Online submission

This is a submission that was made online via the Council's website.

Submitter No.	S311
Submitter Name	Grant Marshall
Submitter first name	Grant
Submitter middle name	Allan
Submitter surname	Marshall
Submitter is contact	Yes
Email	info@nzfernz.co.nz
Wish to be heard	Yes
Joint presentation	Yes
Trade competition	I could not gain an advantage in trade competition through this submission.
Directly affected	N/A
Withhold contact details?	No

Submission points

Plan section	Provision	Support/oppose	Reasons	Decision sought
Natural Hazards	Earthquake Hazard Overlays - All	Amend	Map 65 relates to Lake Poerua and surrounds. This area of Lake Poerua at 2382 Lake Brunner Road ,Inchbonnie has been extensively researched with a consent granted for a 12 section subdivision by the commissioner of the NZ Environmental Court in November 2011. Section 221 for this development was issued by the GDC on 9th August 2018.At time of writing two dwellings have been completed with another undergoing a build and two more consented buildings planned. We are concerned with inaccuracies of the Faultline in Map 65. As part of the approval process for the subdivision,consultation was made between GNS on behalf of the Grey District council, Golders and Canterprise to determine the location of the fault line and the final hazard setback plan drawn by GNS was used to change the subdivision layout to ensure all building sites were outside the setbacks. This map shows the Faultline going straight across the subdivision which is incorrect. It was agreed by all parties that the Faultline was situated in the lake and not in the subdivision footprint.The set back/fault avoidance line consists of the land between the lake edge and the front fence which runs along the front of all the building platforms .Please refer to the Boffa Miskell plan to see the location of the fenced area. There is an omission of a GNS report dated 2008 pertaining to the subdivision at Lake Poerua which has not been included in the technical reports available on the TTPP . This report supersedes those on the TTPP. The information on the website is not complete because a lot of specialist work and investigations was undertaken to resolve a satisfactory conclusion showing the Faultline to be in the lake with the lake edge as a scarp. I do not understand why this was not included in the documentation on the website and am concerned that the technical information gained was not utilised when drawing out the map for the TTPP. Please refer to documents:GNSletter18april, GNSlake poerua, Map65 onlinemapwith20mearthquake hazard overlay2382, pg9 commissioners decision in relation to Rob Langridge GNS,Beca letter28feb and reports.	For an amendment to the Grey Natural Hazards Map book number 65 pertaining to Lake Poerua to accurately reflect the earthquake Faultline and setbacks which was established through extensive research and consultation with GNS science on behalf of GDC and Golders and Canterprise.I have chosen to focus on the 20m mark to simplify the imaging examples. I would also like the inclusion of the GNS report on Lake Poerua dated January 2008 to the technical info in the TTPP.

Natural Hazards	Flood Severe Overlay and Flood Susceptibility Overlay	Amend	The flood overlay includes the hillsides adjacent to Lake Poerua and opposite Lake Brunner road.For example the edge where Mt Te Kinga surrounds Lake Poerua is hillside and not a flat plain and our home at 2261 Lake Brunner road,which is elevated at 170 metres is also included as a flood zone. At 2382 Lake Brunner road,we have research evidence to support a seiche inundation level of 124.5 metres RL contour around Lake Poerua.(refer to Boffamiskell plan showing seiche line in purple) Once the water reaches this level, it then flows southwards towards Lake Brunner. We believe it is important to accurately identify low lying levels using contour lines when mapping a document for public use. As an example when we rang Tower Insurance in April 2022 to discuss renewing our two dwelling insurances on our home property at 2261 Lake Brunner Road, the immediate reply from the agent was to say that our property is in a flood zone which was a surprise because we are at an elevation of 170 metres and nowhere near low- lying land. We do not know the source of the information they were using. We are of the opinion that insurance companies will use the TTPP maps as factual information to increase their premiums which is why it is important to have accurate topographical information in the first instance to show actual areas where flooding could occur. Please see Map65 greyNaturalhazards We also undertook research using Golders Canada on the effects of a tsunami at the lake which should be utilised for mapping purposes.(see pg1Golderstsunami to pg5 Golderstsunami)	To amend the flood overlay concerning hazard map 65 to accurately reflect low lying areas using actual contour lines instead of a broadsweep which includes elevated areas. For the flood overlay to include the seiche line detailing around the Lake Poerua subdivision at 2382 Lake Brunner Road.
[General]	[General]	Amend	Error and omission made on map.Please refer to document Map65 grey zoning. You will see Lake Poerua is an open space zone and there are no boundary marks on the southwestern shores of Lake Poerua where the subdivision lies.	To amend map 65 of Grey Zoning Mapbook 1. To show Lake Poerua as a water body 2. To include all the property boundaries of the subdivision at 2382 Lake Brunner road, Inchbonnie 7875.
Planning Maps and Overlays	Natural Hazards	Amend	Previous earthquake fault line maps, including the draft PDF map on the first TTPP have always been shown to be below our property boundary at 2261 Lake Brunner Road.This current map now shows it to run straight through the back of our property including our home How has this been quantified? Has new research been undertaken in the last year?We are not aware of any geo tech research being undertaken on our land?The change of location is approx 350 -450 metres from its original map location. Please note this also ties in with the changed location of the Faultline now by the subdivision at Lake Poerua which we are also addressing.. Please refer to image Map65 online mapwith20m eartquakehazardoverlay2261. Also note the online mapping system programme always freezes at the point where the screen shot is taken and cannot open /display the page properly.	To use correct information to show the Faultline accurately in Map 65 in particular around my property at 2261 Lake Brunner road. If not, then to provide detailed evidence and documentation to support and the rationale as to why this was changed .

Documents included with submission

Document name Beca letter

File becaletter28february2008reports.pdf

Description Beca letter 28feb and reports

Document name Final subdivision layout with seiche lines and setbacks taken into account

File boffamiskellsubdivisionfinalapprovedplan.png

Description Boffa miskell plan drawn with GNS and GDC approval

Document name GNS letter 18 April 2008

File gnsletter18april2008.pdf

Description Letter from Rob Langridge regarding earthquake hazard setback.

Document name GNS report January 2008

File gnslakepoerua.pdf

Description GNS report for GDC NOT included in TTPP technical reports

Document name Golders tsunami 1

File pg1golderstsunamireportlakepoerua.heic

Description Report on lake Poerua tsunami page 1

Document name Golders tsunami 2

File pg2golderstsunamireportlakepoerua.heic

Description Page 2 lake Poerua tsunami

Document name Golders tsunami 3

File pg3golderstsunamireportlakepoerua.heic

Description Pg 3 lake Poerua tsunami

Document name Golders tsunami 4

File pg4golderstsunamireportlakepoerua.heic

Description Golders lake Poerua tsunami 4

Document name Golders tsunami 5

File pg5golderstsunamireportlakepoerua.heic

Description Golders lake Poerua pg 5

Document name Map65 grey natural hazards

File onlinemapwith20mearthquakehazardoverlayat2261lakebrunnerroad.heic

Description 20 m earthquake overlay at 2261 lake brunner road

Document name Map65 Grey natural hazards

File onlinemapwith20mearthquakehazardoverlayat2382lakebrunnerroadsubdivision.heic

Description 20 m earthquake hazard overlay at 2382 Lake Brunner road subdivision

Document name Map65 Grey natural hazards

File map65greynaturalhazards.heic

Description Flood overlay shown up our home block 2261 lake brunner road which is elevated at 171 metres

Document name Map 65 Grey zoning map book

File	map65greyzoning.heic
Description	Lake Poerua not outlined as a water body and there is no property boundary marks for the 12 sections at 2382 lake brunner road .
Document name	Page 9 of commissioners decision
File	page9ofcommissionersdecisionreferringtogns.png
Description	Reference to Rob Langridge GNS agreement in location of fault avoidance zone

- 3 MAR 2008

David Lovell Smith
PO Box 679
CHRISTCHURCH

28 February 2008
Our Ref: 4212312/300
R1:78432-PAW82L03.DOC

Attention: Patricia Harte

Dear Patricia

Lake Poerua Subdivision - Geotechnical Report

Further to our previous discussions please find attached draft copies of the following:

- GNS Report January 2008
- Copy of my email 17 January 2008
- GNS Response 31 January 2008

Please note these are draft documents only and the final documents are likely to change after discussions with GNS are completed.

At this stage Council proposes to publicly notify the application. However, prior to proceeding with this step we will await any comments you may have.

Yours faithfully
Paul Whyte
Associate (Planning)

on behalf of
Beca Carter Hollings & Ferner Ltd
Direct Dial: +64-3-374 3180
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Copy

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31st January 2008
FOR COMMENT BY PAUL WHYTE
Mr. Paul Whyte
BECA
P.O. Box 13960
Christchurch 8141

Subject: GNS Client Report 2008/11 review of Lake Poerua subdivision

Dear Paul,

This letter aims to clarify some of the points that were made in the GNS review (ref# 2008/11) that you raised with me in a discussion and e-mail around the 17th January 2008 (e-mail included as Appendix).
You have also asked that I provide more detailed comments on the summary written by Cid Chenery in the Golder Associates (2007) report that were overlooked.

A. Paul Whyte e-mail:
I will begin by addressing the comments in your e-mail.

- Yes, there is still a fundamental difference between how we and the Golders Associates interpret the geomorphology and location of the fault scarp. I have outlined my arguments in detail in our 2008 review. My approach as a way through this is outline the process we would use to create Fault Avoidance Zones for this particular project.
- In regards to the area of secondary (Distributed) deformation I cannot comment on *whether* the buildings *should* be constructed. It is my brief as a geologist to follow the Ministry for the Environment Guidelines approach, and to describe the hazards in correspondence to the MfE Guidelines. It is up to planners and the Council to act on those recommendations. I agree with your assessment of the Guidelines, in that they do not provide all of the answers in every case. In Table 1 below I have tried to assess each Lot on a case by case and hazard by hazard basis to eliminate any confusion.

It is worth re-iterating at this point that the MfE Guidelines are not statutory or binding documents, while they are not legislated under the Resource Management Act as such, they provide a guide for planners and councils to consider the life safety hazards to buildings, posed by fault deformation. Several district councils around New Zealand have already adopted the MfE Guidelines as a common tool for planning around fault-related hazards. It is also worth noting that GNS Science and the wider Earth Science community have recently completed a further planning

document[1] regarding landsliding. As with the Active Fault Guidelines, the development of planning guidelines surrounding landslide prone areas was prompted by natural diasters such as those in Matata and Tauranga in 2005. In our review (report 2008/11) we did not apply the landslide guidelines as a basis for decisions, but will use them to address some of your points below.

- Lot 1A is largely encompassed by a zone surrounding a recognised active fault trace. The MfE Guidelines suggest it should have a *Non-Complying* resource consent activity status for BIC 2a and 2b structures. The hazard zone we show on Figure 3 of Langridge & McSaveney (2008) could be reduced in dimension by undertaking further geological studies, e.g. a trench, to determine the nature of the feature there and the width of deformation (see Fig. 6.1 in *Kerr et al. 2003)*.
- Your next point relates to Lots 11-14. These will be discussed below in relation to a summary hazard table.
- Yes, there was a much smaller emphasis on 'non-Alpine Fault' hazards in the 2008/11 report. Based on his experience and familiarity with this project, I am sure that Graham Hancox would have had more comment to make had he been available as a co-reviewer. I will try to discuss these other hazards when describing Lots 11-14 below. Interestingly, a significant driver of these non-Alpine Fault' hazards is in fact the Alpine Fault - via damage in the range due to very strong shaking.
- Section 7.0 of the Golder Associates report was overlooked in the GNS 2008/11 review and will be discussed in detail below.
- With regards to the Resource Management Act I am by no means an expert on how the Act operates. I understand geological terms, e.g. inundation, slippage and debris fall, as referred to within Section 106 of the RMA, and I appreciate that these cover hazards such as debris flow, landslips, and water level, but do not specifically cover active fault deformation. This was one of the purposes of developing the MfE Active Fault Guidelines. I believe I have fulfilled my brief throughout the 2008/11 report regarding recommendations based on these guidelines, but I will repeat those points where necessary for clarity.
- Regarding the final bullet point, these are difficult questions to answer and ultimately, these decisions should be made by planners and the council itself. The table below should provide further clarity for the decision making process. It is my brief to act as a guide for this process.

B. Section 7 of Golder Associates report

Golders have recognised that there are significant natural hazards at the site and that mitigation may be a way forward toward consenting.

7.1 I agree with the statements about the mitigation of house design. More information is required on what is meant by 'asking EQC for guidance on risk of injury and to property' , as this is confusing, i.e. strapping hot water cylinders?. I consider that what hazards are included in the Grey District

[1] Guidelines for assessing planning policy and consent requirements for landslide prone land. Compiled by W. Saunders & P. Glassey. GNS Science Miscellaneous Series 7.

Council Hazards Register should be described in a LIM or PIM report for each property. The hazards described in the Golder and GNS Science reports should be included in the GDC Hazards Register.

7.2 We disagree with the Golders assessment of the location of the Alpine Fault and wish to re-emphasise that the lakeshore is the scarp of the fault along the front of the subdivision. This lends to different approaches as to how to setback from the fault. Usually, a ±20 m buffer would be added to the zone of deformation (usually from top and bottom of scarp). What we have attempted is to account for the zone of warping that occurs as the scarp bulges under compression. In other words, the favourable nature of Lot sites on high points are high due to secondary deformation along the fault. We have extended a zone of *Distributed* deformation across the width of this raised zone to account for modest tilting and folding.

7.3 Golders Associates (2007) suggest a setback of 30 m from the lake edge to avoid liquefaction and lateral spreading. This is the same amount as their active fault setback and is probably a reasonable setback distance for this hazard.

7.4 I concur with the remarks about Ground Improvement.

7.5 I concur with the observations about the possibility of Inundation from Seiche waves. The minimum floor level is 124.5 m (REL). It is clear that this floor level requirement has a substantial effect on the usable areas on Lots 9A through 14 (discussed in more detail below).

7.6 Reinforced earth bunds are proposed as a mitigation measure against inundation from Mine Creek. I am not an expert in the effectiveness of these features. However, it is clear that the Mine Creek fan is very young as the Alpine Fault is not expressed across it as a scarp. This probably means that after the last Alpine Fault rupture, the fan was reactivated through a significant supply of debris from the weak schistose ranges behind the site. Consideration should be given to the risk of debris flows occurring on the sides of the fan, i.e. escaping to the side of the proposed bunds.

7.7 No schistose material has been identified SW of the Mine Creek fan. Therefore, the need for mitigation from debris flow is currently only warranted across Mine Creek fan. This does not rule out the possibility that the rangefront will not collapse in other places during the next big Alpine Fault earthquake as suggested in Langridge & Hancox (2006).

C. Hazards with respect to Lots 11-14

The scan presented as Figure 3 in Langridge & McSaveney (2007) did not extend to the NE end of the proposed site as I was unaware that the area of Mine Creek was still being considered for subdivision in the current scheme. A number of hazards have already been identified in relation to these lots: fault rupture; fault deformation; inundation from seiche wave; and inundation/debris flow from Mine Creek. These will be discussed further below.

The location of the Alpine fault in the area of Mine Creek is especially problematic as the scarp has been removed by young fan sedimentation from Mine Creek. In these cases, where the fault location is *Uncertain* (according to the MfE Guidelines) the best approach is to design a broad Fault Avoidance zone which encompasses the

John
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level of uncertainty based on projecting the fault from places where the location is better known. In this regard the pink primary rupture zone increased in width to accommodate that uncertainty. The fault setback shown on Golders' Figure 5 across the Mine Creek area (blue) is not adequate in this regard. The width of uncertainty probably equates to approx. ± 50 m in this case. This is shown on Figure A of this letter. For those areas shown inside the hachures the MfE Guidelines suggest a *Discretionary* and *Non-Complying* resource consent activity status for BIC 2a and 2b structures, respectively.

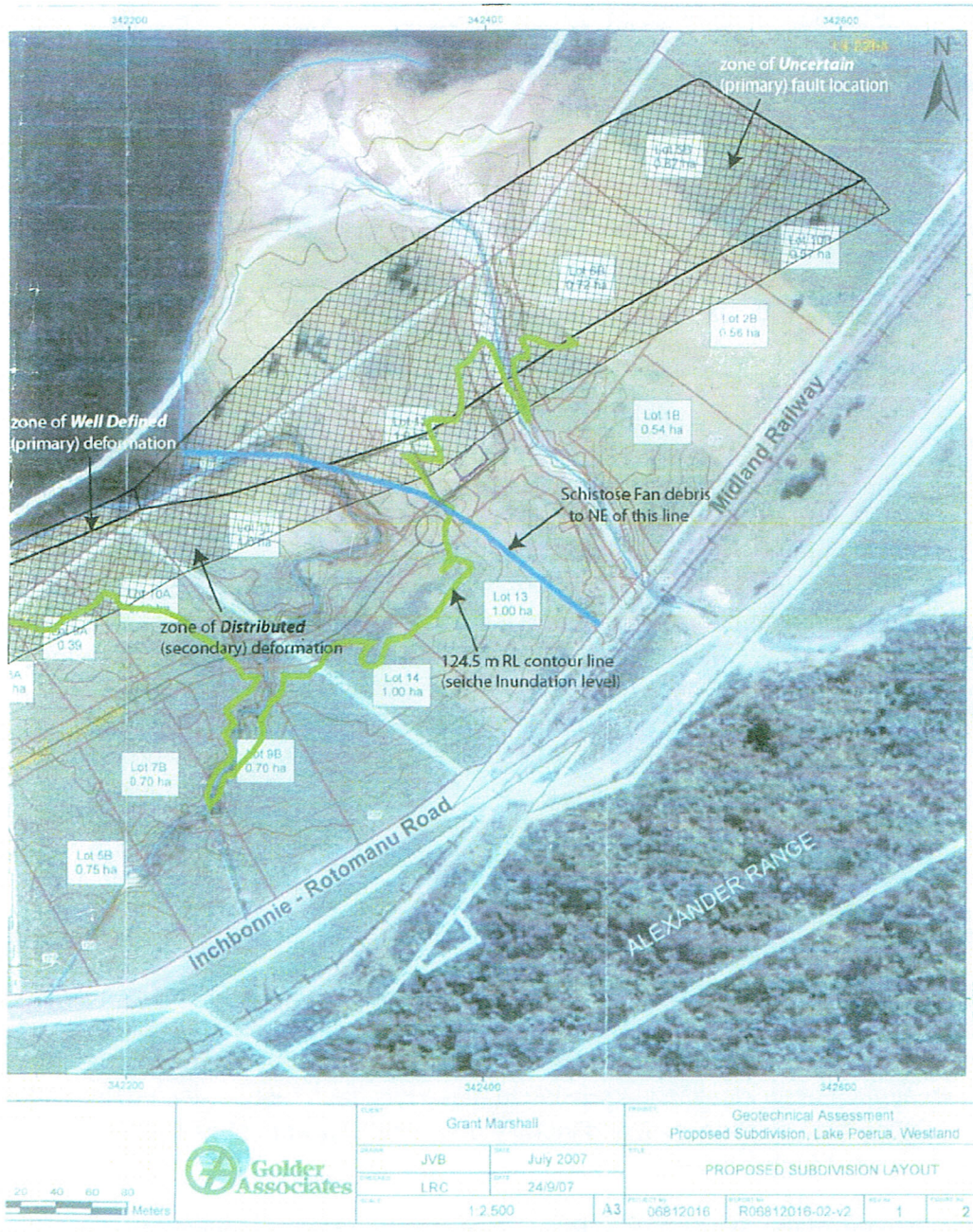

Figure A. Map showing suggested Fault Rupture and Deformation Avoidance Zones in the NE part of the Lake Poerua subdivision. The green line shows the expected seiche inundation level (from the lake) across this area. The blue line demarks the area covered by schistose fan debris.

03 366 7001 671

When the fault is so poorly located it is very difficult to quantify a zone of associated distributed deformation. In this instance, a zone of 20 m has been added to the upthrown (SE) side of the hachured "Uncertain" zone on Figure A. Again, for those areas shown inside this hachured area the MfE Guidelines suggest a *Discretionary* and *Non-Complying* resource consent activity status for BIC 2a and 2b structures, respectively.

Seiche inundation has been described in Golder Associates (2007) report. Their analysis talks about a minimum building platform elevation of 124.5 m RL, i.e. relative to their survey map. I concur with this finding. This contour is shown by the green line on Figure A. The area of inundation covers part of Lot 9, most of Lots 10 & 12, all of Lot 11, and the low frontal edge of Lots 13 & 14.

Inundation and/or *falling debris* hazards are a threat to the area of Mine Creek. Based on the current distribution of fan materials, i.e. where schist-derived fan debris has been mapped by Golder Associates (2007), Lots 12 and 13 would be affected by future re-activation of the fan. Lot 12 is entirely encompassed by the fan and schist-derived deposits. The northern half of Lot 13 is sited across schistose fan material. As a mitigating measure, Golders Associates (2006; 2007) have proposed to construct a 2 m high bund along the edge of the channel of Mine Creek. This may prove effective at diverting material from Lots 12 and 13. However, the bund would need to extend to the SE of the property limits to prevent any debris flow material 'jumping out' of the channel and across those lots.

Data Summary

In this section the observations for all of the Lots is summarised below in Table 1. Some recommendations are also attached. Where the recommendations are not clear, resource consent is either Discretionary, or can proceed outside of the mapped hazard zones.

Lot	type of hazard	Hazard zone(s)	Guideline criteria for BIC 2a/2b	Recommended Action(s)
1A	fault rupture	Well defined	N-Compl/N-Compl	a
2A	fault rupture fault deformation	Well defined Distributed	N-Compl/N-Compl Discretionary/N-Compl	b, c
3A	fault deformation	Distributed	Discretionary/N-Compl	c
4A	fault deformation	Distributed	Discretionary/N-Compl	c
5A	fault deformation	Distributed	Discretionary/N-Compl	c
6A	fault deformation	Distributed	Discretionary/N-Compl	c
7A	fault deformation	Distributed	Discretionary/N-Compl	c
8A	fault deformation	Distributed	Discretionary/N-Compl	c
9A	fault deformation Inundation (seiche)	Distributed	Discretionary/N-Compl Discretionary*	c, d
10A	fault deformation Inundation (seiche)	Distributed	Discretionary/N-Compl Discretionary*	c, d
11	fault deformation Inundation (seiche)	Distributed + Uncertain	Discretionary/N-Compl Discretionary*	c e
12	fault deformation Inundation (seiche) Debris flow (fan)	Distributed + Uncertain	Discretionary/N-Compl Discretionary*	c, f d g
13	Debris flow (fan) Inundation (seiche)		Discretionary* Discretionary*	g d
14	Inundation (seiche)		Discretionary*	d

Abbreviations: N-Compl, Non-Complying; * under the criteria of 100-500 yr return period in Saunders & Glassey (2007).

a – Current hazard is Non-Complying for BIC 2a and 2b. Further geologic studies are required to elucidate nature of primary fault trace; BIC 2a and 2b are likely to be restricted to outside hazard zones

b – Well defined hazard zone is currently Non-Complying as in (a).

c - BIC 2a Discretionary (possible) within Distributed hazard zone; BIC 2a & 2b are both Permitted activities outside of mapped hazard zones
d – building platform must be placed above green seiche inundation line (see Figure A)
e – Lot is entirely below the level of <500 yr return period Inundation. Recommend no subdivision of this Lot)
f – the location of the Alpine Fault is uncertain across the Mine Creek fan. Geophysical studies may elucidate the location of the buried fault
g – almost the entire area of Lot 12 is covered by fan material, and subject to Inundation and fault deformation. Recommend no subdivision of this Lot.

Recommendations:

I recommend that the actions expressed in the preceding Summary section be applied on a Lot by Lot basis. I have attempted to apply a fair analysis to both the hazards and the land use proposal for this land.

The geologic hazards at this site should not be under-estimated. Many of the hazards result from rupture and strong shaking caused by the Alpine Fault. The return period for this event is c. 500 yr and so the concomitant hazards (Inundation, seiche, falling debris, debris flow) are likely to also have a return period of c. 500 yr or less.

Please feel free to contact me again if there is a need to clarify any of the points made above.

Yours sincerely

Dr. Robert M Langridge
Earthquake Geologist

This letter report was internally reviewed for quality purposes by Wendy Saunders, a planner at GNS Science. Wendy was co-compiler of the new Guidelines for landslide prone land.

References:

Golder Associates, 2006. Geotechnical Site Suitability Assessment: Proposed Subdivision, Lake Poerua, Westland. *Consulting Report prepared July 2006 by Joshu Mountjoy and Cid Chenery for Grant Marshall, Cashmere, Christchurch.*

Golder Associates, 2007 (and reports therein). Geotechnical Site Suitability Assessment: Proposed Subdivision, Lake Poerua, Westland. *Consulting Report prepared September 2007 by Cid Chenery for Grant Marshall, Cashmere, Christchurch.*

Kerr J, Nathan, S, Van Dissen, R, Webb, P, Brunsdon, D, King, A, 2003. Planning for Development of Land on or Close to Active Faults: A guideline to assist resource management planners in New Zealand GNS Client Report 2002.124, prepared for the Ministry for the Environment (ME Report 483).

Langridge RM, Hancox GT 2006. Review of proposed Lake Poerua Subdivision, Grey District. GNS Science Consultancy Report 2006/221.

Langridge R.M. & McSaveney M. 2008. Updated review of proposed Lake Poerua subdivision, Grey District. GNS Client Report 2008/11.

Saunders, W., Glassey, P. 2007. Guidelines for assessing planning policy and consent requirements for landslide prone land. Compiled by W. Saunders & P. Glassey. GNS Science Miscellaneous Series 7

Paul Whyte

From: Paul Whyte
Sent: Thursday, 17 January 2008 5:00 p.m.
To: Robert Langridge
Cc: Nathan Hole
Subject: Lake Poerua geotech report

Categories: PM>4212312/300

Rob

Thanks for the review. I have hand written some comments in on the attached copy but I note the following

- As a lay person I found some of the comments a bit "jargony"
- It appears that there will still be a fundamental difference between you and Golders as to where the Alpine Fault is relative to the edge of the lake
- As I understand you are recommending no building on Lot 1A.
- You are suggesting that on the secondary formation it is Council's discretion as to whether buildings should be constructed. However this is precisely the matter we need you to recommend on ie- can buildings be constructed on here or if constructed what type of conditions should attach (eg foundations etc) or is it advisable for buildings to be constructed on the area of the lots outside the secondary formation area. While the MFE guidelines are good they do not provide us with an answer to the above question as we are dealing with the actual subdivision.
- Can you also clarify the situation in respect of Lots 11 (the extent of the secondary formation is not fully shown on your Figure 3) 12, 13 and 14-all are proposed to be built upon. In the Conclusions and Recommendations 5. and 6. doubt is cast on the suitability of lots 11 and 12 at least.
- There appears to be little comment on the "non-alpine fault' hazards. It appears that Mauri Is happy with Golders report although I have noted the negative comments in respect of Lots 11 and 12 above.?
- Can you also comment on Golders proposed Mitigation Measures in section 7.0 of the report.
- In my original letter of 19 October 2007 I asked whether you were of the view the proposal could satisfy Section 106 of the Act. You have referred to the Act in varioius places (eg 5 and 6 of the of the recommendations) but have not provided an overall definitive statement that Council requires in considering this application. This is a critical matter.
- Overall we need an indication as to whether

-the subdivision can proceed as submitted
-the subdivision should be refused
-the subdivision can proceed with additional mitigation measures eg no building on Lot 1A etc

Thanks. Please ring to discuss when you have read.

Regards

Paul Whyte
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Result of EMMA (V4.0.1) attachment processing
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Key

- Public walkway
- Private walkways
- Indicative lot boundaries
- Post and wire stock fencing
- Minimum permissable building level/ Seitch Line *(Note: This line is based on 124.5m contour line and is subject to survey)*
- Pasture
- Native riparian planting
- Open areas including private garden outside curtilage area
- Native bush planting (indicative only)
- Native specimen trees
- Indicative curtilage areas - to be determined at time of house design.

Site Design Principles

- Accommodation of development within the physical parameters and requirements set out by the Heads of Agreement.
- Grouping to avoid unnatural and linear appearance of housing and to ensure a more site responsive outcome.
- Preservation of views to the lake from each dwelling.
- Consideration of view shafts from state highway and main trunk railway line.
- Indigenous planting to soften buildings and integrate into a natural setting, including when viewed from the lake.
- Respect for the preservation of the lake margin with appropriate planting grouped in organic patterns.
- Provision of walking tracks to enhance access and walkability within the site.
- Planting between dwellings and lots to establish visual separation and reinforce privacy.
- Planting between State Highway and dwellings to establish 'buildings in bush' character and provide visual enclosure.
- Use of small scale access lane to link building groups and contribute to the overall character.
- Use of grazed pasture to maintain rural character.

Approx. Scale 1:2000 (A3)

This plan and proposed conditions has been produced by Boffa Miskell as part of an Environment Court mediation process. The plan aims to resolve and integrate issues raised by the Council, submitters and the applicant through a heads of agreement, meetings and notes provided. This plan is conceptual only and subject to preparation of a scheme plan based on surveyed information.

Boffa Miskell

Environment Court Mediation - **Site Concept Mediation Plan** - Lake Poerua

Ref. bml c10086, 5th August 2011

18th April 2008
Mr. Paul Whyte
BECA
P.O. Box 13960
Christchurch 8141

Subject: Resource Consent PL1477-06 Paradise Trust – Lake Poerua

Dear Paul,

This letter aims to continue the discussions of 20 March 2008 that made some progress toward understanding the planning issues for the Lake Poerua subdivision site. In your recent e-mail you asked me to clarify my stance on Surface Fault Avoidance Zones (see e-mail on page 6 of this letter). This clarification was re-iterated in recent letters from Davie Lovell-Smith, dated 31 March 2008 that you forwarded to me.

The best way forward is for me to address the comments in the Davie Lovell-Smith letter. I think we are converging toward some agreement, though there may still be some elements of misunderstanding that have taken place.
During that meeting it was mooted that I should have submitted a plan of our detailed GPS surveying of part of the site. I have included that figure amongst the discussion as it helps explain where some of my thinking on fault location comes from.

Paragraph on Zone 1 – Primary Deformation Zone
I agree with this paragraph explicitly.
I notice that the words *'of flooding'* in Line 3 should probably read 'or flooding'.

Paragraph on Zone 2 20m – Setback Distance
I think the wording used is very close to what I would write. It is prudent to consider a 20 metre setback zone from the top (and bottom) of any fault scarp in New Zealand. For a Class I fault like the Alpine Fault I think it is extremely prudent as a minimum setback. No houses should be sited within this 20 m setback zone.
This was generally agreed by all parties.

In the Lake Poerua example, where some trenching has been done across the upthrown block, we have agreed that there was no documented evidence of primary deformation (large displacements). However, it remains prudent along the Alpine Fault, to maintain a 20 m Fault Avoidance zone from the top edge of the fault scarp as shown in Figure 1. This was generally agreed by all parties

During the last 2 years, in a different part of New Zealand (Hastings and Central Hawke's Bay Districts) we had been asked to map active reverse (dip-slip) faults

(Langridge et al., 2006; Langridge & Villamor 2007). There, we deemed it practical to consider the extra fault damage that occurs above the fault plane on dipping faults. The practical solution (without further geological testing) was to place a double-width (e.g. 40 m) setback on the upthrown side of these faults. This has some relevance with respect to the Alpine Fault, which is a dipping, strike-slip fault, and will be alluded to under "Zone 3" below.

Zone 3 – Part of Original GNS Setback Zone

I apologise for any confusion created by this setback style. As I discussed in our meeting on 20 March 2008, the intention was to recognise that the raised part of the fault scarp has some small, but measurable, hazard associated with its proximity to the dipping plane of the Alpine Fault. I alluded to this above when describing reverse faults in Hawke's Bay.

The intent was to recognise that the ground surface is uplifted, warped or bent above the fault plane of the Alpine Fault - which at a larger scale uplifts the Southern Alps. This 'Zone 3' was c. 40 metre wide and covered the highest portion of the scarp and is mapped as a "zone of Distributed (secondary) deformation" according to the terms used in the Ministry for the Environment Guidelines.

Again, these terms have a meaning when the tables in the MfE Guidelines are applied. For example, see Table 3 in the *Langridge & McSaveney (2008)* review. This shows that for a Class I fault, with Distributed fault trace complexity, that Building Class (BIC) 2a structures are Discretionary Resource Consent activities, while 2b, 3 and 4 are Non-Complying Resource Consent activities. In a way, I am trying to deal with all of the possible land (building) uses that could ever be desired within that zone, e.g. what if a 2-storey Backpackers Lodge was proposed for that specific area?

Ultimately, in the case of this subdivision, Grey District Council is required to determine whether consent is given for specific activities. For this 'Zone 3' area, the most critical decisions surround consenting of BIC 2a (Discretionary) and BIC 2b (Non-Complying) structures. The developer is within his rights to test the Consent process, which designates the 'Zone 3' area as Discretionary for BIC 2a structures.

The simplest solutions in the 'Zone 3' areas would be to: (i) move the house positions to outside of the 'Zone 3' area; or (ii) where the Zone 3 area becomes restrictive for house placement on the current plan, e.g. Lots 1A to 5A, that some further Lot specific geological studies could be undertaken to determine whether any significant deformation exists there. Another alternative, as proposed by the developer, is to re-shape the boundaries of those Lots most impacted by these hazard zones.

Comment on engineering designs:

I cannot recall talking about 'specific geotechnical design required for building' within Zone 3. I want to re-emphasise that I am not an engineer and do not know the best route to take with respect to building design. Having said that, one thing that strikes me as difficult for this subdivision site is that while one engineered foundation design, e.g. pad to raise base level of house, or thick concrete pad, or house built on tall

piles, may be useful to mitigate against one geologic hazard, that that specific mitigation then becomes a negative feature with respect to another hazard at the site, e.g. liquefaction, lateral spreading, or fault rupture.

Bearing in mind that this subdivision site is liable to experience Modified Mercalli Intensity shaking levels of IX to X* during the next Alpine Fault earthquake, it would be prudent to consider whether engineering solutions are a good idea within 40 metres of the fault zone at all.
*Note: Strong ground motion has not previously been mentioned as part of this proposal. As a hazard it is not part of either the Resource Management Act or the MfE Guidelines, but is built into (accounted for) as part of the NZ Building Code.

In my opinion, this is an essential debate in that part of the subdivision that is proposed for the Mine Creek fan area. We have recognised that up to 4 fault movement related hazards (rupture, fan gravel inundation, seiche, strong shaking) are relevant across parts of this fan. Common sense suggests that one single engineering solution will not mitigate against all 4 hazards, and that this area should not be developed.

In *Langridge & Hancox (2006)*, our report concludes that a bund of at least 2m height is required to mitigate inundation hazards from Mine Creek. The bund itself will be the subject of surface displacements across the fault zone during the next Alpine Fault earthquake. These displacements will include many metres (3-7 m) of horizontal slip and c. 1 m of vertical slip. Any engineered bund would not only have to be able to deflect a considerable volume of post-earthquake fan debris along its entire length, but also remain coherent after such fault displacement.

Amendments outlined in Davie Lovell-Smith letter:

I think that the bulleted points describing amendments that will mitigate against hazards are generally good ones:

- the amendment of the boundary between Lots 1A and 2A is reasonable to avoid possible fault traces at the SW corner of the subdivision and to allow more flexibility for siting house lots outside of designated hazard zones (see Figure 1 of this letter).
- The amendment of the road entrance and Lot configuration is also a worthy path forward in avoiding the Surface Fault deformation hazard near the edge of the lake. This will also allow more flexibility for siting house lots outside of designated hazard zones.
- However, based on our assessment of considerable earthquake-related natural hazards on the Mine Creek fan surface, we would suggest that a single bund of c. 2 metre height should be placed along the SW edge of the fan debris deposits as shown in GNS Letter Report 2008/23LR (blue line). This would protect the subdivision lots to the SW from fan inundation following an Alpine Fault rupture and strong shaking event.

Recommendations

With respect to Surface Fault Avoidance Zones, both the developer and GNS have recognised the following ways forward:

1. No-build zones in the area of Primary fault deformation (described as 'Zone 1') and the additional 20 metre setback attached to it ('Zone 2');
2. In the 'Zone 3' areas (a zone of distributed deformation), the simplest way forward is to avoid the zone. This can be specifically achieved by placing the House lots in those parts of the Lots where no hazard zone has been mapped. Re-shaping of the subdivision footprint and the shape and size of Lots as suggested by the developer, will make this process simpler.

The area of Mine Creek should be avoided as there are multiple natural hazards (fault rupture, seiche, fan inundation, strong shaking) related to this area. A bund construction along the southern fringe of the Mine Creek fan deposits would help mitigate the effects of fan inundation to the house lots to the SW of the bund.

If the recommendations described in this letter are followed through on, then I agree, that there should be no requirement for the developer to provide public notification of this application. However, if consent is sought for House Lots within areas identified as natural hazard zones, then these activities should require public notification.

Yours sincerely

Dr. Robert M Langridge
Earthquake Geologist

This letter report was internally reviewed for quality purposes by Dr. Pilar Villamor, an Earthquake Geologist at GNS Science. Pilar was involved in the trenching studies at Inchbonnie and is familiar with the site at Lake Poerua.

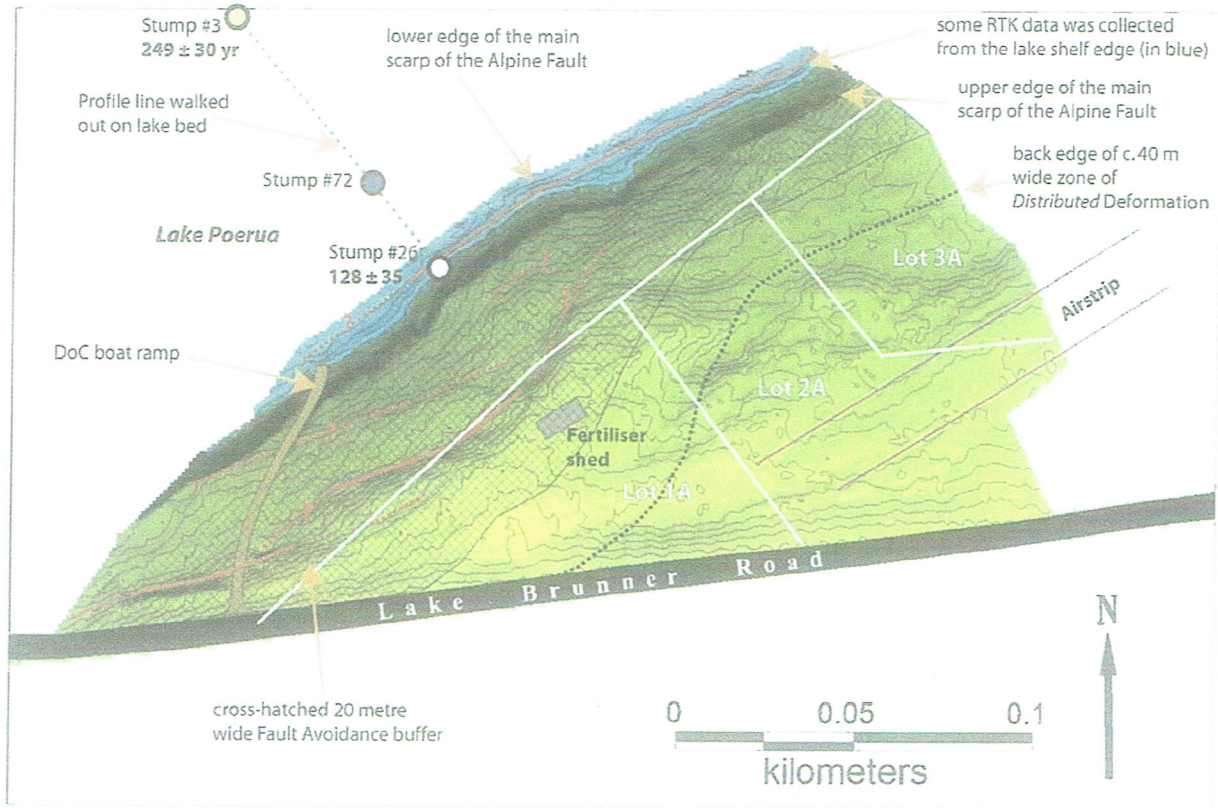

Figure 1. Interpreted GPS-RTK micro-topographic map of the SW corner of the Lake Poerua subdivision site and Dept. of Conservation lot. The main purpose of the map was to extend the features seen in the DoC Carpark across the SW end of the subdivision only. Red lines are interpreted fault locations from the topographic map. Note: They may or may not be faults, but they appear to be. The red line in the lake (blue) shows the location of the base of the main fault trace. The fault zone or rupture zone should be considered as the entire steep face between the top and bottom edges of the fault scarp along the lake front. I have applied a 20 metre Fault Avoidance buffer to the top edge of these mapped fault traces.
Approximate Lot boundaries have been placed on here (I understand these are going to change). My concerns about Lot 1A are reflected in the potential fault traces shown near Lot 1A. An arcuate scallop-shaped feature exits across Lots 2A and 3A. It is not mapped and its origin is unknown (slump scar?).
The bathymetric profile was useful in pinning down where the gradient of the lake bottom changed – it steepened up dramatically within the last 7-10 m of the lake shore at this spot. The uncalibrated radiocarbon dates on tree stumps shown, helped indicate that there has been significant lake level changes in the past. Stump #3 was found under c. 1.5 metres of water.

Rob

Thanks for the meeting last Friday. I need clarification on the following,

As I understood it you were suggesting a 20 m no build zone from the top of the scarp - essentially 20m from the line of the pink zone.

I then understood you to say that building within the remaining secondary deformation zone should be done on a case by case basis. I was not sure whether this was for geotechnical reasons (ie hazards) or for engineering reasons (eg foundations).

The developer however construed your comments as not requiring any case by case assessment in the secondary zone i.e. you can build anywhere outside the 20m no build zone (leaving aside the minimum floor area for the seiche hazard).

Can you please clarify.

Regards

Paul Whyte

Associate (Planning)

Beca
Phone +64-3-366 3521 Fax =64-3-366 3188

References:

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Updated Review of Proposed Lake Poerua Subdivision, Grey District

R. M. Langridge
M. McSaveney

GNS Science Consultancy Report 2008/11
January 2008

EXECUTIVE SUMMARY

GNS Science has been contracted by BECA on behalf of Grey District Council to review updated Consulting Reports (Bell, 2007; Golder Associates, 2007) in relation to a proposed subdivision along the southeastern edge of Lake Poerua in the West Coast region.

The site is adjacent to the Alpine Fault and steep topography and has a number of natural hazard concerns. The Alpine Fault represents New Zealand's most active onland fault and is considered to be a Recurrence Interval Class I fault (RI ≤2000 yr) everywhere along its length. As such, the natural hazards related to any development on or adjacent to the Alpine Fault zone need to be carefully considered with respect to *s106 of the Resource Management Act 1991* and *Ministry for the Environment guidelines on building on or adjacent to active faults* (Kerr et al. 2003). New and improved commercial work presented in Golder Associates (2007) has allowed for a more comprehensive and balanced approach to the natural hazards there.

In this review, we have set out to identify hazard zones related to active fault deformation. This is because we do not concur with the active fault mapping and zonation approach developed, or the results in the report. Our own approach uses the results of GPS topographic and survey maps, a bathymetric profile, surface mapping and radiocarbon dating. We have identified two zones on and adjacent to the proposed site in which primary surface deformation is well-defined. The first is mainly confined to the steep shore face at the edge of Lake Poerua, which is in fact the main fault scarp of the Alpine Fault. This zone has no impact on the proposed subdivision as it is within the "Queen's chain" and cannot be developed. The other well-defined zone is situated about an active fault trace mapped on the the ground and from micro-topography and has a significant impact on the viability of Lot 1A.

A 50 m wide zone of distributed or secondary deformation is included and covers the area adjacent to the two well-defined zones of fault-related deformation. In this zone, large displacements are unlikely, though broad tilting and warping of the surface implies that tectonic deformation is still occurring across this zone. This deformation may not constitute a Life safety issue (risk of collapse to buildings). However, specific engineering solutions could be attempted to address tilting or minor tectonic displacements expected in this zone.

At a "Greenfield" site such as the proposed subdivision site, only Building Importance Category (BIC) 1 (farm sheds etc.) are permitted activities within well-defined fault rupture hazard zones. In the distributed zone of deformation back from the edge of Lake Poerua, BIC 2a (single-storey wooden-frame houses) and 2b structures are *Discretionary* and *Non-Complying* Resource Consent activities, respectively. An alternative to this approach would be to add a 20 m buffer to the well-defined surface fault hazard zone. This would mean that all BIC 2a and 2b structures would be *Non-Complying* within c. 30 m of the lake shore.

A detailed seiche analysis has been undertaken as part of the Golder Associates (2007) report. The findings from this study include the possibility of wave run-ups of 1.4 and 1.7 m from seiche waves generated on Lake Poerua. Such waves would have a significant inundation effect to Lots 11 and 12.

Natural hazard zones described in these reports should be described on LIM reports for each subdivision Lot.

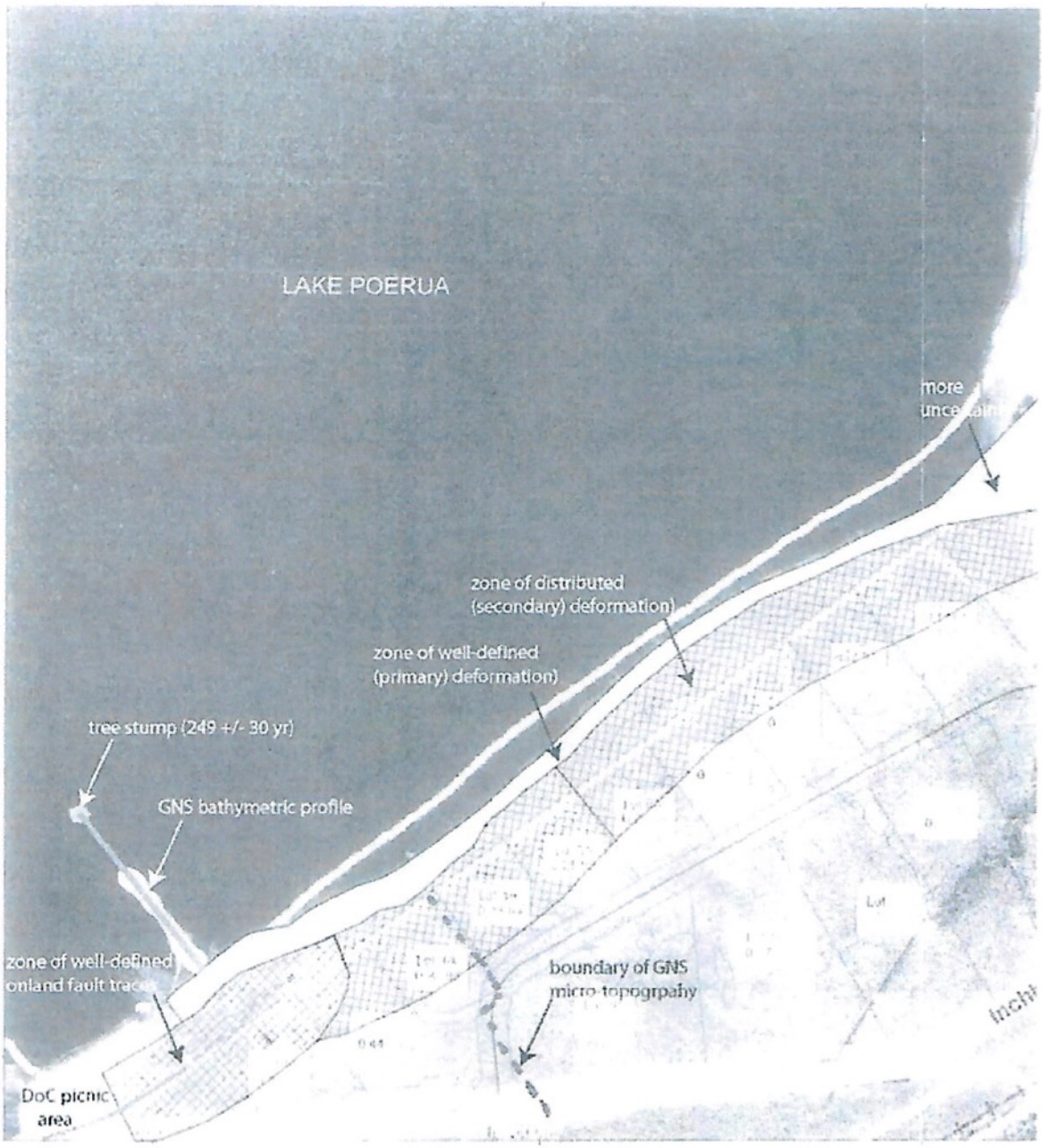

Figure 3 Active Fault Deformation Zonation map for the Lake Poerua lakefront adjacent to the proposed subdivision. The pink coloured zone and hachured zone about the red fault line are considered zones of primary rupture, while the broad hachured area is a zone of secondary (distributed) deformation. The pink zone broadens near Mine Creek where the fault location is poorly expressed. The green line shows the location of the bathymetric profile, which was anchored at a drowned stump, the outside of which was dated.

level of uncertainty based on projecting the fault from places where the location is better known. In this regard the pink primary rupture zone increased in width to accommodate that uncertainty. The fault setback shown on Golders' Figure 5 across the Mine Creek area (blue) is not adequate in this regard. The width of uncertainty probably equates to approx. ± 50 m in this case. This is shown on Figure A of this letter. For those areas shown inside the hachures the MfE Guidelines suggest a *Discretionary* and *Non-Complying* resource consent activity status for BIC 2a and 2b structures, respectively.

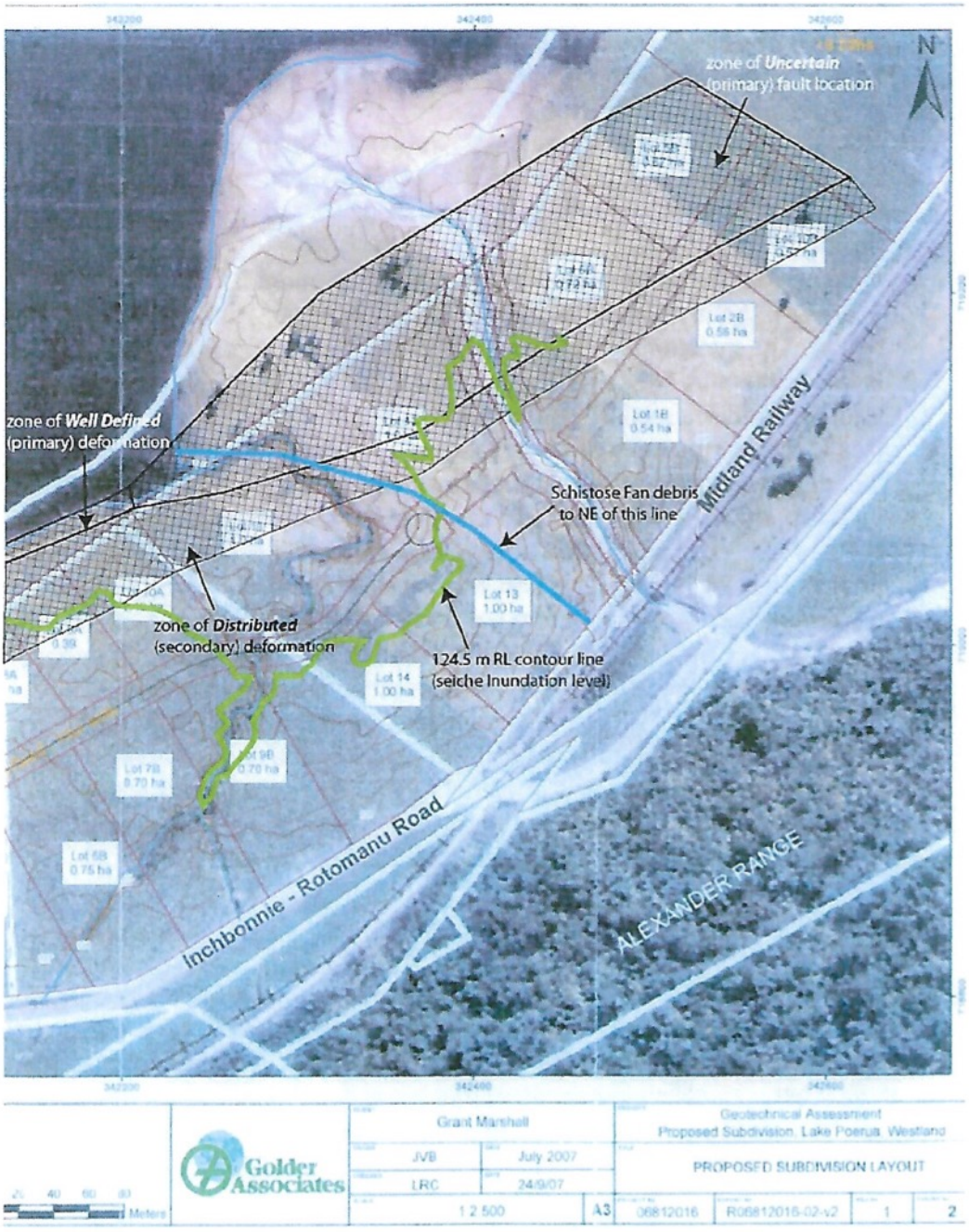

Figure A. Map showing suggested Fault Rupture and Deformation Avoidance Zones in the NE part of the Lake Poerua subdivision. The green line shows the expected seiche inundation level (from the lake) across this area. The blue line demarks the area covered by schistose fan debris.

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July 19, 2007

E/07/325
068-12016

Golder Associates (NZ) Ltd.
Level 1, 79 Cambridge Terrace
Christchurch, New Zealand

Attention: Mr. Cid Chenery

RE: EMPIRICAL LANDSLIDE AND EARTHQUAKE WATER LEVEL SURGE ASSESSMENT, LAKE POERUA, NEW ZEALAND

Dear Cid:

At your request, Golder Associates Ltd. (Golder) carried out an empirical assessment of potential water level surges on Lake Poerua caused by a landslide into the lake or an earthquake along the Alpine Fault which runs adjacent to the lake on the southeast side. The purpose of the assessment was to provide empirical approximations of water level surges which might affect a proposed land development along the southeast side of Inchbonnie Basin. Debris flows from the west side of the lake that have previously affected lake levels have been recorded[1].

1.0 OBJECTIVES

The objectives of the assessment were to:

- Assess maximum wave runup at the proposed development caused by a potential landslide into the Lake.

- Assess the potential lake seiche amplitude or water level surge caused by a rupture of the Alpine Fault and displacement of the lake bed.

These estimated wave runup and seiche amplitudes are anticipated to be used to guide flood construction elevations on the proposed development.

[1] West Coast Regional Council: Natural Hazards Review. 2002. Report by DTEC Consulting to the WCRC

2.0 BACKGROUND

The proposed development is located on the southeastern shore of the Inchbonnie Basin in Lake Peorua. The lake is approximately 1,000 m wide in the northwest-southeast direction at this location. Water depths in the Inchbonnie Basin attain at least 6.5 m with several areas reaching 6.7 m. Water depths along the shoreline of the proposed development are approximately 3 m at 100 m from the shoreline and 1 m at 50 m from the shoreline[2]. Steep slopes are located on the northern side of the lake across from the development. Landslide scars have been recorded on these slopes[3]. A debris flow channel and fan is situated towards the north end of the proposed development. The active Alpine Fault is located on the eastern margin of the lake.

3.0 ANALYSIS

Available, existing data were used for the analysis. No additional data were collected for this assessment.

3.1 Estimated Maximum Landslide Generated Wave Run-up

A landslide may be treated as a point impact on the water surface creating waves which propagate away from the site of impact. Waves generally decrease in wave height with propagation distance from the source since the wave energy is conserved over a longer and longer wave arc similar to the decay of ripples from a pebble tossed in a pond.

Waves from a debris flow event along the debris flow channel situated to the north of the site will propagate out into the lake away from the site. Since these waves will have to travel across the lake twice, they will be smaller than waves generated on the far shore for a similar sized event.

A landslide from the steep slopes across the lake could be large enough to generate a wave in the lake which could impact the proposed development. An estimate, provided by Golder Associates (NZ) Ltd., of design landslide volume potentially delivered instantaneously to the lake is 79 m^3 per metre length of a wedge type failure. This volume would deposit 35 m out into the lake, in water depths of 4.5 m approximately, at a minimum of 1 km from the shoreline nearest to the proposed development.

The maximum wave height generated by this landslide would be limited by depth of water. A conservative estimate of the depth limited wave height is to take 0.78 times

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[2] Lake Ianthe: Lake Poerua 1:8000 Bathymetry, Irwin. J; NZ Oceanographic Institute 1982
[3] Mapworld NZ TopoMAP, Sheet: K32 Ed 2 2000. 1:25,000.

the water depth. Thus the estimated largest wave generated by this landslide would be approximately 3.5 m.

Assuming the waves generated by the landslide propagate across the lake with no loss of energy, as the wave arc lengthens the wave height reduces to meet conservation of energy requirements. An estimate of wave height on the opposite shore can be made by equating the product of the initial wave energy per unit wave width and wave arc length with the final wave energy per unit wave width and final arc length. Wave energy is proportional to wave height squared.

The initial arc length has a radius of 35 m. The final arc length has a minimum radius of approximately 1,000 m. Using these radii and the conservation of energy approach, the final wave height is approximately 0.19 times the initial wave height. With an initial wave height of 3.5 m, the estimated landslide generated wave height along the shore of the development is approximately 0.7 m.

Based on empirical data and experience, wave runup can be estimated as twice the nearshore wave height. Thus wave runup associated with the maximum estimated wave height of 3.5 m from a landslide into the lake is 1.4 m above still water level.

3.2 Estimated Earthquake Generated Wave and Water Level Surge

An earthquake which involves a rupture along the Alpine Fault has the potential to cause a seismically generated seiche in Lake Poerua since the lake is wide and shallow. A seiche is an oscillation of the water surface around a central location caused by stress on the water resulting in the lake surface rising and falling along the shoreline like water sloshing back and forth in a shallow pan. In the case of an earthquake, the seiche is caused by vertical displacement of the lake bed displacing the overlying water and creating a seismically generated wave, rather like a tsunami in the deep ocean.

Based on data provided by Golder Associates (NZ) Ltd., the anticipated vertical rupture of the Alpine Fault may be on the order of 3 m[4]. Large earthquake ruptures in the ocean typically create less than 1 m of vertical displacement in the water surface[5]. Assuming the 3 m displacement produces no more than a 1 m wave in the mean water depth of 5.5 m, which behaves like a seismically generated wave (tsunami), Green's law may be used to estimate shoaling as the wave comes ashore:

[4] Berryman, K.R.; Beanland, S.; Cooper, A.F.; Cutten, H.N.; Norris, R.J.; Wood, P.R. 1992 The Alpine Fault, New Zealand: variation in Quaternary structural style and geomorphic expression. Annales Tectonicae, Special issue - supplement to v.6: 126-163

[5] http://www.appstate.edu/~abbottrn/tsunami/prprts.html

$$Hd^{0.25}w^{0.5} = \text{constant},$$

Where H = wave height, d = water depth and w = width of the bay[6].

Since Lake Poerua is approximately rectangular, w may also be considered constant. A maximum 1 m wave in 5.5 m of water transforms into approximately a 1.3 m wave in 2 m of water 50 m from the shore.

An empirical formula used in Japan to estimate run-up from seismically generated waves is:

$$\log_{10}(R/H) = 0.421 - 0.095\log_{10}(l/L) - 0.254\{\log_{10}(l/L)\}^2$$

Where R = runup height (m), H = shoaled wave height (m), l = distance from shore of the shoaled wave height, L = wavelength of wave[7].

Assuming a unimodal seiche event, the wavelength of the wave will be equal to the width of the lake or 1,000 m. The distance from shore of the shoaled wave is approximately 50 m and the estimated wave height is 1.3 m. Simplifying the equation using the numbers above yields wave runup (R) = 1.3 times the seismically generated wave height (H) or approximately 1.7 m.

A preliminary estimate of the seiche period was made using an online seiche period estimator maintained by the University of Delaware[8]. The lake parameters input into the estimator included a lake width of 1,000 m perpendicular to the fault and a maximum lake depth of 6.5 m. A unimodal seiche event was considered allowing the lake water level to oscillate around one point in the lake. The estimator provided a period of approximately 250 s or slightly over 4 minutes.

An estimate of seismic wave velocity using $V = (dg)^{0.5}$ where V is wave velocity, d is water depth and g is gravity, yields an approximate velocity of 8 m/s, resulting in a period of approximately 270 s, using an estimated mean water depth of 5.5 m.

4.0 SUMMARY

Preliminary estimates of wave runup associated with landslides and water level surge (seiching) associated with an earthquake were developed for a proposed land development on the southeastern shore of Lake Poerua in New Zealand. The preliminary estimated maximum wave height generated by a landslide is 1.4 m at the proposed site. The preliminary estimated seismically generated seiche amplitude is

[6] Shelton Liu, Golder Associates, pers. comm. June 3, 2007
[7] Shelton Liu, Golder Associates, pers. comm. June 3, 2007
[8] http://www.coastal.udel.edu/faculty/rad/seiche.html

1.7 m at the proposed site. The preliminary estimated seismically generated seiche period is of the order of 250-270 s.

5.0 CLOSURE

We trust that the information contained within this letter meets your present needs. Please contact the undersigned should you have questions.

Yours very truly,

GOLDER ASSOCIATES LTD.

Rowland Atkins, M.Sc., P. Geo. (BC)
Senior Coastal Geomorphologist

Reviewed by:

for Peter Morgan, M.Sc., P.Eng. (BC)
Associate, Senior Coastal Engineer

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Te Tai o Poutini Plan

THE WE
REGION

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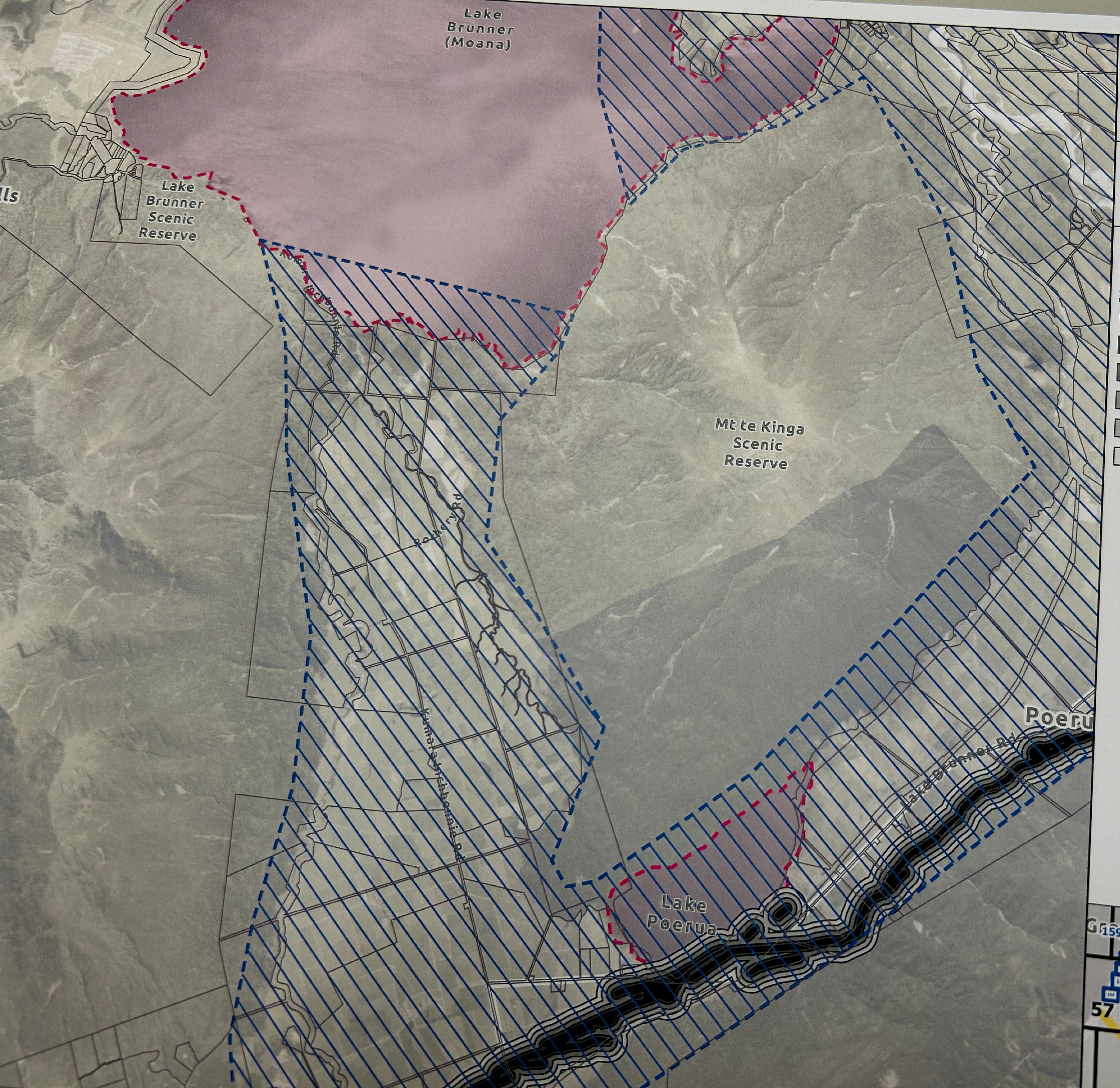

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Grey District

Scale: 1:50,000

0 1 2 Kilometers

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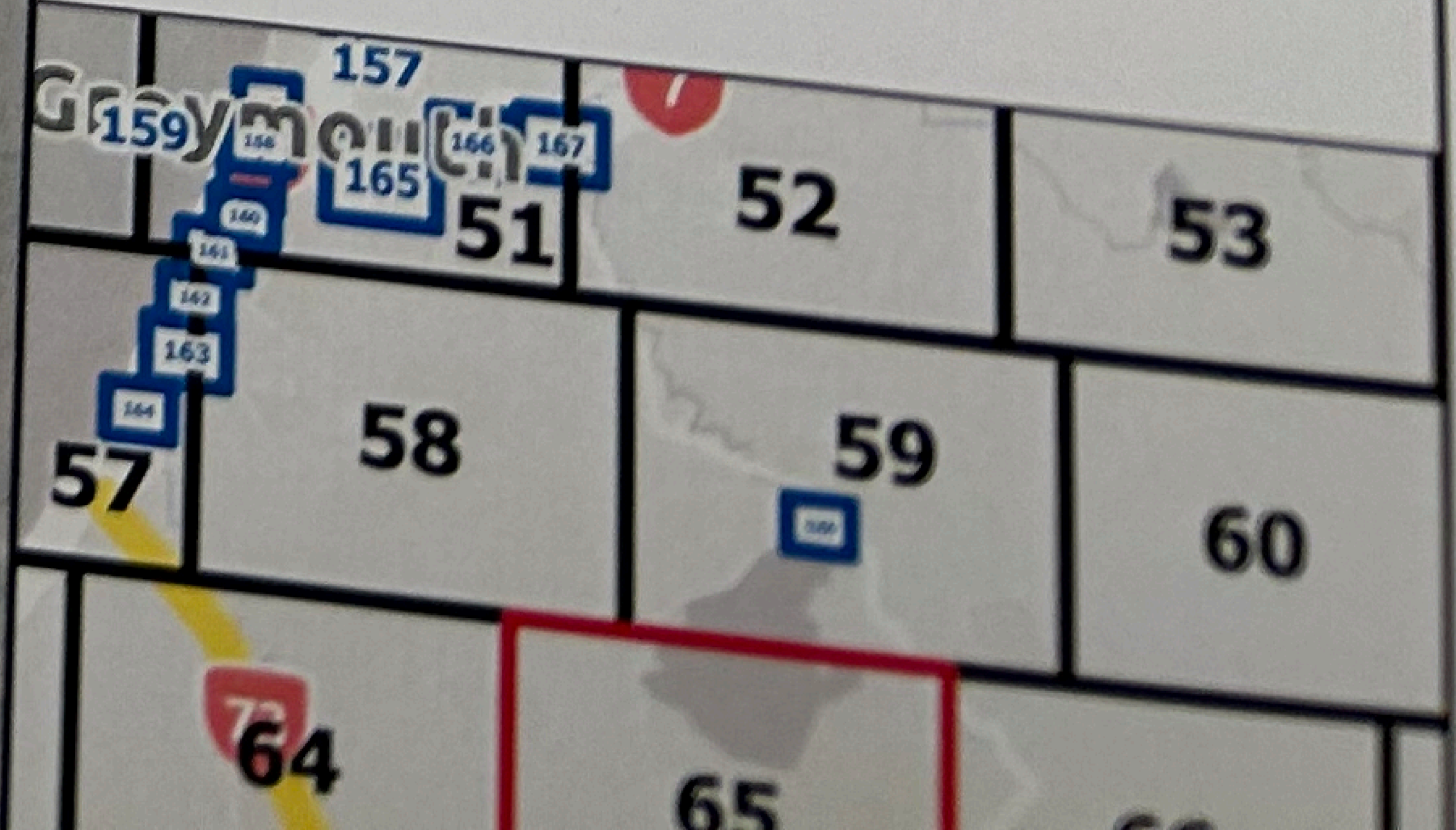
Legend

- Lake Tsunami
- Flood Plain

Earthquake Hazard Overlay

- 20m
- 50m
- 100m
- 150m
- 200m



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Grey District

Scale: 1:50,000

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Legend

- Sites and Areas of Significance to Māori
- Pounamu Management Areas
- Significant Natural Areas
- Outstanding Natural Landscape

SASM81

Lake Brunner (Moana)

SASM82

SASM84

Lake Brunner Scenic Reserve

Mitchells

DOC-011

SASM85

SASM86

SNA-11

Mt te Kinga Scenic Reserve

Rotherys Rd

SNA-7

Poeru

Lake Brunner Rd

SNA-10

Kumara Junction Rd

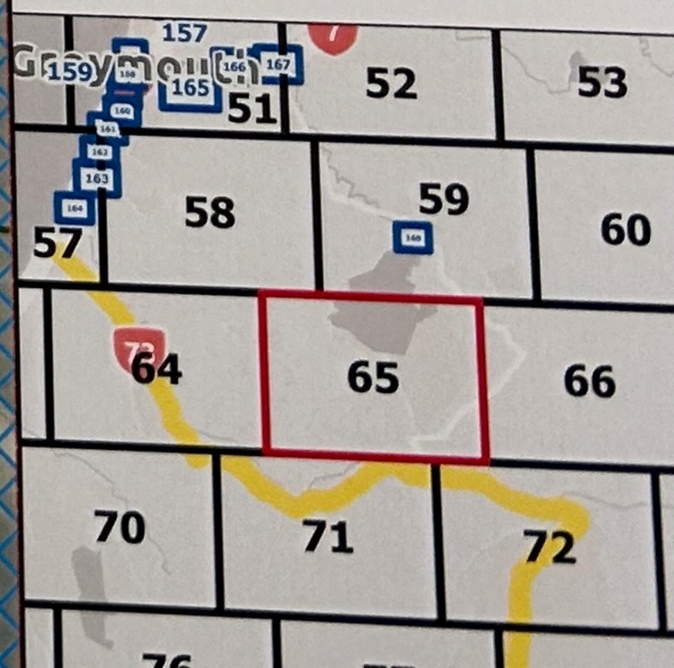
Lake Poerua

SASM97

SASM99

SASM96

SNA-9



- All planting to be indigenous – no cultivars, variegated or hybrids; and
- Sewage treatment to be designed for intermittent loadings.

His vision for the future is for a public access walkway around the lake.

Mr Stewart Robinson represented the Tai Poutini Conservation Board in opposition to the application. He explained that the Board considers that the value of the landscape that is visible to visitors is sufficiently high to be considered as outstanding and requires protection from inappropriate development and subdivision. At present there is little to obstruct the views of Mount Te Kinga and the whole of the lake from the highway and the railway line. The development and the screen planting proposed would impair the appreciation of this view. Mr Robinson supported the views expressed by Dr Steven. While the Board appreciated the remedial work proposed for the lake edge, it considered that the number and distribution of houses and their clustering would have an adverse effect. He considered that the significant distance between the non contiguous parts of each title would create an undesirable precedent and a management problem. Mr Robinson considered that as far as landscape was concerned, the District Plan was an incomplete document. The provisions in the District Plan are based on a preliminary assessment only.

Mr Ibbotson raised the issue of the unformed legal road at the lake edge. Given that an esplanade strip was proposed, he indicated that this may engender a need for a road stopping procedure. Mr Prebble indicated that no survey work had been done but the applicant would prefer to provide a strip.

Dr Langridge who had peer reviewed the geotechnical report on behalf of the Council indicated that he was happy with the applicant's proposed fault avoidance zone. He emphasised that the landscape was of relatively recent origin with the lake being only 6-700 years old. The area was one of high seismic risk and the Alpine Fault can generate large events with movements of up to 6m horizontal and 2-3m vertical every three to four hundred years.

Dr Steven emphasised the need to consider the wider context of the site which was immediately contiguous to an outstanding natural landscape. He considered that the