



24 August 2023

South Wairarapa District Council  
PO Box 6  
Martinborough 5741

Tim Langley  
cc Stefan Corbett

## **Hinekura Road Landslide - Geotechnical assessment for Option 3 road alignment – Services Proposal**

Dear Tim and Stefan,

This letter presents our updated proposal, which takes into account your comments on our 10 July 2023 proposal as discussed at our meeting of 11 July.

Our 10 July proposal provided a scope of drilling and geophysical investigations to investigate depth of the large landslide (“the landslide” below), to allow developing a model of the landslide to better understand what has caused it and its behaviour. Given the anticipated cost of such an investigation SWDC has requested that we put forward a reduced scope of investigations whilst acknowledging the increased risk (of failure) with this approach.

This letter presents our updated proposed scope of work.

### **Introduction**

A summary of the work completed to date on this project was presented in the appendix to WSP letter dated 10 July 2023.

As of late 2022 SWDC’s preferred option to reinstate Hinekura Road was to bypass the landslide on the upslope side (Option 1 on Figure 1 appended). However, given funding constraints for Option 1, the desire to reopen access more quickly, and apparent lack of movement of the landslide, a route across the landslide was considered a possibility. This option was noted as Option 3 in drawings prepared for SWDC in February 2023 (Figure 1). SWDC made a decision in June 2023 to pursue Option 3, to reconstruct the road across the landslide, on a similar alignment to the original road.

### **Philosophy of investigations and assessment for Option 3**

The proposed scope covers investigations and assessment to better understand the nature and behaviour of the landslide and the associated shallower instability that is associated with main landslide. Investigating both will enable a better understanding of the possible future failure modes and the likelihood of these occurring. This will inform risk management procedures in the design, construction and operation of the road.

While the landslide appears to have not moved for over 12 months, the likely future behaviour of the landslide is not well understood. Given this and the fact that stabilisation of the landslide is not economically practical, SWDC should be prepared for further movement of the landslide and damage to any reconstructed road. Hence the new road

along the Option 3 alignment is considered a short (to at best medium) term measure, with damage expected due to deep or shallow movement at some stage in the future. We note that SWDC managed the earlier movements of the landslide (of 3 to 4m per event) in 2020 and 2021 by reconstructing the road along the same alignment. However the June 2022 movement of ~80m was on a different magnitude, but the rate (moderate to rapid) was slow enough that a motorist could have (initially) driven off it. The likelihood of a worst case scenario, a large scale extremely rapid movement, will be assessed.

While the central part of the landslide (Figure 3) has performed like a large raft (or series of rafts) the lower steep slope through which Option 3 route passes is more complex and has areas of localised shallower instability, superimposed on the deeper landslide mass, (Refer Figure 4).

In addition, to movement of the landslide itself the stability of some of the adjacent slopes has been compromised by the main landslide eg immediately toward Hikawera Road.

Consideration of both the main landslide and the subsidiary shallower landslide features will need consideration during the risk assessment, design and construction. We understand that SWDC wish to obtain an assessment which provides sufficient certainty for the outcome without being a major cost. If due to cost SWDC wish to exclude part or all of subsurface investigations for the main landslide and just focus on investigating the alignment itself, any assessment will include greater uncertainty about how the main landslide will behave and measures that can assist enhancing its stability.

At each stage of the proposed work, the performance of the landslide will be kept under surveillance and if signs of significant reactivation are noted we will meet with SWDC to discuss any implications for the way forward.

## **Outcome**

The outcome of this work will be a risk assessment of the Option 3 route to assist SWDC to make a decision on whether to proceed to design and construction.

WSP can progress to design following risk assessment on the understanding that the design life of this section of road will be significantly less than a normal road, with potential for deterioration of level of service and future disruption and safety implications. Risk management measures such as monitoring/alerts (for user safety – such as proposed after the initial movement in June 2022) and reconstruction of the road after a movement event are procedures that can be implemented.

## **Statement of Limitation:**

As explained above in carrying out the services WSP can take no responsibility for the duration of stability of the road at this location.

Any road design carried out by WSP would be completed on the understanding that the design life is less than normal and that the road could be compromised by movement of the landslide at any time.

Notwithstanding the above WSP will undertake to provide risk assessment and risk management advice to SWDC during the various phases of work to maximise the performance of the road.

### Summary of Services

WSP propose to investigate the risks to Option 3 by:

1. Carrying out slope monitoring activities (refer separate offer of service)
2. Carrying out geotechnical investigation activities (as detailed in a later section).
3. Carrying out a risk assessment based on assessment of the investigations and monitoring of the landslide, detailing the likelihood and consequences for various event scenarios ranging from reactivating smaller landslide features along the alignment to very rapid movement of the whole landslide.

WSP propose to advise SWDC on risk management for Option 3 by

4. Providing advice on measures that can be incorporated into the road design to help mitigate the various slope instability risks (e.g. minimising cut and fill volumes, optimisation of the route, drainage measures etc)
5. Carrying out design of part or all of the road section assuming that SWDC accept that this will be a limited design life solution.
6. Providing support to SWDC as required during construction
7. Provide support to SWDC as required with ongoing support for monitoring and / or inspections.

### Overview of investigations

We have differentiated the proposed investigations into those required to investigate:

- The main landslide and
- The alignment for Option 3

Carrying out the former provides a greater level of certainty about the nature of the landslide (in particular its geometry). The geometry is important as it helps us model the landslide and understand its behaviour and in particular how modifications to the slope (e.g. during earthworks) can negatively or positively affect the behaviour of the landslide.

This scope of work for this assessment is outlined below.

### Scope of Work and Methodology

We understand that a new drone survey will be carried out as soon as possible, prior to and separate to the scope of this proposal. The results of this survey forms a key part of the assessment outlined below.

We propose the following staged methodology for the investigation with 'hold points' to agree the way forward with SWDC at the different stages. Investigations (provisional subject to approval from SWDC):

1. **Stage 1- Engineering Geological Mapping** and review of previous data -
  - a) Review of previous information including WSP reports, memos and data, UAV and historic aerial photos, geological maps)
  - b) Review latest slope monitoring data (include observations from locals) to identify any areas of change/movement.
  - c) Carry out desk based geomorphic mapping of the current landslide features from latest 2023 UAV imagery and 3D model.
  - d) Carry out ground truthing / field mapping along the corridor of the Option 3 route (and slope above and below) as far west as Hikawera Road, including documenting the nature and extent of the ground damage from slope movements, and
  - e) Conduct walkover across the remainder of the landslide and environs including assessing contributing factors to instability such as water sources, landslide toe erosion etc related to: (i) the overall landslide and (ii) smaller scale Option 3 corridor slope failures.

2. **Preliminary Geotechnical assessment**

Provide preliminary risk assessment for Option 3 based on mapping and assessment of survey data and recommend subsurface investigations required to address key risks for Option 3, also comment on viability of Option 4 (should option 3 be inadvisable).

**HOLD POINT 1 – meet with SWDC to confirm next stage**

3. **Geophysical Investigation**

The proposed geophysical investigation will comprise one or more Multichannel Analysis of Surface Waves (MASW) Survey lines in an attempt to image the geometry of the base of the landslide (Refer Figure 3) to feed into the 3D model of the landslide.

4. **Borehole drilling investigations (Provisional) –**

- a) 4-5 boreholes to up to 20m deep to facilitate earthworks / remedial works assessment for the proposed Option 3 alignment (see Figure 2 for the provisional testing locations) including instability at the west end of the landslide
- b) 2 to 3 boreholes each to up to 50m deep to assess the depth of the landslide, at representative locations to allow preparing a preliminary 3D model of the landslide (for carrying out slope stability assessment). Boreholes are proposed upslope and downslope of the option 3 alignment (refer Figure 3 for locations), with inclinometers installed.
- c) Procurement, specification, supervision and logging of boreholes by WSP staff

Doing both a) and b) total drilling is 6 to 8 boreholes at 150 to 250m of drilling. Estimated contactors cost is \$150K to \$300K based on Cape Palliser project.

The above represents a similar scope to Cape Palliser Road investigations (which was 6.5 boreholes and 171m of drilling and duration of 6 weeks (but included stand-down of 1 week plus due to bad weather/slip risk). The Cape Palliser contract included Traffic Management which would not be required at Hinekura Road, however the contractor would need to be happy to work on the landslide (which is expected to be the case if the landslide is dormant) and obtain suitable access to drill sites.

**5. Geotechnical Investigation Report (GIR) and Ground Model**

Results of the ground investigation will be summarised and presented in a factual report. This will present the results of the geomorphic mapping, the borehole logs, plans, survey monitoring layout and details of the preliminary ground model.

WSP will discuss the findings with the Client, to agree on whether a further stage of investigations is required to address unresolved risks. **(HOLD POINT 1b)**

**6. Geotechnical Risk Assessment (GRA) Report**

A Geotechnical Risk Assessment Report (GAR) will be prepared, in which the findings of the previous steps will be interpreted. The report will include:

- a) Discussion of the geomorphology, drainage and geology of the landslide and adjacent slopes and the slope failure mechanisms operating.
- b) Presentation of the landslide/slopes ground model
- c) Slope stability assessment.
- d) Assessment of the stability of the different sections of the landslide including consideration of the monitoring data.
- e) Risk assessment to the proposed Option 3 road discussing the various failure scenarios.
- f) Measures that SWDC can take to mitigate risks to the road during design, construction and operation.
- g) Stormwater / culvert considerations.

WSP will meet and discuss the findings of the report with the Client and obtain approval to commence design. **(HOLD POINT 2)**

**7. Design**

Prepare Design Drawings and technical specification for earthworks, road and drainage/stormwater and Design Philosophy statement. No allowance is made for retaining wall design or tender inputs.

**8. Longer Term Monitoring**

To facilitate up-to date risk assessment and understand the relationship between the landslide movement and groundwater / rainfall conditions, WSP recommends the monitoring of the installed instrumentation over as long a period as possible

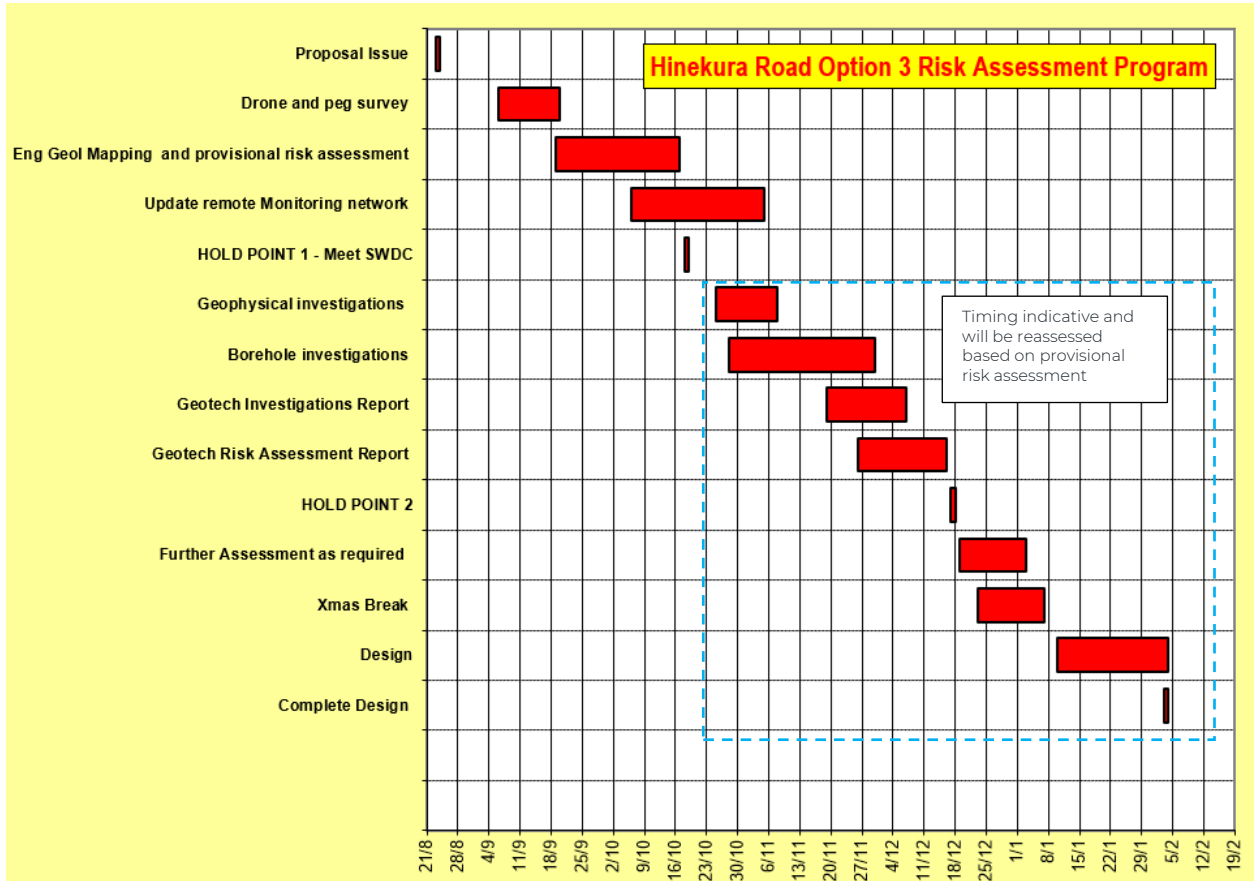
(of the order of at least 12 months from commencement of monitoring). This includes data collection, and the production of factual reports.

- a) Inclinometer, piezometer and survey pin data is to be monitored at least quarterly.
- b) The data will be compiled into quarterly factual monitoring reports commenting on movement and including any rainfall response, and any elevated risk status.
- c) At the Client's discretion, data may be collected following heavy rain events.

Following the monitoring period (e.g. quarterly), an interpretative monitoring memo can be prepared. This will outline a summary of the ground movement trends in relation to climatic factors etc, reassessment of risk to the proposed roading network, and recommendations regarding risk mitigation to the roading network. WSP will discuss the findings of the report with SWDC.

## Anticipated Programme

The table below provides our expected timing for the completion of the various tasks. Given the demand on geotechnical and drilling resources we will reassess after the mapping phase.





### Cost Estimates

Indicative estimates for the various stages are included in the scope section.

Item	Indicative Cost Estimates
Project Management	say \$20K
<b>Stage 1</b>	
Mapping and Preliminary Geotechnical Assessment	
Review of previous data and Engineering Geological Mapping	\$15K
Preliminary Geotechnical assessment	\$6K
Workshop with SWDC to confirm next stage	\$3K
<b>Stage 2</b>	
MASW (Geophysical) Investigation for landslide depth	\$25K
Borehole drilling investigations	
a) Estimated contactors cost - Doing all 6 to 8 boreholes- <u>*reduced if only do shallow boreholes</u>	\$150K to \$300K* (Provisional)
b) WSP fees - Procurement, specification, supervision and logging of boreholes by WSP staff- assumes grad (PL2) at 8 weeks full time, plus senior supervision. <u>*reduced if only do shallow boreholes</u>	\$70K to \$120K*
Geotechnical Investigation Report (GIR) and Ground Model	\$6K
Geotechnical Assessment (GAR) Report	\$30K
Design Drawings and specification and Design philosophy statement	\$50K to \$60K
Construction support	Hourly rates
Longer Term Monitoring	(\$TBC)
Contingency	Say \$30K

An estimate of fees is \$300K if we exclude deep investigations for the landslide and only focus on the alignment itself and \$560K if deep investigations are included. These are indicative figures based on the Cape Palliser rates and would require refining based on actual agreed scope and contractor rates.

We will provide an updated costing once the scope has been confirmed.





We look forward to your feedback and discussing this further with SWDC.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'A Murashev'.

Alexei Murashev  
Technical Director - Geotechnical

A handwritten signature in blue ink, appearing to read 'D Stewart'.

David Stewart  
Technical Principal – Geotechnical

# Figures

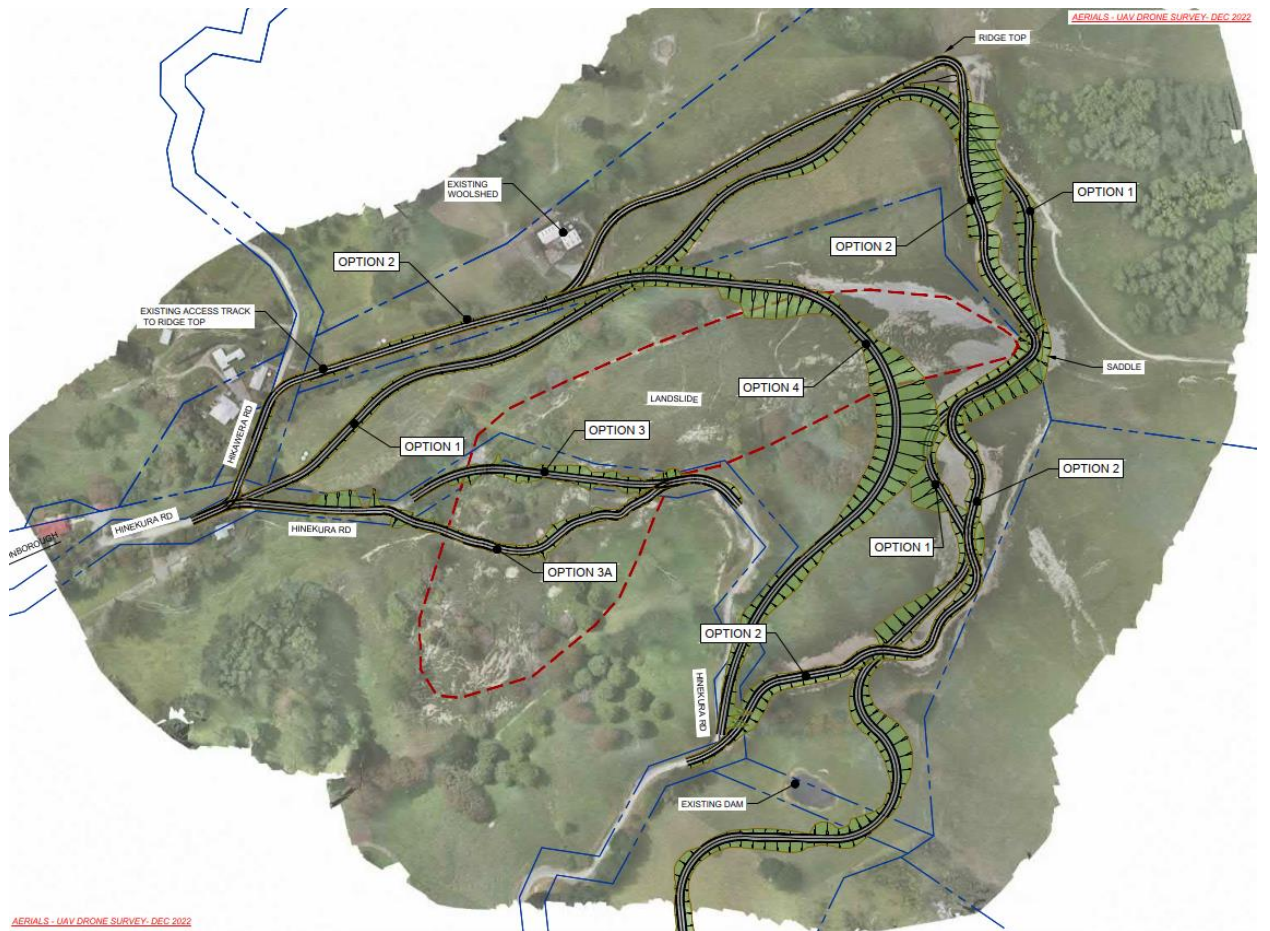


Figure 1: WSP road realignment Options plan as at February 2023

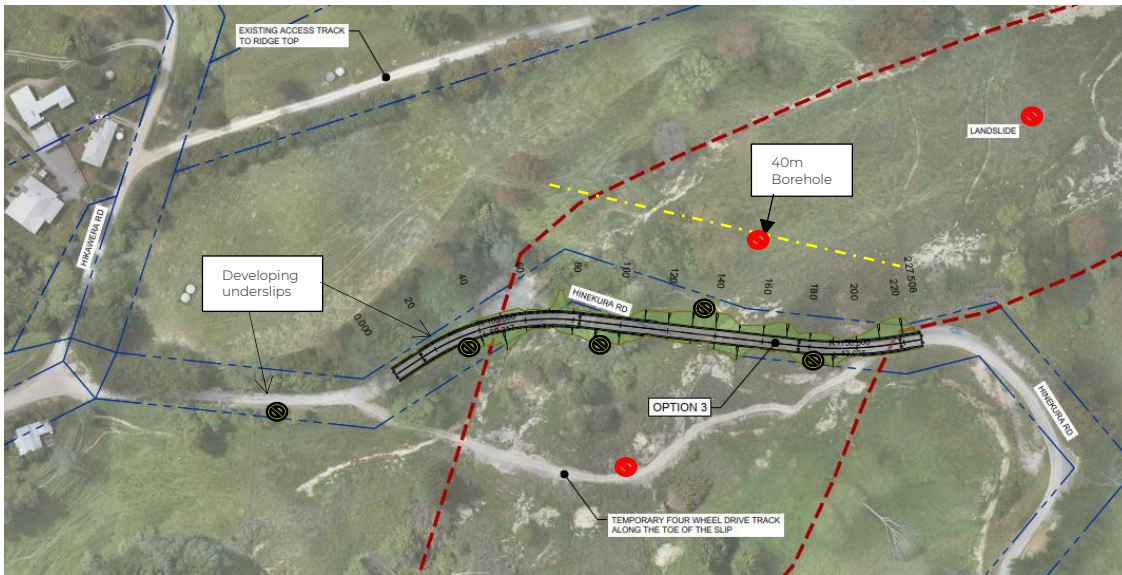


Figure 2: Provisional Design for Option 3 as at February 2023 showing locations of proposed boreholes for the road (black) and the landslide (red) and proposed MASW geophysical line (yellow) (Refer Figure 3 for wider view of investigation locations). Dec 2022 UAV image.



Figure 3: Provisional borehole locations (8) and Geophysical line. Red investigations are deep to investigate landslide depth. October 2022 base photo showing translated road pavement.



Figure 4: Site as at 14 December 2022, with lower 4WD track in foreground constructed on 'rafts' of pavement displaced downslope from Hinekura Road (approx. original road dashed).