquake (MCE), which is by definition the largest reasonably conceivable earthquake possible along a known fault or seismogenic source zone, is a deterministic method. Probabilistic analyses are commonly used where the earthquakes occur in conjunction with known structures with known activity rates and in areas of diffuse historic seismicity where large regions of similar historic seismicity can be assigned characteristic ground motions based on the rate of historic earthquakes. This type of analysis results in probabilities of occurrence or non-exceedance versus time or return period. Both approaches were used in this study.

3.1 Deterministic Analysis

There are four key elements to performing deterministic seismic hazard analyses (DSHA) for use in project design, namely: (1) determination of seismogenic structures or seismogenic source zones; (2) definition of the associated characteristic earthquake magnitudes; (3) the distances between the project site and the seismogenic sources, and; (4) selection of an appropriate attenuation function to represent the decay of earthquake ground motions with distance and estimate the ground motions at the project site. The following sections outline these key elements and discuss the assumptions and methodologies employed in determining each of these elements for the current study.

3.1.1 Earthquake Database

The deterministic seismic hazard analysis conducted for this study included a review of earthquake records from the Canadian National Earthquake Database (NEDB). A search of the NEDB was performed for a 150 km radius around a central Latitude and Longitude of 64.0^{o} N and 135.9^{o} W for Dublin Gulch (Figure 1). The search was restricted to earthquakes with moment magnitudes of 4 or greater, as magnitudes below this will have little impact on engineering works. Due to the historic, and even current, paucity of seismograph stations in the region, the database only includes earthquakes that have occurred since 1985.

The results of the earthquake search included local magnitude (M_L), short-wave body magnitude (m_b), and moment magnitude (M_w). These magnitude measurement scales are essentially equal for moment magnitudes of 6 or less (Idriss, 1985). They were therefore not converted to reflect the same magnitude scale. The search yielded 19 shallow earthquakes (18 km depth or less) that occurred within a 150 km radius, 16 between magnitudes 4 and 4.9, and three between magnitude 5 and 5.1. The two largest earthquakes in the 150 km record were located east and southeast of the site, at distances of 89 km and 148 km, respectively. These earthquakes were both magnitude 5.1, and occurred on November 25, 1997 and September 24, 2005 in the region of the Mackenzie Mountains.

3.1.2 Seismogenic Source Zones

Assessment of seismic hazards for the Eagle Gold site requires consideration of potential earthquake source zones, either identifiable seismogenic faults or larger areas with common seismogenic characteristics. Once source zones have been identified, maximum earthquakes can be assigned for each source zone. In the following sections, potential fault sources and source zones are identified. Considering that ground motions resulting from earthquakes with source-to-site distances greater than about 150 km are relatively small, the study area for the hazard assessment was restricted to those sources lying within 150 km of the project site.

Typically deterministic studies are restricted to assessing faults or source zones (large areas with common seismogenic characteristics) that have shown to or are suspected of having displaced Quaternary-age (less than approximately 1.8 million years) deposits, and are therefore generally considered "active." According to Maurice Colpron of the Yukon Geological Survey (Personal Communication, 2011), the Dublin Gulch area is not known to contain Quaternary-age faults. The site-specific search therefore included all known faults near Dublin Gulch, and was performed using Geographic Information System (GIS) shapefiles provided through the Yukon Geological Survey. The search resulted in 3,145 individual fault listings within 150 km of the site. The majority of these faults do not appear to have been studied in detail, and few details are available concerning type, orientation, total length, or age. Many of the individual fault segments are part of larger fault systems. The catalog (Table 1) has therefore been restricted to named faults in the area, most of which have been studied and can be tracked in a literature search, and includes the longest individual segments and the segments closest to the site for each fault source. The faults listed in Table 1 are labeled in Figure 1.

Table 1: Named Faults Near Dublin Gulch

FAULT ID	FAULT TYPE	FAULT NAME	LENGTH (km)	NEAREST DISTANCE TO SITE (km)
10666	Fault, defined, thrust, upright	CALLISON LAKE NORMAL FAULT	8.2	72.1
8011	Fault, defined, thrust, upright	CALLISON LAKE THRUST FAULT	1.2	62.6
7388	Fault, defined, thrust, upright	CALLISON LAKE THRUST FAULT	7.6	68.4
27530	Fault, approximate, thrust, upright	DAWSON THRUST	53.2	44.2
7650	Fault, defined, normal/reverse	FOREST FAULT	7.6	116.6
28896	Fault, defined, normal/reverse	FOREST FAULT	4.0	109.5
13467	Fault, assumed, movement undefined	JOSEPHINE CREEK FAULT	0.4	53.6
13697	Fault, approximate, movement undefined	JOSEPHINE CREEK FAULT	2.1	53.7
11592	Fault, assumed, movement undefined	KATHLEEN LAKES FAULT	12.0	73.7
27133	Fault, defined, thrust, upright	LOWER LAKE CREEK THRUST	9.4	66.7
8457	Fault, defined, thrust, upright	LOWER RAE CREEK THRUST	2.7	90.0
9113	Fault, defined, thrust, upright	LOWER RAE CREEK THRUST	0.7	82.8
11707	Fault, assumed, thrust, upright	Moose Lake Thrust	2.1	89.3
23905	Fault, extrapolated, thrust, upright	Moose Lake Thrust	19.7	96.8
8663	Fault, defined, thrust, upright	NORTH FORK THRUST FAULT	0.3	123.2
9347	Fault, defined, thrust, upright	NORTH FORK THRUST FAULT	13.5	123.5
12284	Fault, assumed, thrust, upright	Robert Service Thrust	58.7	32.0
12838	Fault, approximate, thrust, upright	ROBERT SERVICE THRUST	3.2	15.2
13138	Fault, assumed, movement undefined	Sideslip Lake Fault	13.2	101.8
23915	Fault, approximate, movement undefined	Sideslip Lake Fault	2.0	95.4
13665	Fault, approximate, normal/reverse	SPRAGUE CREEK FAULT	7.5	35.3
13692	Fault, approximate, normal/reverse	SPRAGUE CREEK FAULT	0.8	34.7
26882	Fault, extrapolated, dextral	TINTINA FAULT	14.9	82.5
26631	Fault, extrapolated, dextral	TINTINA FAULT	39.2	104.3
13679	Fault, approximate, thrust, upright	TOMBSTONE STRAIN ZONE UPPER BOUNDARY	21.6	6.8
27690	Fault, approximate, thrust, upright	TOMBSTONE THRUST	29.2	29.3
8273	Fault, defined, thrust, upright	UPPER LAKE CREEK THRUST	1.1	67.3
8009	Fault, defined, thrust, upright	UPPER LAKE CREEK THRUST	4.8	76.6
10298	Fault, assumed, thrust, upright	WERNICKE FAULT	0.2	129.3
9856	Fault, defined, thrust, upright	WERNICKE FAULT	8,409	133.7

The youngest known fault in the vicinity of the site which is large enough to generate strong ground motions appears to be the Tintina Fault, which is a major strike-slip fault that stretches from British Columbia to Alaska, and is estimated to have last moved during the Eocene (approximately 54-36 million years ago). Other large historic faults in the area include the Dawson, Tombstone, and Roberts Service thrust faults, which are Cretaceous in age (approximately 141-65 million years ago). The remaining faults listed in Table 1 appear to be related to collisional-deformation during the Cretaceous. It must be emphasized that these structures were active during a very different seismogenic framework than exists in the area today, and they are therefore not included in the DSHA. While earthquakes have occurred in the area near Dublin Gulch in the recent past, they do not appear to be associated with specific geologic structures exhibiting offset or displacement at the ground surface.

A review of potential earthquake source zones in the project area, based on recent earthquake history and the existing seismogenic framework, confirms seismic activity related to movement in nearby mountain ranges. Areas that show a concentration of earthquake activity in the 26 years covered in NRCAN's database include the Wernecke/Mackenzie (these mountains are grouped as a single seismic source for the purposes of this study), and Ogilvie Mountains, as noted previously in Section 2.0. An MCE associated with one of these sources is likely to control the design PGA. For purposes of the DSHA, the distance to these two source zones was assumed to approximately coincide with the base of the mountains at their nearest point to the site. A typical method for assigning a MCE to site-specific area sources is to add 0.5 to 1.0 magnitude to the maximum magnitude in the earthquake history. However, due to the short span of the earthquake history, and considering the earthquake magnitudes on a regional scale (Section 2.0), a conservative magnitude of 7.0 was assigned to these sources, summarized below:.

- Wernecke/Mackenzie Source Zone, M = 7.0, Epicentral Distance (D) = 60 km
- Ogilvie Source Zone, M = 7.0, D = 30 km

3.1.3 Attenuation Relations

Seismic hazard analyses require an attenuation relationship to represent the decay of earthquake ground motions with distance, or a combination of weighted attenuation relationships, in order to produce estimated ground motions for use in project design. Most recently published applicable attenuation relationships are based on a database of worldwide strong motion recordings provided by the Pacific Earthquake Engineering Research (PEER) Center for their Next Generation Attenuation (NGA) project. In general, these attenuation relationships are considered applicable to the western United States and other tectonically active regions that experience shallow crustal faulting (Campbell and Bozorgnia, 2007). These attenuation relationships are therefore also considered applicable to the Dublin Gulch Property.

The NGA project supported five teams in the development of new empirical ground motion models for the estimation of peak ground accelerations and 5%-damped pseudo-acceleration response spectra. Each team was given access to the same database and a set of criteria dictating the limiting parameters of the final product, but otherwise the researchers were allowed to make their own interpretations. The five NGA model development teams included Abrahamson and Silva (2008); Boore and Atkinson (2008); Campbell and Bozorgnia (2008); Chiou and Youngs (2008); and Idriss (2008). In general, the NGA models provide median and aleatory uncertainty values for peak ground acceleration (PGA), peak ground velocity (PGV), peak ground displacement (PGD), and response spectral acceleration (PSA) and displacement (SD) for oscillator periods ranging from 0.01 to 10.0 seconds. The models are valid for earthquake magnitudes ranging from 4.0 to 8.0, and distances ranging from 0 to 200 km. A Microsoft Excel spreadsheet published by Dr. Linda Al Atik in September, 2009, includes the five NGA attenuation models and allows for the calculation of averages weighted at the user's discretion. The spreadsheet is available through the PEER website (http://peer.berkeley.edu/ngawest/index.html) and, according to Dr. Atik, has been compared with success to other calculation files (Al Atik, Linda, 2010).

3.1.4 Attenuation Model Input

The NGA spreadsheet requires earthquake magnitude, and specific fault parameters be input, namely geometry-related values such as: site-to-source distances, fault rupture depth, fault rupture width, and dip of rupture plane; depths to 1.0 km/s and 2.5 km/s shear wave velocity horizons; average shear wave velocity in the upper 30 m of the foundation materials (V_{s30}); sense of fault movement (i.e., normal, reverse, strike-slip, or unspecified); and, whether the site lies on the hanging wall (hanging wall factor) or foot wall, in the case of normal or reverse faults. This last factor is meant to account for the fact that ground motions on the hanging wall are typically higher than those observed on the footwall of a fault.

According to Cassidy et al. (2005), large earthquakes that have occurred in the Mackenzie Mountains are generally shallow thrust faults that often do not have a surface expression. This is assumed to be the case for earthquakes in the Wernecke and Ogilvie Mountains as well, based on the tectonic framework of the area and the northeasterly movement of the Yukatat microplate. Both source zones were modeled assuming movement on a thrust fault dipping to the southwest. This is a conservative assumption, as this puts the Dublin Gulch Property on the hanging wall for both source zones. In addition, a shallow dip of 30 degrees and a depth of 6 km were assumed, based on the earthquake history and the gentle to moderate dip described for historic shallow thrust faults in the area (Mair et al., 2006). Empirical relationships by Wells and Coppersmith (1994), which relate segment lengths to magnitude, and magnitude to rupture area, were used to back-calculate segment lengths, and then, based on the segment lengths, estimate rupture widths. Depths to 1.0 km/s and 2.5 km/s shear wave velocity horizons are not known, but as this is the expected case for most analyses, default values are provided by the NGA models; these values were used for the Dublin Gulch Property. The average shear wave velocity in the upper 30 m of the foundation (V_{s30}) was assumed to be 750 m/s, a typical value for the National Building Code of Canada (NBCC) "firm ground" soil class C.

3.1.5 Notes on Deterministic Model Conservatism

Conservative assumptions for this portion of the study mainly relate to magnitude and source orientation, and the method of analysis itself (deterministic using the MCE). MCE events are the largest possible earthquake that could reasonably be associated with a seismogenic structure under the presently known or presumed tectonic framework with no consideration given to the probability that such an event will occur. The MCE is also conservatively assumed to occur at the closest point of the source zone to the project site. Theoretically, no ground motion should occur which exceeds that of the MCE.

The value used for shear wave velocity in the upper 30 m of the foundation was based on a regional average used in the NBCC. Considering the shallow depth to bedrock at the site, the actual value may well be higher, which would lead to a lower anticipated PGA. However, raising it to 1100 m/s (i.e., soft rock), only reduces the PGA by 0.01g to 0.03g from the PGA values reported (Table 2).

3.1.6 Deterministic Peak Ground Accelerations

A primary result of deterministic seismic hazard analysis is an estimate of peak ground acceleration (PGA) that can be expected at the site given the various geological and seismological parameters of the region. Table 2 presents a comparison of PGA estimates for the two sources expected to contribute the greatest potential ground motions within the 150 km radius of the Eagle Gold property. All PGA estimates presented in Table 2 reflect an average value derived from applying equal weights to the 2008 NGA models discussed previously.

Table 2: Deterministic Peak Ground Acceleration Estimates for Dublin Gulch

Seismic Source	PGA (g)	Distance from Site (km)	MCE
Wernecke/Mackenzie Source Zone	0.10	60	7.0
Ogilvie Source Zone	0.27	30	7.0

3.2 Probabilistic Analysis

A consequence of deterministic analyses is that there is no consideration of probability or risk associated with the identified hazards. Ground motions associated with MCE are discrete values, whereas ground motions derived from probabilistic analyses, by definition, have likelihoods of occurrence associated with them. For instance, interpolation of the NRCAN 2005 National Building Code of Canada Seismic Hazard data indicates a ground motion of 0.19g at Dublin Gulch (Table 3) has a 10 percent chance of exceedance in 50 years. This equates to a risk of an earthquake occurring that exceeds 0.19g approximately every 475 years. A probabilistic analysis is included in order to assist Victoria Gold Corp. with quantification of the risks associated with seismic hazards at the Eagle Gold property.

The probabilistic analysis was initially conducted using the NRCAN 2005 National Building Code Seismic Hazard website http://earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-eng.php to determine the peak horizontal ground acceleration (PGA) for various return periods. The website is a tool developed by NRCAN to calculate probabilistic response spectra with different hazard levels for spectral periods up to 2.0 seconds at any location (the equivalent spectral response period for peak ground acceleration is 0.0 seconds). The on-line calculator uses an average shear wave velocity in the upper 30 meters (V_{s30}) that corresponds to NBCC 2005 soil class

C (360-750 m/s). The median (50th percentile) peak ground accelerations for 10%, 5%, and 2% probabilities of exceedance in 50 years were calculated using the on-line calculator. For comparison, Stephen Halchuk of NRCAN (Personal Communication, 2011) provided mean values for the same probabilities. Both are shown in Table 3.

Table 3: Probabilistic Ground Motions for Dublin Gulch
NRCAN 2005 National Building Code of Canada Seismic Hazard Interpolation

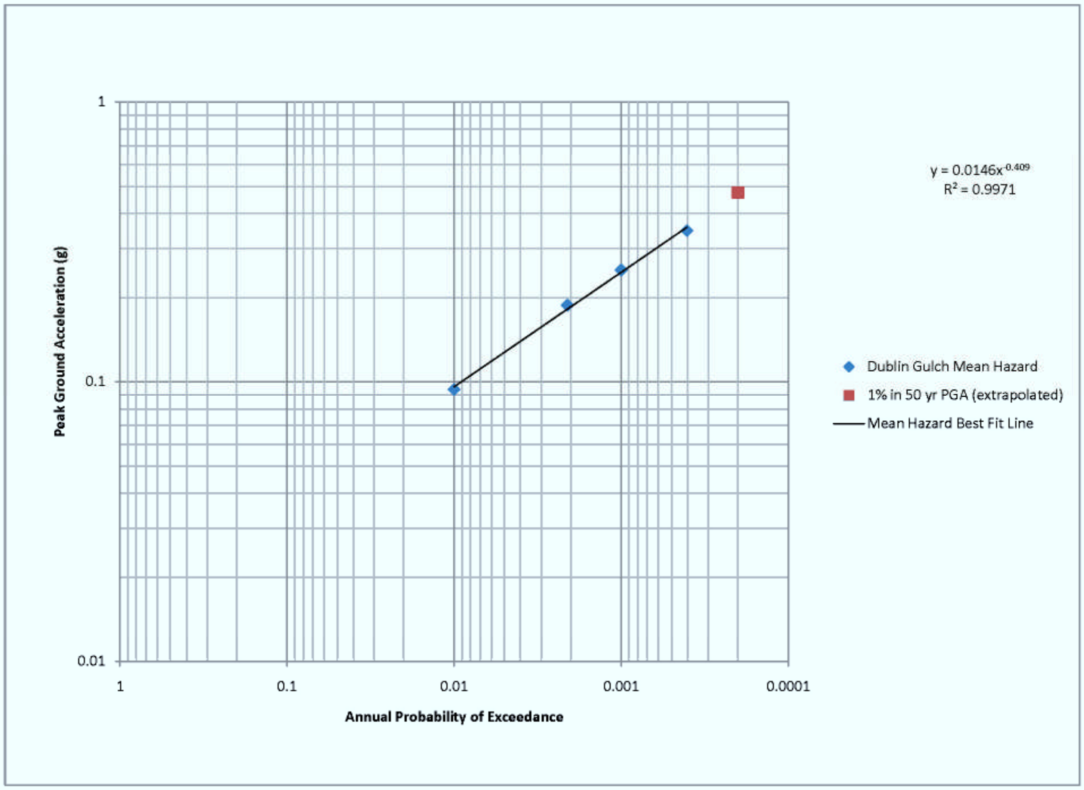
Probability of Exceedance in 50 years (%)	Approximate Equivalent Return Period (yrs)	Median Peak Ground Acceleration (g)	Mean Peak Ground Acceleration (g)
10%	475	0.14	0.19
5%	975	0.18	0.25
2%	2475	0.25	0.35

4.0 Discussion

The design PGA should be chosen based on regulatory requirements and the level of tenable risk to the project. The Yukon Water Board Licensing Guidelines reference use of the MCE, but also defer to the 2007 Canadian Dam Association (CDA) guidelines for water management structures. The CDA requires a mean (rather than median) 1 percent in 50 yrs probability of exceedance (approximate return period of 5,000 yrs) PGA for high hazard water management structures. For the moment, it is unclear which regulatory guidelines will take precedent for the various engineering works at the Eagle Gold mine site. However, a PGA corresponding to a 5,000-year event is not available through NRCAN, as this probability category is beyond the intended purpose of the NBCC models (Personal Communication with Stephen Halchuck, 2011). Extrapolating a value for this low probability ground motion, according to NRCAN recommendations, results in a PGA of 0.48g (Figure 2). This mean value is larger than the MCE ground motions, which implies an event with a larger moment magnitude than the MCE may reasonably be expected to occur. This is contrary to the definition of an MCE. The large difference between the extrapolated 5,000-yr PGA and the MCE PGA can be explained by the fact that the 5,000-yr extrapolation is not constrained by the current tectonic environment. In addition, NRCAN emphasizes that low probability values extrapolated from their models can be given little credence, and should only be used as a screening tool to determine if a site-specific seismic hazard assessment is warranted. The site specific hazard study has shown that there is a very short earthquake history for the area, and, in particular, there have been very few earthquakes large enough to formulate a meaningful site-specific earthquake forecast model, which would be required to perform a site-specific probabilistic analysis. Such an analysis would result in a prediction for a 5,000-year event based on only 26 years of available earthquake history.

Figure 2: Extrapolation of NRCAN Mean Probabilistic PGA Values to a 5,000-year Event

(0.0002 Annual Probability of Exceedance)



Considering the level of conservatism inherent in a deterministic analysis, and the added conservatism discussed in Section 3.1.5, Tetra Tech recommends a design PGA of 0.27g based on an MCE of moment magnitude 7.0.

5.0 Conclusions and Recommendations

This memorandum provides a summary of a seismic hazard analysis performed for Victoria Gold Corporation's Eagle Gold project, located near Dublin Gulch in the Yukon Territory, Canada. Peak ground accelerations were developed for both deterministic analyses and probabilistic analyses. A Microsoft Excel spreadsheet that applies a weighted average to five attenuation relationships developed through the PEER NGA project was used for the deterministic analyses, while data published by NRCAN was used to determine probabilistic site ground motions and their corresponding probabilities of occurrence. These results are summarized in Tables 2 and 3.

Tetra Tech recommends a design PGA of 0.27g for high hazard facilities, as determined using an MCE of moment magnitude 7.0. For facilities requiring a PGA based on a return period of 1,000 years or less, the mean NBCC values from Table 3 may be used.

6.0 References

Abrahamson, N. A. and W. J. Silva, 2008, Summary of the Abrahamson and Silva NGA Ground-Motion Relations, Earthquake Spectra, 24: 67-97.

Al Atik, Linda, 2010, University of California, Berkeley, personal communication.

Boore, David M. and Atkinson, Gail M., 2008, Ground-Motion Prediction Equations for the Average Horizontal Component of PGA, PGV, and 5%-Damped PSA at Spectral Periods between 0.01 s and 10.0 s, Earthquake Spectra, 24: 99-138.

Cassidy, John F., Rogers, Garry C., and Ristau, J., 2005, Seismicity in the vicinity of the SNORCLE corridors of the northern Canadian Cordillera, Canadian Journal of Earth Science, 42: 1137-1148.

Campbell, Kenneth W. and Bozorgnia, Yousef, 2007, Campbell-Bozorgnia NGA Ground Motion Relations for the Geometric Mean Horizontal Component of Peak and Spectral Ground Motion Parameters, Prepared for the Pacific Earthquake Engineering Research Center, University of California, Berkeley, PEER Report 2007/02.

Campbell, Kenneth W. and Bozorgnia, Yousef, 2008, NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD and 5% Damped Linear Elastic Response Spectra for Periods Ranging from 0.01 to 10.0 s, Earthquake Spectra, 24: 139-172.

Chiou, Brian S.J. and Youngs, Robert R., 2008, An NGA Model for the Average Horizongal Component of Peak Ground Motion and Response Spectra, Earthquake Spectra, 24: 173-216.

Colpron, Maurice, 2011, Yukon Geological Survey, personal communication.

Halchuk, Stephen, 2011, Natural Resources Canada, personal communication.

Idriss, I. M. (1985). "Evaluating seismic risk in engineering practice," Proceedings of the 11th International Conference of Soil Mechanics and Foundation Engineering, San Francisco, CA, Vol. 1, pp. 255-320.

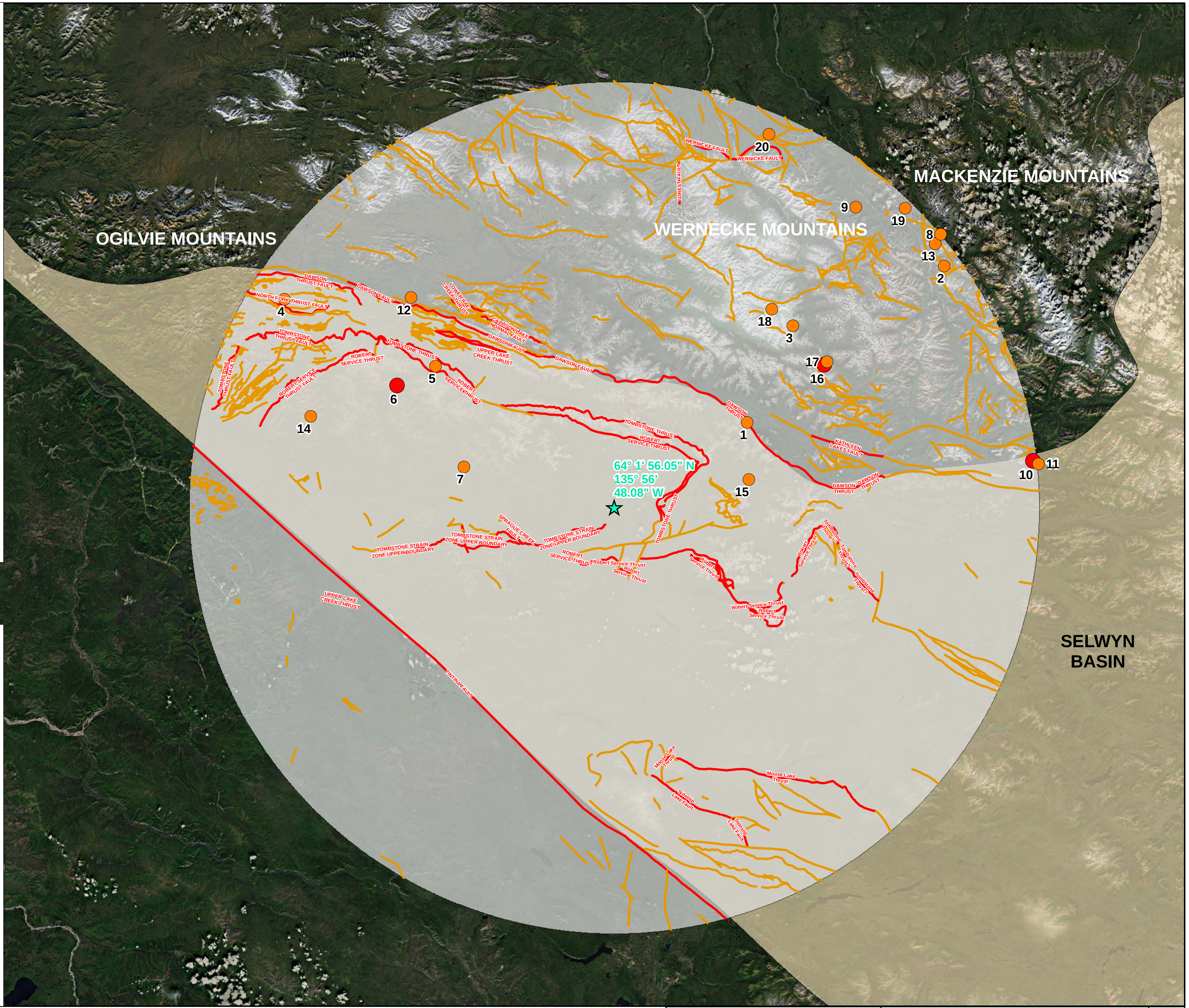
Idriss, I.M., 2008, An NGA Empirical Model for Estimating the Horizontal Spectral Values Generated By Shallow Crustal Earthquakes, Earthquake Spectra, 24: 217-242.

Mair, John L., Hart, Craig J.R., Stephens, Julian R., 2006, Deformation history of the northwestern Selwyn Basin, Yukon, Canada: Implications for orogen evolution and mid-Cretaceous magmatism, Geological Society of America Bulletin, 118: 304-323.

Wells, D.L., and Coppersmith, K.J., 1994, New Empirical Relationships among Magnitude, Rupture Length, Rupture Width, Rupture Area, and Surface Displacement: Bulletin of the Seismological Society of America, Vol. 84, No. 4, pp 974-1002.

Dublin Gulch Earthquake Catalog

Point ID	Date	Lat	Long	Mag
1	1985/08/09	64.32	-135.01	4.0ML
2	1987/03/02	64.83	-133.59	4.3ML
3	1991/06/13	64.63	-134.7	4.8ML
4	1991/10/22	64.61	-138.46	4.8MB
5	1993/04/16	64.44	-137.31	4.0ML
6	1996/07/21	64.37	-137.58	5.0ML
7	1996/10/16	64.13	-137.05	4.9ML
8	1996/11/27	64.93	-133.62	4.0ML
9	1997/01/04	65.01	-134.26	4.9mb
10	1997/11/25	64.22	-132.92	5.1ML
11	1997/11/25	64.21	-132.88	4.8ML
12	1998/04/07	64.65	-137.53	4.3ML
13	2000/02/23	64.9	-133.66	4.1ML
14	2001/06/04	64.25	-138.19	4.0Mw
15	2003/12/06	64.14	-134.98	4.0ML
16	2005/09/24	64.51	-134.46	5.1Mw
17	2005/10/21	64.52	-134.44	4.0Mw
18	2007/06/23	64.68	-134.86	4.3Mw
19	2010/08/07	65.01	-133.89	4.5Mw
20	2010/12/12	65.23	-134.93	4.0Mw



LEGEND

FAULTS WITHIN 150KM RADIUS[1]

🟥	NAMED FAULT
🟧	UNNAMED FAULT
▨	150 KM BUFFER
☆	AREA OF INTEREST
🟨	SELWYN BASIN

EARTHQUAKE MAGNITUDE[2]

●	5.0–5.9
●	4.0–4.9

Source: (1) Yukon Geological Survey –
http://www.geology.gov.yk.ca/databases_gis.html
(2) Earthquakes Canada Online Bulletin –
http://earthquakescanada.nrcan.gc.ca/stnsdata/

N

SCALE IN KILOMETERS
0 25 50

Issued by:

TETRA TECH
350 Indiana Street, Suite 500
Golden, Colorado 80401
(303) 217-5700 (303) 217-5705 fax

DUBLIN GULCH – FAULTS
IN 150 KM RADIUS &
EARTHQUAKE DATA

A
REVISION

Project:	EAGLE GOLD	Project no.:	114–201045X
Location:	YUKON TERRITORY	Date:	APRIL 2011

FIGURE 1

APRIL 2011 T:\GIS\TEMPORARY\Dublin Gulch\mxds\DublinGulch_Earthquake.mxd By: Drew York