289407 Redacted

TCC/WBOPDC Geo-professional meeting

6 July 2022

Tauranga City

Agenda

1. Welcome - s 7(2)(f)(ii) [redacted]
2. Geo-professional application and renewal process - s 7(2)(f)(ii) [redacted]
3. Possible changes in Cat 1 and Cat 2 scope of works. – s 7(2)(f)(ii) [redacted]
4. Investigations, slope stability issues and retaining walls – s 7(2)(f)(ii) [redacted]
5. Which design earthquake should we be using – s 7(2)(f)(ii) [redacted]
6. Other

Tauranga Geo-Professional Application & Renewal Process

Refer to:

DS-10 - Appendix C - Geo-Professional Accreditation System

- Only Geo-professionals that are Council-accredited can undertake the responsibilities of a Geo-Professional.
- Cat. 1 - provide advice on <u>all</u> geotechnical issues within *Council*'s area.
- Cat. 2 - provide advice on <u>a limited</u> number of less complex issues...
- Cat. 3 - provide advice <u>under supervision</u> by others (Cat. 1 or 2).

- *Refer to:* DS-10 - Appendix B.5 Table 1: Geo-Professional Requirements for Geohazard Risk Assessment and Mitigation ... for more information on the types of work each Category of Geo-Professional can undertake.

Tauranga Geo-Professional Application & Renewal Process

Refer to:

DS-10.7.1 Geo-Professional - Requirements

- All must be either:
  - CPEng (Engineers), or
  - CPEng (P. EngGeol.) (Engineering Geologists)

- *Refer to:* DS-10.7.1 Geo-Professional (b), (i) to (x) ... for more information on the requirements.

Tauranga Geo-Professional Application & Renewal Process

Refer to:

DS-10 - Appendix C.3   Accreditation Period

- Accreditation on the Register is for a period of 5 years.
- As the end of the 5-year period approaches, the geo-practitioner will be reviewed based on frequency and quality of reports presented to Council within that 5-year period.

Refer to:

DS-10 - Appendix D.1   List of Accredited Geo-Professionals

Tauranga Geo-Professional Application & Renewal Process

Refer to:

DS-10.7.2 Suitably Qualified and Experienced (SQE) Professional

- SQE Professionals shall only work within the category that they are accredited for.

Tauranga Geo-Professional Application & Renewal Process

Refer to:

DS-10.7.2 Application Form: IDC - Landform & Geotech Reqt's

https://www.tauranga.govt.nz/our-future/strategic-planning/infrastructure-development-code/landform-and-geotechnical-requirements

Application for geo-professional accreditation

Tauranga City

Western Bay of Plenty District Council

Application Category:
(Tick Appropriate Category)

- ☐ Category 1 Geotechnical Engineer
- ☐ Category 2 Geotechnical Engineer
- ☐ Category 3 Geotechnical Engineer or Engineering Geologist
- ☐ Category 1 Engineering Geologist
- ☐ Category 2 Engineering Geologist

Applicant Name: ____________________

Position Title: ____________________

Company Name: ____________________

Postal Address: ____________________

____

Phone: (Bus): ____________________ **(Mob):** ____________________

Email: ____________________

IMPORTANT:

- Applicants shall be familiar with the content of section *DS-10 Natural Hazards & Earthworks* of the Tauranga City Council *Infrastructure Development Code (IDC)* to facilitate the processing of this application.
- Applications shall meet all requirements of *DS-10.7* & *DS-10 Appendix C* of the *IDC*.
- Refer to "Tips for successful applications" appended to this application form
- More information is available on the following website:

http://www.tauranga.govt.nz/our-future/strategic-planning/infrastructure-development-code/landform-and-geotechnical-requirements

<u>This application includes the following electronic information emailed to idc@tauranga.govt.nz*:</u>

This application includes the following electronic information emailed to idc@tauranga.govt.nz*:

- ☐ Relevant tertiary qualifications and details of specialist courses undertaken.
- ☐ A resume of the applicant's professional experience.
- ☐ Evidence of Chartered Engineering New Zealand membership and professional registration, either CPEng (with practice area Geotechnical for Category 1 and 2) and/or CMEngNZ (PEngGeol). Note - you may apply for accreditation in advance of your application for CPEng / PEngGeol but award will be delayed until such a time as CPEng / PEngGeol is confirmed.
- ☐ A statement of tutelage in Engineering Geology or Geotechnical Engineering supplied by a Chartered Professional Engineer or PEngGeol.
- ☐ A list of reports prepared by the applicant stating geographic location of the subject sites, dates and reference numbers. Please ensure that at least one of these reports covers stability issues on volcanic ash soils and specify what your role was in the preparation of each of the reports.
- ☐ **Four (4)** selected reports from the above list which illustrate the applicant's original work. Ensure that all reports are complete with full appendices as issued and includes the factual geotechnical data.
- ☐ Signed copy of this application form
- ☐ Deposit as per https://www.tauranga.govt.nz/council/forms-fees-and-payments/fees-and-charges/development-works-fees. Please deposit funds into (ANZ) Tauranga City Council General Account 06-0433-0213474-00 with *Name of applicant and company* in the reference field and *GEOTECH APP* in the particulars field.

Signed:________________________________ **Dated:** / /

*Maximum email size 20MB, multiple emails can be submitted or an electronic file transfer system used.

Application for geo-professional accreditation

Tauranga City

Western Bay of Plenty District Council

Tips for successful applications

1. At least two (preferably more) of the submitted reports to be authored (or partially authored) by you. The remaining reports must identify (in the list of reports) the extent of your significant review inputs.

2. The majority of the reports should be for sites located within TCC (ideally) and WBOPDC areas.

3. Evidence of a ground model **you** have developed for a site where your assessment of the stability of slopes in volcanic ashes was completed, of particular interest is how you consider the stability model for short term, high intensity rainfall conditions and the modelling of groundwater in the stability analyses;

4. For all relevant reports, ensure geological cross sections are prepared and included – separate to outputs from stability analysis programs; so that we can see how the model was developed, i.e. location and depth of each test and distance from the section. Show the extent of the proposed works on the section for reference.

5. Ensure a site plan is included that shows where all the tests and critical components (e.g. retaining walls) are located and where the cross sections are in relation to the proposed development.

6. If the site development includes significant earthworks, ensure a cut-fill plan is included.

7. Ensure all site investigation data referred to in the report and relied upon for development of the ground model are appended to the report.

8. If your report is a second or third report and relies on earlier reports for ground model development or other key factual data, ensure that data is appended. Same applies for subdivision reports where ground models were prepared for earlier stages of the subdivision.

9. Ensure your submission displays a breadth of skills and your work samples include evidence of working on steep sites, slopes in volcanic ashes, liquefaction, lateral spread (where this is an issue), soft ground settlement (predictions & mitigation) and sites where multiple hazards are present.

10. You don't necessarily need to submit the most complicated and the longest report you've ever been involved with. If there are multiple authors and co-authors this makes it hard for us to pick out the bits you actually completed yourself and we may end up giving it less weighting.

11. Other areas of interest to the panel include earthworks in the Bay of Plenty (e.g. allophanes), reduction in bearing capacity with increased depth (e.g. Pahoia tephra), apparent preconsolidation pressures in some of the ashes especially under high fills, amongst others.

12. Comment on whether the site investigation data for each submitted report has been uploaded to the NZ Geotechnical Database (NZGD).

13. Please make sure your application includes all the relevant information as we will not provide you with the opportunity to provide additional information before or after the interview.

Tauranga Geo-Professional - References

Refer to:

DS-10 – Appendix A.1 – Geotechnical Reference List (*pdfs available*)

https://www.nzgs.org/tauranga-bay-of-plenty-bop-technical-references/

- Slope stability
- Geology
- Maps from TCC & Retrolens
- Seismic matters
- LQ & Ground Improvement
- Soakage
- Other
- Technical Guidance – NZGS/MBIE Modules
- Soil Properties & Performance
- Project experience
- Earth Science – Univ. of Waikato

Examples … Slope Stability

4. OTHER TAURANGA CITY COUNCIL REFERENCE MATERIAL: (All files in zip format – Section 4A, Sections 4B-4G**)**

A. Slope Stability

a. "Relic Slip Verification Study – Tauranga District Council Environs", Laurie Richards, David Bell and Roydon Thompson, 31 March 2001 (TCC OZONE Technical Library ref. TL485).

b. "Tauranga Storm Event of 18 May 2005: Landslip Issues" – Final Causation Report, BD Hegan, L Wesley and L Richards, (TCC OZONE Technical Library ref. TL2325).

c. "The Design of Permanent Slopes for Residential Building Development – Full Report", SA Crawford & PJ Millar, EQC Research Project 95/183, published in NZ Geomechanics News, June 1998, (TCC OZONE Technical Library ref. TL 607).

d. A summary of the above Crawford & Millar report is presented in the 9th ANZ Conference on Geomechanics (1999) technical paper, "The Design of Permanent Slopes for Residential Building Development", by Crawford & Millar.

e. "Stability Assessment Checklist for Consent Applications", SA Crawford & PJ Millar (1998), Extract – NZ Geomechanics News (June 1998).

f. "Relic Slip Verification Study – Tauranga District", DH Bell, L Richards & R Thompson (2003), NZ Geotechnical Society Symposium, Tauranga.

g. "Stability Assessment of Coastal Land in Tauranga County", Tonkin & Taylor (1981), ref.4879.

h. "Omokoroa Point – Land Stability Investigation Report", prepared by CP Gulliver, Tonkin & Taylor and BF Houghton, NZ Geological Survey, DSIR (1980), T+T ref.4487-2. (TCC OZONE Technical Library ref. TL214).

i. "Geotechnics on the Volcanic Edge", Proc. from NZ Geotechnical Society Symposium, Tauranga (2003), convened and edited by SA Crawford, P Baunton & Dr S Hargraves.

Examples ... Geology

B. Geology

a. "Geology of the Tauranga Area, incl. Sheet U14 1:50,000", RM Briggs, GJ Hall, GJ Harmsworth, AG Hollis, BF Houghton, GR Hughes, MD Morgan & AR Whitbread-Edwards, (1996), Occasional Report No. 22, University of Waikato, Dept of Earth Sciences, collaborating with BOP Regional Council and Institute of Geological & Nuclear Sciences.

b. "Geology of the Maketu Area, Bay of Plenty, North Island, New Zealand, incl. Sheet V14 1:50,000", RM Briggs, DJ Lowe, WR Esler, RT Smith, MAC Henry, H Wehrmann & DA Manning, (2006), Occasional Report No. 26, Department of Earth and Ocean Sciences, University of Waikato in collaboration with Bay of Plenty Regional Council. Report excl. geology map V14 can be retrieved from https://hdl.handle.net/10289/14488

c. "GEOLOGY OF THE ROTORUA AREA: SCALE 1:250,000 DIGITAL DOWNLOAD (Free)

d. "Quaternary Surfaces and Sediments at Waihi Beach" (1961), Kear & Waterhouse, NZ Journal of Geology & Geophysics 4:4 434-451.

e. "Age of Quaternary Surfaces at Waihi Beach" (1971), MJ Selby WA Pullar & JD McCraw, Earth Sciences Journal, Vol.5 No.2.

f. "Landform Development in Central Coastal BOP Region" (2003), JH Rae, NZGS Symposium, Tauranga.

Examples … Maps, Seismic, LQ & Ground Impr.

C. Maps from TCC & Retrolens

a. "Mapi" – Tauranga City GIS Map resource for "Natural Hazards, Man-made hazards and Land Features" including:
- Slopes (2:1, 3:1 & 4:1) and Relic Slips
- Sloping areas requiring a TCC Category 1 Geotechnical Stability Assessment
- Liquefaction vulnerability areas
- Ground motion hazards for liquefaction & landslides
- Areas especially prone to settlement – peat deposits, estuarine/alluvial soils & compressible soils
- Geomorphology
- Building Restriction lines
- Soakhole decommissioning
- Uncertified fills

b. "Retrolens" – resource for historical aerial photography

D. Seismic Loading & Site Classification

a. "Re-Evaluation of NZ Seismic Hazard for Geotechnical Assessment & Design", M Cubrinovski, B Bradley F Wentz & A Balachandra, NZ Society for Earthquake Engineering Bulletin Vol. 54 (May 2021 – early release).
b. "Site Subsoil Class Determinations in Tauranga, NZ", E Pearse-Danker & L Wotherspoon, Geomechanics News (June 2016).
c. Refer to NZS 1170, Part 5 and NZTA Bridge Manual (3rd Edition)

E. Liquefaction & Ground Improvement

a. "Liquefaction Hazard Assessment – Tauranga Eastern Zone, TC52/19" (2020), J Russel & ME Jacka, Tonkin & Taylor, ref 1009973.v1.
b. "Liquefaction Hazard Assessment – Tauranga Western Zone, TC51/19" (2020), D Mahoney, K Martelli & R Griffiths, Aurecon NZ Ltd, ref 506454, Rev. 1
c. "Microzoning for Earthquake Hazards for the Western Bay of Plenty" (2003), Report by Opus International Consultants Ltd.
d. "LQ Hazards in the Western BOP" (2003), P Brabhaharan & J Thrush, NZGS Symposium Tauranga.

Examples …
Soil Properties & Performance
Project experience

6. OTHER GEOTECHNICAL REFERENCE MATERIAL FOR TAURANGA & WESTERN BOP (All files in zip format**):**

A. Soil Properties & Performance

a. "Geotechnical Properties of Two Volcanic Soils" (2003), LD Wesley, NZGS Symposium Tauranga.
b. "Compaction Properties of BOP Volcanic Soils" (1980), IM Parton & AJ Olsen, 3rd ANZ Conf. on Geomechanics, Wellington.
c. "Engineering Geology of the Ruahihi Power Scheme"(2003), DA Burns & AJ Cowbourne, NZGS Symposium, Tauranga.
d. "Is There a Potassium-based Solution to Sensitive Soil Slipping in the BOP?" (2017), T Robertson, VG Moon & DJ Lowe, NZGS Symposium, Napier.
e. "Sensitive Pyroclastic Soils in the BOP – Microstructure to Failure Mechanisms" (2017), VG Moon, PR Mills, MO Kluger, DJ Lowe, CJ Churchman, WP de Lange, DA Hepp, S Kreiter & T Morz, NZGS Symposium, Napier.
f. "Landslides in Sensitive Soils, Tauranga, NZ" (2013), VG Moon, MJ Cunningham, MJ Wyatt, DJ Lowe, T Morz & ME Jorat, NZGS Symposium, Queenstown.

B. Projects & Experience

a. "Canal Failure, Ruahihi Hydro-Electric Power Scheme, Bay of Plenty, NZ" (1988), LE Oborn, 5th ANZ Conference on Geomechanics, Sydney.
b. "Design & Construction of a Large Cut in Sensitive Volcanic Ash Soils" (2003), DL Dennison & NJ Edger, NZGS Symposium, Tauranga.
c. "Design of a Pile Reinforced Embankment, PJK Expressways Project, Tauranga" (2003), AJ Cowbourne. NZGS Symposium, Tauranga.
d. "Liquefaction Assessment for an Urban Road Project in BOP" (2017), H Wahab &PJ Clayton, 20th NZGS Symposium, Napier.
e. "Determination of Age of Tauranga/Maketu Basin Peats Based on Apparent Pre-consolidation Pressure Due to Soil Creep" (2015), IC Manley, L Cho & KC Cheung, 12th ANZ Conference on Geomechanics-Wellington.
f. "Tauranga Harbour Link foundation pile construction & testing" (2008), N Wharmby, M Zame, R Hillier &P Burton, 18th NZGS Symposium
g. "South British House – A collaborative approach for the seismic upgrade of a building" (2017), H Wahab & K de Graaf, 20th NZGS Symposium, Napier.

Examples … Earth Science – Univ. of Waikato

C. Earth Science (from University of Waikato, NZ)

a. "Tephrochronology in Aotearoa New Zealand" (2021), JL Hopkins, DJ Lowe & JL Horrocks, NZ Journal of Geology and Geophysics, 64:2-3, 153-200, DOI: 10.1080/00288306.2021.1908368
b. "Tephrochronology in NZ – Supplemental Tables SM1 and SM2", Hopkins et al. 2021.
c. "Inception of the Modern North Island NZ Volcanic Setting between 3.0 and 0.9 Ma" (2021), A Pittari, ML Prentice, OE McLeod, EY Zadeh, PJJ Kamp, M Danisik & KA Vincent, New Zealand Journal of Geology and Geophysics, 64:2-3, 250-272, DOI: 10.1080/00288306.2021.1915343
d. "The Taupo Eruption Sequence of AD232 in Aotearoa NZ: A Retrospection" (2021), DJ Lowe & A Pittari, Journal of Geography (Chigaku Zasshi), Vol. 131 (1), 117-141, doi:10.5026/jgeography.130.117.
e. "Sub-millennial eruptive recurrence in the silicic Mangaone Subgroup tephra sequence, New Zealand, from Bayesian modelling of zircon double-dating and radiocarbon ages" (2020), M Danišík, DJ Lowe, AK Schmitt, B Friedrichs, AG Hogg, & NJ Evans, Quaternary Science Reviews, Vol. 246, 15 Oct. 2020, 106517, ISSN 0277-3791, https://doi.org/10.1016/j.quascirev.2020.106517
f. "Wiggle-match Radiocarbon Dating of the Taupo Eruption (2019) _with supplemental docs", AG Hogg, CJN Wilson, DJ Lowe, CSM Turney, P White, AM Lorrey, SW Manning, JG Palmer, S Bury, J Brown, J Southon & F Petchey, Nature Communications 10, 4669, https://doi.org/10.1038/s41467-019-12532-8
g. "Rainfall Threshold for Initiating Effective Stress Decrease and Failure in Weathered Tephra Slopes" (2020), MO Kluger, M Ehsan Jorat, VG Moo S Kreiter, WP de Lange, T Morz, T Robertson & DJ Lowe, Landslides Journal Vol. 17, 267-281, doi:10.1007/s10346-019-01289-2.
h. "A New Attraction-Detachment Model for Explaining Flow Sliding in Clay-Rich Tephras" (2017), MO Kluger, VG Moon, S Kreiter, DJ Lowe, GJ Churchman, DA Hepp, D Seibel, M Ehsan Jorat & T Morz, Geological Society of America, Publication Vol. 45, No. 2, 131-134, www.gsapubs.org
i. "Tales of the Unexpected: Halloysite Delivers Surprises and a Paradox" (2016), DJ Lowe and GJ Churchman.
j. "Unique but Diverse: Observations on the Formation, Structure and Morphology of Halloysite" (2016), JG Churchman, P Pasbakhsh, DJ Lowe & BKG Theng, Clay Minerals, Vol.51 395-416, doi:10.1180/claymin.2016.051.3.14
k. "Halloysite Behaving Badly: Geomechanics and Slope Behaviour of Halloysite-rich Soils" (2016), VG Moon, Clay Minerals, Vol.51 517-528, doi:10.1180/claymin.2016.051.3.09

Handover to [redacted]

Corrina Place, Welcome Bay

DS-10 - Apx B.5 Table 1: Geo-Professional Requirements for Geohazard Risk Assessment and Mitigation

Category 2 Geo-Professional (Current)

Category 2 Geo-Professionals are required to undertake assessments when the following conditions apply:

2.3 - Areas not covered by Categories 1 or 3.

2.5 - To certify fill where placed on ground sloping between 18º and 26º.

Category 2 Geo-Professional (Proposed)

2.3 - Seismic ground hazard including soil liquefaction and mitigation of effects; specifically excluding any sites within the 4H:1V downslope zone and any site where lateral spread is mapped as possible[1].

2.4 - Areas not covered by Categories 1 or 3.

2.6 - To certify fill where placed on ground sloping less than 18º.

1. Per liquefaction hazard maps by T&T & Aurecon, March 2020

DS-10 - Apx B.5 Table 1: Geo-Professional Requirements for Geohazard Risk Assessment and Mitigation

Category 1 Geo-Professional (Current)

Category 1 Geo-Professionals are required to undertake assessments when the following conditions apply:

1.4 - Seismic ground hazard including soil liquefaction and mitigation of effects

1.5 - Lateral spread issues

1.8 - To certify fill where placed on any ground defined above (i.e. where original slope is greater than 2H:1V or where evidence of instability is present); or elsewhere where fill thickness exceeds 3m.

Category 1 Geo-Professional (Proposed)

1.4 - Seismic ground hazard including soil liquefaction and mitigation of effects

1.5 - Lateral spread issues

1.8 - To certify fill where placed on any ground defined above (i.e. where original slope is greater than 3H:1V or where evidence of instability is present); or elsewhere where fill thickness exceeds 3m.

Tauranga Geotechnical Reporting Issues

- identified by TCC staff and accreditation panel

Hinewa Road, Otumoetai, May 2005

Disturbed Pahoia Tephra (and other ashes)

Corrina Place, Welcome Bay

Sub-surface investigations

MBIE / NZGS Module 2 Section 1.3

With respect to site investigation, it is the responsibility of the geotechnical professional to:

› direct the collection of existing data
› conduct field reconnaissance
› plan and scope the site investigation
› initiate and supervise the site investigation
› review progress
› develop and supervise laboratory testing of field samples.

Sub-surface investigations

MBIE / NZGS Module 2 Section 1.3

The perceived cost savings of not having field supervision can easily be lost due to the geotechnical professional not being able to see for themselves the behaviour of the ground during sampling, or because unusual or unexpected ground conditions are encountered. Observation of the investigation activities allows the geotechnical professional to make recommendations and implement changes as required, in a timely manner.

Sub-surface investigations

MBIE / NZGS Module 2 Section 2.4.3

Subsurface investigation programmes, regardless of how well they may be planned, must be flexible enough to adjust for unexpected or significant variations in subsurface conditions that are encountered during the field work.

Table 2.1: Recommended Minimum Deep Geotechnical Investigation Intensity[1] for Plan Change or Subdivision Consent Applications

PROJECT STAGE	RECOMMENDED MINIMUM CUMULATIVE NUMBER OF DEEP INTRUSIVE GEOTECHNICAL SITE INVESTIGATION LOCATIONS[1] — SITE PLAN AREA[2]: MORE THAN 10 HECTARES	1 TO 10 HECTARES	GREATER THAN 2,500 M² BUT LESS THAN 1 HECTARE	2,500 M² OR LESS
PLAN CHANGE	11 plus additional 1 per 4 hectares (or part thereof) of site area in excess of 10 hectares	6 plus additional 1 per 1.8 hectares (or part thereof) of site area in excess of 1 hectare	4 plus additional 1 per 3,750 m^2 (or part thereof) of site area in excess of 2500 m^2	1 per 625 m^2 (or part thereof) of site area
SUBDIVISION CONSENT	26 plus additional 1 per 0.5 hectares (or part thereof) of site area in excess of 10 hectares	6 plus additional 1 per 0.45 hectares (or part thereof) of site area in excess of 1 hectare		

1 In addition to the number, the spatial arrangement of investigations should be such that the site is adequately characterised.

2 In areas where there is insufficient groundwater information, piezometers should also be installed at a density sufficient to adequately determine the depth to groundwater (eg 1 per 5 deep investigation locations), particularly for potentially liquefaction prone land.

Sub-surface investigations

MBIE / NZGS Module 2 Section 3.1 Cone Penetration Testing

(This section discusses liquefaction assessment but the comments are relevant to all investigation programmes.)

> The frequency of CPT/borehole pairs required for such an exercise should be selected by the geotechnical professional using engineering judgement and general knowledge of soil variability in the site area. However, as a guide in the absence of previous site information of data in the immediate vicinity, one borehole per five CPT locations is likely to be adequate for large projects. Alternatively, for a small site with five CPT soundings and variable ground conditions, at least two boreholes may be needed to confirm the CPT correlations

Sub-surface investigations

MBIE / NZGS Module 2

3.3 Test Pits

Test pits or trenching can be a relatively quick and economical method to assess shallow ground conditions. They are particularly useful for in situ examination of the subsurface conditions and for geologic mapping (eg trenching for fault traces), and they allow the collection of large disturbed and undisturbed samples of geomaterials.

Welcome Bay, May 2005

Slope stability issues

i. A lack of down slope tests to help refine the soil model.

i. A lack of boreholes to correlate with the CPT interpretations of the soils and to enable soil sampling.

ii. A lack of test pits to provide a good means to observe the soils, check for the presence and extent of previous fills and to win samples for testing, i.e. compaction, CBR…

iii. Inconsistent identification of older tephra layers in the soil models.

iv. Inadequate modelling of pore water pressure / rain water fronts above the ground water level when assessing slope stability during heavy rain conditions.

v. Occasional use of reduced ground accelerations when assessing seismic slope stability.

vi. Inconsistent allowance for cyclic softening / reduced soil strengths in clay like layers when assessing seismic slope displacements.

vii. Building Restriction Lines not always being placed in appropriate locations.

viii. A lack of comment about the position of Building Restriction Lines requiring review if fill is placed above or below them (behind or in front).

ix. A lack of on-site confirmation of Building Restriction Lines to confirm survey contours match site conditions.

Liquefaction and Lateral Spreading

Edgecumbe Dairy Factory 1987 [redacted]

Liquefaction assessment issues

i. A lack of boreholes to correlate against the CPT interpretations to confirm soil types and fines content and no sensitivity analysis of the fines content correction factor in the liquefaction analyses.

ii. In low lying areas no allowance for sea level rise during the design life of the structure.

Liquefaction assessment issues

TCC / WDC Practice Note – Managing natural hazards under the Building Act 2004, (Nov. 2020)

- The economic life of a typical building is 75 to 80 years, compared to the NZBC Design Life of ≥50years.
- For Building Code compliance allow for the RCP8.5 median sea level rise over the life of the building.
- This is 700mm above the present level for an 80 year economic life, compared to 400mm for the NZBC Design Life of ≥50years.
- TCC groundwater model to consider sea level rise scenarios (Aug 2022)

https://www.tauranga.govt.nz/living/building-and-renovations/types-of-building-projects/land-subject-to-natural-hazards

https://www.tauranga.govt.nz/living/natural-hazards/projections-climate-change-and-sea-level-rise

Section 4.2 - https://www.building.govt.nz/assets/Uploads/building-code-compliance/b-stability/b1-structure/planning-engineering-liquefaction.pdf

Retaining Wall Issues

i. A lack of a proper assessment of the global stability of retaining walls allowing for weak soils layers at depth and relic slip surfaces where appropriate.

ii. Occasional use of reduced ground accelerations when assessing the global stability of retaining walls. (i.e. the acceleration which allows for movement of the wall, NZGS Module 6)

iii. Occasional lack of contour information beyond site boundaries which may allow the construction of walls retaining fill at the top of slopes without proper assessment of overall slope stability and/or non-assessment of reduced foundation support below the wall.

- Often there is a lack of access to carry out repairs or replacement of retaining walls at the end of their design life.
  - Ground treated timber poles are supposed to last 50 years but this is not guaranteed if they are cut or drilled through.
  - The economic life of a house is typically 75 to 80 years, compared to the NZBC Design Life of ≥50years.

Aotearoa New Zealand's First Emissions Reduction Plan (May 2022) - Building and Construction Section

In 2018 nearly 9.4% of domestic emissions were building related.

This does not include emissions due to the manufacture and transport of imported materials.

There is no specific mention of earthworks.

Action 12.1.1: Progress regulatory change to reduce embodied emissions of new buildings

The Government consulted on a Whole-of-Life Embodied Carbon Reduction Framework in 2020. The framework would require reporting and measurement of whole-of-life embodied carbon emissions – from manufacturing building materials to disposing of them at the end of a building's life. The framework would cap new buildings' whole-of-life embodied carbon and reduce the cap over time.

Aotearoa New Zealand's
First Emissions Reduction Plan (May 2022)

- Building and Construction

In their role as building-consent authorities, local government co-regulate the building system. They will have a role to play in implementing proposed Building Code requirements to report and measure whole-of-life embodied carbon and operational emissions. Local government will also have a role in reducing construction and demolition waste.

All parts of the building and construction sector have a role in reducing emissions. For instance, designers, engineers and architects can develop and offer lower-emissions building designs, builders can reduce construction waste onsite, and industry training organisations can build the climate change skills and capability needed for the workforce.

Flat sites and retaining walls are very often not necessary – why not just build down the slope using timber piles???

Advantages of working with the slope:

- Less destruction of local land forms to form bland suburbs.
- No long term retaining wall repair, maintenance and access issues.
- A reduction in sediment run off during construction.
- A reduction in the use of earthmoving machinery, hence noise and CO_2 emissions.
- A significant reduction in the volume of concrete required, hence a reduction in CO_2 emissions from cement manufacture.
- A significant reduction in the use of imported steel and associated CO_2.
- A significant reduction in the volume of good quality aggregates required (a finite resource).
- A reduction in soil compaction resulting from earthworks during cutting and filling and hence a reduction in stormwater runoff.
- Overland flow can occur beneath buildings.
- Short term ponding can occur beneath buildings to reduce the peak demand on infrastructure.
- Floors are readily able to be re-levelled should there be settlement due to static or seismic loading.

How many walls are there?


23/05/2005

Reporting

TCC Infrastructure Development Code
DS-10-Appendix C.5 Further Responsibilities of Geo-Professionals

e) Provide all test results, calculations and analysis in full that supports the conclusions of a geotechnical assessment.

Reporting

Who is the audience for the report?

- The Council?
- Other engineers?
- The owner?

- What do they need to know?

- What questions are they going to ask?

- TCC/EQC Stability Assessments Checklist

CHECKLIST FOR STABILITY ASSESSMENTS

FACTUAL INFORMATION

1. INTRODUCTION
   - ☐ Report prepared for who?
   - ☐ Site Location
   - ☐ Outline of proposed development
   - ☐ Comment on need for earthquake assessment
2. TOPOGRAPHY
   - ☐ Outline current landform (slope shape, height gradient, irregularities, erosion, soil creep/terracettes)
   - ☐ Outline surface drainage patterns
   - ☐ Review aerial photos
   - ☐ Comment on any previous earthworks
   - ☐ Comment on any existing instability
   - ☐ Additional site features (e.g. vegetation/trees structures retaining walls, roads/driveways, services)
3. SITE HISTORY
   - ☐ Outline current/previous landuse
   - ☐ Comment on previous siteworks
   - ☐ Reference "District Hazard Map"/GIS
   - ☐ Comment on previous instability
   - ☐ Performance of existing structures
   - ☐ Review aerial photos
   - ☐ Comment on previous contamination
4. GEOLOGY
   - ☐ Describe geological setting
   - ☐ Refer to relevant maps
   - ☐ Geological influences on stability (e.g. bedding, weak materials, faults)
   - ☐ Describe seismic setting
5. INVESTIGATIONS
   - FIELD
     - ☐ Inspection by geotechnical specialist
     - ☐ Descriptions of soils/rock in borelogs (Ref.1)
     - ☐ Outcrop/cutting descriptions
     - ☐ Record Extent of any cracking
     - ☐ Other field tests (e.g. CPT, etc.)
     - ☐ Monitoring of ground movements
     - ☐ Groundwater measurements and observations (seepage, subsurface erosion)
   - LABORATORY
     - ☐ Outline tests undertaken
     - ☐ Summarise results
     - ☐ Previous testing in local area
6. SUBSURFACE CONDITIONS
   - ☐ Geological interpretation
   - ☐ Summarise subsoil conditions, e.g. extent of fill topsoil, nature and distribution of soils/rock
   - ☐ Describe soil strengths/density, likely behaviour - refer to tests and logs
   - ☐ Highlight weak/sensitive/loose soils or rock defects
   - ☐ Describe groundwater conditions, subsurface drainage, expected seasonal fluctuations

APPENDICES
- ☐ Borelogs, Testpit Logs, Logs of Exposures (Ref.1)
- ☐ Laboratory Results
- ☐ Specifications for Remedial Works/Fills
- ☐ Site Photos

INTERPRETATION/DISCUSSION

7. SLOPE STABILITY (Ref. 2,3,4)
   - ENGINEERING GEOLOGICAL ASSESSMENT:
     - ☐ Discuss site features
     - ☐ Discuss geological setting/influences
     - ☐ Influence of rainfall/groundwater
     - ☐ Reasons for landform (local, regional)
     - ☐ Likely slope failure mechanisms
     - ☐ Potential for instability
     - ☐ Effects of the development on slopes
     - ☐ Consequence of instability
     - ☐ Empirical assessment (qualitative)
     - ☐ Risk rating applied
     - ☐ State whether stability analyses are required
   - GEOTECHNICAL ENGINEERING ANALYSES
     - ☐ Geotechnical slope model correct?
     - ☐ Analytical method stated
     - ☐ Determination of critical section of slope
     - ☐ Assessment of strength parameters
     - ☐ Assessment of groundwater profile/rainfall
     - ☐ Back analysis of any existing failures
     - ☐ External loads due to the development
     - ☐ State need for seismic analysis
     - ☐ Normal FOS requirements:
       - Static (Design gwt) FOS ≥ 1.5
       - Static (Extreme gwt) FOS ≥ 1.2
       - Seismic (150 year EQ) FOS ≥ 1.2
     - ☐ Sensitive analyses for parameters required?
     - ☐ Results and comments
8. GEOTECHNICAL EFFECTS OF DEVELOPMENT
   - ☐ Slope stability risk increased or reduced?
   - ☐ Is the development feasible?
   - ☐ Need to drain slopes (surface/subsurface)?
   - ☐ Need to remove/upgrade fill?
   - ☐ Subsurface drainage beneath fills?
   - ☐ Need to retain slopes/secure rock faces?
   - ☐ Foundation conditions/requirements
   - ☐ Effect of stormwater/effluent disposal
   - ☐ Effect of service lines rupture (e.g. SW, sewer)
   - ☐ Effect of river/coastal erosion
   - ☐ Seismic effects on development and slope
   - ☐ Maintenance requirements for life of the development
9. CONCLUSIONS AND RECOMMENDATIONS
10. STATEMENT BY GEOTECHNICAL ASSESSOR AS TO THEIR ABILITY & QUALIFICATIONS TO PREPARE THIS GEOTECHNICAL ASSESSMENT

DRAWINGS/FIGURES
- ☐ Site Plan: ☐ Borehole/Testpit Locations
  - ☐ Outline of Proposed Development
- ☐ Site Engineering Geological Maps
- ☐ Site Contours Maps } Cuts and fills
- ☐ Cross Sections } indicated
- ☐ Geotechnical Model
- ☐ Stability Analyses Results

REFERENCES
1. Guidelines for the Description of Soils & Rock, NZ Geomechanics Society (1985)
2. Assessment of Slope Stability at Building Sites, BRANZ Study SR4, (1987)

Reporting

Pre-empt the questions.

Answer these questions in each section of the report as appropriate:

- Who?
- What?
- Why?
- When?
- Where?
- How?

Mauao,
29 Jan 2011

The effects of kumara pits on slope stability

REVISED GEOTECHNICAL MODULES RELEASED (Nov 2021) AND NSHM

- MBIE released revised Earthquake geotechnical engineering practice series in Nov 2021. Regulatory status as guidance under the Building Act.

- NZ National Seismic Hazard Model (NSHM) is being revised by NZ and international scientists. Scientific knowledge and best practice have advanced since 2012 (including corrections to subduction interface sources, updated in 2019) including:
  - Size of earthquakes generated by Hikurangi Subduction fault
  - Learnings from Canterbury and Kaikoura earthquakes

- MBIE will translate outputs of the revised NSHM into Building Code. Until then, **designers are encouraged to make use of guidance for geotechnical design of <u>new building work</u>**.

- Hazard values based on limited hazard seismic data but **reflects best practice and latest scientific knowledge in interim while NSHM under review** (expected to be completed in August 2022).

- Note limitations of the guidance, what they can and can't be used for and other documents may provide more specific guidelines or rules for specialist structures.

Te Tauira Matapae Pūmate Rū i Aotearoa
NSHM The New Zealand National Seismic Hazard Model
A GNS Science Led Research Programme

Module 1 Rev 1 – Appendix A

Table A1: Peak Ground Acceleration (a_{max}) and Earthquake Magnitude (M) values recommended for Geotechnical Assessment, for Site Classes A, B, C, D and E, for level ground conditions

LOCATION ID NUMBER[a]	TOWN/CITY	PEAK GROUND ACCELERATION (a_{max})[b] AND RECOMMENDED FOR USE FOR ALL SITE CLASSES								EARTHQUAKE MAGNITUDE (M)[c],[d],[e] VALUES (A, B, C, D AND E) — WITHOUT MODIFICATION[f]						
		RETURN								PERIOD						
		25-YEAR		50-YEAR		100-YEAR		250-YEAR		250-YEAR	500-YEAR		1000-YEAR		2500-YEAR	
		a_{max}(g)	M	a_{max}(g)	M	a_{max}(g)	M	a_{max}(g)		M	a_{max}(g)	M	a_{max}(g)	M	a_{max}(g)	M
23	Tauranga	0.07	5.9	0.10	5.9	0.15	5.9	0.22		5.9	0.30	5.9	0.39	5.9	0.53	5.9
24	Mount Maunganui															
25	Waihi															
26	Te Puke															
27	Putāruru															
28	Tokoroa	0.08	6	0.11	6	0.16	6	0.24		6	0.32	6	0.41	6	0.57	6

a_{max} and Meff values for subsoil Class C based on NZTA Bridge Manual (2018), Table C6.1; R-value based on NZS1170.5, Table 3.5;

"Results from a generic site-specific PSHA might be available from city and regional councils for some regions and urban centres of New Zealand which are currently covered by the NZTA Bridge Manual hazard. It is recommended to make use of such studies when evaluating the hazard parameters for geotechnical assessment."

Regional Seismic Hazard Study for Tauranga City Council (Bradley Seismic Limited, 2019)

- TCC engaged BSL to undertake seismic hazard assessment for Tauranga City
- BSL Model provides lower estimates for PGA and slightly higher Magnitude estimates
- The ground motions from BSL are not anticipated to be materially different from the expected outputs from the updated National Seismic Hazard Model (NSHM)
- BSL Model uses the same general fault model and the ground motion prediction equations (though fewer) as the NSHM model
- The primary intent of the TCC ground motions was that they be used for geotechnical assessment of **new residential buildings within Tauranga City boundaries only**

Return period (years)	NZGS Module 1		BSL Seismic Model	
	PGA (g)	Magnitude (M)	PGA (g)*	Magnitude (M)
25	0.07	5.9	0.04 to 0.07	6.1
100	0.15	5.9	0.08 to 0.12	6.1
250	0.22	5.9	0.12 to 0.17	6.2
500	0.30	5.9	0.15 to 0.20	6.2
1000	0.39	5.9	0.19 to 0.25	6.3

Adapted from T&T, 2022

*Lower and upper PGA values correspond to Vs30 values of approximately 600 and 180 m/s respectively. Module 1 uses 300 m/s.

Module 1 (2021) vs. BSL (2019) for Tauranga City

- BSL (2019) acceptable as an alternative for residential building (NZS3604).
- All other developments/projects to meet the Nov. 2021 NZGS/MBIE Module 1 EQ Geotechnical Engineering Guidelines (if appropriate), or the BSL/TCC seismic model approach if supported by a supplementary report by a recognized seismic hazard expert along with a Cat.1 Geotechnical Practitioner supporting this approach
- Date of switchover (from BSL/TCC or Module 1, to a new national seismic model) as the date of a MBIE publication confirming acceptance of the new national seismic model design approach

TCC awaiting advice from MBIE / NZGS on the current thinking, and needs to consider options and implementation before making changes