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memorandum

TO	Munro Project Team	FROM	Neil Crampton
	c/ Cooper Rapley Lawyers	DATE	24 June 2024
RE	Mt Munro Windfarm: Recently Identified Active Faults – Consent Condition Considerations		

This memorandum provides an update regarding the recently identified active faults in the wind farm and terminal substation site at Mt Munro.

I have read the GNS faulting report provided by Tararua District Council (*Langridge RM, Morgenstern R, Coffey GL. 2021 Active fault mapping for planning purposes across the western part of the Tararua District Lower Hutt (NZ): GNS Science 85p. Consultancy Report 2021/03)* which is referred to below as “the report”. Relevant key aspects of the report are attached as background in Attachment 1.

I have the following summary comments, related to the faults for consideration regarding consent conditions for the windfarm:

- Refer to the image below for the location of the three active faults in question.

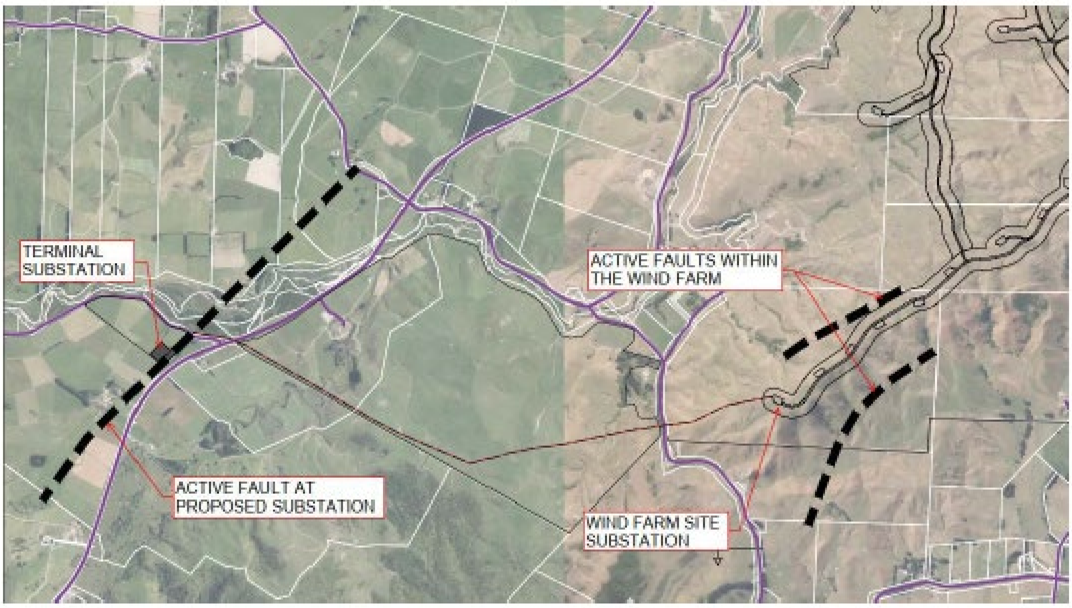

Figure 2: Approximate location of active faults identified by GNS in December 2021.

- The 3 newly identified faults in the windfarm/Terminal Substation site are Unnamed Active Fault Traces that have not been assigned a name in the report.
- The traces have however been assigned a Fault Awareness Area (FAA) which is +/-250 m width from the mapped fault trace.
- In the report, the FAA's have recommended planning actions which depends on the type of fault activity and the proposed activity at a given site (i.e. Building Importance Category (BIC)) as shown in the table at the end of this memo. For example, the actions recommended for an Important or Critical Structure (BIC 3 and 4) are:

Important or critical structures (BIC 3 and 4)	• Consideration of the surface fault rupture hazard should be a specific assessment matter if resource consent for a new structure is required. • Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures determined for the accurately mapped fault (e.g. set-back or engineering measures).

- Given the above, I am of the opinion that Meridian should address the newly identified faults in a consent condition that is consistent with the recommendations in the GNS report.

Please call me if you want to discuss any of the matters in this memo.

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Prepared by

Neil Crampton

Technical Director – Geotechnics

Table 4.3 Recommended planning actions for faults assigned with Fault Awareness Areas (FAAs) in the Tararua District (modified from Barrell et al. 2015).

Proposed Activity	**Recommended Actions for FAAs**		
	For Faults with RI <5000 Years	**For Faults with RI >5000 Years**	**For Possibly Active Faults and Faults without RI Data**
Single residential dwelling (BIC 2a and 2b in part)	• Fault maps in District Plans *and* fault information on LIMs and PIMs.		
Normal structures and structures not in other categories (BIC 2b, apart from single dwellings)	• Consideration of the surface fault rupture hazard should be a specific assessment matter if resource consent for a new structure is required. • Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).	• Fault maps in District Plans *and* fault information on LIMs and PIMs.	
Important or critical structures (BIC 3 and 4)	• Consideration of the surface fault rupture hazard should be a specific assessment matter if resource consent for a new structure is required. • Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures determined for the accurately mapped fault (e.g. set-back or engineering measures).		
New subdivision (excluding minor boundary adjustments)	• Consideration of the surface fault rupture hazard should be a specific assessment matter. • Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).		• Fault maps in District Plans *and* fault information on LIMs and PIMs.
Plan Changes	• Consideration of the surface fault rupture hazard should be a specific assessment matter. • Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).		

Attachment 1: Active Fault Report Taraua District – FAA Extract from GNS Report

4.4.1 Fault Awareness Areas

FAAs were first developed for the districts of the Canterbury region (Environment Canterbury; ECan) as an alternative to the use of FAZs (Barrell et al. 2015). This was in part undertaken because Canterbury has many districts with large undeveloped areas and with many of the faults having been mapped at scales of between 1:50,000 and 1:250,000. It was realised that the overall cost of mapping all faults in the region at more detailed scales was prohibitively expensive with respect to the benefit in terms of reduced risk from surface faulting. Thus, the concept of a FAA was developed to cover large areas of under-developed land where active faults were known to occur on QMAP geologic maps and in the NZAFD (Heron 2020; https://data.gns.cri.nz/af/). Notwithstanding, fault mapping at these scales is not detailed enough to delineate FAZs around the faults nor for directly applying the MfE Guidelines (Kerr et al. 2003) to mitigate fault rupture hazard. Thus, FAAs in the Canterbury region were developed to use regional fault mapping widely at 1:250,000 scale.

In the Canterbury region, the FAAs were delineated in two ways: (i) as relating to a fault mapped as 'definite (well expressed)', 'definite (moderately expressed)', 'likely (well expressed)' or 'likely (moderately expressed)' and some folds – in these cases the FAAs had a width of ±125 m about the mapped feature; and (ii) for all other faults and folds ±250 m about the mapped feature.

In consultation with ECan and its district councils, a set of 'recommended actions' were developed so that the FAAs would be useful for planning decisions for each district council in the region (Table 4.3; Barrell et al. 2015). Table 4.3 shows BIC in relation to fault expression (as above) and divides faults into two recurrence interval divisions: RI <5000 years (which corresponds to RI Class I, II and III) and RI >5000 years (which corresponds to RI Class IV and above). In addition, Table 4.3 outlines situations where a new subdivision might be considered or where the council is making a plan change. Specific actions in Table 4.3 refer to "fault maps *being used* in District Plans", "fault information *being used* on LIMs and PIMs" [6] and "consideration *necessary for a* surface fault rupture hazard assessment". Thus, the purpose of a FAA is to highlight that there may be a tectonic feature or fault within that area and facilitate action in regard to them. While this FAA approach is not part of the MfE Guidelines, the recommended actions for FAAs can be used in a similar way to the MfE Guidelines and still provide a way forward in terms of planning actions for active faults.

We were limited in this study by the scope of the project to define FAZs within the eight priority areas. However, extensive detailed mapping was undertaken on many other faults, including faults with RI Class I, such as the Wellington and Mohaka faults. In this study, we have modified the table of Barrell et al. (2015) to focus on recurrence interval; thus, Table 4.3 is headed by columns of RI <5000 years, RI >5000 years and a third column for faults without recurrence interval data. The modification removes the qualifier related to fault likelihood and expression (e.g. definite versus likely and well-expressed versus moderately or not expressed). While we have mapped all fault features with the terms accurate, approximate and uncertain (and these exist in the GIS attributes), we acknowledge that, for FAAs, it is relevant to divide faults based on recurrence interval.

6 Land (LIMs) and Property (PIMs) Information Memorandums.

Therefore, we have adopted a similar approach to Barrell et al. (2015) for zoning many of the active faults in the western part of the Tararua District that are outside the eight priority areas where FAZs are developed. In this study, FAAs are developed with a width of ±125 m about a mapped feature when it is accurate or approximate in terms of its fault location. When a mapped feature has an uncertain location, or where we have used the original 1:250,000-scale line work, we have adopted a width of ±250 m (Figure 4.5). In future, if development is proposed for areas with a FAA status, then further fault mapping and/or geologic studies would be recommended to better define the location of surface faulting and deformation. The recommended actions shown in Table 4.3 are appropriate for faults in the Tararua District that have an FAA.

Table 4.3 Recommended planning actions for faults assigned with Fault Awareness Areas (FAAs) in the Tararua District (modified from Barrell et al. 2015).

<table>
<tr><th rowspan="2">Proposed Activity</th><th colspan="3">Recommended Actions for FAAs</th></tr>
<tr><th>For Faults with RI <5000 Years</th><th>For Faults with RI >5000 Years</th><th>For Possibly Active Faults and Faults without RI Data</th></tr>
<tr><td>Single residential dwelling (BIC 2a and 2b in part)</td><td colspan="3">• Fault maps in District Plans and fault information on LIMs and PIMs.</td></tr>
<tr><td>Normal structures and structures not in other categories (BIC 2b, apart from single dwellings)</td><td>• Consideration of the surface fault rupture hazard should be a specific assessment matter if resource consent for a new structure is required.
• Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).</td><td colspan="2">• Fault maps in District Plans and fault information on LIMs and PIMs.</td></tr>
<tr><td>Important or critical structures (BIC 3 and 4)</td><td colspan="3">• Consideration of the surface fault rupture hazard should be a specific assessment matter if resource consent for a new structure is required.
• Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures determined for the accurately mapped fault (e.g. set-back or engineering measures).</td></tr>
<tr><td>New subdivision (excluding minor boundary adjustments)</td><td colspan="2">• Consideration of the surface fault rupture hazard should be a specific assessment matter.
• Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).</td><td>• Fault maps in District Plans and fault information on LIMs and PIMs.</td></tr>
<tr><td>Plan Changes</td><td colspan="3">• Consideration of the surface fault rupture hazard should be a specific assessment matter.
• Site-specific investigation, including detailed fault mapping at 1:35,000 or better and appropriate mitigation measures for the accurately mapped fault (e.g. set-back or engineering measures).</td></tr>
</table>

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An example of FAAs developed in this study is shown in Figure 4.5, where the FAA widths are either ±125 or ±250 m. Following the approach of Barrell et al. (2015) is also useful as, in many cases, we were also able to apply RI Classes from the literature or define preliminary RI Classes from mapping and profiling the faults. This makes it relatively simple to distinguish between faults that have recurrence intervals of <5000 years (RI Class I–III) or > 5000 years.

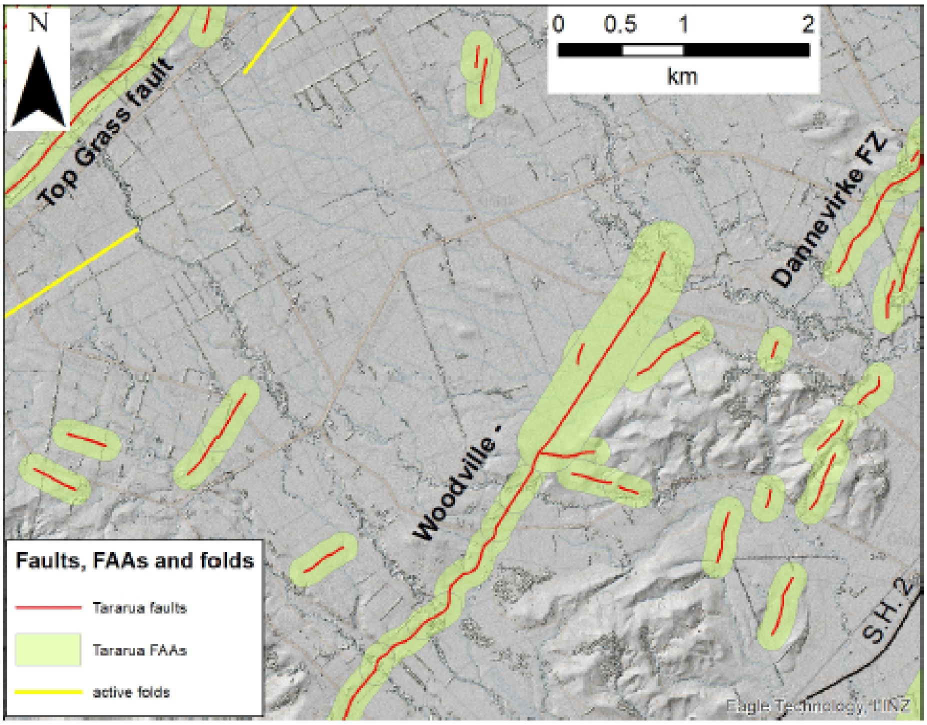

Figure 4.5 Fault Awareness Area (FAA) map for the area southeast of Dannevirke, showing part of the FAA for the Woodville-Dannevirke Fault Zone. Active fold traces have been mapped southeast of the Top Grass fault.

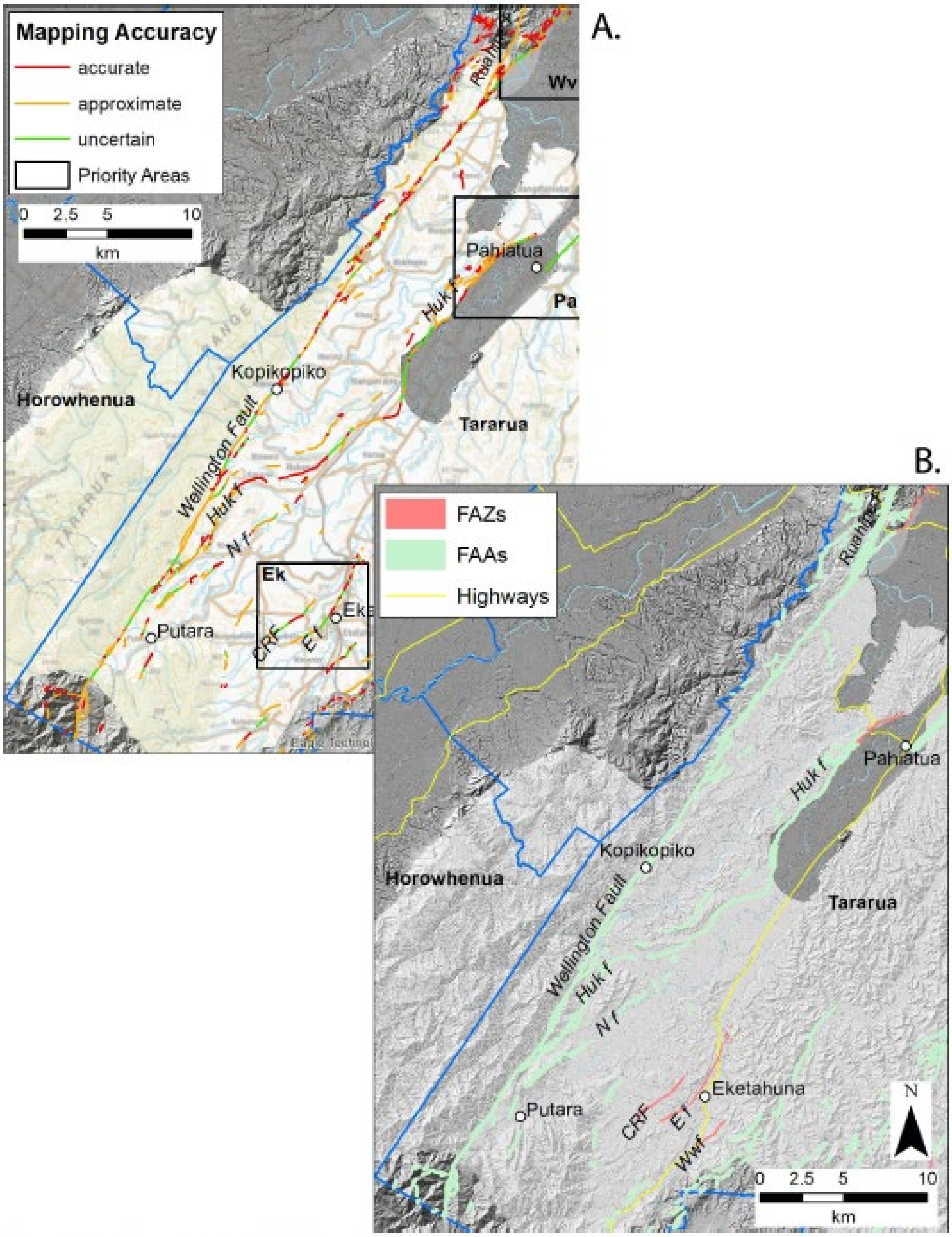

Figure A1.4 Maps showing the Wellington Fault and the southwestern part of the Tararua District. (A) Faults symbolised by locational accuracy, as shown in the legend, along with several of the Tararua District Council priority areas (Al, Alfredton; Ek, Eketāhuna; Pa, Pahiatua; Wv, Woodville). (B) FAZs and FAAs across the same area. Fault abbreviations: CRF, Cliff Road Fault; E f, Eketāhuna fault; Huk f, Hukanui fault; N f, Nireaha fault; Wwf, Waiwaka fault.

An outcome of the more detailed mapping in this study is the recognition and characterisation of several fault strands that splay or diverge from the Wellington Fault into the forearc basin (Figure A1.4). These are discussed in other sections below.