GEOLOGY
GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES

Technical Review Memorandum

Project Name	Tauranga Landslide Study – Mount Maunganui and Papamoa Update		
Subject	Review of WSP Memorandum (dated 6 September 2024)		
Memo Date	3 October 2024		
ENGEO Memo No.	01	**ENGEO Project No.**	025120.000.001
To	s 6(c) - Maintenance of Law Tauranga City Council	**Copy**	File
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1 Introduction

ENGEO have been engaged by Tauranga City Council ('TCC') to provide peer review services to support the Tauranga City Landslide study, being completed by WSP. This memorandum presents our peer review of WSP's recent memorandum (Ref. 2-9B441.03, 6 September 2024).

2 Review Comments

2.1 General

The objective of the WSP memorandum is to set out the basis of for establishing slope instability regression and run out hazard zones to be applied for the Mount Maunganui and Papamoa suburbs in an updated hazard layer on TCC's online geospatial portal. Two key geomorphologic terrains are considered as part of WSP's assessment. These being the Hopukiore Mt Drury area (rhyolitic lava outcrop) and the Mount Maunganui and Papamoa coastal strip area (Holocene-aged sand dunes). This memorandum provides an overview of our review for each geomorphic terrain, along with identified outstanding query items for consideration by WSP.

2.2 Hopukiore Mt Drury

WSP provide a brief overview of the geology of Hopukiore Mt Drury, comprising rhyolite lava capped by a combination of weathered bedrock, localised colluvium and mantling tephra. A failure zone of 1V:2H is shown on the map which we understand reflects the current council GIS mapped failure zone, originally recommended by Bell et al (2001) for ash and alluvial slopes and applied across the city. WSP propose a slope run out of 1V:2.5H and a slope regression zone of 1V:3H for Hopukiore Mt Drury.

A summary of specific comments and queries raised by our review is presented in Table 1. In the absence of site-specific investigation data WSP propose for the regression zone to be kept consistent with other volcanic slopes in the city. Given the shallow depth to rock, this is considered to be conservative.

It is not clear how the geomorphological data or assumed parameters in Table 1 of the WSP memo were used to determine setback or run-out zones. We consider an opportunity exists to undertake back analysis to derive a quantitative model that better fits with the qualitative assessment approaches undertaken.

Table 1: Summary of Review Comments – Hopukiore Mt Drury

Item	Comment / Question
1	**Triggering mechanisms** – We consider that a clearer explanation of WSP's interpretation of the slope failure mechanisms should be provided to give better context to the conclusions reached. This is likely to be a combination of rockfall (which is discussed later in the memo) and likely translational or sliding failure of overburden material under rainfall trigger. There are a number of outcrops that show the soil rock interface and in general ground conditions comprise shallow rock with limited opportunity for significant regression of soil slopes.
2	**Table 1** – Table 1 should clarify that unit parameters used for modelling represent a drained case.
3	**Table 1** – The table describes the overburden as 'topsoil' which is somewhat misleading. The overburden soils are likely to comprise a combination of materials including weathered rock / boulder colluvium and ash. Topsoil would only make up a small proportion of the soil profile.
4	**Table 1** – It is unclear why soil parameters are presented if these were not used in any quantitative analyses.
5	**Slope Runout** – The methodology is unclear in describing how a 1V:2.5H run-out zone was derived. Was it purely qualitative based on professional judgement, review of landform, or was this supported by any empirical model? It is important to make this clear. It remains unclear as to what reliance, if any, was given to quantitative analyses vs geomorphological mapping. We recommend that it is made clear as to what WSP mainly relied upon to reach their conclusions on runout and regression angles.
6	**Slope Runout** – Whilst we understand and agree with the need to show the current modelled runout line (1V:4H) as a comparison, we are unsure of the need to present the 1V:2.75H run out. It introduces confusion, particularly as there is no clear discussion as to why both 1V:2.75H and 1V:2.5H lines were modelled. Consider removing.
7	**Slope Regression** – Section 3.3.1 is unclear, and we suggest this section is revisited to clearly explain the reasoning for the conclusions reached. We agree that in the absence of site-specific information quantitatively analyses alone is not determinative. The opportunity exists to undertake back analyses utilising geomorphological mapping to derive appropriate ground models and soil parameters for forward analyses. By combining and converging qualitative and quantitative models you will be able to present a more compelling and robust argument as to the conclusions reached.

Item	Comment / Question
8	**Sensitivity checking** – If some back analyses was undertaken there may be additional opportunity for sensitivity checks considering variability in thickness of overburden unit and its contribution to regression and run-out.
9	**Northern perimeter of Hopukiore** – The northern edge of the Hopukiore is excluded from the analyses. We are unsure as to why this has been omitted. WSP to confirm whether this is deliberate exclusion of this slope, or whether it fell outside the height and slope gradient bounds adopted for the city-wide assessment. If this exclusion relates to modifications to the slope, then ENGEO would suggest that reasoning alone is not sufficient, particularly as slope hazard assessments have consider other modified landforms around the city as part of the wider study.

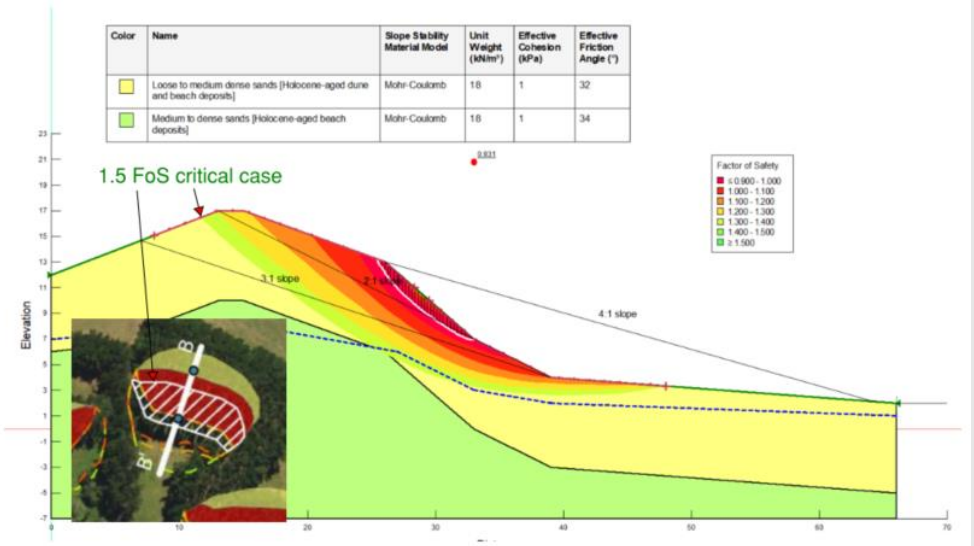
2.3 Mt Maunganui / Papamoa Dune Sands (Te Tumu)

WSP describe unmodified natural slopes within the Mount / Papamoa area as comprising dune features underlain by loose to medium dense sands. A failure zone of 1V:2H is shown on the maps which is consistent with that applied across the city. We would challenge whether a 1V:2H failure zone is applicable to a sand slope based on our understanding of these soil types and failure mechanisms. This is supported by WSP slope models showing critical failure surfaces (FoS <1) to occur within a ~1V:1H regression line. A summary of specific comments and queries raised by our review is presented in Table 2.

Slope regression has been determined through limit equilibrium stability analyses adopting typical factors of safety under long-term drained and shorter-term elevated groundwater cases. Slope models provided by WSP show that a long-term drained case governs and a 1V:2.5H regression is recommended. Looking at the analysis present, a 1V:2H would be a more representative regression line, particularly given the soil conditions present.

As with Hopukiore Mt Drury, it is unclear how geomorphological interpretation, or the analyses have been used to inform the recommended run out of 1V:2.5H. Given the granular and free draining nature of these soils, it is difficult to conceive that a failure of 4 m high sand slope could result in a run out distance of ~10 m. These are not sensitive soils and are less susceptible to extreme elevation of pore pressures. ENGEO suggest that further thought be given for justifying what appears to be a quite conservative run out zone.

Table 2: Summary of Review Comments – Mount Maunganui / Papamoa Dunes (Te Tumu)

Item	Comment / Question
1	**Table 1** – Parameters selected for analyses appear generally appropriate for sand, however WSP should consider whether the second unit [Medium Dense to Dense Sands] is necessary and whether it introduces unintended consequences. Whilst it appears this modelled unit has little bearing on the slope analyses, it may bias other sites that are modelled. In the absence of site-specific data, ENGEO suggest that a uniform model is adopted with a single unit and parameter.
2	**Slope Runout** – As per comment for Mt Drury, is there any need to present the 1V:2.75H run out if not ultimately used for anything. Consider removing.
3	**Figure 2 clarification** - Shows the extent of the 1V:2H failure zone to sit behind the FoS 1.5 envelope. But when we compare this to the slope model, the critical 1.5 failure surface sits behind the 1V:2H **zone, not the other way around**. Please can WSP review and rectify where necessary?  *Figure 3: Section B-B' Case 1: Normal Conditions. Static.*
4	**Modelled Sections** – for clarity it may be appropriate just to show the failure surface contours to FoS = 1.2 only.
5	**Modelled Sections** – for clarity it may be more appropriate to also show the 1V:2.5H line of regression line to make it easier to compare where the proposed regression line site relative to the quantitative modelling results.

3 Discussion

Please consider the above comments which are intended to ensure the methodology philosophy supporting the derivation of the regression and run out line is clear, robust and defensible. For the interests of clarity and with some degree of public interest, we anticipate that any updates to the methodology and assumptions made will be provided within a technical report made following the same structure as that provided within earlier reporting completed for the city. If the memorandum is to be adapted for this purpose, we recommend further review, and edits are made to improve readability, clarity and accuracy.

Prepared by

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Reviewed by

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Limitations

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ii. Only a limited amount of information has been collected to meet the specific technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties.

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