Memorandum

To	Ben Greenwood
Copy	Rob Bond
From	Paul Jaquin
Office	Queenstown
Date	23 January 2020
File	
Subject	Meads Road

1 Situation

Damage has occurred to Meads Road around the 17th December 2019, to east of the Bee Burn stream and alluvial fan, below Peak AA9B, and to the west of the Terrace Stream Fan.

A site visit was undertaken on 19th December 2019 by Ben Greenwood and Rich Gurnell of QLDC, and Al Haig of Downer, and Paul Jaquin of WSP. Met with the Station manager who described the situation.

Hair line cracking in the road appeared a week or so prior, and were gradually increasing in size. The length of the crack is approximately 60m, and at the time of the visit the vertical displacement was approximately 150 – 200mm.

The cracking appears to be in the form of a slip circle headscarp, with the cracking across the whole width of the road, and some movement into the up slope area.

The road appears to have been constructed by a cut into the existing material, though no details on the road construction have been reviewed.

Lake Hawea was constructed in 1958, which raised the lake level by approximately 18m.

There were significant rain events in the run up to Christmas 2019, and the lake levels increased around the district.

At the time of the slips, then lake levels was around 345.2m, increased from 338.5m in October 2019, (an increase of 6.7m).

We understand that Contact Energy have an easement at the Lake shore level.

We understand from the station manager that there was a slip in this area around 1994, which was field and a timber culvert installed at that time. This is expected to coincide with the flooding which occurred across the region in January 1994.

The road provides access to the Hawea conservation area, and the Station is required to provide access for 6 / 4WD vehicles per day.

2 Geology

The site is underlain by Otago schist, and Meads road in this area runs along a large Holocene river fan deposits from the areas of the Bee Burn, which comprise angular mixed boulder, gravels, sands and silts. Peak AA9B is considered to be a harder schist outcrop, which has been filled around by the Holocene Fan Deposits. The road cutting and the slope of Peak AA9B in this area are consistent with this expected geology, comprising angular gravels in a sandy silty matrix. Figure 2

3 Cause of the slip

The slip appears to be a deep seated rotational failure through the Holocene Fan deposits. A number of slip surfaces may have formed, meaning a rigid scallop shaped block of soil has rotated. This has manifested itself as a series of headscarp cracks at road level.

The cause of the slip is considered to be a reduction of the strength of the material and increase in mass at the base of the slope, caused by increased saturation as a result of the increase in lake level.

Wave action on the lake may also have contributed to the removal of material in the vicinity of the base of the slope, compounded by the high water levels at this time

In addition, the drainage of part of Peak AA9B are directed through to this section of Meads road, and to the timber culvert installed following the 1994 event. This culvert was not observed on site, but during the visit, the flow from the water table was observed to be flowing into the headscarps, which would act to further reduce their strength.

4 Recommendations to repair

4.1 Do nothing

The road is not currently useable, the slip poses a risk to light traffic and to pedestrians. As such a 'do nothing' option would not be preferable.

4.2 Anchored retaining wall

The provision of an anchored retaining wall would provide a robust solution for this section of road.

Given the steep nature of the site, and the variable lake level, it is considered necessary to provide a double anchored steel column retaining wall.

The slip material would be excavated and replaced, which would require temporary retaining of the existing upslope and cut faces.

A similar recent project at Chaslands in Southland was approximately $30k/m, and therefore for a 60m length of wall a rough order cost for this would be around $1.8million.

Refer SK02 for a sketch detail of this solution.

The length of Meads road south from the slip is also at risk of slippage in a similar event, and therefore this repair would not necessarily fix the problem given a similar event in the future.

4.3 Dig out and replace

A lower cost option would be the removal and replacement of the slipped body of material. This would expose the failure surface and enable further assessment prior to re-engineering.

Specific design of the fill material would allow for a steepening of the downhill slope, which could be constructed using large angular boulders, which could be used as rock armour at the base of the slope to protect against wave action.

This could be combined with a narrowing of the road, cutting of the upslope bank and reduction in road level to minimise the geotechnical risks.

Works to improve the upslope drainage would also be required to mitigate future risks

Such as solution would potentially be subject to settlement and damage over time, but may be more suitable given the number and type of vehicles using the road.

Indicative costs for such earthworks vary depending on the exact solution and the source of materials, and are expected to be of the order of $3-5k/m, ie $180k - $300k.

The length of Meads road south from the slip is also at risk of slippage in a similar event, and therefore this repair would not necessarily fix the problem given a similar event in the future.

4.4 Realignment of the road

Realignment of the road may also be a suitable solution.

Realignment below the existing road along the beach may be suitable in all but the highest lake level situations. However the location of the easement for Contact Energy and the requirement to access the road at high lake levels may make this option not viable. The provision of a simple gravel road over the approximate length of 600m, at an estimated rate of $250/m would equate to $150k.

Realignment of the road above the existing road, above the treeline may be suitable. This would require discussions with the landowner as the road corridor is not currently on this alignment. Some tree clearance to access the eastern section of road will be required, and the area crossing the Terrace Creek stream will require review. The provision of a simple gravel road over the approximate length of 600m, at an estimated rate of $250/m would equate to $150k.

A route which could be adopted for the station is a relocation of the road to the north of Peak AA9B. This appears to follow some existing farm tracks, but some sections may require bridges or culverts, and the resolution of boundary issues. This would also be subject to a route evaluation.

Notes:
These estimates should be market tested.
The proposed routes would require further survey and assessment
Costs are for physical works only and do not include professional fees, landowner liaison, or legal engagement

4.5 Options summary

Table 1 Summary Options table

Solution	Advantages	Disadvantages	Cost
Anchored wall	Robust solution	Expensive. Additional sections of Meads road still at risk of damage	$1.8million
Reconstruction	More cost effective	Less robust, reduced road width. Additional sections of Meads road still at risk of damage	$180k – $300k
Access along lake level	More cost effective	Does not provide access at high lake levels. Requires land ownership changes	$150k
Cut new track above existing	More robust	Requires land ownership changes	$150k
Divert road around the back of peak AA9B	Robust solution	Requires land ownership changes	-

Figure 1 Site location plan. Peak AA9B to the west of the site

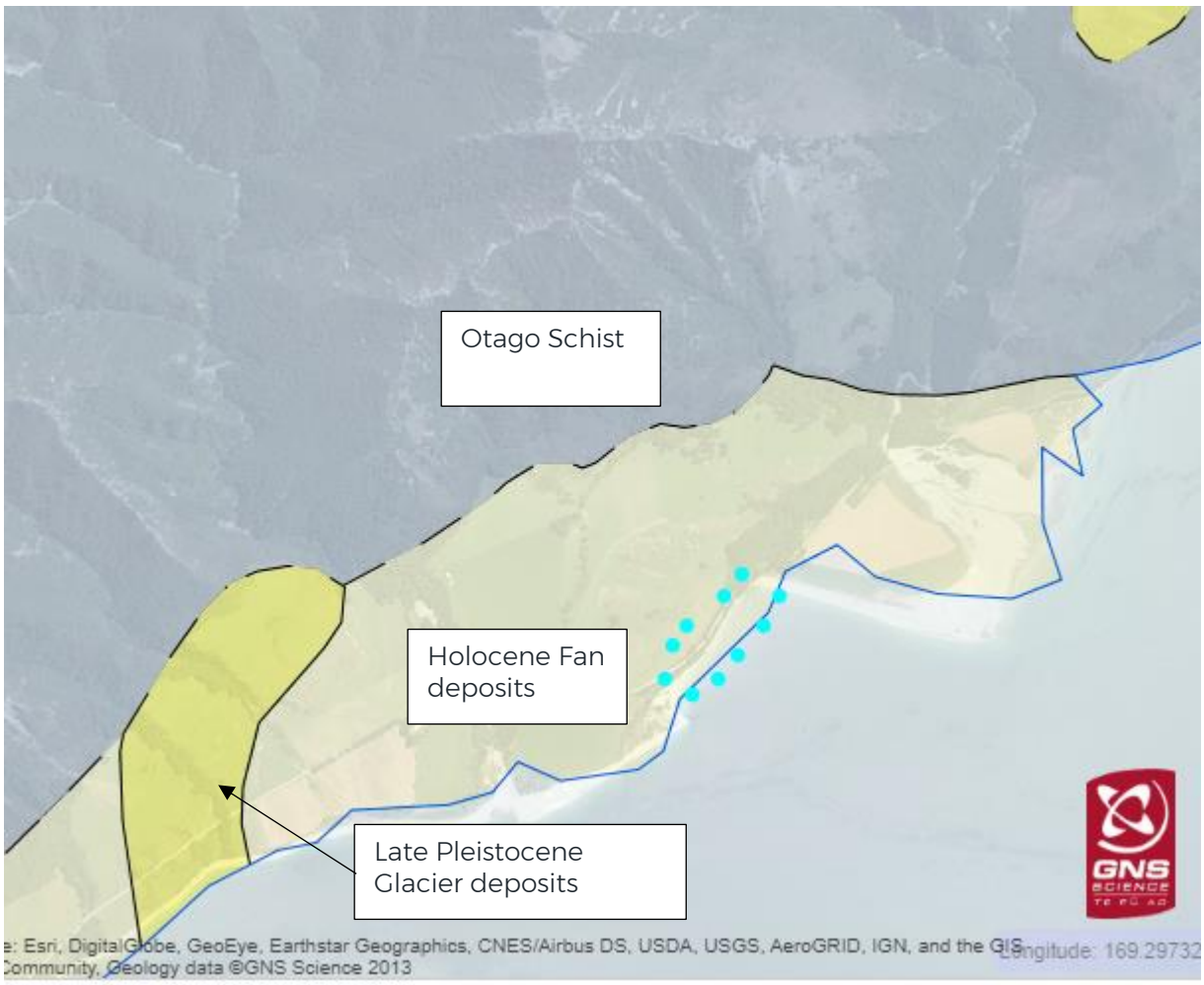

Figure 2 Site Geology. GNS Webmaps

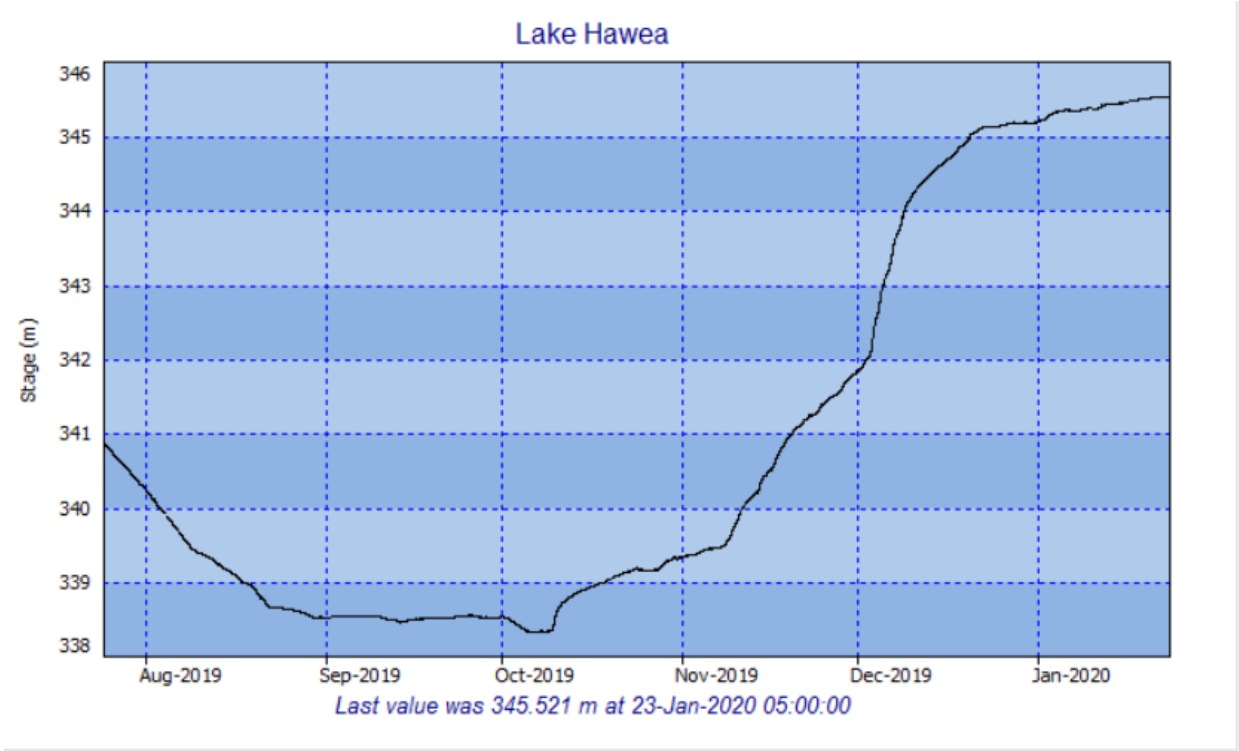

Figure 3 Lake Hawea Lake levels

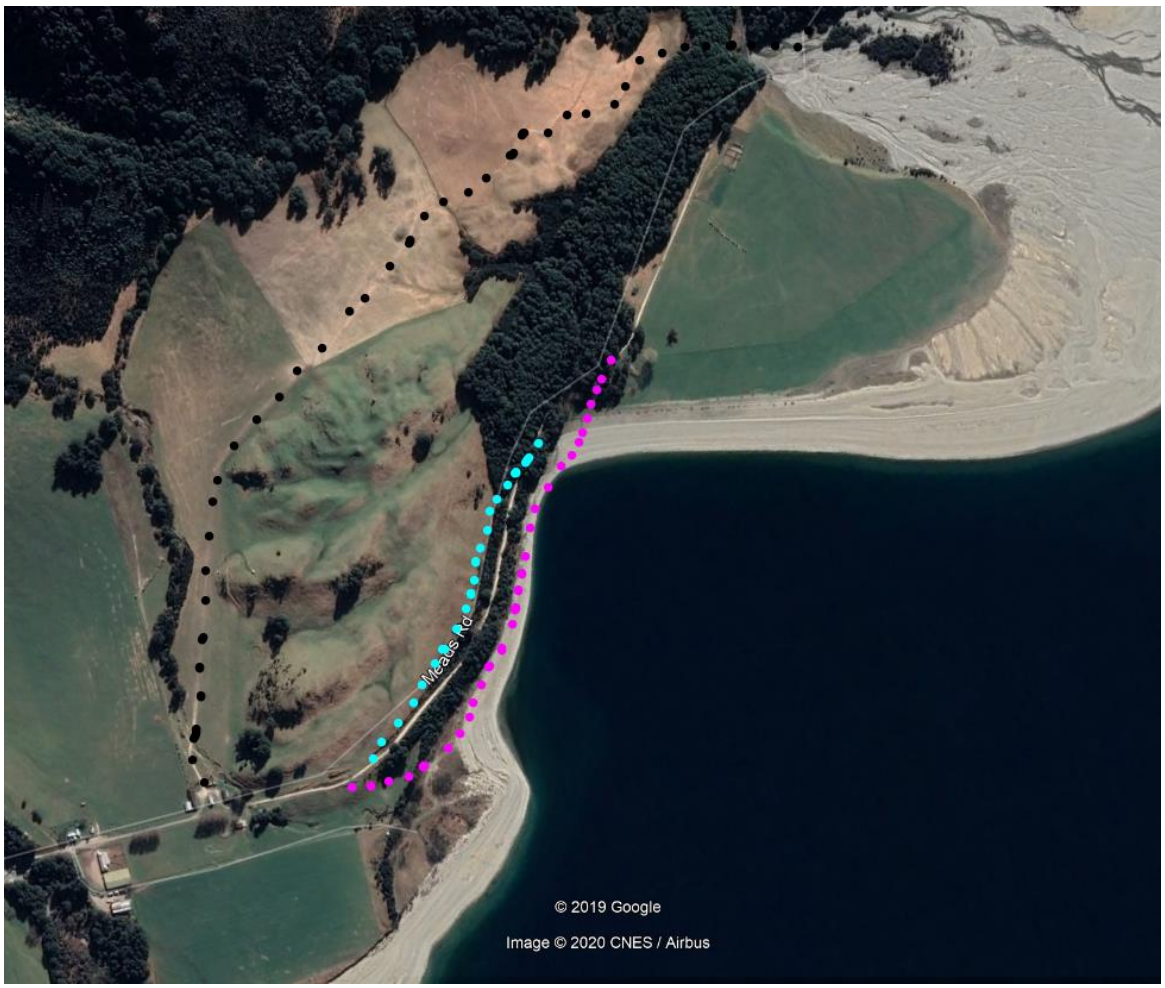

Figure 4 Alternative routes to avoid the slip. High level shown green, beach level shown purple, and longer route shown black

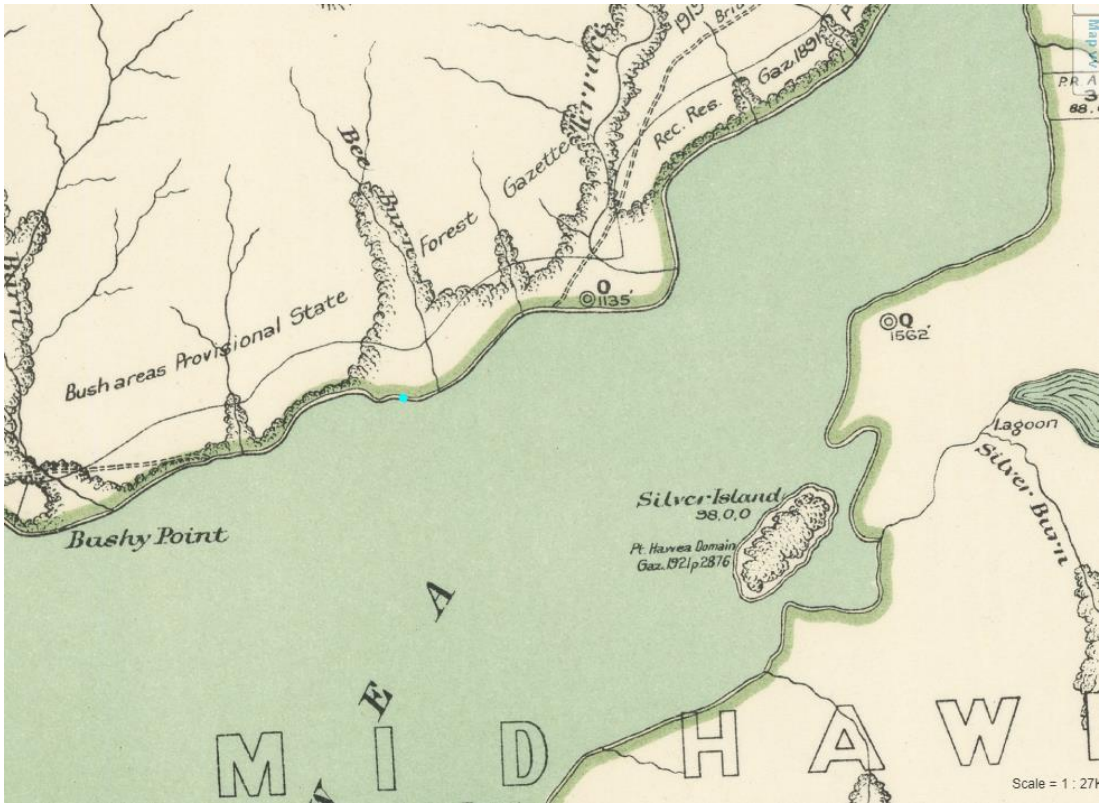

Figure 5 Historic mapping 1923 , showing the site. The road shown to only extent to Kidds Bush campsite.

5 Photographs

Photograph 1 – Looking east at the headscarps

Photograph 2 – Looking west from the slip

Photograph 3 – The area below the slip, with some washed out material

Photograph 4 – Looking west from the slip

Photograph 5 – Looking west from the slip

Photograph 6 – Below the slip to the lake

CALCULATION SHEET

Project/Task/File No:

Project Description: Meads Road

Sheet No SK01 of

Office: CT / PS

Computed: / 01 / 2020

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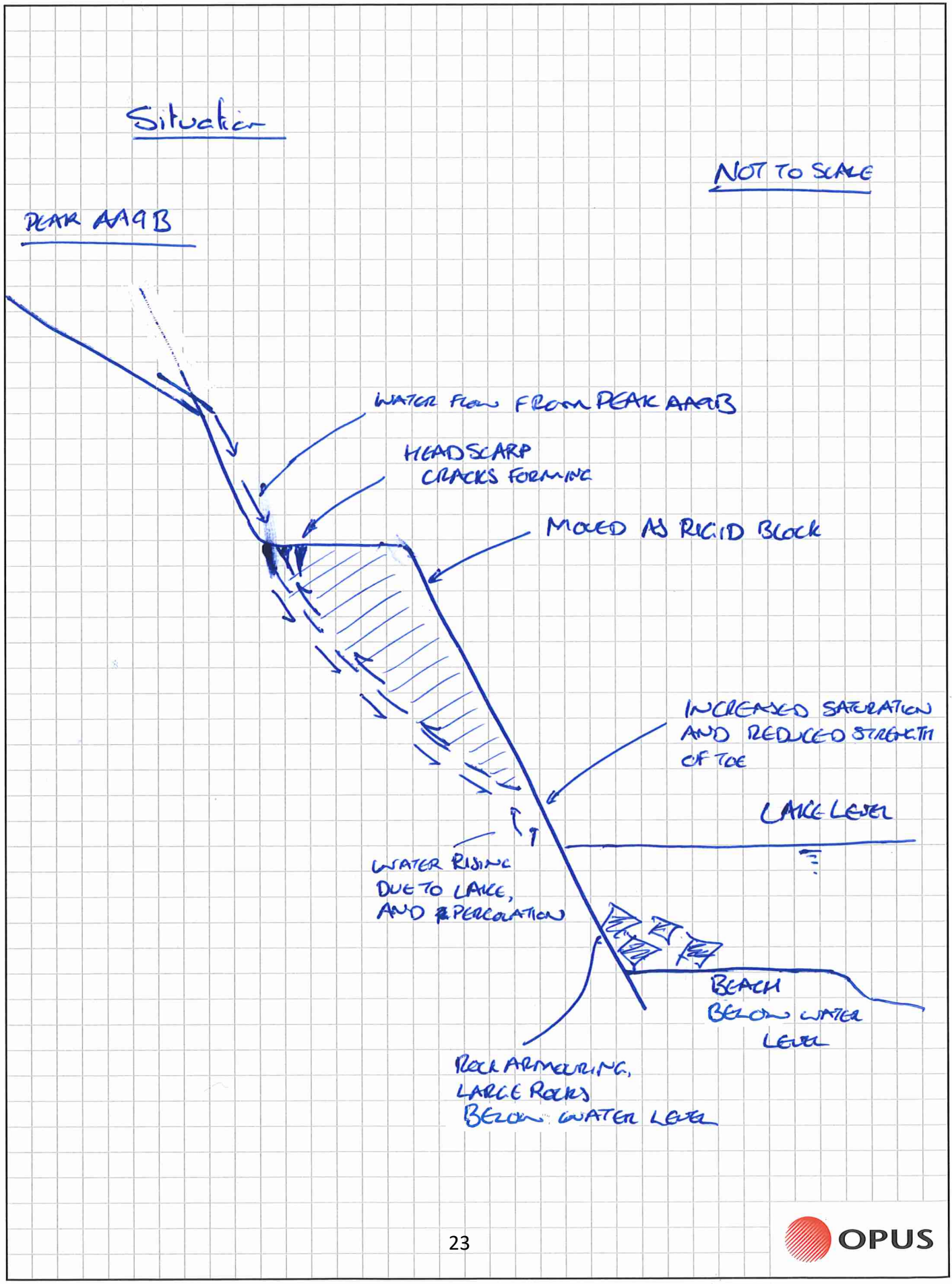

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Office: CT - PJ

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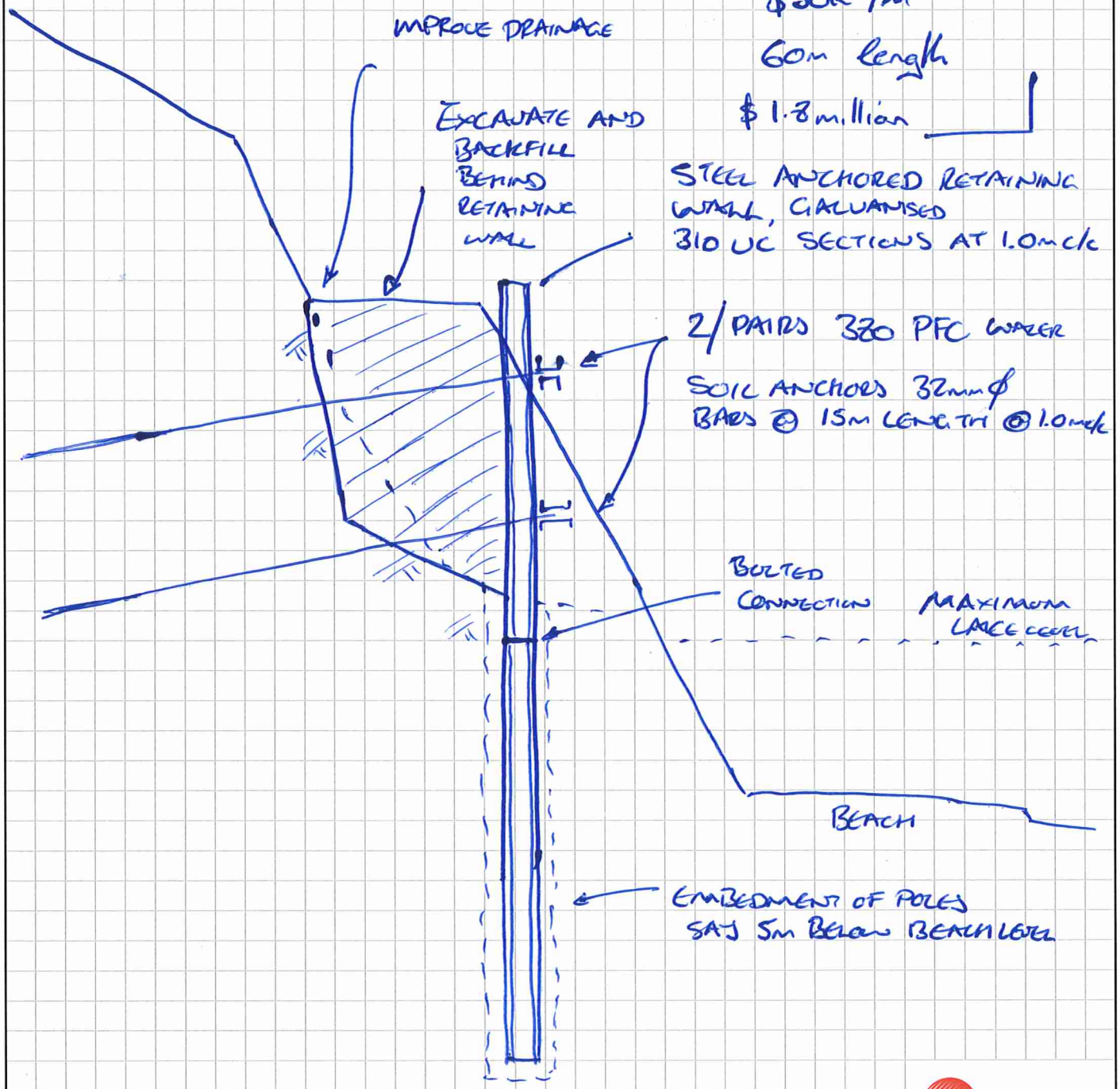
Anchored retaining wall

CONCEPT
NOT FOR CONSTRUCTION

Approximate cost
$30k /m
60m length
$1.8 million



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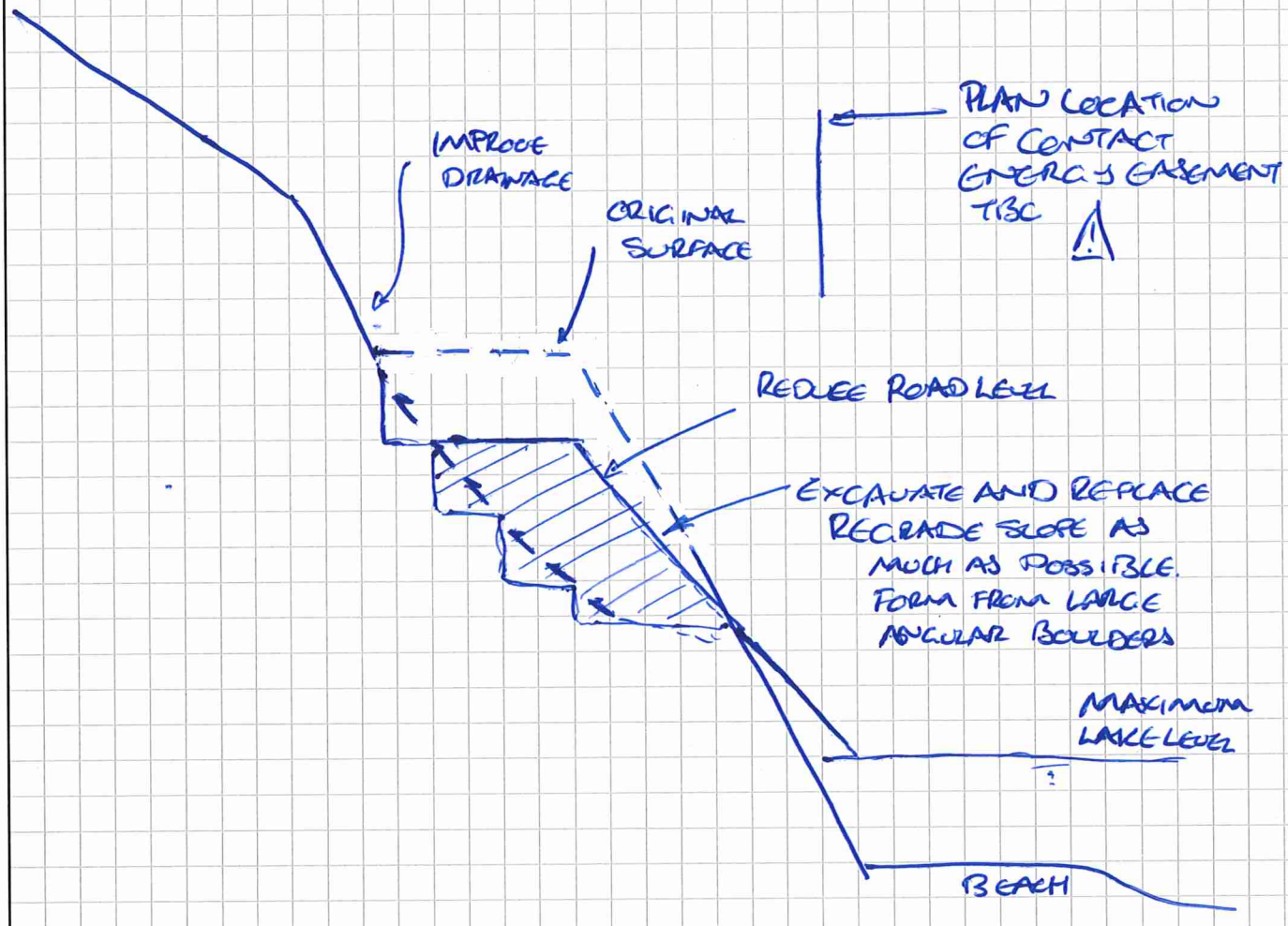
Dig out and replace

CONCEPT NOT FOR CONSTRUCTION



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