BEFORE THE WAIMAKARIRI DISTRICT PLAN REVIEW HEARINGS PANEL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	the hearing of submissions and further submissions on the Proposed Waimakariri District Plan
AND	hearing of submissions and further submissions on Variations 1 and 2 to the Proposed Waimakariri District Plan
	Hearing Stream 12E: Rezoning Requests

SUPPLEMENTARY STATEMENT OF EVIDENCE OF MASON VOUT REED (GEOTECHNICAL ENGINEERING) FOR RICHARD AND GEOFF SPARK (PDP SUBMITTER 183 / VARIATION 1 SUBMITTER 61)

Dated 2 August 2024

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Introduction

1. My name is Mason Vout Reed.

2. My area of expertise, experience, and qualifications are set out in my First Statement of Evidence dated 4 March 2024 for this hearing stream.

3. The purpose of this supplementary evidence is to respond to matters raised in the Officer's Report dated 22 July 2024 relevant to my evidence.

Code of Conduct

4. I have read the Code of Conduct for Expert Witnesses (contained in the Environment Court Practice Note 2023) and I agree to comply with it. Except where I state that I rely on the evidence of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

Response to Officer's Report

5. In my evidence below I have focussed on the key geotechnical matters raised in the evidence of Mr Aramowicz, which is provided in a memo (dated 15 July 2024), appended to the Officer's Report, namely:

    (a) The geotechnical hazard associated with the presence of shallow peat soils across parts of the subject site

    (b) Measures which will be suitable to mitigate the risk of road pavements, underground services and building platforms being adversely affected by settlement of the peat soils.

6. In my First Statement of Evidence, dated 4 March 2024, I stated that a surficial layer of peat soils was encountered overlying some parts of the subject site, at depths ranging between approximately 0.3 m and 0.8 m below the existing ground surface (generally immediately below the topsoil layer). These soils were encountered to depths of between approximately 0.4 m and 1.5 m below the existing ground surface, at the locations of these test positions, corresponding to a layer thickness of between approximately 0.1 m and 1.1 m. The layer of peat soils appears to be thicker within Block A, on the northern side of Boys Road. On the southern side of Boys Road, within Block B, the peat layer is generally no thicker than approximately 0.4 m.

7. There is a risk, in my opinion, that differential settlement could occur, particularly in areas where subdivisional filling extends over parts of the site which 'transition' between areas underlain by peat soils and areas underlain by less compressible soils. This has the potential to adversely affect shallow service lines and shallow foundations, if these are not appropriately designed for the site conditions. However, it is my opinion that the estimated ground settlements are not 'excessive' – particularly for Block B, because the peat is generally less thick.

8. To address this, I therefore recommend that any proposed subdivisional fill earthworks undertaken for the site should incorporate appropriately designed and monitored preloading, in order to provide suitable building platforms at the site.

9. An alternative to preloading would be to excavate (i.e. remove) the surficial peat soils from beneath the site. This is considered to be more practical for Block B where the base of the peat soils is expected to be between approximately 0.6 m and 0.8 m below the existing ground surface. For Block A, the base of the peat extends to depths of up to approximately 1.5 m below the existing ground surface. The removal of the peat, in this area, would likely require some dewatering and would therefore likely be less practical/economical than for Block B.

10. It is my opinion, providing any subdivisional earthworks are undertaken in accordance with the relevant New Zealand Standard Codes of Practice and any recommendations provided in the Geotechnical Report, that building platforms should be available at the site, which would be suitable for future residential and potentially light industrial development.

11. Mr Aramowicz's evidence discusses a project, in the Christchurch region, which he is aware of, where preloading of peat soils was used, and because the preloading was not appropriately designed for the site conditions, that there were "*significant delays and costly re-work*".

12. Mr Aramowicz also states that he is aware of subdivisions in the Christchurch region, which are underlain by shallow peat soils, which have been adversely affected by on-going settlement.

13. Based on his experience, Mr Aramowicz has stated that it is "*technically preferable*" to undercut the peat soils from beneath any shallow building foundations, roads and services.

14. Mr Aramowicz, however, goes on to state:

> "*Alternatively, Council may agree to a subdivision development that requires any shallow peat to only be removed from future roads, providing new buildings are supported on either deep piled or stiffened-slab foundations. Council may also require a low-pressure sewer system be used to mitigate the future risk of differential settlement (subsidence) occurring between the house and the services within the roads*."

and

> "*In summary, the site contains soft ground and peat. Subdivision design and construction will need to be undertaken in a way that minimises the risk of subsidence to future roads, underground services and building foundations.*"

15. I concur with Mr Aramowicz's 'summary statement' that subdivision design and construction will need to be undertaken in a way that minimises the risks posed by the surficial peat soils to the stability of future roads, underground services and building foundations.

16. Given the shallow depth to the base of the surficial peat soils overlying Block B (between approximately 0.6 m and 0.8 m below the existing ground surface), it is likely, in my opinion, that undercutting of the surficial peat soils may well be the most practical remedial measure, for Block B, and would remove the risk posed by the surficial peat soils on the stability of roads, building platforms and underground services.

17. However, for Block A, the base of the peat soils extends to depths of up to approximately 1.5 m below the existing ground surface. The removal of the peat, in this area, would likely involve significant excavation works which could intercept the phreatic surface and would likely require dewatering works, which would not be the best construction technique to mitigate the potential effects on the environment. For Block A, it is my opinion that appropriately designed and monitored preloading, would be a viable option to provide suitable building platforms at the site.

18. Mr Aramowicz's opinion on the effectiveness of preloading appears to be based on his knowledge of a previous motorway project in the Christchurch region, and in particular the difficulties in determining theoretical soil compressibility coefficients for the preloading design.

19. Preloading design, and the associated soil settlement, is dependent on many factors, including, but not limited to, the following:

    (a) The nature of the peat soils, in particular the water content and organic content

    (b) The depth and thickness of the peat soil layer

    (c) The groundwater conditions

    (d) The permeability of the surrounding soils, i.e. flow paths for dissipation of excess spore water pressures

    (e) The nature and configuration of the fill loading, in particular the thickness of the 'final' fill layer and the relative thickness of the preloading fill layer

    (f) The length of time the preloading is applied.

20. It is likely that all of the factors listed above, for the subject site, are not consistent with the site conditions that would have existed for the motorway project, that Mr Aramowicz cites as an example of 'failed' preloading. Therefore, I do not think it is appropriate to preclude the use of preloading at the subject site, based on the 'negative' experience of a single site (likely with dissimilar site conditions and loading conditions to the subject site).

21. Preloading of highly compressible soils is a well recognised mitigation measure, to provide suitable building platform for sites underlain by peat soils. I have been involved in numerous subdivision developments for sites across New Zealand, which are underlain by peat soils. Recently I was the geotechnical lead engineer for Te Whāriki subdivision – Lincoln, which has similar ground conditions to the subject site, i.e. peat soils and high groundwater. In 2023, I was also the geotechnical lead engineer for a subdivision site in Papamoa (Bay of Plenty) which is underlain by significant peat deposits, which will involve preloading. I was also involved in the development of the GP Farms race track in Meremere. Part of this race track is underlain by deep highly compressible organic soils, which abuts ground underlain by bedrock. Preloading was successfully undertaken for this project and was able to provide for a pavement subgrade, with no tolerance for any on-going differential settlement (which would be noticeable for a race track).

22. It is my experience that the inherent uncertainties involved in predicting soil compressibility coefficients for organic soils can be addressed by undertaking appropriate preload test pad construction and monitoring, prior to any bulk earthworks.

An appropriate programme of preload test pad monitoring provides empirical data relating to actual soil settlement and also enables the measurement of any on-going settlement (following removal of the preload). If any preloading were to be undertaken for the subject site, the design of the preloading would be based on the empirical results of comprehensive preload test pad monitoring.

23. In summary, I concur with Mr Aramowicz's statement that "*subdivision design and construction will need to be undertaken in a way that minimises the risk of subsidence to future roads, underground services and building foundations.*" It is my opinion that this will likely involve either, or a combination of, the following:

    (a) Appropriate undercutting of surficial peat soils beneath the footprint of the subdivision. This is likely to be more practical for Block B.

    (b) Subdivisional fill earthworks incorporating appropriately designed and monitored preloading. For preloaded areas, foundation systems will likely be required to comprise concrete waffle slab type foundation systems, designed assuming 'TC1' site conditions.

Mason Reed
2 August 2024