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MATAKANUI GOLD LIMITED
BENDIGO-OPHIR GOLD PROJECT
SITE-SPECIFIC SEISMIC HAZARD STUDY REPORT

Prepared for: 08 August 2025

Matakanui Gold Limited

EXECUTIVE SUMMARY

This report provides a site-specific seismic hazard assessment (SSSHA) for the Bendigo-Ophir Gold Project (BOGP). The results are required for the safe design of the Tailings Storage Facility (TSF) in accordance with the New Zealand Dam Safety Guidelines (NZDSG) published in 2024 (Ref. 1). The results are suitable for other structures, with due consideration for the specific basis of design being applied and compliance with the Building Act (Ref. 9), Regulations and Codes (Ref. 10).

Peak ground acceleration (PGA) and spectral acceleration values are provided along with mean magnitudes for design.

For the site, the seismic hazard contribution from shallow crustal earthquakes is the most notable. This includes known and undefined faults in the wider local region, with notable contribution from the Alpine Fault at the 1 in 150 year level. The Alpine Fault (closest distance of ~115km, potential magnitude up to M_w 8.6) is considered as a shallow crustal fault. At 1 in 10,000 year levels of shaking, at shorter spectral periods, including those typical of the TSF embankment, it is the local faults, known and undefined, that contribute most to the seismic hazard at this intensity level, and less so the Alpine Fault. The Puysegur Margin Subduction Zone (closest distance ~90 km) has a contribution. It contributes at all spectral periods for the OBE (33 to 48 %) and long spectral periods for the SEE (26 to 40 %). The TSF will be designed to be robust and safe from all potential earthquake sources contributing to the seismic hazard.

There are two nearby active fault sources contributing to the seismic hazard, the Dunstan (closest distance of 9 km) and Pisa (closest distance of 13 km) fault systems, with maximum magnitude estimates between M_w 7.1 and 8.3. The Pisa fault system aligns with the branches of the Cluden (15 km), and Grandview Faults (15 km) which can act together. Table 1 in the report provides a further summary of the characteristics of these fault sources which are shown in Figure 1. There are no known active faults expressed at the surface through the BOGP site.

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CONTENTS

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1.0 INTRODUCTION

Engineering Geology Limited (EGL) has been engaged by Matakanui Gold Limited (MGL) to provide a site-specific seismic hazard assessment (SSSHA) for the Bendigo-Ophir Gold Project (BOGP). The BOGP is located on the Bendigo and Ardgour Stations in the Dunstan Mountains of Central Otago. MGL is a subsidiary company of Santana Minerals Limited (SML).

This report presents the brief methodology and results of the SSSHA for the site. The results are required for the design of the Tailings Storage Facility (TSF) in accordance with the New Zealand Dam Safety Guidelines (NZDSG) published in 2024 (Ref. 1). The TSF will be designed as a High Potential Impact Classification (PIC) dam as defined by NZDSG (Ref. 1). The results of the SSSHA may also be useful for other design purposes.

Results were developed using the 2022 National Seismic Hazard Model (NSHM22, Ref. 2) using OpenQuake Engine (Ref. 3). NSHM22 represents a fundamental revision of the seismic hazard science in New Zealand. It incorporates the latest developments in scientific understanding of seismic sources within New Zealand and state-of-art knowledge with respect to estimation of seismic hazard.

2.0 SITE DESCRIPTION

The BOGP site is located in the Dunstan Mountains of Central Otago Region, approximately 20 km northeast of Cromwell. The site lies within Otago Schist, along the boundary of textural zones 3 and 4 (TZ3 and TZ4), separated by the Thomson Gorge Fault (TGF), a non-active reverse fault with an 8 km offset. The schist originated from Permian-Triassic sedimentary rocks, metamorphosed during the Cretaceous period under greenschist facies conditions. Orogenic gold mineralisation occurred in the Rise and Shine Shear Zone (located on the BOGP site) during this metamorphism. The region has undergone multiple faulting events related to the Alpine Fault since 25 Mya, with glaciation shaping the valleys, leaving moraines and tills from the last glaciation (~650 kya).

The coordinates of the site used in this SSSHA are Latitude -44.951°, Longitude 169.430° in the World Geodetic System 1984 (WGS84). According to the New Zealand Community Fault Model (CFM, Ref. 4), there are two nearby active fault systems, the Dunstan (closest distance 9 km) and Pisa (closest distance 13 km) faults systems. The Cluden, and Grandview faults are also nearby and can act a part of the Pisa fault system. Figure 1 shows the locations of the site and nearby active faults. The characteristics of the Dunstan, Pisa, Cluden, and

Grandview faults are summarised in Table 1. There are no known active faults expressed at the surface through the BOGP site.

Earthquake design loads are affected by the subsurface ground conditions present at a site. This SSSHA utilises V_{s30}, the time average shear wave velocity of the upper 30 m of soil and rock, as the parameter to characterise the local ground conditions. Initial measurements of shear wave velocity of the rock at the TSF indicate a design value of approximately V_{s30} 1000 to 1500 m/s. Representative V_{s30} values for different site conditions, including 850, 1000, and 1500 m/s were run. The V_{s30} value range represents rock conditions, with no or very shallow stiff soil cover.

3.0 METHODOLOGY

Aligning with the requirements in NZDSG 2024 for a High PIC dam, two design earthquake levels have been assessed. They are:

- The Operating Basis Earthquake (OBE) based on mean probabilistic values with a 1 in 150 year Annual Exceedance Probability (AEP).
- Safety Evaluation Earthquake (SEE), either based on mean probabilistic values with a 1 in 10,000 year AEP or 84th percentile values from deterministic results from the Controlling Maximum Earthquake (CME). For the SEE an aftershock one magnitude less than the main shock shall also be considered.

The probabilistic seismic hazard analysis (PSHA) was undertaken using the OpenQuake engine (Ref. 3). OpenQuake has been developed by the Global Earthquake Model (GEM) Foundation and is widely used in the international earthquake engineering profession. The application of the NSHM2022 in the OpenQuake engine was developed by the New Zealand scientific community.

Probabilistic estimates of peak ground acceleration and spectral accelerations have also been provided at 1 in 500 and 1 in 2,500 AEPs.

Deterministic seismic hazard analyses (DSHA) for the CME have used the ground motion characterisation models (GMCMs) and the associated logic tree weightings applied in NSHM22 for New Zealand (Ref. 2).

4.0 RESULTS AND DISCUSSION

4.1. Probabilistic seismic hazard results

PSHA peak ground acceleration (PGA) and spectral acceleration (SA) results, for V_{s30} values of 850, 1,000, and 1,500 m/s are summarised in Tables 2 to 4. The results for mean spectral acceleration (SA_{RotD50}) for the OBE (1 in 150 AEP) and SEE (1 in 10,000 AEP) design cases are plotted in Figure 2, 3 and 4, along with the SEE aftershock. Spectral acceleration for 1 in 150 AEP, 1 in 500 AEP, 1 in 2,500 AEP, and 1 in 10,000 AEP and plotted together in Appendix A as additional information.

4.2. Disaggregation of the probabilistic seismic hazard results

Disaggregation plots of the earthquake sources contributing to PSHA for PGA, SA(0.15s), SA(0.5s), SA(1.0s), and SA(3.0s) are presented in Appendix B. Tables 5 and 6 summarise the mean magnitudes, mean rupture distances, and Tectonic Region Type (TRT) contributions for the 1 in 150 AEP and 1 in 10,000 AEP events. The table results and disaggregation plots indicate that the seismic hazard contribution from shallow crustal earthquakes are the most notable. This includes known and undefined faults in the wider local region, with notable contribution from the Alpine Fault at the 1 in 150 year level. Note the Alpine Fault (closest distance of ~115 km) is grouped in the shallow crustal faults in Table 5 and 6. At 1 in 10,000 year levels of shaking, at shorter spectral periods (PGA, 0.15 s, and 0.5 s), the mean rupture distance of 20 km to 34 km indicates that it is the local faults, known and undefined, that contribute most to the seismic hazard at this intensity level, and less so the Alpine Fault. The Puysegur Margin Subduction Zone (closest distance ~90 km) has a contribution indicated by the Subduction Interface and Subduction Intraslab contribution in Table 5. It contributes at all spectral periods for the OBE (33 to 48 %) and long spectral periods for the SEE (26 to 40 %).

4.3. Deterministic seismic hazard results

To assess the CME the maximum potential rupture from any earthquake source which has a 100,000 year average recurrence interval or less were considered. They were:

- Dunstan Fault, magnitude M_w =8.0 rupture, at 9 km distance, 84%ile motion
- Pisa Fault, magnitude M_w =8.2 rupture, at 13.1 km distance, 84%ile motion
- Alpine Fault, magnitude M_w =8.6 rupture, at 115 km distance, 84%ile motion

The CME is determined to be a magnitude M_w 8.0 rupture on the Dunstan Fault at 9 km distance. The response spectra for the Dunstan Fault rupture 84th percentile values are shown in Figures 5 to 7 for the different V_{s30} values against the PSHA spectra mean, 10th percentile and 90th percentile values. In Appendix C in Figures C1 to C3, deterministic 84th percentile spectra calculated for the Dunstan, Pisa, and Alpine Fault are all shown against the mean PSHA spectra. Tables C1 to C3 in Appendix C provide the data.

A magnitude M_w = 8.8 rupture on the Puysegur Margin Subduction Zone, at 90 km distance was also checked. This was not the critical rupture for the CME.

For comparison, the PSHA 1 in 10,000 year AEP result with the deterministic Dunstan Fault Rupture is shown in Figures 5 to 7 for different V_{s30} values. The 84th percentile magnitude 8.0 rupture on Dunstan Fault is higher than the 1 in 10,000 year probabilistic spectra for nearly all spectral periods. NZDSG requires the TSF to be designed for the lesser of the 1 in 10,000 year or CME response spectra. The 1 in 10,000 year response spectra is recommended for the TSF SEE design case. Tables 2 to 4 and Figures 2 to 4 summarise the recommended response spectra for the TSF.

4.4. Aftershock

Aftershock PGA and response spectra values were derived deterministically. For peak ground acceleration and short spectral periods (0.15 s) the 1 in 10,000 year PSHA mean magnitude and mean rupture distance is M_w 6.7 to 6.8 at 20 km. Taking M_w 6.8 as the mean magnitude for the main earthquake shock, a magnitude M_w 5.8 was used to develop the response spectra for the aftershock. This is one magnitude less than the main shock. This approach aligns with NZDSG 2024 guidelines (Ref. 1). The rupture distance was set at D = 9 km for this calculation and standard deviation parameter (epsilon) adjusted to achieve a consistent basis for the main shock and aftershock spectra. This approach determines the shape of the spectra and the drop in magnitude reduces the intensity of shaking or loading. Note for spectral period 0.5 s the mean magnitude is M_w 7.5 for the main shock. The same aftershock spectra can be used for 0.5 s, as for the shorter periods. However, the magnitude for the aftershock shall be taken as M_w 6.5. The aftershock spectra for different V_{s30} values are provided in Tables 2 to 4 and Figures 2 to 4 with the OBE and and SEE spectra. The aftershock spectra for the different V_{s30} values are plotted together in Figure C4 for comparison, in Appendix C. Table C4 in Appendix C provides the aftershock data.

4.5. Orientation of ground motion parameters

All results presented in this report are for the median of the maximum spectral acceleration observed over all horizontal orientations, termed SA_{RotD50}.

SA_{RotD50} is considered appropriate for the design of structures that are azimuth-dependent, i.e., the dynamic properties of the structure (e.g., stiffness) are dependent on the orientation being considered (Ref. 5). The SA_{RotD50} is appropriate for the geotechnical design, if the design method itself is derived based on SA_{RotD50} (for example when using the Bray and Macedo method (Ref. 6) for embankment displacement estimation).

For azimuth-independent structures (e.g., a structure whose footprint is axisymmetric such as silos and circular tanks), the 100th percentile (i.e., maximum) of the SA value ($SA_{RotD100}$) obtained by rotating the horizontal components through all angles may be more appropriate (Ref. 7). Modification ratios to obtain $SA_{RotD100}$ from SA_{RotD50} based on Boore and Kishida (Ref. 8) are provided in Table 7, if required.

For many years in New Zealand the parameter SA_{Larger} has been used for building design response spectra. This is the larger component of the two recorded horizontal records and is typically less than $SA_{RotD100}$ and more than SA_{RotD50}. Modification ratios to obtain SA_{Larger} from SA_{RotD50} based on Boore and Kishida (Ref. 8) are provided in Table 7, if required.

When selecting response spectra for design, the designer should consider the design basis for the specific structure and which parameter is appropriate to use.

5.0 RECOMMENDED DESIGN SPECTRA

The report presents the results of a SSSHA for the BOGP. The assessment has been undertaken for the TSF. However, the results may be useful for other design purposes with due consideration for the basis of design or assessment and compliance with the Building Act (Ref. 9), Regulations and Codes (Ref. 10).

For the TSF (as a High PIC dam) the design response spectra for SA_{RotD50} for the OBE, SEE, and aftershock levels of shaking are summarised in Tables 2 to 4 and shown in Figures 2 to 4.

For design, magnitude is often required to apply with the selected design shaking intensity parameter. Mean magnitudes are provided in Tables 5 and 8.

The response spectra and seismicity parameters are based on a free-field ground motion (i.e., relatively flat or gently sloping ground). Topographic amplifications effects for embankments are to be applied separately in the TSF assessment.

PGA and SA values have been provided for three V_{s30} values, 850, 1000, and 1500 m/s. The V_{s30} values represent sites with rock conditions, with no or very shallow stiff soil cover. If other V_{s30} values are required, EGL can run the NSHM for other specific values.

6.0 CONCLUSION

A SSSHA has been completed for the proposed TSF at the BOGP. PGA and SA values are provided along with mean magnitudes for design. The results are suitable for other structures, with due consideration for the specific basis of design being applied and compliance with the Building Act (Ref. 9), Regulations and Codes (Ref. 10). The SSSHA includes many earthquake sources. The TSF will be designed to be robust and safe from all potential earthquake sources contributing to the seismic hazard.

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TABLES

1 TO 8

List of Tables

TABLE 1: Summary of Known Active Faults within about 20 km of the Dam Site (based on CFM).

Name	Dunstan	Pisa	Cluden**	Grandview**
Fault ID	771	772	770	767
Source-to-site Distance, Rrup (km)	9.0	13.1	14.7	15.4
Domain Name	Otago	Otago	Otago	Otago
Magnitude (Mw)*	7.15 to 7.95	7.75 to 8.25	7.35 to 8.05	7.85 to 8.35
Mean Rate (per year)	3.61e-6 to 8.94e-5	7.36e-7 to 2.54e-5	2.55e-7 to 5.38e-6	2.94e-7 to 2.19e-5
Dip (°)	45	45	60	60
Dip Direction	NW	W	NW	E
Dominant Sense of Movement	Reverse	Reverse	Reverse	Reverse
Subordinate Sense of Movement	Null	Dextral	Dextral	Sinistral
Rake (°)	90	110	110	70
Average Slip Rate (mm/year)	0.5	0.1	0.1	0.1
Depth (km)	28.0	28.9	27.1	26.9
Length (km)	60.9	48.5	25.9	29.4

* Includes rupture of multiple segments of adjacent faults together.
** Cluden and Grandview Faults are adjacent to the Pisa Fault and align with this fault system.

TABLE 2. Response Spectra (5% Damped) for Design and Evaluation of BOGP (unit: g) with V_{s30} = 850 m/s.

Period (s)	BOGP (Vs30 = 850 m/s)				
	OBE (1 in 150 AEP)	SEE (1 in 10,000 AEP)	Aftershock	1/500 AEP	1/2,500 AEP
PGA	0.130	0.920	0.433	0.245	0.512
0.01	0.130	0.920	0.454	0.245	0.512
0.02	0.137	0.979	0.515	0.260	0.543
0.03	0.154	1.106	0.596	0.293	0.613
0.04	0.177	1.280	0.918	0.336	0.705
0.075	0.256	1.934	1.046	0.490	1.047
0.1	0.285	2.181	1.131	0.546	1.175
0.15	0.305	2.355	1.039	0.585	1.266
0.2	0.290	2.234	0.923	0.556	1.202
0.25	0.267	2.013	0.815	0.510	1.096
0.3	0.243	1.829	0.641	0.465	0.997
0.4	0.205	1.533	0.517	0.392	0.839
0.5	0.174	1.304	0.328	0.336	0.718
0.75	0.125	0.937	0.226	0.245	0.524
1	0.097	0.718	0.120	0.190	0.406
1.5	0.063	0.456	0.077	0.124	0.264
2	0.047	0.338	0.038	0.094	0.198
3	0.027	0.198	0.024	0.056	0.116
4	0.019	0.142	0.017	0.040	0.086
5	0.014	0.110	0.012	0.030	0.066
6	0.011	0.085	0.008	0.023	0.051
7.5	0.008	0.064	0.005	0.017	0.038
10	0.005	0.044	0.433	0.012	0.026

TABLE 3. Response Spectra (5% Damped) for Design and Evaluation of BOGP (unit: g) with V_{s30} = 1,000 m/s.

Period (s)	BOGP (Vs30 = 1,000 m/s)				
	OBE (1 in 150 AEP)	SEE (1 in 10,000 AEP)	Aftershock	1/500 AEP	1/2,500 AEP
PGA	0.120	0.850	0.400	0.226	0.472
0.01	0.120	0.850	0.419	0.226	0.472
0.02	0.127	0.907	0.480	0.240	0.503
0.03	0.144	1.037	0.561	0.273	0.573
0.04	0.166	1.217	0.871	0.317	0.668
0.075	0.243	1.864	0.984	0.467	1.004
0.1	0.268	2.084	1.042	0.515	1.116
0.15	0.280	2.185	0.939	0.538	1.169
0.2	0.262	2.027	0.822	0.502	1.088
0.25	0.237	1.797	0.717	0.454	0.976
0.3	0.214	1.613	0.556	0.409	0.879
0.4	0.178	1.333	0.445	0.341	0.730
0.5	0.150	1.124	0.282	0.290	0.620
0.75	0.109	0.807	0.194	0.212	0.453
1	0.084	0.618	0.103	0.163	0.351
1.5	0.055	0.393	0.067	0.108	0.228
2	0.041	0.292	0.035	0.082	0.171
3	0.024	0.180	0.024	0.051	0.107
4	0.018	0.138	0.016	0.038	0.082
5	0.013	0.107	0.012	0.029	0.064
6	0.010	0.084	0.008	0.022	0.049
7.5	0.008	0.063	0.005	0.017	0.037
10	0.005	0.043	0.400	0.011	0.025

TABLE 4. Response Spectra (5% Damped) for Design and Evaluation of BOGP (unit: g) with V_{s30} = 1,500 m/s.

Period (s)	BOGP (Vs30 = 1,500 m/s)				
	OBE (1 in 150 AEP)	SEE (1 in 10,000 AEP)	Aftershock	1/500 AEP	1/2,500 AEP
PGA	0.106	0.752	0.351	0.198	0.415
0.01	0.106	0.752	0.370	0.198	0.415
0.02	0.112	0.806	0.428	0.211	0.444
0.03	0.128	0.932	0.507	0.243	0.512
0.04	0.149	1.109	0.792	0.286	0.605
0.075	0.221	1.718	0.885	0.425	0.919
0.1	0.239	1.890	0.917	0.462	1.005
0.15	0.244	1.934	0.815	0.471	1.027
0.2	0.224	1.762	0.706	0.431	0.939
0.25	0.201	1.545	0.615	0.385	0.833
0.3	0.181	1.383	0.479	0.347	0.749
0.4	0.150	1.144	0.388	0.291	0.625
0.5	0.129	0.974	0.250	0.250	0.537
0.75	0.096	0.712	0.175	0.186	0.400
1	0.075	0.554	0.095	0.146	0.315
1.5	0.050	0.360	0.063	0.099	0.209
2	0.038	0.278	0.034	0.078	0.162
3	0.023	0.174	0.023	0.048	0.103
4	0.017	0.136	0.016	0.036	0.080
5	0.013	0.106	0.012	0.028	0.062
6	0.010	0.083	0.008	0.022	0.048
7.5	0.007	0.062	0.005	0.016	0.036
10	0.005	0.043	0.351	0.011	0.025

TABLE 5. Mean Magnitude and Distance from Hazard Disaggregation.

AEP	Intensity Measures	M_w	D (km)	TRT Contribution (%)		
				Shallow Crust	Subduction Interface	Subduction Intraslab
1 in 150	PGA	6.4	83	**67**	26	7
	SA(0.15)	6.3	74	**66**	26	8
	SA(0.5)	7.3	86	**60**	33	7
	SA(1.0)	7.3	168	**54**	40	6
	SA(3.0)	7.7	212	**52**	45	3
1 in 10,000	PGA	6.8	20	**83**	9	8
	SA(0.15)	6.7	20	**82**	9	9
	SA(0.5)	7.5	34	**82**	11	7
	SA(1.0)	7.4	65	**74**	21	5
	SA(3.0)	8.0	146	**62**	37	1

Notes:

1. V_{s30} is taken as 1,000 m/s.
2. Mean Magnitude (Mw); Mean Source-to-site Distance (D); Tectonic Region Type (TRT).

TABLE 6. Average Magnitude and Distance from Hazard Disaggregation.

TRT	Intensity Measures	1 in 150 AEP		1 in 10,000 AEP	
		M_w	D (km)	M_w	D (km)
Shallow Crust	PGA	6.6	43	7.2	10
	SA(0.15)	6.5	39	7.2	10
	SA(0.5)	7.0	54	7.3	14
	SA(1.0)	7.3	67	7.5	22
	SA(3.0)	7.8	89	7.9	54
Subduction Interface	PGA	8.0	127	8.3	121
	SA(0.15)	8.0	127	8.2	121
	SA(0.5)	8.0	131	8.4	122
	SA(1.0)	8.0	138	8.4	124
	SA(3.0)	8.1	150	8.5	131
Subduction Intraslab	PGA	7.1	142	7.7	125
	SA(0.15)	7.1	143	7.6	126
	SA(0.5)	7.2	147	7.7	126
	SA(1.0)	7.3	151	7.7	128
	SA(3.0)	7.6	158	7.9	130

Notes:

1. V_{s30} is taken as 1,000 m/s.
2. Weighted-average Magnitude (Mw); Weighted-average Source-to-site Distance (D).

TABLE 7. Conversion Ratios for different SA Values for Consideration of Ground Motion Orientations

Period (s)	SA_{larger}/SA_{RotD50}	$SA_{RotD100}/SA_{RotD50}$
PGA	1.107	1.188
0.01	1.107	1.188
0.02	1.107	1.188
0.03	1.107	1.188
0.04	1.107	1.188
0.075	1.107	1.188
0.1	1.107	1.188
0.15	1.114	1.195
0.2	1.119	1.203
0.25	1.123	1.210
0.3	1.126	1.216
0.4	1.131	1.224
0.5	1.134	1.227
0.75	1.137	1.230
1	1.139	1.232
1.5	1.141	1.235
2	1.144	1.237
3	1.146	1.241
4	1.148	1.251
5	1.155	1.259
6	1.162	1.267
7.5	1.171	1.276
10	1.178	1.287

Note: SA_{larger}: Larger value of the two as-recorded components at each period; SA_{RotDnn}: nn-th percentile of the Sa value obtained by rotating the horizontal components through all non-redundant angles.

TABLE 8. Design Seismic Parameters for Geotechnical Analysis.

V_{s30} (m/s)	Design Earthquake	1 in 150 AEP	1 in 2,500 AEP	Aftershock
850	**PGA (g)**	0.130	0.920	0.433
	M_w	6.4	6.8	5.8
1,000	**PGA (g)**	0.120	0.850	0.400
	M_w	6.4	6.8	5.8
1,500	**PGA (g)**	0.106	0.752	0.351
	M_w	6.4	6.8	5.8

FIGURES

1 TO 7

List of Figures

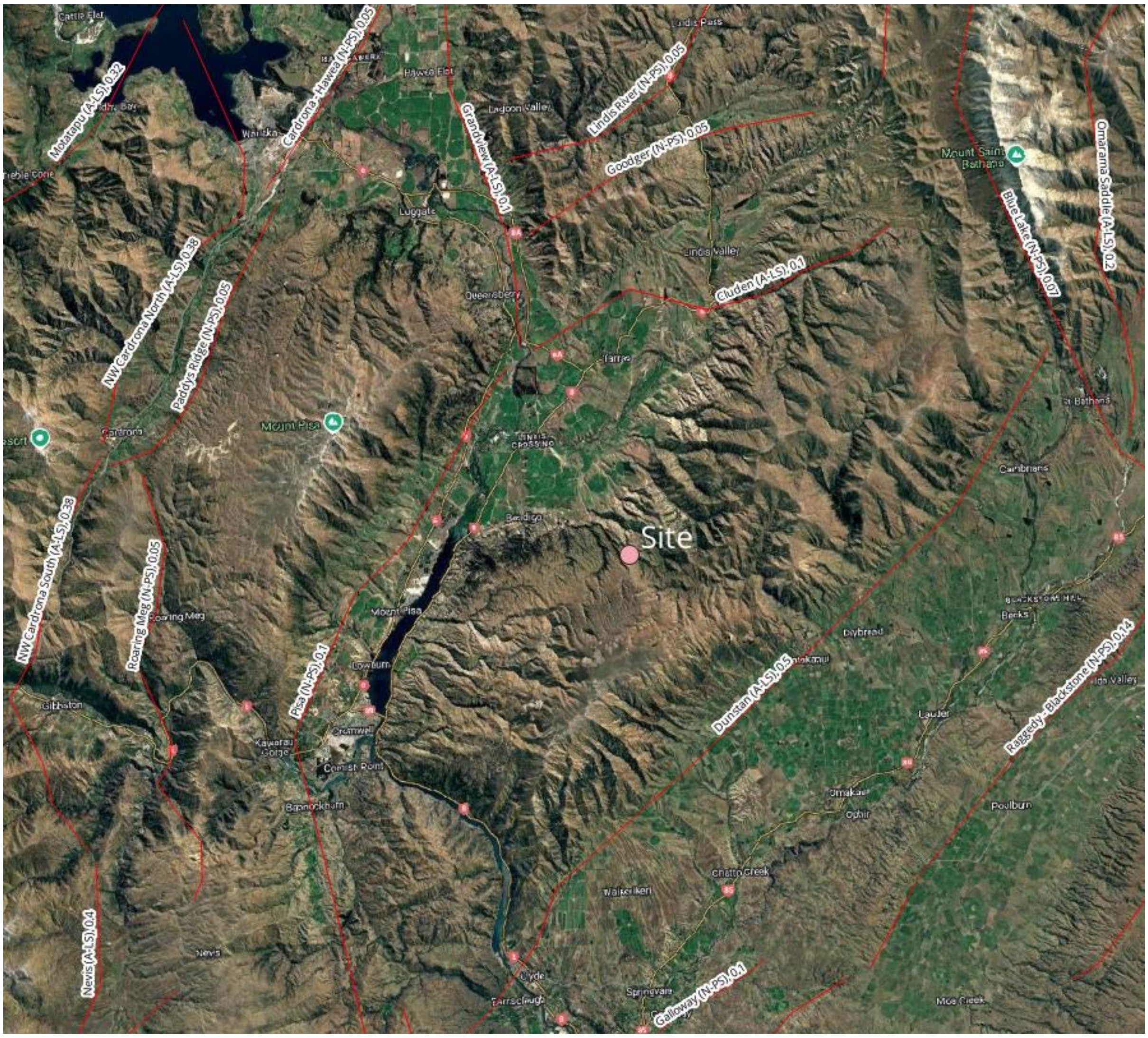

FIGURE 1. Site Location and Nearby Active Faults.

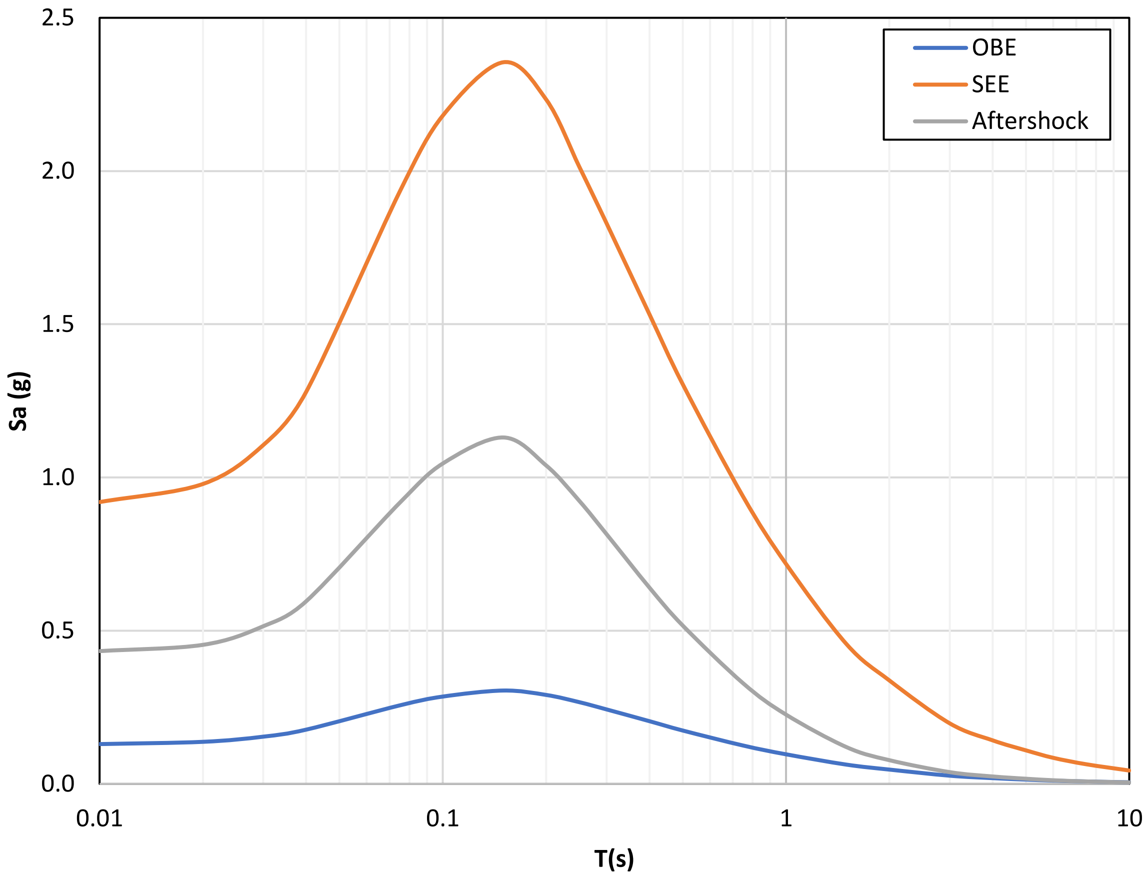

FIGURE 2. Mean Response Spectra (OBE, SEE, and Aftershock) for BOGP (V_{s30} = 850 m/s).

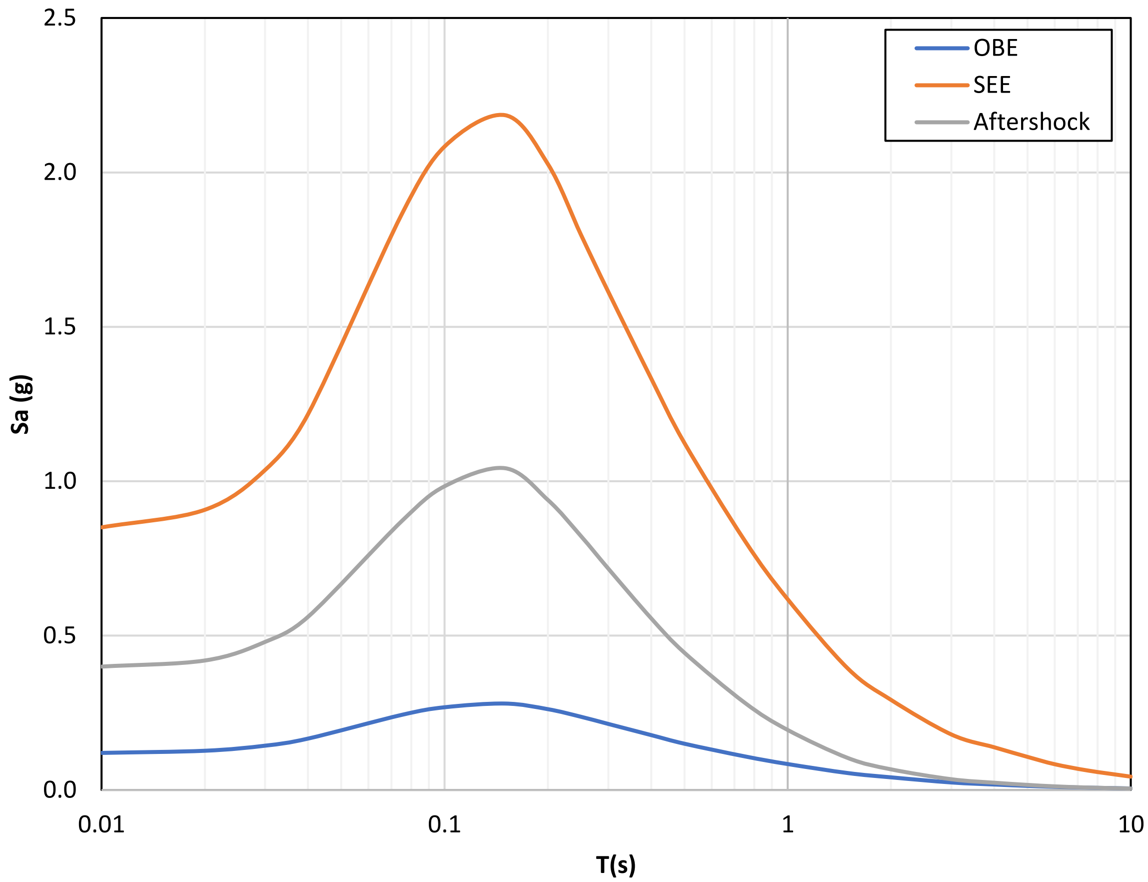

FIGURE 3. Mean Response Spectra (OBE, SEE, and Aftershock) for BOGP (V_{s30} = 1,000 m/s).

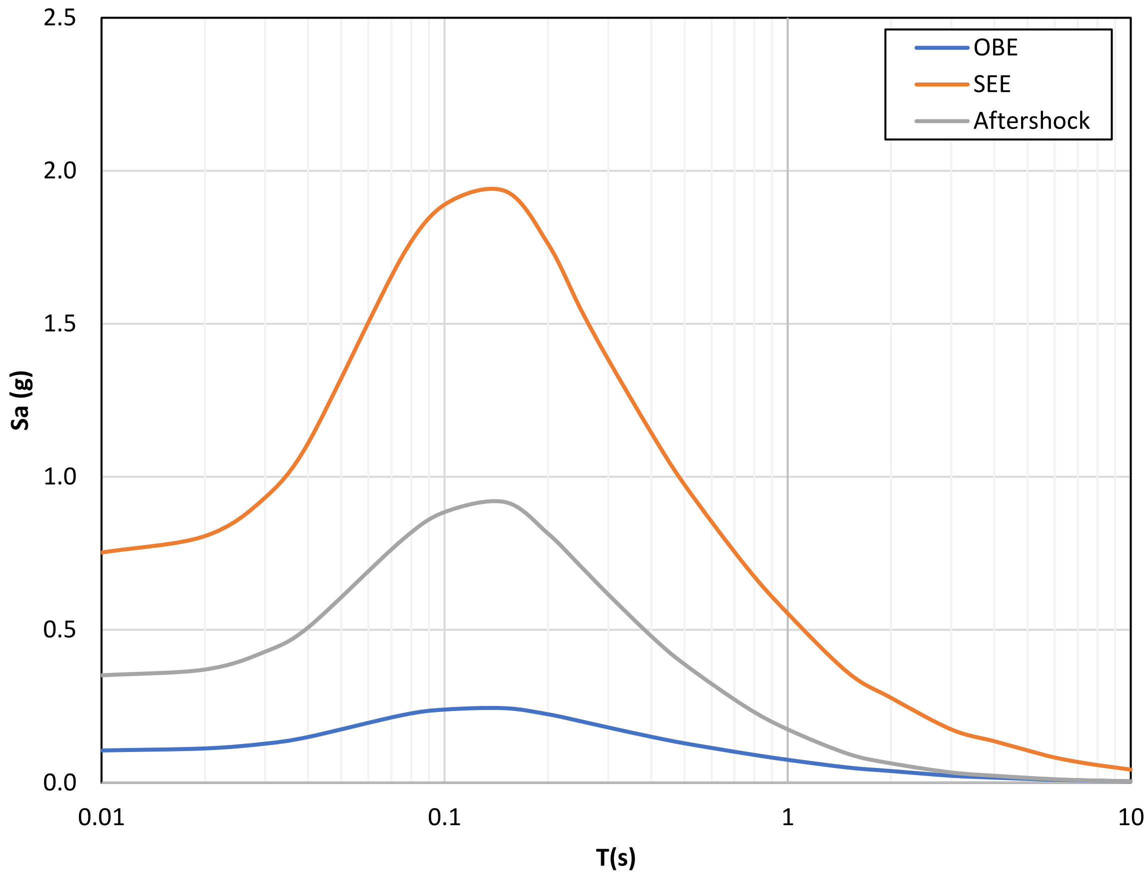

FIGURE 4. Mean Response Spectra (OBE, SEE, and Aftershock) for BOGP (V_{s30} = 1,500 m/s).

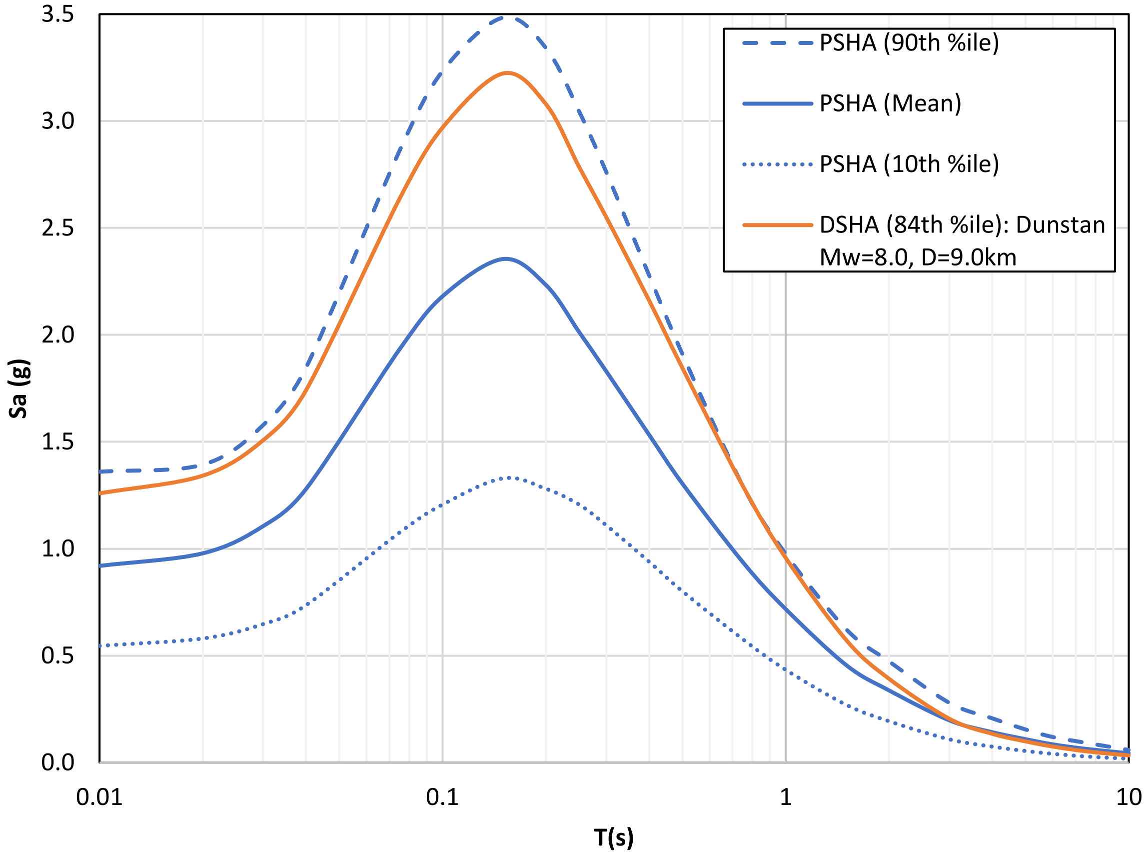

FIGURE 5. Spectra Comparison between DSHA (84th Percentile) and PSHA (10th Percentile, 90th Percentile, and Mean) for V_{s30} = 850 m/s.

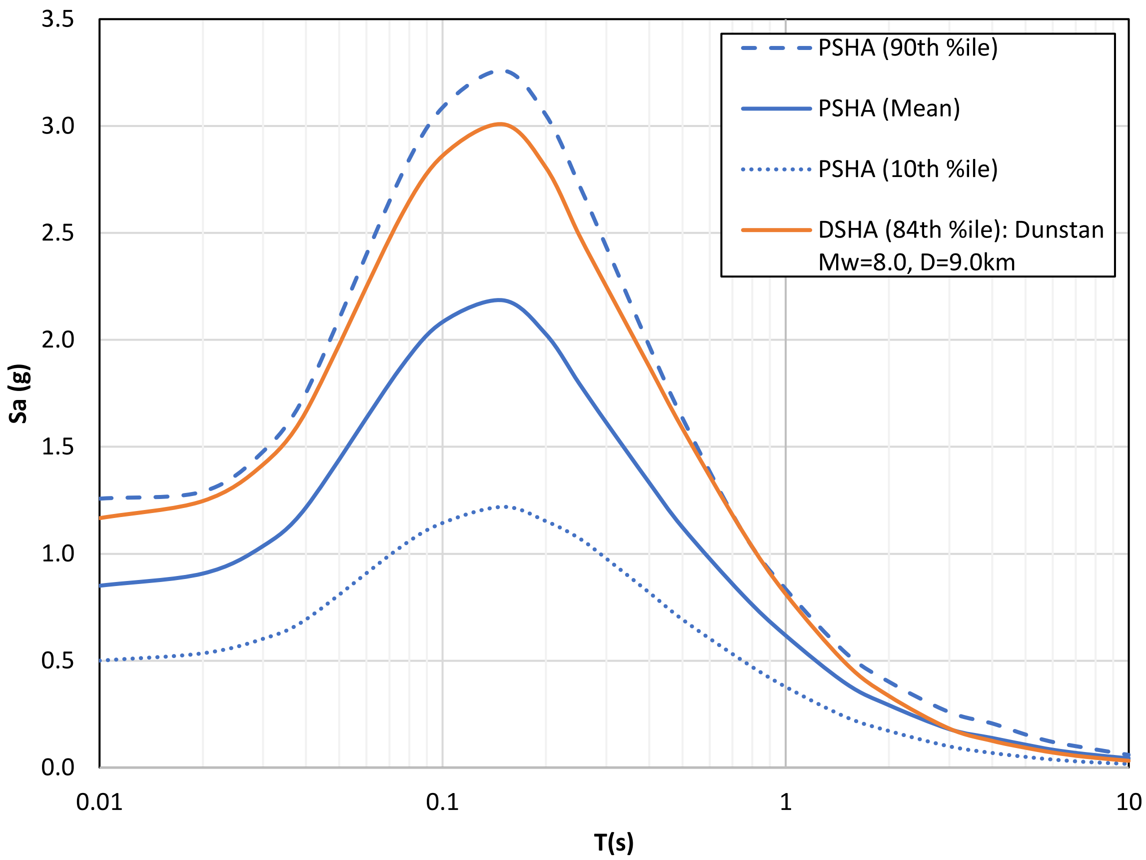

FIGURE 6. Spectra Comparison between DSHA (84th Percentile) and PSHA (10th Percentile, 90th Percentile, and Mean) for V_{s30} = 1,000 m/s.

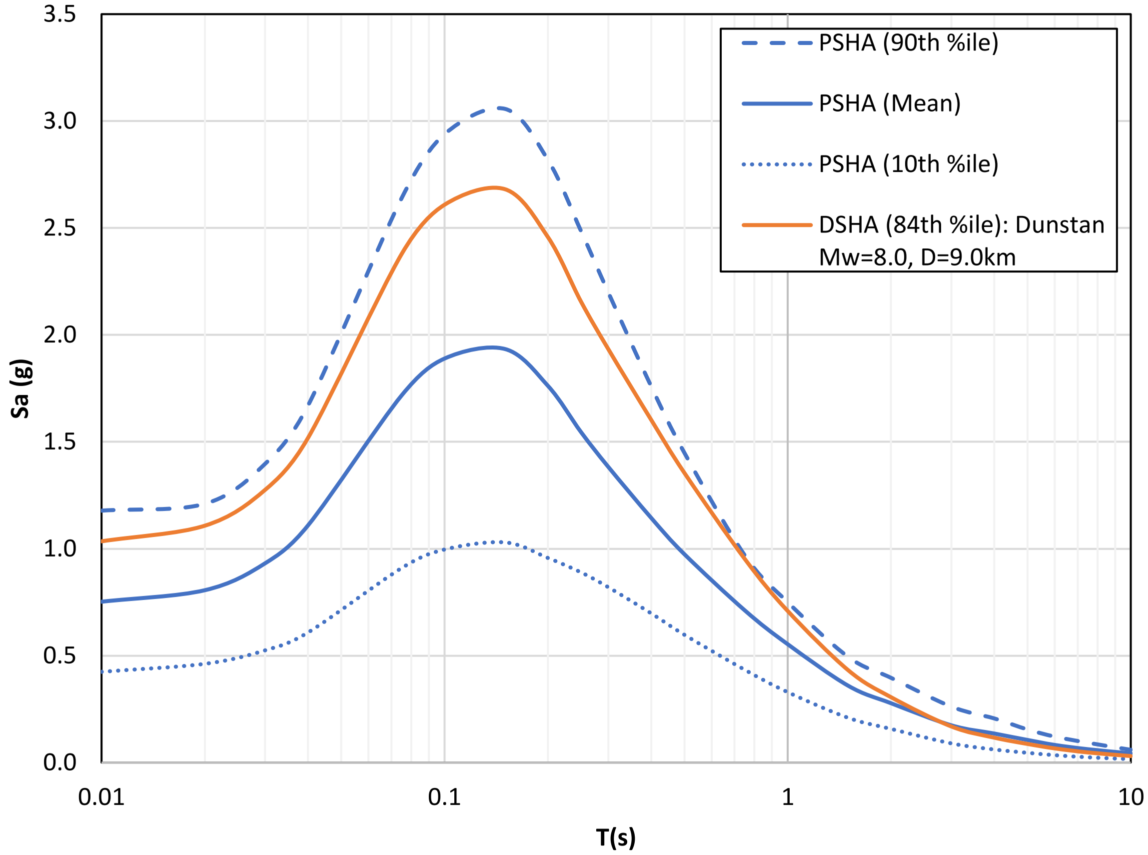

FIGURE 7. Spectra Comparison between DSHA (84th Percentile) and PSHA (10th Percentile, 90th Percentile, and Mean) for V_{s30} = 1,500 m/s.

APPENDIX A

PROBABILISTIC SEISMIC HAZARD ANALYSIS (PSHA) PLOTS

List of Figures in Appendix A

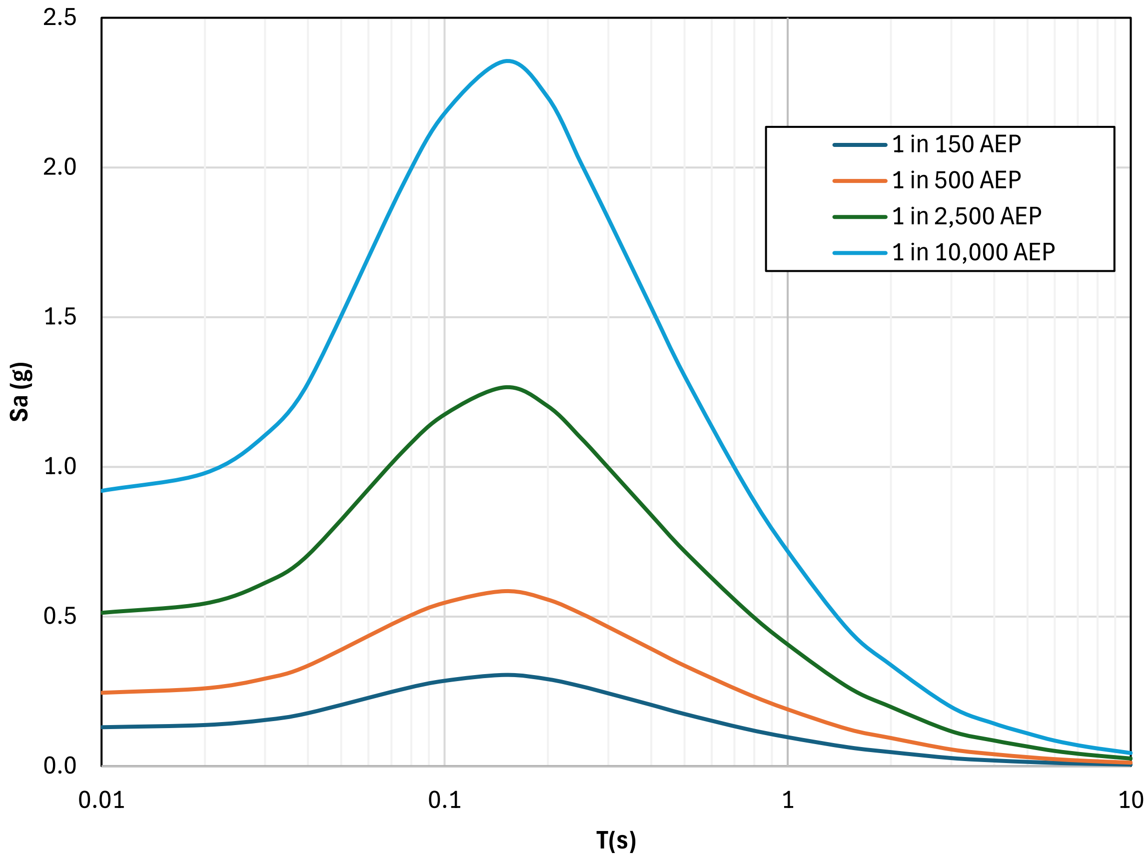

Figure A1: Mean Response Spectra from PSHA for BOGP (V_{s30} = 850 m/s).

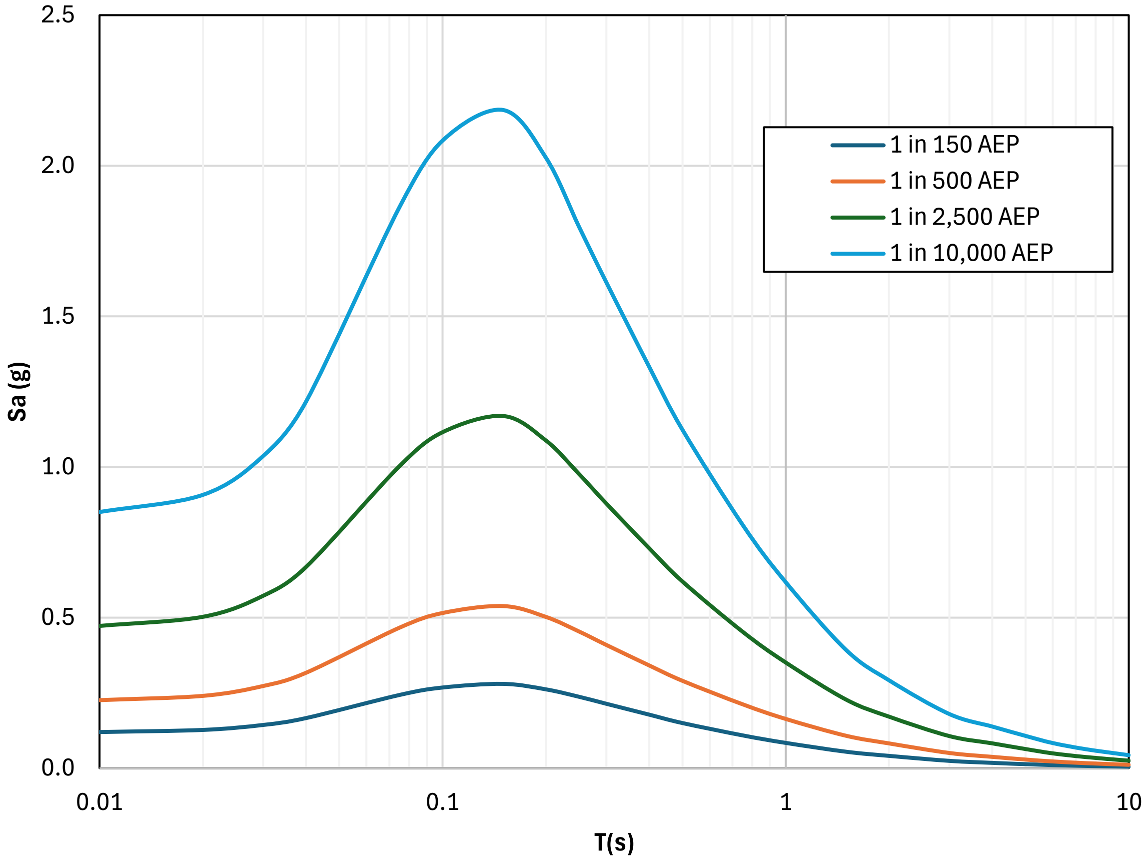

Figure A2: Mean Response Spectra from PSHA for BOGP (V_{s30} = 1,000 m/s).

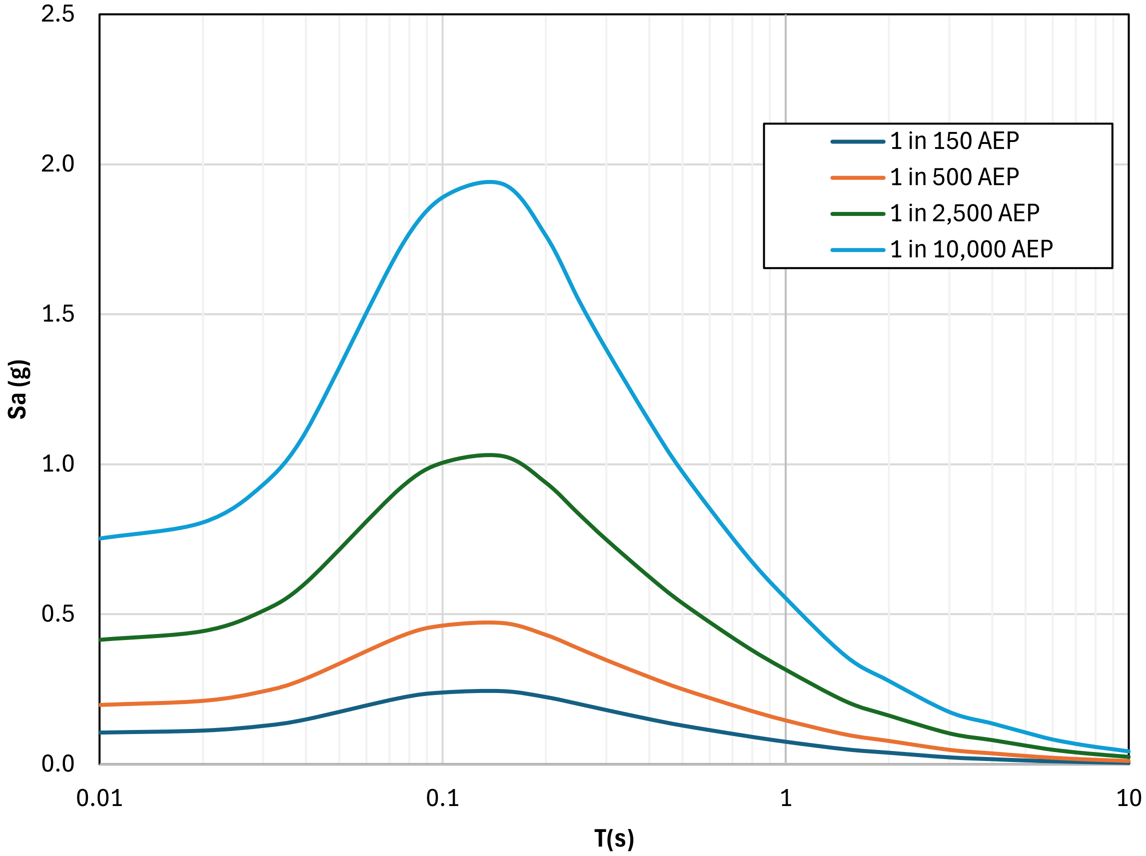

Figure A3: Mean Response Spectra from PSHA for BOGP (V_{s30} = 1,500 m/s).

APPENDIX B

HAZARD DISAGGREGATION PLOTS

List of Figures in Appendix B

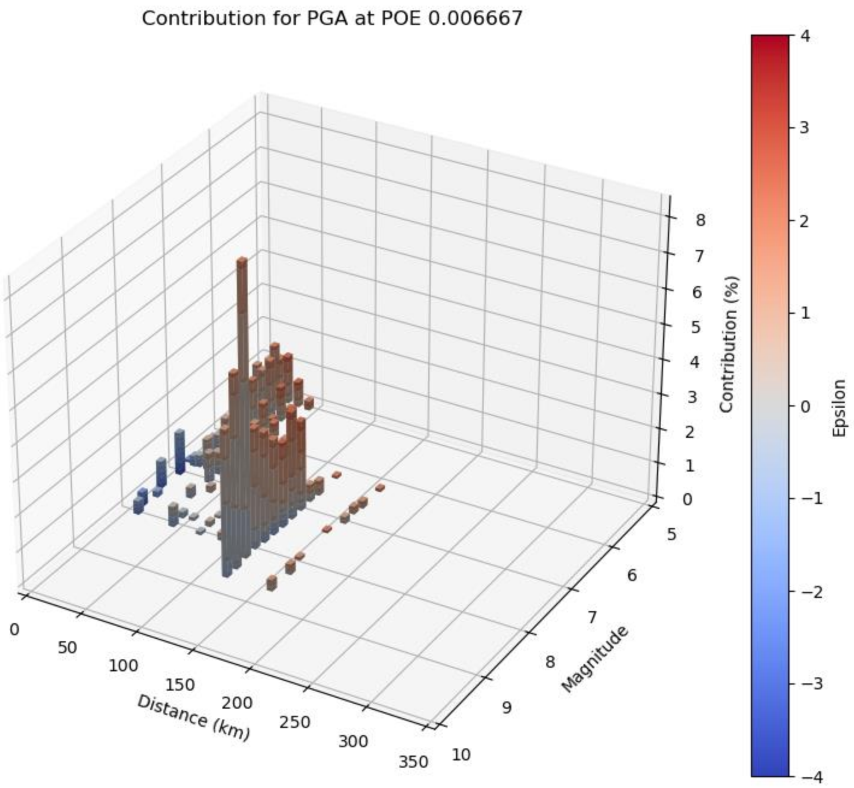

Figure B1: PGA Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 150 AEP)

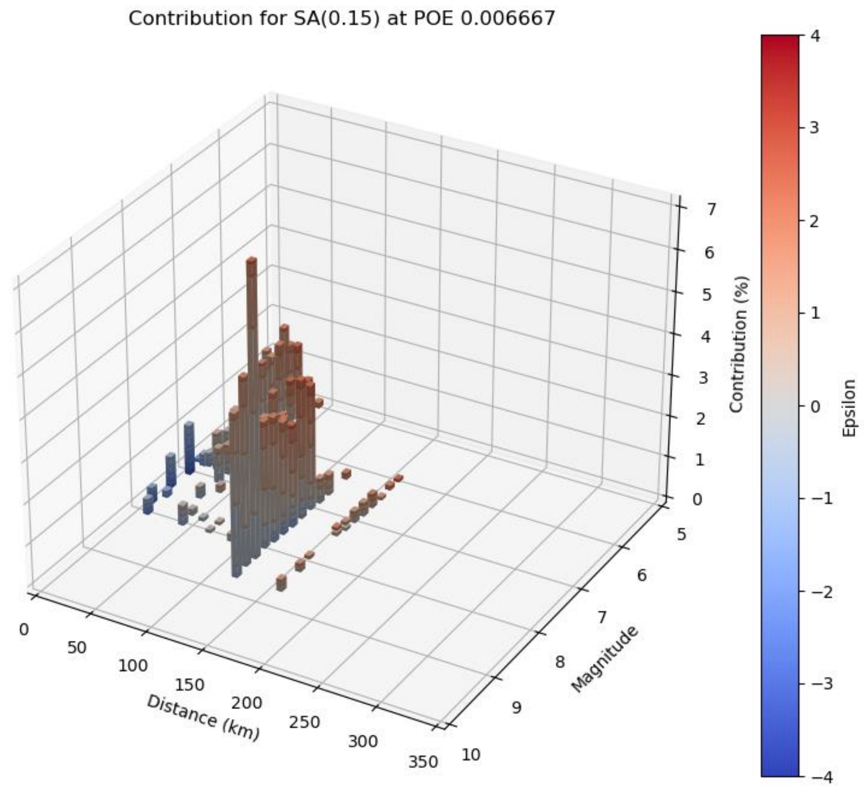

Figure B2: SA(0.15) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 150 AEP)

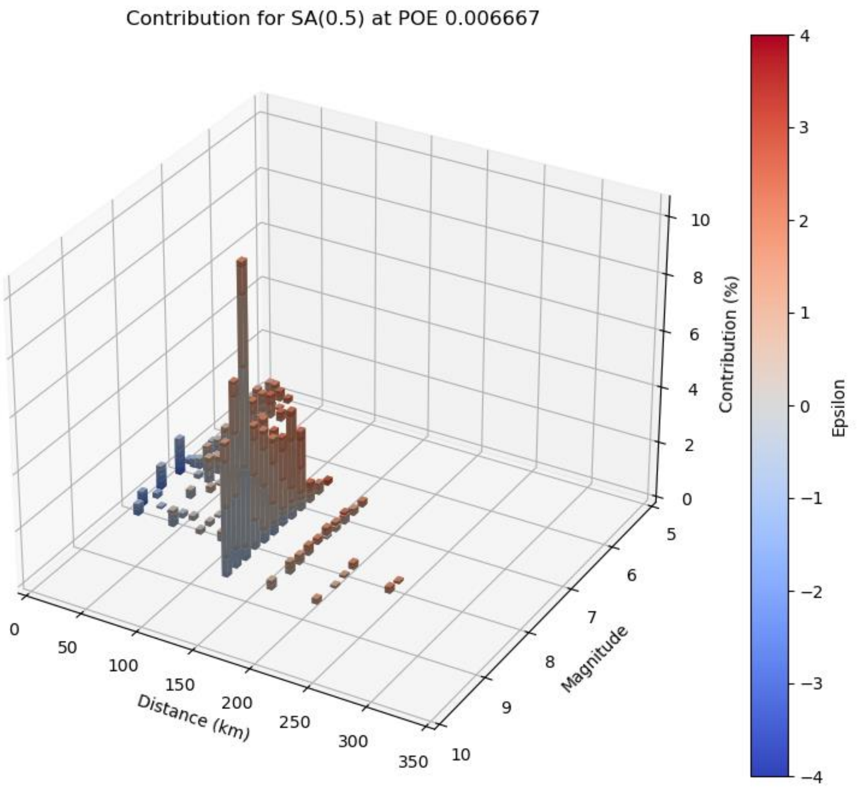

Figure B3: SA(0.5) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 150 AEP)

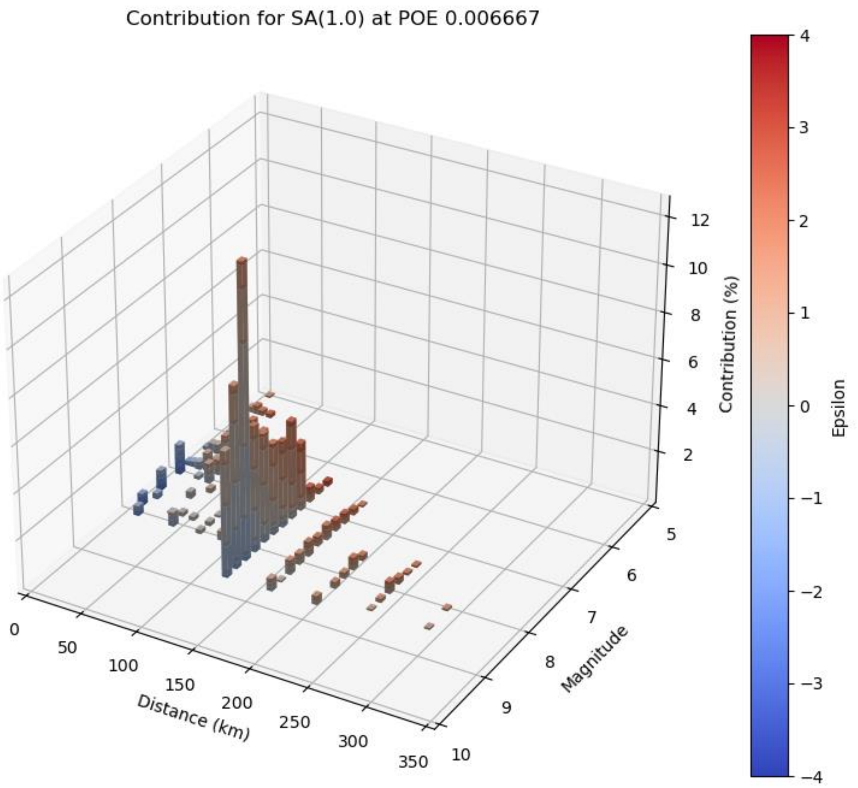

Figure B4: SA(1.0) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 150 AEP)

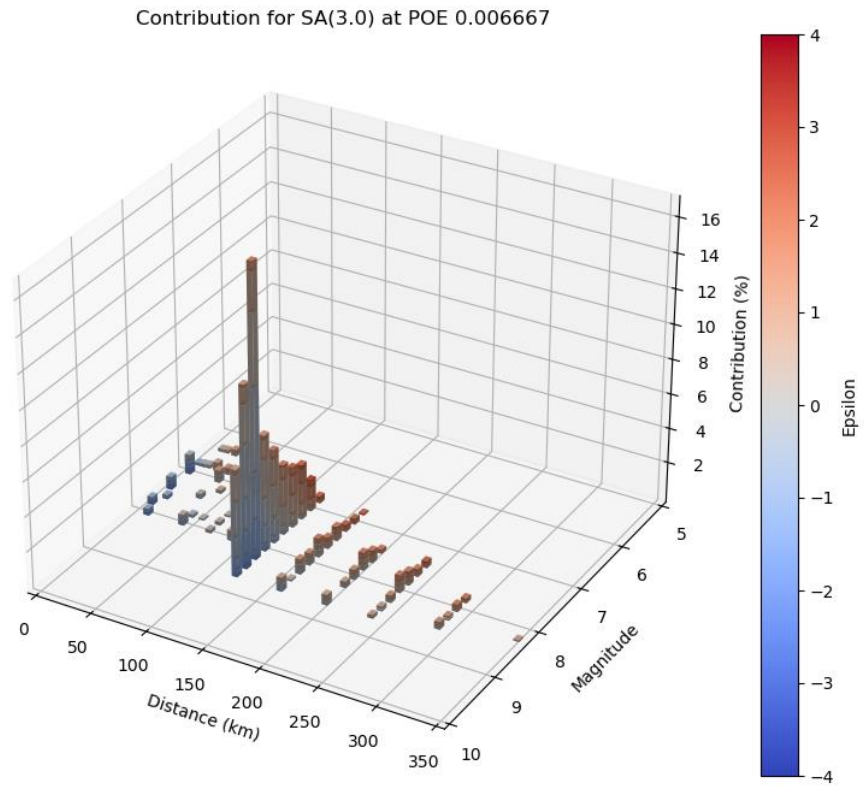

Figure B5: SA(3.0) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 150 AEP)

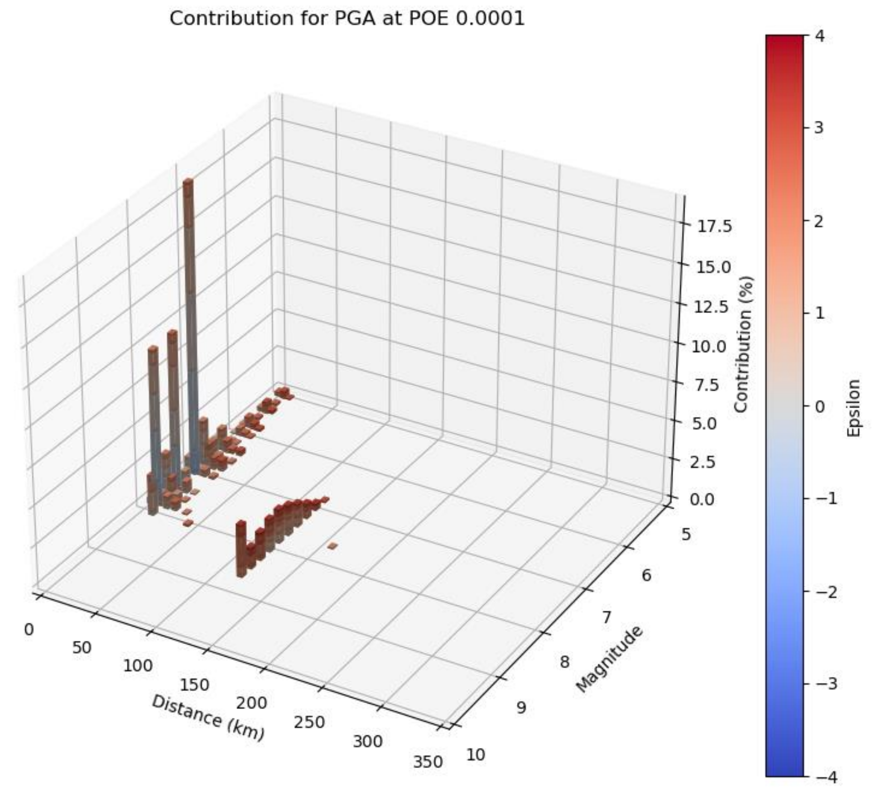

Figure B6: PGA Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 10,000 AEP)

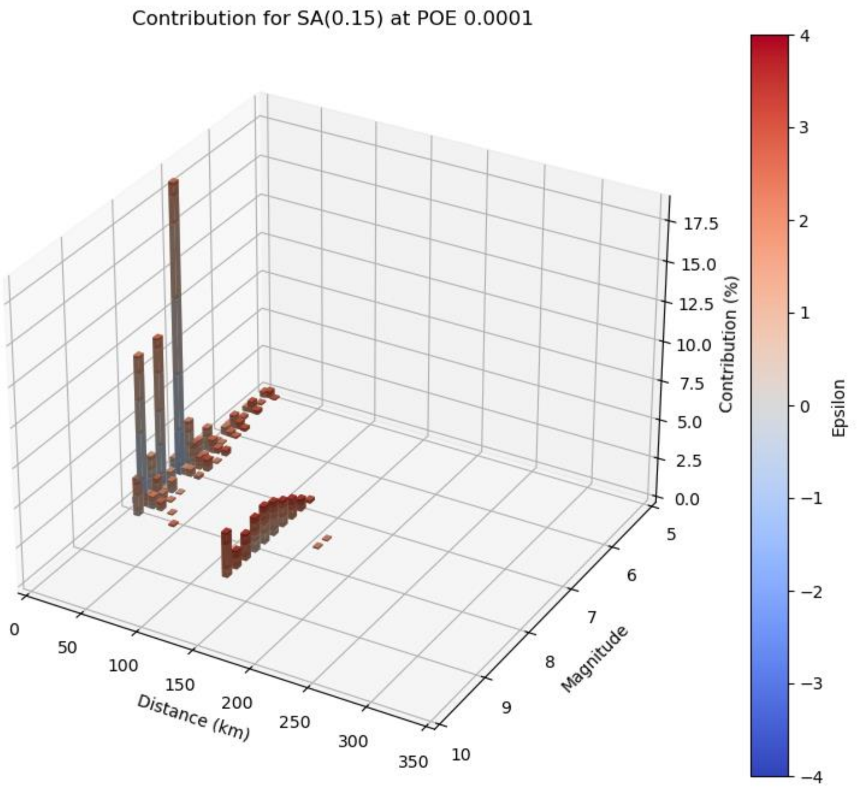

Figure B7: SA(0.15) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 10,000 AEP)

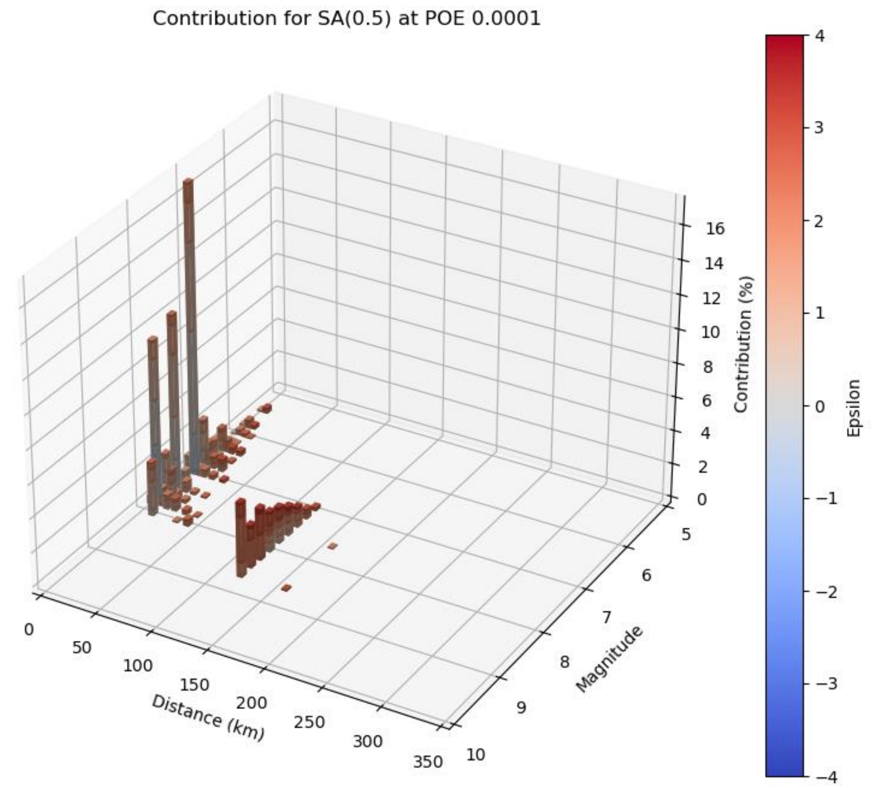

Figure B8: SA(0.5) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 10,000 AEP)

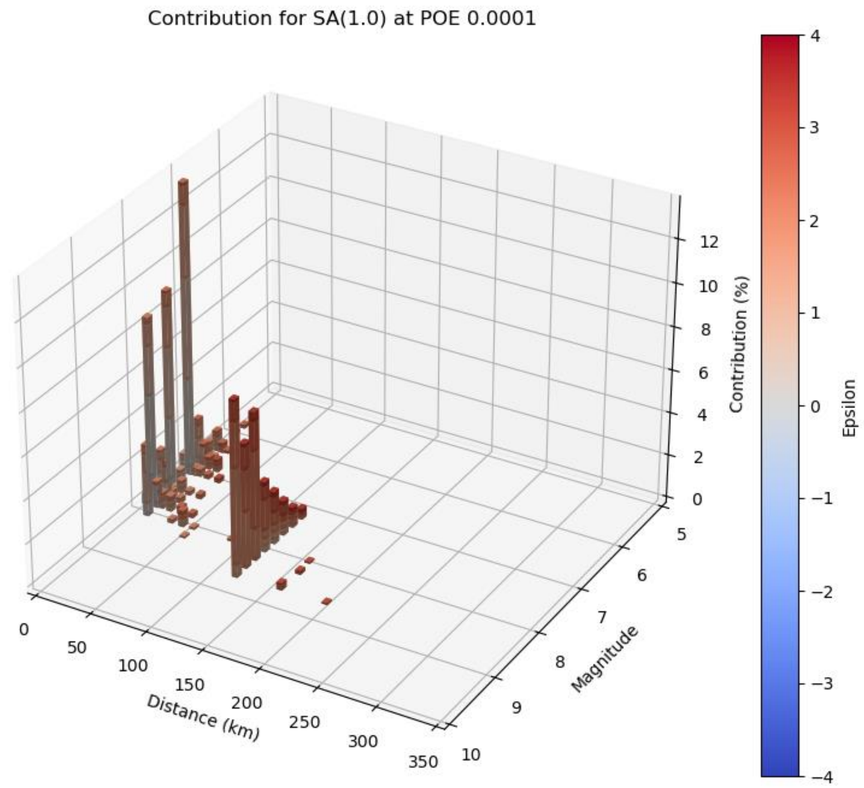

Figure B9: SA(1.0) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 10,000 AEP)

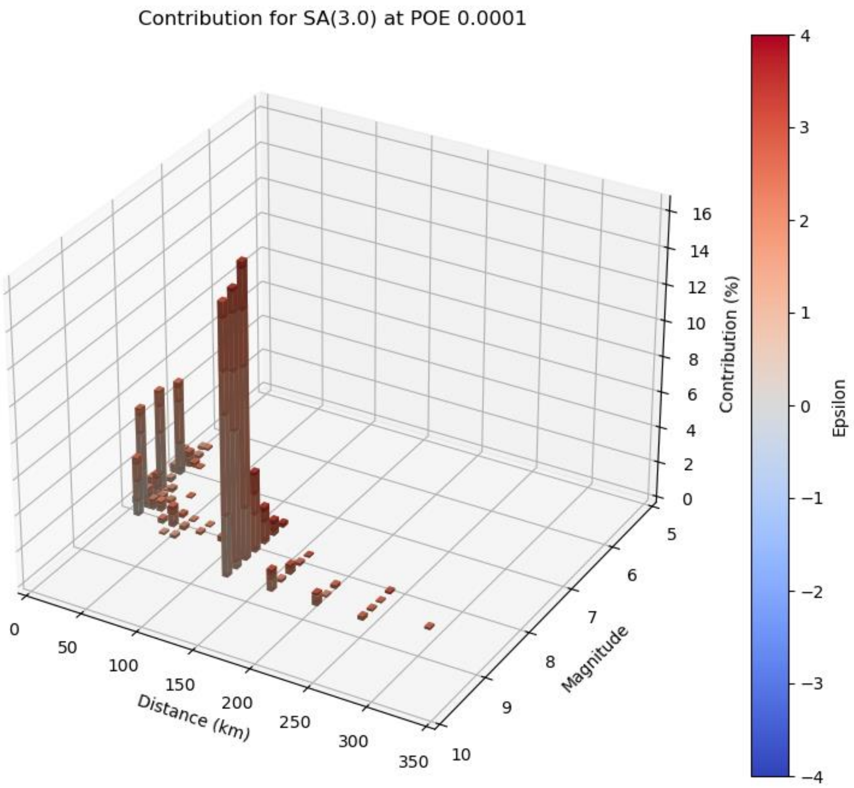

Figure B10: SA(3.0) Hazard Disaggregation by Magnitude and Distance for BOGP (1 in 10,000 AEP)

APPENDIX C

DETERMINISTIC SEISMIC HAZARD ANALYSIS (DSHA) PLOTS

List of Tables in Appendix C

Table C1. 84th Percentile Response Spectra from DSHA for BOGP with V_{s30} of 850 m/s.

Period (s)	84th Percentile Response Spectra (g)		
	DSHA 1	DSHA 2	DSHA 3
PGA	1.259	0.722	0.141
0.01	1.259	0.722	0.141
0.02	1.342	0.764	0.148
0.03	1.508	0.846	0.160
0.04	1.741	0.954	0.177
0.075	2.639	1.385	0.234
0.1	2.970	1.562	0.256
0.15	3.223	1.734	0.280
0.2	3.079	1.692	0.284
0.25	2.785	1.572	0.276
0.3	2.550	1.460	0.268
0.4	2.160	1.266	0.247
0.5	1.845	1.105	0.227
0.75	1.294	0.817	0.184
1	0.958	0.627	0.153
1.5	0.574	0.400	0.113
2	0.392	0.293	0.091
3	0.205	0.174	0.063
4	0.135	0.122	0.049
5	0.099	0.092	0.039
6	0.075	0.071	0.031
7.5	0.053	0.051	0.025
10	0.033	0.033	0.017

Notes:

1. DSHA 1 for Dunstan Fault with Magnitude M_w = 8.0 and Source-to-site Distance D = 9.0 km;
2. DSHA 2 for Pisa Fault with Magnitude M_w = 8.2 and Source-to-site Distance D = 13.1 km; and
3. DSHA 3 for Alpine (George to Jacksons) Fault with Magnitude M_w = 8.6 and Source-to-site Distance D = 115.0 km.

Table C2. 84th Percentile Response Spectra from DSHA for BOGP with V_{s30} of 1,000 m/s.

Period (s)	84th Percentile Response Spectra (g)		
	DSHA 1	DSHA 2	DSHA 3
PGA	1.166	0.665	0.130
0.01	1.166	0.665	0.130
0.02	1.247	0.706	0.137
0.03	1.418	0.789	0.149
0.04	1.666	0.900	0.166
0.075	2.567	1.327	0.221
0.1	2.861	1.480	0.239
0.15	3.009	1.599	0.257
0.2	2.806	1.529	0.255
0.25	2.490	1.397	0.244
0.3	2.250	1.282	0.235
0.4	1.876	1.096	0.213
0.5	1.586	0.948	0.194
0.75	1.102	0.696	0.157
1	0.812	0.532	0.129
1.5	0.486	0.339	0.095
2	0.335	0.250	0.078
3	0.182	0.155	0.056
4	0.125	0.113	0.046
5	0.093	0.086	0.037
6	0.070	0.066	0.030
7.5	0.050	0.048	0.024
10	0.032	0.031	0.017

Notes:

1. DSHA 1 for Dunstan Fault with Magnitude M_w = 8.0 and Source-to-site Distance D = 9.0 km;
2. DSHA 2 for Pisa Fault with Magnitude M_w = 8.2 and Source-to-site Distance D = 13.1 km; and
3. DSHA 3 for Alpine (George to Jacksons) Fault with Magnitude M_w = 8.6 and Source-to-site Distance D = 115.0 km.

Table C3. 84th Percentile Response Spectra from DSHA for BOGP with V_{s30} of 1,500 m/s.

Period (s)	84th Percentile Response Spectra (g)		
	DSHA 1	**DSHA 2**	**DSHA 3**
PGA	1.035	0.580	0.113
0.01	1.035	0.580	0.113
0.02	1.108	0.617	0.119
0.03	1.276	0.698	0.131
0.04	1.519	0.807	0.148
0.075	2.379	1.205	0.199
0.1	2.609	1.325	0.212
0.15	2.681	1.398	0.223
0.2	2.458	1.314	0.218
0.25	2.155	1.186	0.206
0.3	1.934	1.084	0.197
0.4	1.603	0.925	0.178
0.5	1.355	0.803	0.163
0.75	0.952	0.602	0.135
1	0.709	0.468	0.114
1.5	0.432	0.306	0.086
2	0.306	0.232	0.073
3	0.169	0.145	0.053
4	0.117	0.106	0.044
5	0.087	0.081	0.035
6	0.066	0.063	0.029
7.5	0.048	0.046	0.023
10	0.031	0.030	0.016

Notes:

1. DSHA 1 for Dunstan Fault with Magnitude M_w = 8.0 and Source-to-site Distance D = 9.0 km;
2. DSHA 2 for Pisa Fault with Magnitude M_w = 8.2 and Source-to-site Distance D = 13.1 km; and
3. DSHA 3 for Alpine (George to Jacksons) Fault with Magnitude M_w = 8.6 and Source-to-site Distance D = 115.0 km.

Table C4. Aftershock Response Spectra Adjusted from DSHA for BOGP.

Period (s)	Aftershock Response Spectra (g)		
	V_{s30} = 850 m/s	V_{s30} = 1,000 m/s	V_{s30} = 1,500 m/s
PGA	0.443	0.409	0.358
0.01	0.443	0.409	0.358
0.02	0.474	0.439	0.387
0.03	0.543	0.507	0.453
0.04	0.634	0.599	0.542
0.075	0.973	0.926	0.845
0.1	1.102	1.041	0.935
0.15	1.177	1.085	0.952
0.2	1.089	0.984	0.849
0.25	0.959	0.852	0.727
0.3	0.847	0.745	0.634
0.4	0.669	0.581	0.497
0.5	0.538	0.463	0.401
0.75	0.350	0.301	0.266
1	0.244	0.210	0.189
1.5	0.134	0.115	0.105
2	0.088	0.076	0.072
3	0.043	0.039	0.037
4	0.026	0.025	0.024
5	0.017	0.017	0.016
6	0.012	0.012	0.011
7.5	0.008	0.008	0.007
10	0.005	0.004	0.004

Note: DSHA results were adjusted by assuming that the aftershock has the same number of standard deviations as PSHA results.

List of Figures in Appendix C

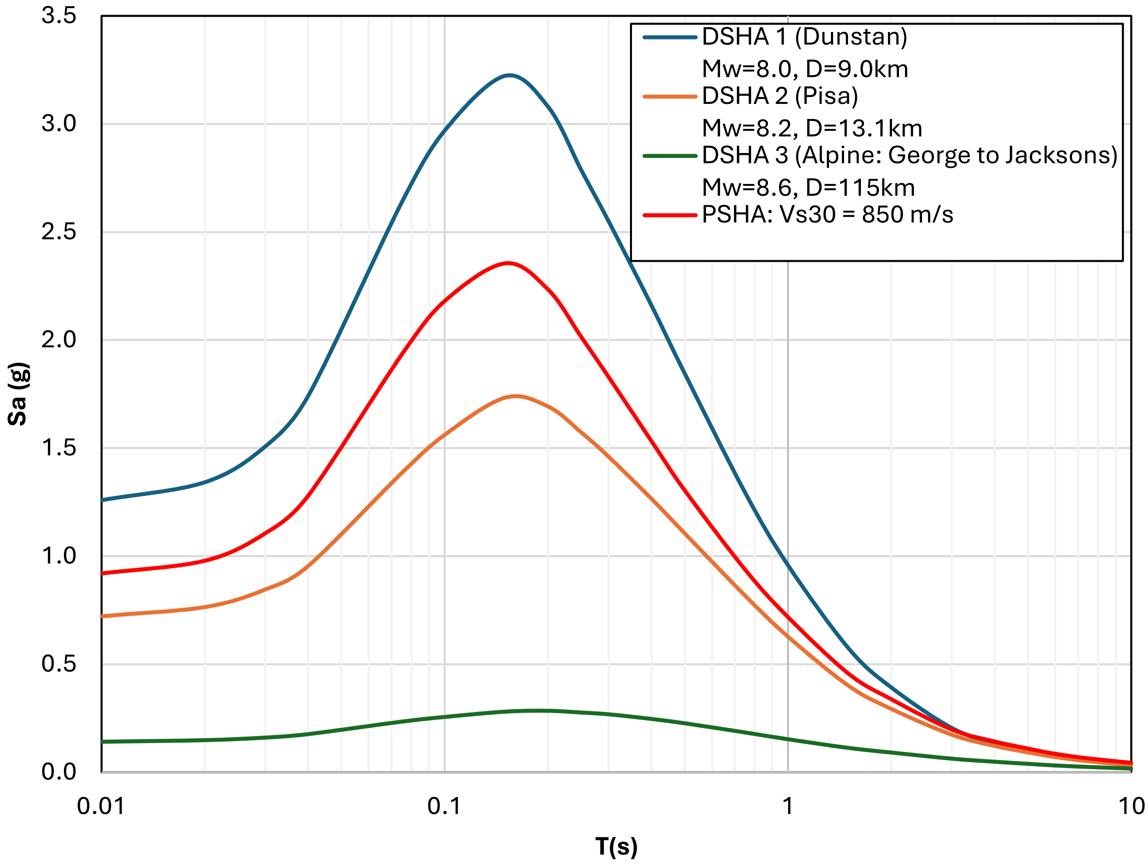

Figure C1: 84th Percentile Main Shock Response Spectra from DSHA for BOGP with V_{s30} = 850 m/s.

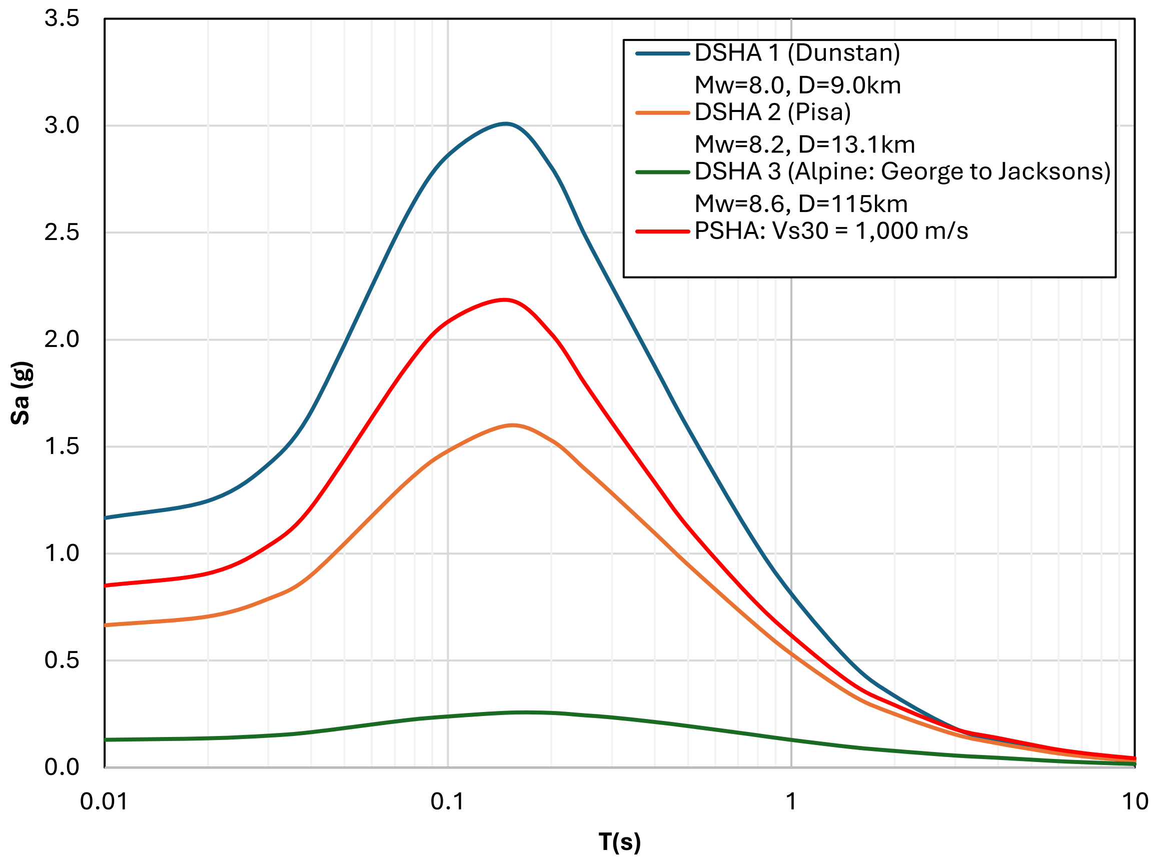

Figure C2: 84th Percentile Response Spectra for Main Shock from DSHA for BOGP with V_{s30} = 1,000 m/s.

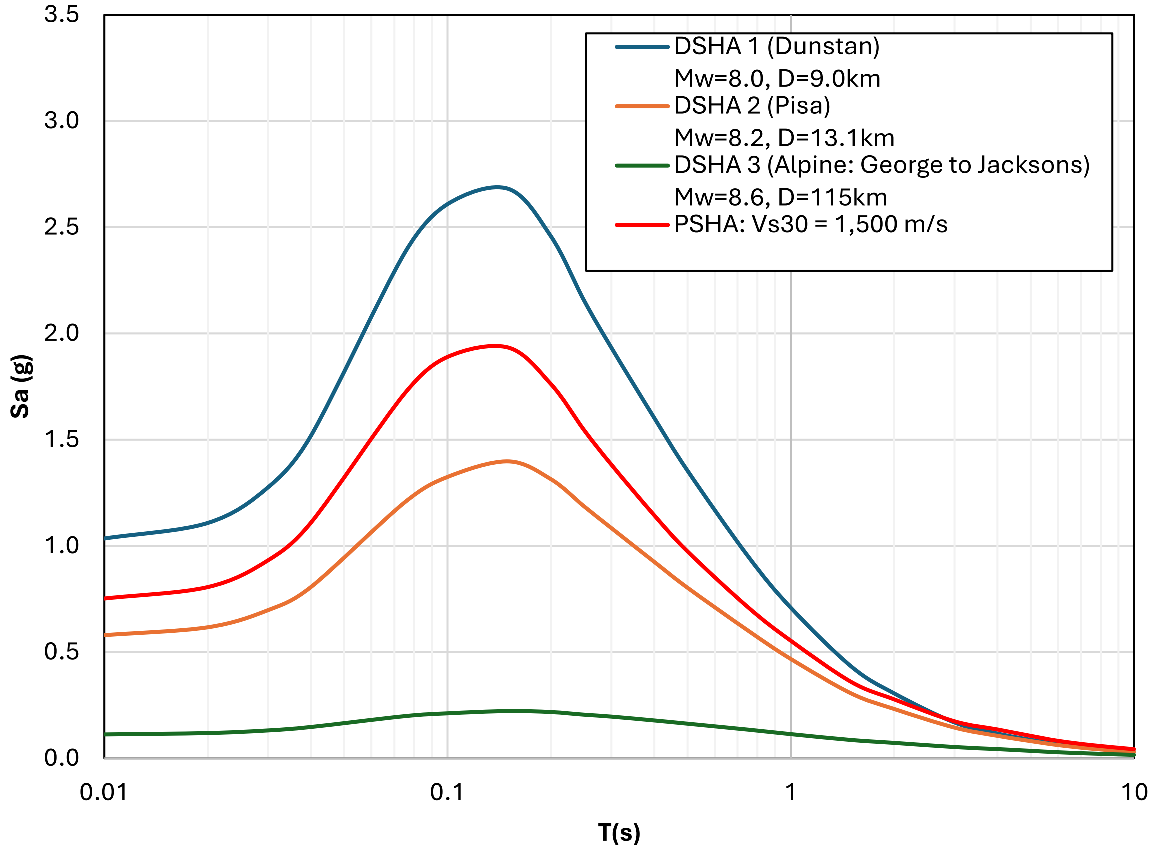

Figure C3: 84th Percentile Response Spectra for Main Shock from DSHA for BOGP with V_{s30} = 1,500 m/s.

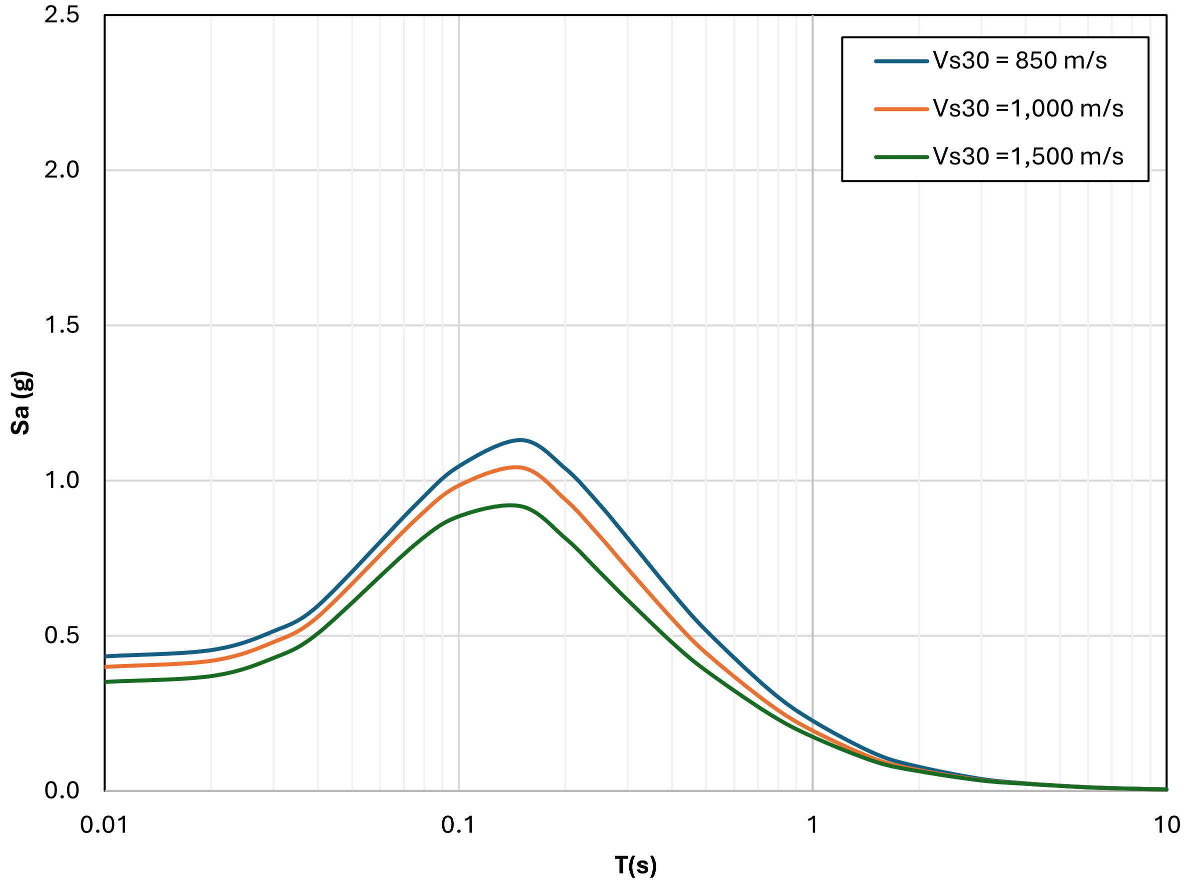

Figure C4: Aftershock Response Spectra adjusted from DSHA for BOGP.