Before the Independent Hearing Panel

Appointed by West Coast Regional Council

Under	the Resource Management Act 1991
In the matter of	a Hearing on Submissions on the Proposed Te Tai Poutini Plan
	Hearing Stream: Natural Hazards Part C
	Grant Marshall (Submitter ID # S311)
	Submission Point: S311.004

EVIDENCE OF NICHOLAS KELVIN HARWOOD

NATURAL HAZARDS – EARTHQUAKE HAZARD

23 September 2024

INTRODUCTION

1 My name is Nicholas (Nick) Kelvin Harwood.

2 I hold a BEng (Hons) Engineering Geology & Geotechnics, MSc Soil Mechanics & Engineering Seismology, and Diploma of Imperial College (London).

3 I am a Chartered Professional Engineer (CPEng) and Chartered Member of Engineering New Zealand (CMEngNZ), specialising in geotechnical natural hazards risk management and geotechnical earthquake engineering.

4 I am employed by Eliot Sinclair & Partners Ltd where I have worked since 2015 and have the position of Principal since 2016.

5 My work experience includes over 25 years as a consulting geotechnical engineer in natural hazards risk assessment and land development, with the past 22 years based in New Zealand.

6 I have presented evidence as expert witness previously. This will be my first opportunity to appear before the Independent Hearing Panel appointed to hear submissions in relation to Proposed Te Tai o Poutini Plan (pTTPP).

CODE OF CONDUCT FOR EXPERT WITNESSES

7 Whilst this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing my evidence.

8 Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

7 In my evidence I address the following issue:

(a) The Section 42A Officer's Report relating to the Natural Hazards (Earthquake Hazard Overlays), Officer recommendation to amend/accept the S311.004 submission [S.42A report not dated].

CONTEXT

8 This evidence is provided on behalf of Grant Marshall (Submitter ID # S311) to support his submission (S311.004) regarding the mapped location of the Alpine Fault: "*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.*" (Ref. S42A Report, Section 7.3, p. 42).

9 Mr. Marhsall is the owner of the site at 2261 Lake Brunner Road, Inchbonnie. The site is a parcel of rural land that includes Mr. Marshall's home and accommodation business (Hidden Valley Lodge). See site plan in Appendix A.

10 I understand that the mapping change Mr. Marshall referred to in his submission is a change in the mapped location of the Alpine Fault trace between that shown in the public domain GNS NZ Active Faults Database (1:250,000 scale)[1] and the pTTPP PDF Maps[2]. See site plan in Appendix A.

11 With my knowledge and experience I understand the difference between the two mapped datasets, and I don't question why there are differences in the mapped fault trace locations *between the two datasets*. However, the purpose of my evidence is to review the S42A response to submission S311.004, which I find to be incomplete and misleading.

[1] https://www.gns.cri.nz/data-and-resources/new-zealand-active-faults-database/
[2] https://ttpp.nz/ttpp-pdf-maps/

REVIEW

12 The S42A response (Section 7.3 Earthquake Hazard Overlays) to submission S311.004 includes reference to a 2022 GNS report[3] commissioned by the West Coast Regional Council (WCRC).

13 The 2022 GNS Report was only put into the public domain and made available for review in September 2024. It was only by chance that having reviewed the S42A report and seeing a footnote reference on Page 41 that I was able to obtain the GNS report in time for this Hearing.

14 S42A Para. 114 states: "Revised fault avoidance zone (FAZ) mapping for the Alpine Fault in 18 priority areas (three in Buller District, three in Grey District and 12 in Westland District) was received from GNS Science subsequent to the notification of the TTPP that allowed for further refinement of the overlays." S42A Paras. 114 to 118 inclusive provide the commentary response to S311.004 and should be read in conjunction with my evidence. See S42A Report extract in Appendix B.

15 S311.004 is explicitly interested to "… use correct information to **(i) show the Faultline accurately** in Map 65 **(ii) in particular around my property at 2261 Lake Brunner Road**. If not, then to **(iii) provide detailed evidence and documentation** to support and the rationale as to why this was changed." I have added the bold emphasis to highlight matters of material interest to S311.004 and my review of the S42A report response.

16 I have reviewed the 2022 GNS report. In my opinion, the reporting overall is scientifically robust in its methods, though it explicitly recognises there are notable limitations in the ability to locate the Alpine Fault trace / corridor, and that there is clear distinction made between geographic areas where the fault trace/s is/are confidently located and areas where there is notably less confidence (aka "uncertain").

17 The degree of confidence is expressed in assigned technical attributes, such as "Accuracy" and "Fault Complexity". In the mapping the confidence is expressed in the different colour coded lengths of the Fault Avoidance Zone (FAZ) and the widths of the various zonings. In general terms, the wider the zone the less laterally constrained the fault trace is and/or there is a broader area of expected land deformation, or the fault location is not known.

18 Section 4.3 of the 2022 GNS report covers the 'Lake Poerua Priority Area'. I have extracted Section 4.3 and added my review comments – see Appendix C. At the hearing, I will explain the extract with my annotations.

[3] Langridge, R.M., Morgenstern, R., Coffey, G.L., Clarke, L.B. 2022. Updated Alpine Fault mapping and fault avoidance zones for priority areas in the West Coast region. Lower Hutt (NZ): GNS Science. 63p. Consultancy Report 2022/08.

19 The land at 2261 Lake Brunner Road lies within this GNS priority study area. The Lake Poerua priority area spans a c. 10km stretch of the Alpine Fault along a strip of LiDAR data that extends from the Taramakau River located southwest of the site and extending to the northeast beyond Lake Poerua to Brown River.

20 Through the Lake Poerua area the GNS mapping variously has mapped lengths of high confidence (aka *well-defined* FAZ) and low confidence (aka *uncertain poorly-constrained* FAZ), and lengths of intermediate confidence.

21 Under the TTPP hearings review process I only have the 2022 GNS report as the technical basis for the mapping presented in the S42A report, and the S42A Officer's interpretation of that report (Paras. 114 to 118, inclusive).

22 I find the GNS report to be scant on details of the rationale and methods of mapping through and adjoining the site 2261 Lake Brunner Road – what I refer to as the "Middle length" in annotated Figure 4.5. Additionally, the reporting explicitly notes the "large uncertainty" in the interpretation to dogleg the fault, and hence I reasonably infer the associated 'large uncertainty' in running the mapped trace through the land and building/s at the site along a FAZ mapped as "uncertain constrained".

23 There are limitations to fully and properly reviewing the TTPP/GNS reporting on the fault location at the site given the lack of evidence and detail in the available reporting (GNS, 2022) for the Lake Poerua Priority Area – my annotated pages highlight queries, suggestions, and potential inconsistencies in the mapping.

24 Also, with the 2022 GNS report only being released in Sept 2024 it has not been possible for timely and effective public consultation on the report and its implications for landowners, and to have the opportunity to have questions addressed (as the MfE strongly promotes in its 2003 Active Fault Guidelines[4]).

25 I recognise that internally GNS may well have detailed records and justification for their field mapping and FAZs, and that perhaps the 2022 report is a condensed report summarising their work. However, from the public domain perspective, I only have the 2022 report as being the basis for the TTPP mapping and S42A reporting, and it is not sufficient to understand or accept the mapping or S42A recommendations as they relate to the site.

[4] Planning for development of land on or close to active faults (MfE, 2003): https://environment.govt.nz/publications/planning-for-development-of-land-on-or-close-to-active-faults-a-guideline-to-assist-resource-management-planners-in-new-zealand/

MATTERS RAISED IN SECTION 42A REPORT

26 Addressing the points raised in S311.004 for the site and the S42A response, I note the following:

26.1 The S42A Officer's recommendation is to accept the 2022 GNS report FAZ mapping given for the Lake Poerua Priority Area as the mapping response to address S311.004 at the site. (Ref. S42A Paras 117, 118, 124).

26.2 S311.004 explicitly sought for the TTPP mapping to "show the Faultline accurately". However, the TTPP mapping at the site is "uncertain", and GNS Section 4.3.2 explicitly notes the "large uncertainty in its location and orientation" where the FAZ doglegs to run into the site from the west. Hence, the S311.004 requirement for accuracy is not met.

26.3 S311.04 explicitly sought a response in relation to the land at 2261 Lake Brunner Road. The S42A response does not address the site area. Instead, in Para. 118 & Figure 2 the report refers to land to the west of the site. The site is out of frame to the east in S42A Figure 2. Hence, the S311.004 requirement to address the site is not met.

26.4 If the fault could not be mapped accurately at the site, S311.04 explicitly sought evidence and documentation to support the rationale for the new mapping. The reporting does not provide accuracy and nor does it address the site, hence evidence and documentation is warranted to address S311.004 and this not provided in GNS (2022), nor the S42A report. Hence, the S311.004 requirement for reporting content is not met.

26.5 Para.117 states: "As such the recommended Earthquake Severe Hazard Overlay represents the well-defined and well-defined extended FAZs, and the recommended Earthquake Susceptibility Hazard Overlay represents the distributed, uncertain constrained and uncertain poorly constrained FAZs." There is no explanation given for distinguishing the two Overlays. There is an implication (e.g. S42A, p.193, Para 627) that the Earthquake Severe Hazard Overlay applies to land areas with a "high level of risk", from which I infer that the TTPP is implying Earthquake Susceptibility Hazard Overlay does not have a "high level of risk". However, this is only my inference. In practical terms, what is the difference in risk between the two overlays? How has the S42A report defined the risk and distinguished risk between Overlays? There is no explanation given of the risk assessment process applied (required under the MfE Guidance) in the S42A report nor its Section 32AA assessments.

OTHER MATTERS

27 With the GNS (2022) report having not been made available to the public until the last minute ahead of the Hearings (in Sept 2024), this has presented a major inhibition to the public being able to fully understand the nature of revised FAZ mapping and the implications for their properties.

28 I note the MfE 2003 Guidelines present key lessons from Wellington and Kapiti Coast from approx. 20 years ago that highlighted the need for extensive public consultation and sharing of information. It was only by chance that I was able to obtain the GNS 2022 report and then benefit from the Hearing granting a (short) extension of time for preparation of evidence.

29 I expect most property owners are unaware of the GNS (2022) report and have not been able to consider the matters or respond to the Hearing. I recommend the Commissioners review whether the public has been given enough time to understand and respond to the 2022 FAZ mapping.

30 The MfE 2003 Guidelines require fault assessment and mapping to be accurate and the right scale for the intended end-use, which for the TTPP the intended use is property-specific regulation. MfE comments:

30.1 Section 2.1 – "Maps showing the location of hazards around property boundaries must be developed at the right scale."

30.2 Section 5.2 Maps must have "… adequate detail for planning purposes, which requires detail to at least property boundary level."

31 However, the GNS 2022 report states (p.44) : "We note that this project is undertaken at a regional scale and site-specific studies at property scale are outside the scope of this report". I would like clarification as to the accuracy and scale of the GNS 2022 mapping, its compliance with the MfE Guidelines for accuracy and scale, and whether it is appropriate to be applied at the property scale for use in TTPP planning matters.

CONCLUSIONS

32 S311.004 is demonstrably not addressed in the S42A report, but rather the S42A report (and the supporting GNS report) confirms uncertainty in mapping, and is absent in details / evidence to support the mapping provided.

33 The many FAZ areas at and around the site to the south-west and north-east have no details / evidence / papers / reports provided or referenced to support their location or FAZ designation.

34 S42A Para. 118 concludes that the new Overlays will address S311.004, then goes on in Para. 124 to recommend the pTTPP mapping be replaced with the new GNS mapping. At the site. the S42A Para. 124 recommendation to replace the pTTPP mapping is not supported, and the premise that S311.004 has been met is not true.

35 Accordingly, the new FAZ mapping cannot be adopted for the site (or the adjoining land).

RECOMMENDATIONS

36 S311.004 should be revisited and the S42A response updated to explicitly address the submission, and in a detailed substantiated manner. This is likely to involve GNS providing specific and detailed reporting for the FAZ mapping at the site and in the adjoining land in the Lake Poerua area. It is important that all the mapped FAZ lengths and limbs are explained to give the continuity in reporting on either side and through the site.

37 I recommend that an additional Case Example be prepared to cover the site and for the reporting to include refences to all reporting/fieldwork/evidence/papers etc that have been relied upon for the site's detailed mapping. We should not rule out that a detailed review finds the most plausible FAZ to run to the north of the site and not through it. It is also entirely possible that the fault trace is not a continuous physical feature, as was observed after the Kaikoura Earthquake.

38 My review finds that it is more plausible to join the 'certain' map traces running north-east from the lake. I concur with GNS Section 4.3.2 that "It is possible that the fault is more north-east striking in this area than what is mapped and that its trace is buried beneath large, recently active alluvial fans, such as those emanating from Homestead and Dry creeks". I find this more plausible than mapping a wide swathe of "uncertain poorly-constrained" FAZ through a pronounced dogleg the likes of which is not evident or mapped elsewhere in the GNS Figure 4.5 area.

39 I would like to be party to the site's FAZ review to keep a technical watching brief rather than wait until its conclusion and finding further material queries with the reporting, as I have found in my review of the S42A report (and GNS report) presented in this evidence.

40 Furthermore, I recommend:

40.1 The Commissioners review whether the 2022 GNS report being absent from the public domain until Sept 2024 has compromised the public consultation process,

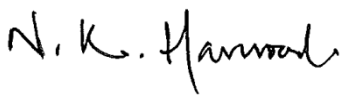
40.2 That the S42A report clearly follows the MfE 2003 Guidelines in its assessment and communication of fault hazard risk, and clearly articulates the rationale for adopting different risk levels/profiles for the different FAZ areas. It does not appear clear or consistent to me how the S42A report considers risk in the manner communicated by GNS; for example, in GNS Section 6.0 and notably Section 6.3 regarding the different FAZ areas and building types. The lack of clarity may be due to the TTPP adopting different terminology and definitions to that used in the MfE Guidelines and GNS 2022 report.

40.3 That clarification be sought as to the accuracy and scale of the GNS 2022 mapping, its compliance with the MfE Guidelines for accuracy and scale, and whether it is appropriate to be applied at the property scale for use un TTPP planning matters.

CLOSURE

41 Thank you for the opportunity to present my evidence. I will happily take any questions.

Dated 23 September 2024



Nick Harwood

Enc.

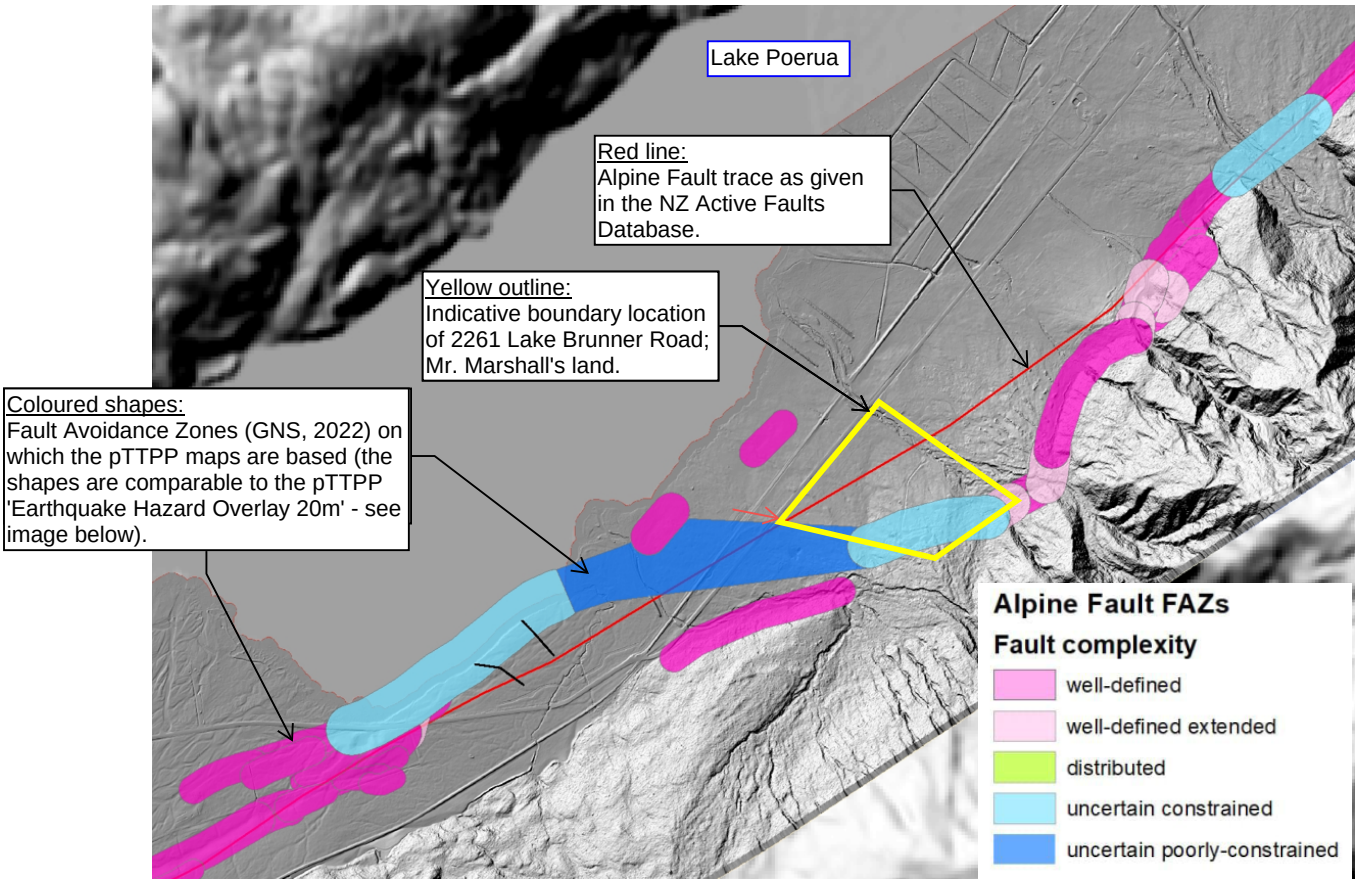
Appendix A: Site location plan

Appendix B: Extract from S42A Report; Section 7.3 Earthquake Hazard Overlays

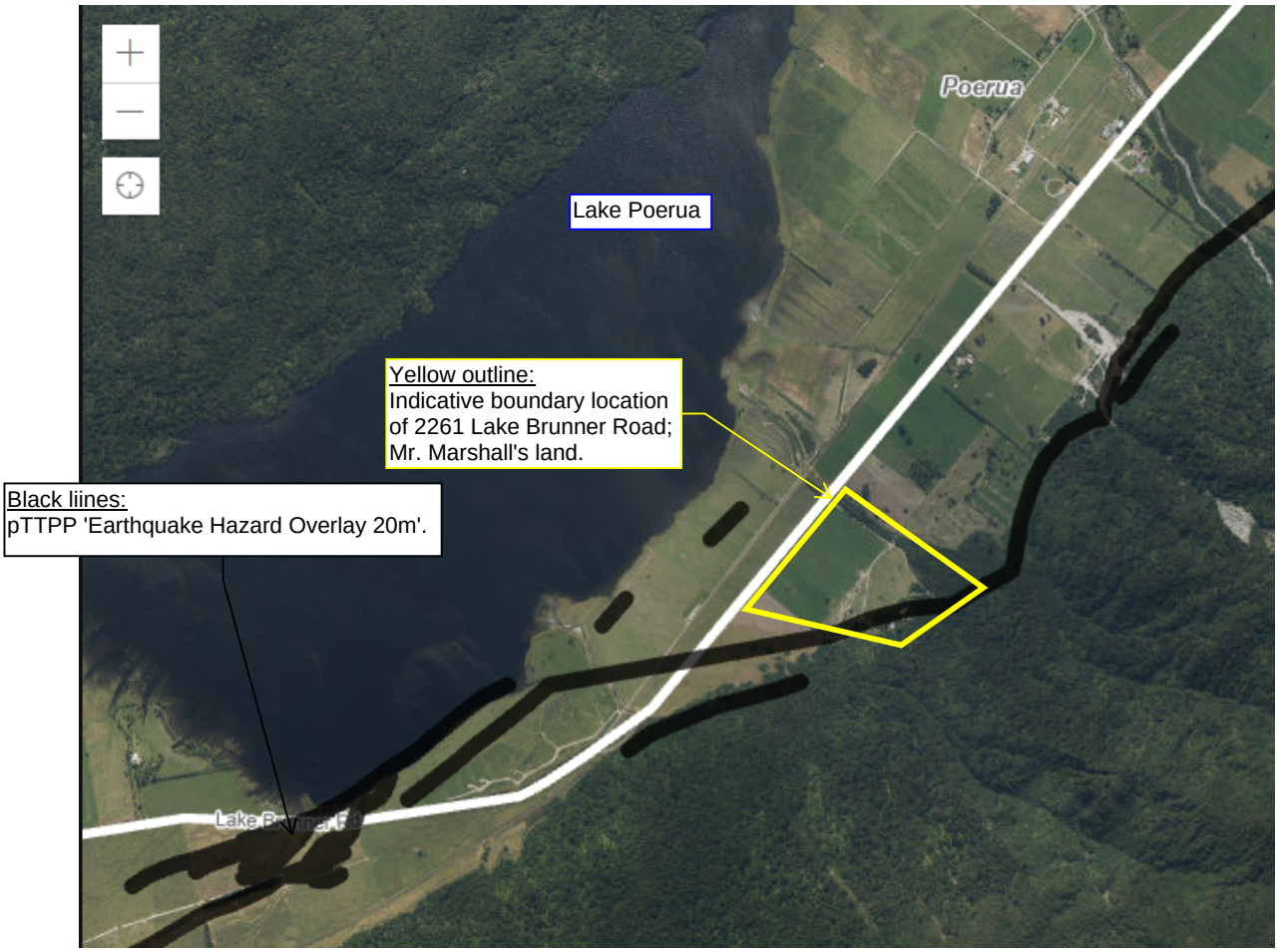
Appendix C: Extract from GNS (2022): Annotated Section 4.3 Lake Poerua Priority Area

APPENDIX A

Site location plan



Alpine Fault mapping:
NZ Active Faults Database and proposed amended trace locations (based on GNS, 2022).



Extract from TTPP online hazard map; Alpine Fault trace (Earthquake Hazard Overlay 20m buffer zone); sourced 16 February 2024. https://westcoast.isoplan.co.nz/eplan/0/76

APPENDIX B

Extract from S42A Report; Section 7.3 Earthquake Hazard Overlays

106. Submissions (S18.001, S33.001. S50.001, and S483.015, S504.004, S504.005, and S351.001) raised concerns regarding the flood mapping in respect to specific properties and areas. We have no reason to believe that the flood hazard modelling upon which the Flood Severe and Flood Susceptibility Overlays is based is incorrect or contains significant errors. There has been no evidence presented through the submission process which demonstrates the need for these reports to be peer reviewed as there are incorrect assumptions or approach applied to the modelling. On this basis, we do not propose to remove the flood hazard extents from these submitters properties.

Recommendations

107. That the Flood Plain Overlay and all associated provisions be deleted from TTPP. It is recommended that all other Flood Hazard Overlays remain in the TTPP.

108. It is recommended that submissions and further submissions are either accepted, accepted in part or rejected as shown in Appendix 2.

Section 32AA Evaluation

Effectiveness and Efficiency

109. The deletion of the Flood Plain Overlay will improve the effectiveness of the plan as this overlay was a precautionary layer that was not based on accurate mapping. This will also improve the efficiency of plan administration, as the Flood Plain Overlay captured a large number of properties. The deletion of this overlay will provide more certainty for property owners, and ensure that they are not subjected to provisions, for which there is a low level of certainty regarding the underlying science.

Costs and Benefits

110. The benefits of deleting the overlay are high, as it will provide certainty for property owners and will reduce the number of resource consent applications received by councils in the region (while noting only rules for subdividing in this overlay were notified). There will be no costs of removing the overlay and therefore the benefits outweigh the costs.

Risk of Acting or Not Acting

111. The information upon which the overlay is based is not accurate, is insufficient and uncertain. However, there is a risk from deleting the overlay in that it does cover properties that are known to be subject to inundation from past events. The precautionary approach of Policy NH-P2 will provide direction for decision-makers in such instances.

Decision About the Most Appropriate Option

112. The deletion of the Flood Plain Overlay is the most appropriate way to achieve the objectives of the plan, compared to retaining it.

7.3 Earthquake Hazard Overlays

Submissions

Submitter Name (ID)	Submission Point	Position	Decision Requested
General			
Grant Marshall (S311)	S311.005	Amend	I would like the inclusion of the GNS report on Lake Poerua dated January 2008 to the technical info in the TTPP

Submitter Name (ID)	Submission Point	Position	Decision Requested
Stephen Hogg (FS52)	*FS52.3*	*Support*	*Allow*
Scenic Hotel Group (S483)	S483.018	Oppose	Earthquake Hazard Overlays – All Should any of the changes that restrict development be adopted then financial assistance or compensation - in conjunction with central government agencies needs to be investigated as appropriate.
Toka Tū Ake (S612)	S612.021	Amend	Add all active faults in the region to planning maps, including exclusion zones.
Westpower (FS222)	*FS222.0356*	*Oppose*	*Disallow*
Toka Tū Ake (S612)	S612.048	Amend	Incorporate uncertainty and distributed fault deformation into earthquake hazard (fault avoidance) zones, as directed by the MfE guidelines for planning around active faults
Westpower (FS222)	*FS222.0357*	*Oppose*	*Disallow*
Site Specific			
Scenic Hotel Group (S483)	S483.013	Oppose	Oppose Earthquake Overlays on the following properties: • Scenic Hotel Franz Josef Glacier 45 SH6 Franz Josef Glacier • 24 Cowan Street, Franz Josef Glacier • 26 Cron Street, Franz Josef Glacier • 2 Condon Street, Franz Josef Glacier
Grant Marshall (S311)	S311.001	Amend	Amend the Earthquake Hazard Overlay 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.
Stephen Hogg (SFS52)	*FS52.1*	*Support*	*Allow*
Grey District Council (FS1)	*FS1.296*	*Support in Part*	*Allow in Part*
Grant Marshall (S311)	S311.004	Amend	To use correct information to show the Faultline accurately in Map 65 in

Submitter Name (ID)	Submission Point	Position	Decision Requested
			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

Analysis

113. Toka Tū Ake (S612.048) seeks that the Earthquake Hazard Overlays are amended to incorporate uncertainty and distributed fault deformation in line with the Ministry for the Environment guidelines for planning around active faults[1] (hereinafter referred to as the Active Fault Guidelines). We agree with this submitter that the Earthquake Hazard Overlays as notified do not adequately represent a risk-based approach to managing the risk from this hazard, as the buffers are arbitrary setbacks that do not account for the uncertainty in the location of the fault.

114. Revised fault avoidance zone (FAZ) mapping for the Alpine Fault in 18 priority areas (three in Buller District, three in Grey District and 12 in Westland District) was received from GNS Science[2] subsequent to the notification of the TTPP that allowed for further refinement of the overlays. As the adoption of this new mapping will not include any additional sites into the overlays and will in fact result in a significant reduction in the number of properties impacted by the overlays, it is considered appropriate to include it as part of this process.

115. Associated with the revised mapping, the overlays and associated provisions have been amended to follow more closely with the approach recommended in the Active Fault Guidelines. This means that where the fault is well-defined or well-defined extended, the planning controls are more restrictive than where the fault is uncertain constrained or uncertain poorly constrained. In the notified version of the TTPP maps, the fault trace is mapped with concentric setbacks applied, which does not adequately represent the uncertainty that is present where the fault trace and deformation zone are uncertain constrained or uncertain poorly constrained.

116. As described in the GNS Science report, the FAZs have widths of as little as 80m (well-defined) to as wide as 300m (uncertain poorly constrained). Each FAZ includes a 'setback' zone of 20m around the deformation width buffer (or fault location uncertainty buffer) to provide a margin of safety and accommodate the possibility of secondary deformation and ruptures that can occur close to primary fault ruptures.

1. _____

[1] Kerr J., Nathan S., Van Dissen R.J., Webb P., Brunsdon D., King A.B. (2003) Planning for development of land on or close to active faults: a guideline to assist resource management planners in New Zealand. Lower Hutt (NZ): Institute of Geological and Nuclear Sciences. 71p. Client Report 2002/124. Prepared for Ministry for the Environment.

[2] Langridge, R.M., Morgenstern, R., Coffey, G.L., Clarke, L.B. 2022. Updated Alpine Fault mapping and fault avoidance zones for priority areas in the West Coast region. Lower Hutt (NZ): GNS Science. 63p. Consultancy Report 2022/08.

117. To promote consistency, the naming of the new recommended Earthquake Hazard Overlays was chosen to align with those for other hazards addressed by the TTPP, and the classification of the earthquake hazards was chosen to align with the activity status of the buffers as notified. As such the recommended Earthquake Severe Hazard Overlay represents the well-defined and well-defined extended FAZs, and the recommended Earthquake Susceptibility Hazard Overlay represents the distributed, uncertain constrained and uncertain poorly constrained FAZs.

118. This recommendation will also address the submissions of Grant Marshall (S311.001, S311.004, S311.005) in part, as the inclusion of the updated GNS mapping will reduce the extent of the overlay on his property at 2261 Lake Brunner Road, and in the Lake Poerua area, as well as changing the overlay to a less restrictive Earthquake Susceptibility Overlay that reflects the uncertainty in the location of the Alpine Fault in this area, as shown in Figure 2 below.

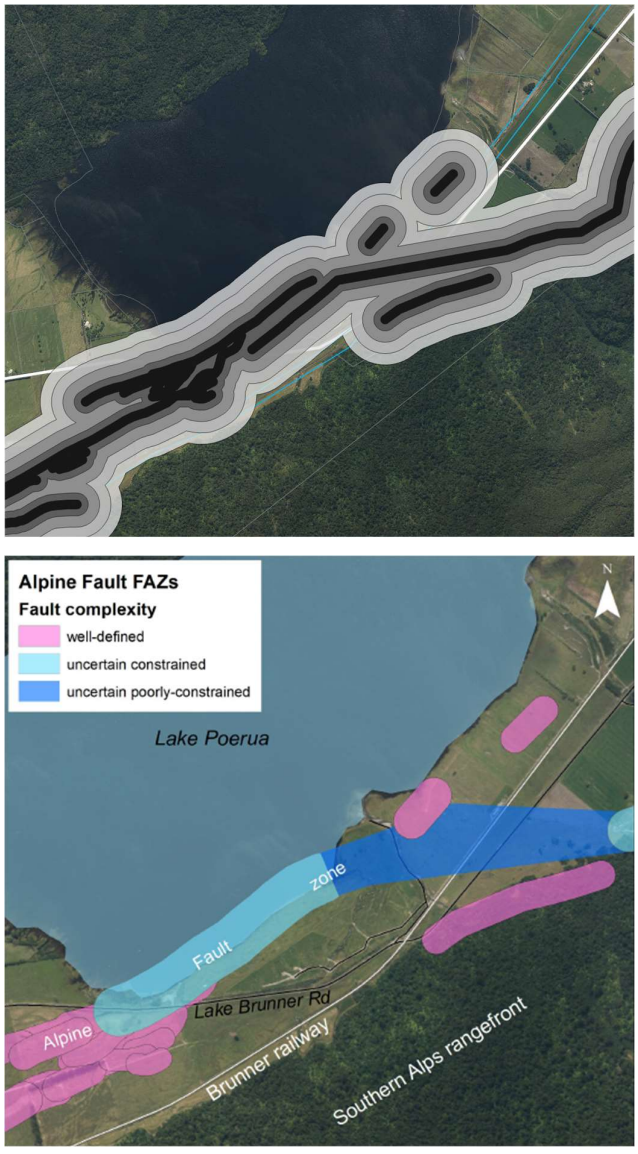


Figure 2: Extent of Earthquake Hazard Overlays as notified in the TTPP (top) vs. recommended extent of Earthquake Hazard Overlays (bottom) as per Langridge et al. (2022) at Lake Poerua.

119. Consideration has also been given to the impact upon properties owned by Scenic Hotel Group at Franz Josef as per submission S483.013. While 24 Cowan Street and 2 Condon Street will be located in the Earthquake Severe Overlay under the proposed changes, and will have similar restrictions as per the notified overlays, only the south-east corner of 26 Cron Street will be within the Earthquake Severe Overlay, with the existing building not being subject to an earthquake hazard overlay, which it currently is. The Scenic Hotel at 45 State Highway 6 will no longer be subject to an earthquake hazard overlay.

120. Figure 3 has been inserted for reference to demonstrate the extent of the recommended changes at Franz Josef township generally.

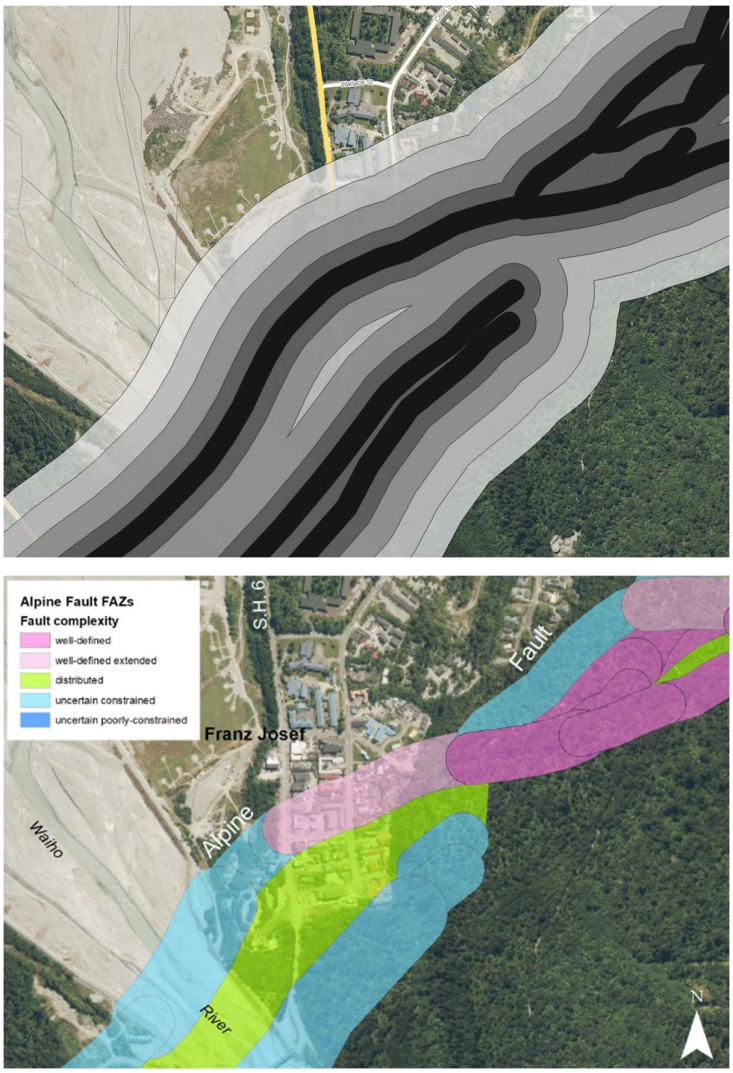


Figure 3: Extent of Earthquake Hazard Overlays as notified in the TTPP (top) vs. recommended extent of Earthquake Hazard Overlays (bottom) as per Langridge et al. (2022) at Franz Josef Village.

121. For those properties owned by the Scenic Hotel that are still within the Earthquake Hazard Overlays, we have no reason to believe that the fault hazard modelling that has been undertaken is incorrect or contains significant errors. There has been no evidence presented through the submission process which demonstrates the need for the overlay to be removed from these properties. On this basis, to give effect to s6(h) of the RMA it would

be inappropriate to remove the Earthquake Hazard Overlays from TTPP and it is our position that they should remain.

122. Scenic Hotel Group (S483.018) seeks for there to be an investigation into financial compensation as a result of loss of development rights arising from the FAZ or the natural hazard overlays. Territorial authorities are required under Section 31 of the RMA to "*control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards".* The proposed natural hazards chapter and associated provisions are council exercising its required function, and therefore there is no requirement to provide financial contribution for loss of development rights arising from the exercising of this function.

123. Toka Tū Ake (S612.021) also seeks that all active faults in the region are included on the planning maps with associated FAZs. However, the overlays as now proposed represent the most current and up to date scientific information on the Alpine Fault which has been prioritised due to the significant risk that this fault poses. While we agree it would be preferable for the TTPP to include all active faults, this is a matter of resourcing, and is not an option at the current time. For these reasons, we recommend that this submission point be rejected.

Recommendations

124. It is recommended that the Earthquake Hazard Overlays as notified are deleted and replaced by two new overlays, being the Earthquake Severe Overlay and the Earthquake Susceptibility Overlay and the maps are updated to reflect this change.

125. It is recommended that submissions and further submissions are either accepted, accepted in part or rejected as shown in Appendix 2.

Section 32AA Evaluation

Effectiveness and Efficiency

126. We consider that the proposed changes to the Earthquake Hazard Overlays, while considerable, are more efficient and effective than the notified provisions in achieving the objectives of the proposed TTPP because they reflect the complexity and uncertainty inherent in fault rupture, which the overlays and provisions as notified do not. This will ensure that development does not occur where the risk from fault rupture is high, while taking a more enabling approach to development in areas where the risk is lower.

127. The proposed new maps also follow the non-statutory national direction regarding land use planning for fault hazards. This is a form of mapping that is used nationally and well understood by a number of practitioners. As a result, it is more effective and efficient in using mapping that is well-understood, as opposed to bespoke mapping which can confuse the outcomes sought under the objectives.

Costs and Benefits

128. The benefits of the recommended changes are high, as a significant number of properties will no longer unnecessarily sit within the Earthquake Hazard Overlays, and conversely no additional properties will be impacted. We have not identified any cost associated with the proposed change in approach. The changes will streamline the provisions, resulting in improved plan interpretation and more efficient plan administration.

Risks of Acting or Not Acting

129. There is no risk from acting, however the risk from not acting is that property owners will have unnecessary restrictions placed upon their development rights, there will not be clarity about the activities that the provisions apply to, nor what the provisions are trying to achieve.

Decision About the Most Appropriate Option

130. We are of the opinion that the proposed amendments to the Earthquake Hazard Overlays, and specifically the introduction of fault complexity and uncertainty into the policies, rules and overlay maps are the most appropriate way to achieve the objectives of the plan compared to the notified provisions.

7.4 Land Instability Overlay

Submissions

Submitter Name (ID)	Submission Point	Position	Decision Requested
Northern Buller Communities Society Incorporated (S142)	S142.007	Oppose	Review the land instability overlay for the Granity, Ngakawau and Hector areas.
Northern Buller Communities Society Incorporated (S142)	S142.008	Oppose	Remove the land instability overlay on the former mines survey office and the Lyric Theatre in Granity.
TTPP Committee (S171)	S171.012	Amend	i. Delete the Land Instability Hazard overlay on the area as shown at Granity in the map attached. ii. Add a Land Instability Hazard overlay to the area north of Hector as shown in the map attached - Area seaward of the Red dotted line is the Land Instability Hazard area.
Jackie and Bart Mathers and Gillman (S228)	S228.002	Amend	We submit that this overlay is incorrectly positioned and should be based on the current known land instability area north of Hector as per the current Buller District Plan. If the overlay is to be extended, then a more objective, reasoned analysis should be done on the area to ensure it identifies more closely with known areas of risk rather than what appears to be an arbitrary analysis based on very recent occurrences related to rainfall.
David Marshall (S347)	S347.001	Amend	The Land Instability Overlay for the Granity/Ngākawau/Hector area in map 19 of the Natural Hazards Map needs amendment to a much smaller area, such as that suggested in the England and Co. report. This report is available

APPENDIX C

Extract from GNS (2022): Annotated Section 4.3 Lake Poerua Priority Area

Nick Harwood review comments 3 Sept 2024

What are these indications?
Papers / reports available?

4.3 Lake Poerua Priority Area

The Lake Poerua priority area spans a c. 10 km stretch of the Alpine Fault along a strip of LiDAR data that extends from the Taramakau River to the northeast beyond Lake Poerua to Brown River (Figure 4.5). Northeast of Brown River, the fault is largely situated within native forest east of Rotomanu. There are some indications, particularly from Evans Creek to Brown River, that the fault is located along the range front. In these areas, fault scarps and traces have a complex geomorphology, indicating a suite of overlapping thrusts and strike-slip traces (Upton et al. 2017). These sorts of features were also mapped along the Alpine Fault in the Whataroa and Franz Josef areas (Barth et al. 2012; Langridge et al. 2014).

FAZ buffers developed for the Lake Poerua priority area range in width from a minimum of 60 m for accurate, well-defined traces to up to 300 m for uncertain poorly constrained traces (Figure 4.5).

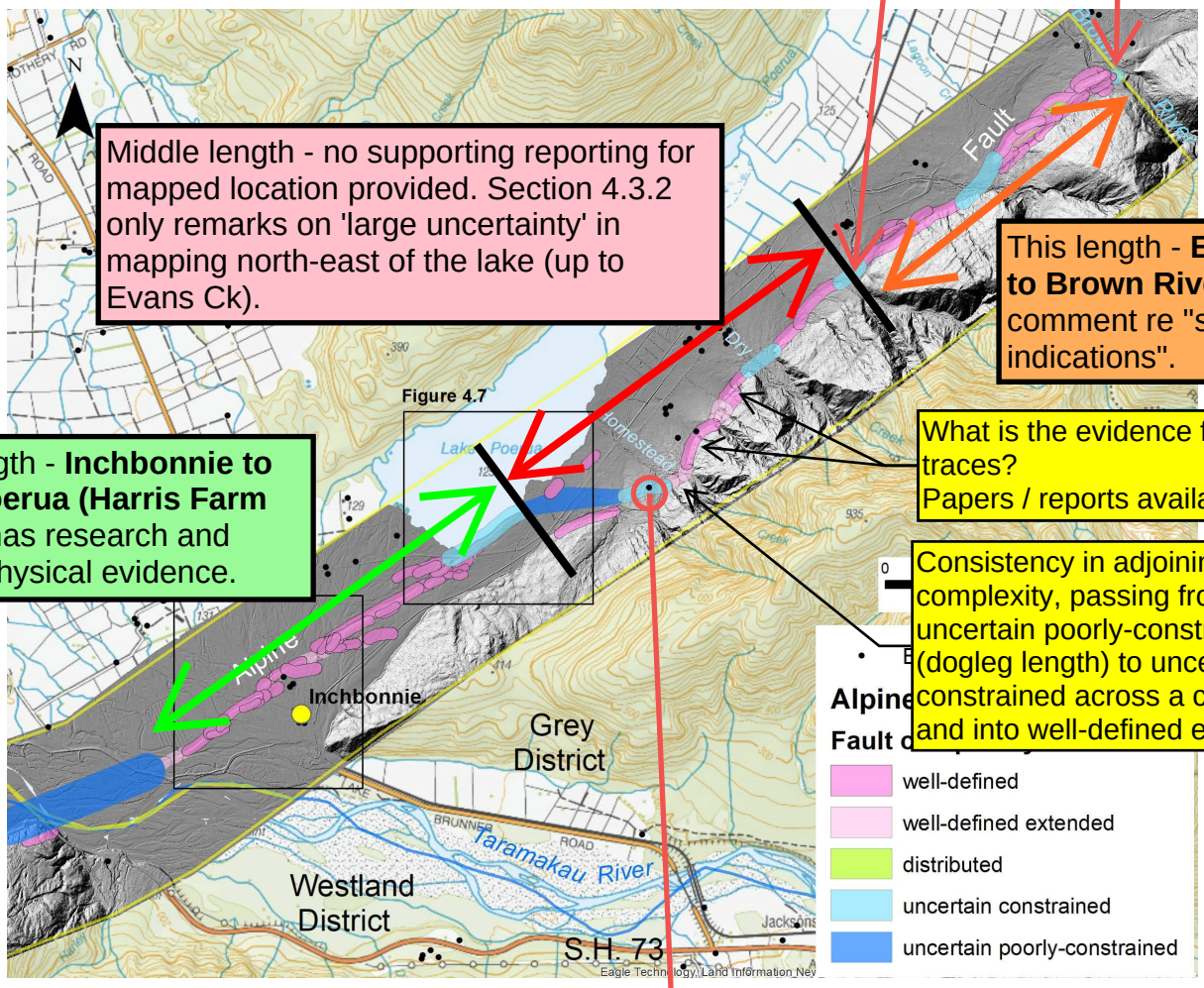


Figure 4.5 Fault Avoidance Zones (FAZs) in the Lake Poerua priority area (yellow polygon), northeast of the Taramakau River in Grey District. FAZ buffers have been developed for all traces (faults not shown in this view). Buildings are from LINZ Topo 50 digital map data. Detailed maps of Inchbonnie and Lake Poerua are indicated by black boxes.

Client's land & building

The 'uncertain' trace is mapped as running through the building.

Nick Harwood review comments 3 Sept 2024

This length - **Inchbonnie to Lake Poerua (Harris Farm area)** - has research and strong physical evidence. OK

4.3.1 Inchbonnie Case Example

The Alpine Fault is well-studied in the Inchbonnie area, with slip rate and paleoseismic data coming from a site northeast of the village and from Lake Poerua (Berryman et al. 1992; Langridge et al. 2010, 2012; Howarth et al. 2018). The fault location is uncertain across the Taramakau River. Between the Taramakau River and Lake Poerua, fault traces and scarps have a left-stepping *en echelon* pattern (Figure 4.6). In the stepover areas between the longer traces/scarps, there are many short fault traces mapped, and distributed deformation is likely within these stepover areas.

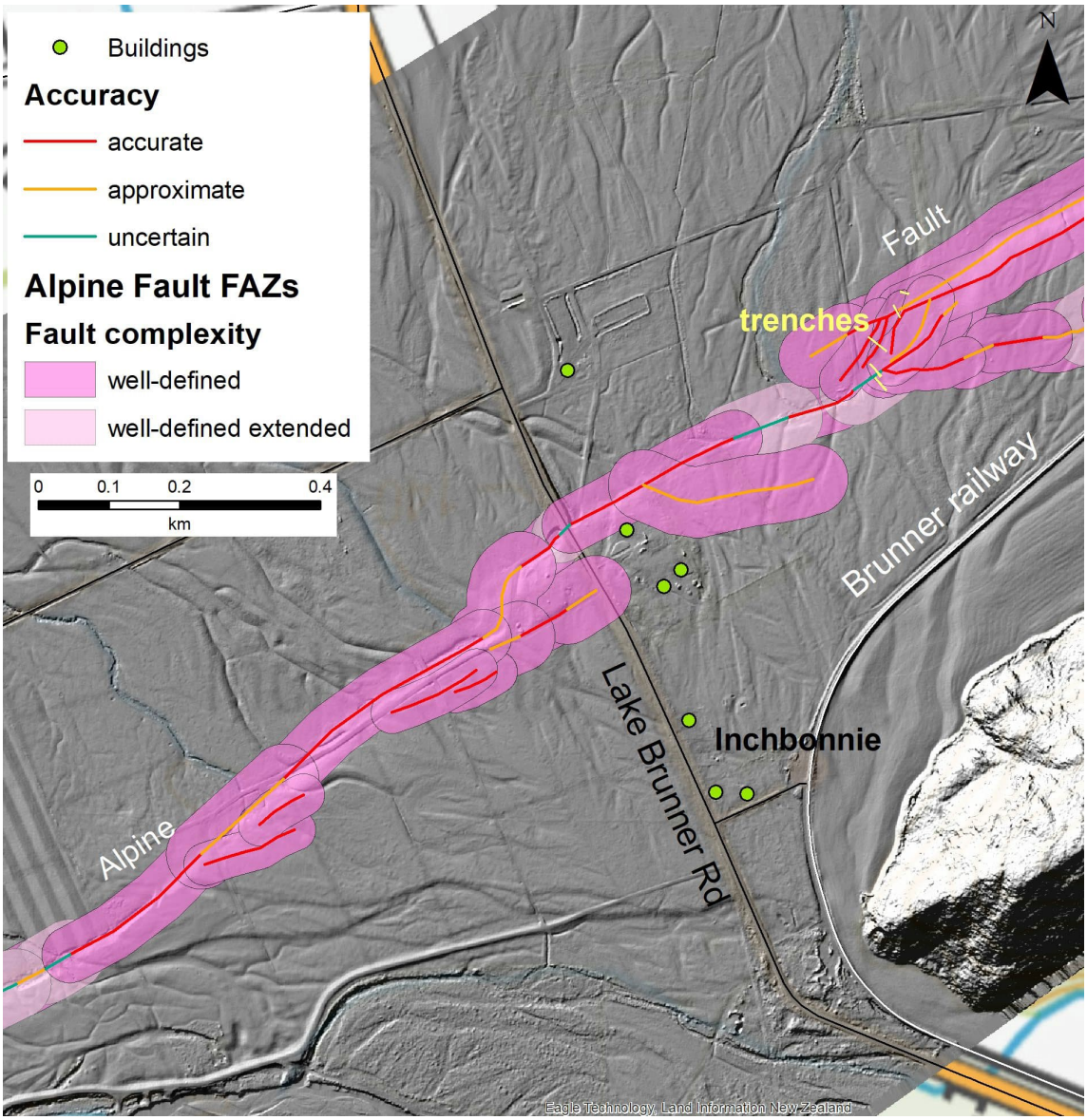


Figure 4.6 Alpine Fault traces and Fault Avoidance Zones (FAZs) in the Inchbonnie village area near the Taramakau River in Grey District. Trenches excavated across fault traces by GNS Science are shown in yellow; green dots represent buildings.

Research trenches excavated on the Harris farm (Figure 4.6) confirmed the location and origin of each of the mapped fault traces there (Langridge et al. 2010; Howarth et al. 2018). At Inchbonnie, there are a few buildings close to the FAZs defined there, one of which is probably a dwelling, i.e. BIC 2a (Figure 4.6).

Nick Harwood review comments 3 Sept 2024

The abrupt dogleg from the lake front into Homestead Creek land and buildings is not supported by evidence, and no references given in the report.

Important reporting re Homestead Creek area adversely affected by large uncertainty in mapping.

4.3.2 Lake Poerua Case Example

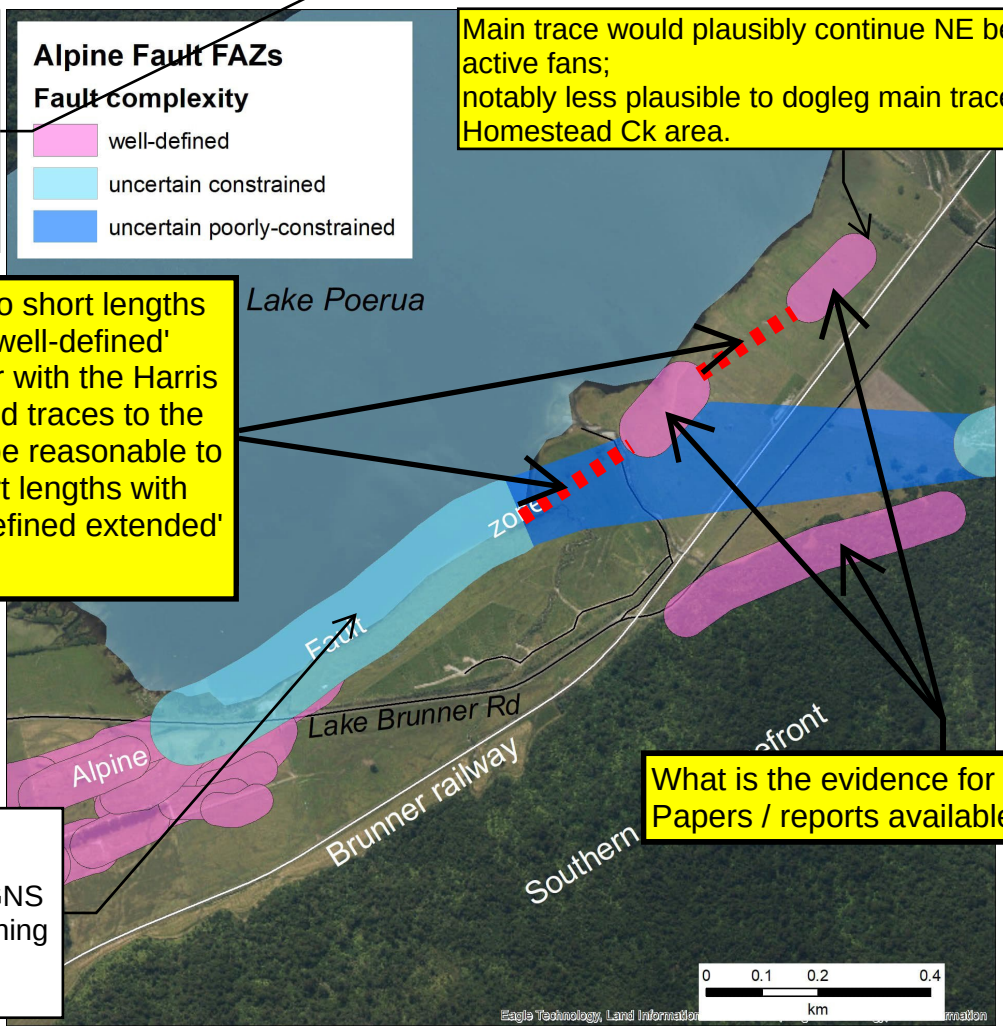
GNS Science undertook reviews of the location of the Alpine Fault for a proposed subdivision at Lake Poerua (Langridge and Hancox 2006; Langridge and McSaveney 2008). The straight northeast-trending southern shoreline of Lake Poerua was interpreted as being the eroded fault trace of the Alpine Fault (Langridge et al. 2010, 2012). These authors inferred that the fault was located just offshore in the shallows of the lake. In this study, we have tried to emulate the dimensions of the FAZ defined by Langridge and McSaveney (2008) and taken up by the Grey District Council. Nevertheless, even with the luxury of airborne LiDAR, there is considerable uncertainty as to where the fault is located to the northeast of the lake, as indicated by an uncertain poorly constrained FAZ (Figure 4.7).

Agreed

Northeast of the lake, we interpret the fault as departing from its left-stepping pattern and stepping to the right toward the range front. Where the fault steps right, there is large uncertainty in its location and orientation, resulting in a FAZ width of 300 m in the Homestead Creek area. It is possible that the fault is more northeast-striking in this area than what is mapped and that its trace is buried beneath large, recently active alluvial fans, such as those emanating from Homestead and Dry creeks. Thus, our current interpretation is to step the fault across from Lake Poerua to the base of the range front at Homestead Creek (Figure 4.5).

Not supported by the evidence / commentary in the report, and not as plausible as NE-striking interpretation.

Main trace would plausibly continue NE beneath recently active fans;
notably less plausible to dogleg main trace towards Homestead Ck area.



Given the the two short lengths are mapped as 'well-defined' and are co-linear with the Harris Farm well-defined traces to the SW, wouldn't it be reasonable to connect the short lengths with light pink 'well-defined extended' traces?

What is the evidence for these traces? Papers / reports available?

This FAZ area defined by consultants & GNS review for adjoining subdivision.

Figure 4.7 Alpine Fault traces and Fault Avoidance Zones (FAZs) in the Lake Poerua area northeast of Inchbonnie in Grey District. FAZs in the vicinity of the lake have been designed to follow the size and shape of previously defined FAZs.