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REPORT

Tonkin+Taylor

Mauao Base Track Repair Options Assessment

Prepared for
Tauranga City Council
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1 Introduction

Tauranga City Council (TCC) engaged Tonkin + Taylor (T+T) to undertake an assessment of repair options for a landslip that has occurred on the Mauao (Mount Maunganui) base track.

The landslip is located on the southern side of Mauao and occurred on 5 April 2017, likely triggered by the heavy rainfall in the days leading up to the event. An approximately 14 m long section of the base track has subsided during the landslip including several Pohutukawa trees. Photos of the landslip are attached in Appendix A.

The base track is the only Accessible Route around the base of Mauao, Mount Maunganui, and provides significant amenity value for the community and tourists.

TCC wish to reinstate the base track with a long term solution involving repairing the landslip or relocating the track. This report looks at six engineered options for reinstatement.

2 Site information

T+T visited the Site on 11 April 2017 and carried out a tape measure and laser range finder survey of the landslip. The headscarp is approximately 14 m wide and the landslip face is approximately 10 m high with a slope of 1H:1.2V. The debris at the toe of the slope is approximately 1.3 m above the surrounding foreshore level. A large portion of the landslip debris including several Pohutukawa trees has shifted relatively intact onto the foreshore.

The existing upper slope to the north of the track is approximately 7 m high with a slope of 1H:1V and is heavily vegetated including a large Pohutukawa tree. There were no signs of recent landslips on this slope. Beyond the upper slope there is a relatively flat area of farm land which we understand is part of an archaeological site.

Figure 1: Landslip location plan. Aerial sourced from Tauranga City Council, 2015 Aerials Tauranga City Council, BOPLASS Ltd, Tauranga City Council, LINZ.

The published geology of the area[1] indicates that the site is underlain by Minden Rhyolite Subgroup deposits comprising Rhyolite to Rhyodacite flow banded lavas. These are overlain at the site by a sequence of bedded silt and sand deposits with colluvium also present. During the site visit, water was observed seeping from a sand layer near the base of the landslip face.

Sketches 6 and 7 showing the plan and cross section of the landslip are attached in Appendix B.

3 Options assessment

The following remediation options to be assessed were agreed with TCC prior to preparing this report:

1 Reinstate the track in the existing location using a structural wall to repair the failed slope (e.g. mechanically stabilised earth, timber crib wall or similar);

2 Reinstate the track in the existing location by constructing a foot bridge to span the failed area;

3 Realign the track slightly from the existing location by excavating further back into the existing slope and using slope stabilisation;

4 Relocating the track above the landslip (max 1:12 gradient); and

5 Relocate the track to a lower level around the base of the slope by constructing a timber board walk or rock revetment.

In addition, we have assessed the following sub Option 3a: Reinstate the track in the same location with soil nails, and construct a timber retaining wall at the top of the landslip face and downslope of the track.

For each option we have considered the following in our report:

- Engineering considerations including constructability, long term performance and residual risks of damage due to future storm events;
- High level cost estimates; and
- Statutory considerations including consenting, archaeological impacts and potential effects to landscape and vegetation.

High level cost estimates for each option are based on the following assumptions:

- Base construction costs. Rates are sourced from QV cost builder (formerly Rawlinsons) and tender rates received by T+T from similar projects within the last 5 years;
- Contractors' preliminary and general items at s 7(2)(h) – Co of base construction cost;
- Design and construction monitoring costs between s 7(2)(h) – Co and s 7(2)(h) – Co of construction costs;
- Contingency of up to s 7(2)(h) – Co and
- No allowance for consenting costs.

The cost estimates are presented as a range which was generated by carrying out a sensitivity check for key rates in each option.

[1] *Leonard, G.S.; Begg, J.G.; Wilson, C.J.N. (compilers) 2010: Geology of the Rotorua area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 5. 1 sheet + 102 p. Lower Hutt, New Zealand. GNS Science.*

We note that the surface of Mauao is subject to slope instability around its full perimeter due to the site geology and relatively steep gradients. The landslip is located along an approximately 150 m length of track which is located relatively high above the foreshore, and the seaward slopes are steep with a high risk of slope instability.

Options 1 to 3a presented in this report, would reinstate an approximately 18 m long section of track only, and would not reduce the risks of future track closures due to land instability on other slopes in the vicinity of the site. Option 5 involves a new track alignment located below the 150 m track section described above.

Each option is described in the following sections.

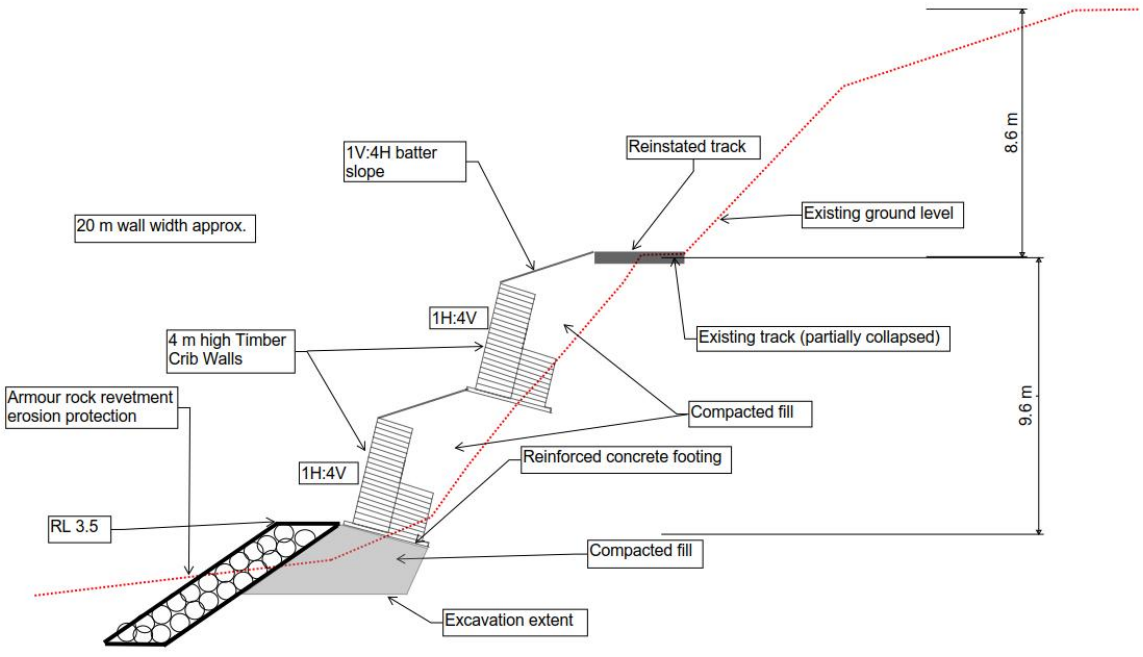
3.1 Option 1 – Repair slip with structural wall

Option 1 is to reinstate the track in its current location by constructing a structural wall such as a timber crib or mechanically stabilised earth (MSE) wall in front of the slip face. The MSE wall was not considered further because a minimum wall width of approximately 6 m is required for the geogrid reinforcement. This would require either excavation at the toe of the landslip which may undermine the slope, or significantly more backfill than a crib wall if the toe of the slope was moved seaward from its current location.

A timber crib wall consists of a timber block grid structure filled with graded small diameter rock (25 mm – 100 mm) which acts as a gravity retaining wall to stabilise the slope. The base of the wall is founded on a reinforced concrete slab. For this option, the crib wall foundation will be constructed on compacted fill base protected by a rock revetment. The crest of the revetment will be constructed to an elevation of approximately 3.5 m RL to reduce the risk of damage to the crib wall from wave action.

The crib wall option would likely consist of 2-3 separate crib walls terraced back into the slope to minimise the crib wall height and backfill volume required. The crib wall width would be approximately 20 m.

Sketch 1 below shows the typical arrangement of Option 1.



Sketch 1: Timber crib wall typical arrangement.

3.1.1 Engineering considerations

Engineering considerations for this option include:

- The wall would be a long term robust solution unlikely to be damaged in future storms. However, future slips adjacent to the wall could undermine it from the sides and require repair;
- The wall arrangement (wall sizes and location of terraces) can be designed to minimise the visual impact of the structure on the surrounding environment. Further, the wall would not be visible to track users but visible to people on the beach;
- A geotechnical investigation will be required for detailed design including drilling of bore holes to understand the site geology and confirm the wall design parameters. This would likely require Archaeological Authority;
- There is a risk to construction personnel while working below the slip face during the initial excavation works and assembly of the crib wall;
- Restricted access to the landslip base for heavy machinery to form the wall foundation and revetment. Access would likely be restricted to smaller machines at low tide initially;
- Fill material to construct the crib wall would need to be imported and delivered to the base of the slope. Transporting material over the farmland above the site may raise cultural issues as the topsoil layers would likely be damaged potentially exposing archaeological remains. Transport and unloading by barge may be difficult due to the shallow water depth adjacent to the site; and
- Consideration should also be given to investigating other landslip prone areas in the vicinity of the site to reduce the risk of future track closures.

3.1.2 High level cost estimate

The high level cost estimate range for this option including detailed design and construction is from s 7(2)(h) – Commercial activities

3.1.3 Statutory considerations

Based on the preliminary concept for the structure, the following statutory approvals are required:

Bay of Plenty Regional Council (BOPRC) consent

Resource Consent is required from BOPRC under the following provision of the Proposed Regional Coastal Environment Plan (PRCEP);

- Rule PZ 10 Discretionary – Structure within Port Zone.

Resource consent is required from BOPRC under the following provision of the Water and Land Plan (WLP);

- Rule 1C Discretionary – Earthworks within 20 metres of the CMA.

Tauranga City Council (TCC) consent

Resource consent is required from TCC under the following provisions of the TCC City Plan;

- Rule 6A.6 Non complying – New structure within outstanding natural feature and landscape area.
- Rule 13A.12 Discretionary – Structure within the conservation zone which exceeds building height or building scale conditions.

- Rule 13A.11 Restricted Discretionary – Structure within the conservation zone which is within 15 metres of MHWS.
- Rule 7C.9 Discretionary – Structure and associated earthworks within a Significant Maori Area.
- Rule 7E.5 Discretionary – Structure and associated earthworks within a Significant Archaeological Area.

Dependant on the final design, land use consent may also be required from TCC for the clearance of indigenous vegetation within an outstanding natural feature and landscape area.

Archaeological Authority

An Archaeological Authority should be obtained from Heritage NZ prior to proceeding within any works associated with implementing any option identified in this report. This is discussed in further detail below.

A search of Archsite has confirmed that the proposed structure is approximately 150 m from a registered archaeological pa site. Mauao is also identified as a Significant Archaeological Area under the TCC city plan. It is understood that many unrecorded archaeological sites are likely to be present on Mauao and that these sites could be disturbed as a result of implementing any of the options set out in this report. Therefore an Archaeological Authority should be obtained from Heritage NZ prior to proceeding within any works associated with implementing an option identified in this report.

Summary

Overall, regional consent is required under the Proposed Regional Coastal Environment Plan (PRCEP) as a discretionary activity, and the Water and Land Plan (WLP) as a discretionary activity. Land use consent for a non complying activity is required under the Tauranga City Council (TCC) City Plan. The non complying activity status means that the resource consent process will be rigorous. Given the site is within an Outstanding Natural Feature and Landscape under the TCC City Plan, the landscape and natural character effects of the structure will need to be carefully considered in the design, consenting and construction process.

Given Mauao has significant cultural significance to Maori and is identified as a Significant Maori Area under the TCC City Plan, and as the site is within an Indigenous Biological Diversity Area B under the PRCEP, any cultural effects and ecology effects will also need to be carefully considered in the design, consenting and construction process. DOC and Tangata Whenua should be engaged with throughout the process.

3.2 Option 2 – Footbridge over slip area

Option 2 involves constructing a footbridge over the landslip founded on either side of the landslip head scarp with a span of approximately 17 m.

This option was considered unfeasible after some development and discussions with TCC. As such it was not fully developed. The key engineering and statutory issues with this option are as follows:

- The bridge abutments would require deep piled foundations in order to be founded on sound material unlikely to subside in future landslip events. The piles would likely need to be large diameter timber or steel piles sufficient to withstand earth forces from a landslip. Alternatively, the slope would need to be stabilised in the vicinity of the abutment piles;
- The bridge would be susceptible to damage by falling debris from future landslips on the upper slope above the bridge and around the piled foundations. Therefore this option would not provide a long term solution;

- Addition of manmade structures is not in keeping with the Mauao natural landscape;
- Construction of the bridge would require access for large vehicles including a crane to lift the bridge components into place, an excavator and trucks to transport the bridge beams to the site. This may cause damage to culturally sensitive areas adjacent to the site. To access the western bridge foundation, equipment would likely need to be brought to site via barge; and
- Consideration should also be given to investigating other landslip prone areas in the vicinity of the site to reduce the risk of future track closures.

3.2.1 Statutory considerations

The option of constructing a footbridge over the slip area has the same statutory consenting requirements and considerations as Option 1 discussed in Section 3.1.3 of this report with the exception of the PRCEP consenting requirements, and Rule 13A.11 under the TCC City Plan. This is because the footbridge would not be located within the CMA, and therefore does not require a coastal permit, and is not likely to be within 15 metres of MHWS, and therefore Rule 13A.11 of the TCC City Plan does not apply.

3.3 Option 3 – Slope stabilisation with soil nails and trimming of upper slope

Option 3 involves excavating into the existing upper slope by approximately 2 m horizontal distance to provide sufficient width for a new walking track. Both the landslip face and upper slope would then be stabilised with soil nails.

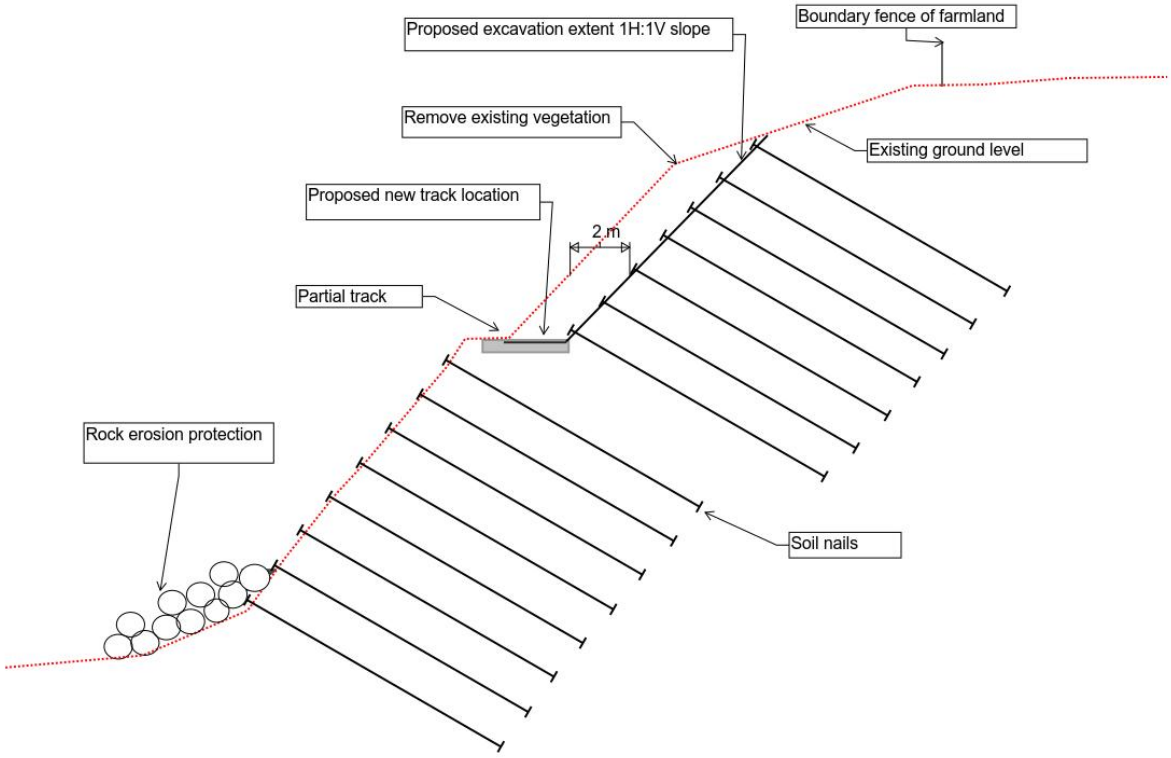
Soil nails, or ground anchors, are generally installed by drilling a hole into the slope face (100 – 150 mm diameter), inserting a steel reinforcing anchor (typically 20 mm diameter reinforcing steel) then using high pressure grout to fill the hole. The grout sets and forms a bond against the walls of the hole. The anchor is then tightened against the slope using a fastener and large size anchor plate. A debris mesh is pinned against the slope to prevent local debris falls. The slope may then be initially stabilised with a biodegradable matting or hydro seeding.

The soil nails can be installed by specialist contractors that abseil down the slope and use hand operated equipment to do the drilling and grouting works. However, it is more cost effective if equipment such as cherry pickers can access the site to lift the drilling equipment. Based on discussions with contractors we have assumed these works would be carried out with a cherry picker or excavator for access.

For developing the cost estimates we have assumed the soil nails are spaced at 1.5 m centres horizontally and vertically. The cost estimate is sensitive to this spacing due to the relatively high cost of the soil nails to other construction items. The soil nail spacing would be confirmed during detailed design based on the site investigation data. The soil nails would be installed to stabilise an approximately 18 m width of the landslip face.

Rock erosion protection would be required at the toe of the slope to reduce the risk of coastal erosion undermining the stabilised slope.

Sketch 2 below shows details of Option 3.



Sketch 2. Slope stabilisation with soil nails and excavation of the upper slope.

3.3.1 Engineering considerations

Engineering considerations for this option include:

- The soil nail stabilised slopes will provide a stable long term solution. However, adjacent slopes may still be affected by landslips;
- There is a risk to construction personnel while working below the slip face during the initial excavation works;
- A geotechnical investigation will be required for detailed design including drilling of bore holes to understand the site geology and confirm the wall design parameters. This would likely require an Archaeological Authority;
- Material excavated from the upper slope would need to be disposed of as landscape fill on Mauao which may require transport over culturally sensitive areas and a suitably sized disposal area;
- Vegetation clearance would be required on the upper slope including the large Pohutukawa tree to install the anchors. If it was not removed the anchors would likely kill the tree which would then become a hazard;
- Access for machinery and materials for constructing the landslip toe rock erosion protection would likely be via barge which may be difficult due to the shallow water depth adjacent to the site; and
- Consideration should also be given to investigating other landslip prone areas in the vicinity of the site to reduce the risk of future track closures.

3.3.2 High level cost estimate

The high level cost estimate range for this option including detailed design and construction is from s 7(2)(h) – Commercial activities

3.3.3 Statutory considerations

The option of slope stabilisation with soil nails, and trimming of the upper slope with construction of rock erosion protection at the base has the same statutory consenting requirements and considerations as Option 1 discussed in Section 3.1.3 of this report.

3.4 Option 3a – Reinstate the track with soil nails on lower slope and construction of a timber retaining wall adjacent to track

Option 3a involves stabilisation of the landslip face (as per Option 3) and construction of a timber pole retaining wall at the top of the stabilised slope to provide sufficient width to reinstate the track. This would remove the requirement for additional excavation and stabilisation of the upper slope. The soil nails would be installed to stabilise an approximately 18 m width of the landslip face.

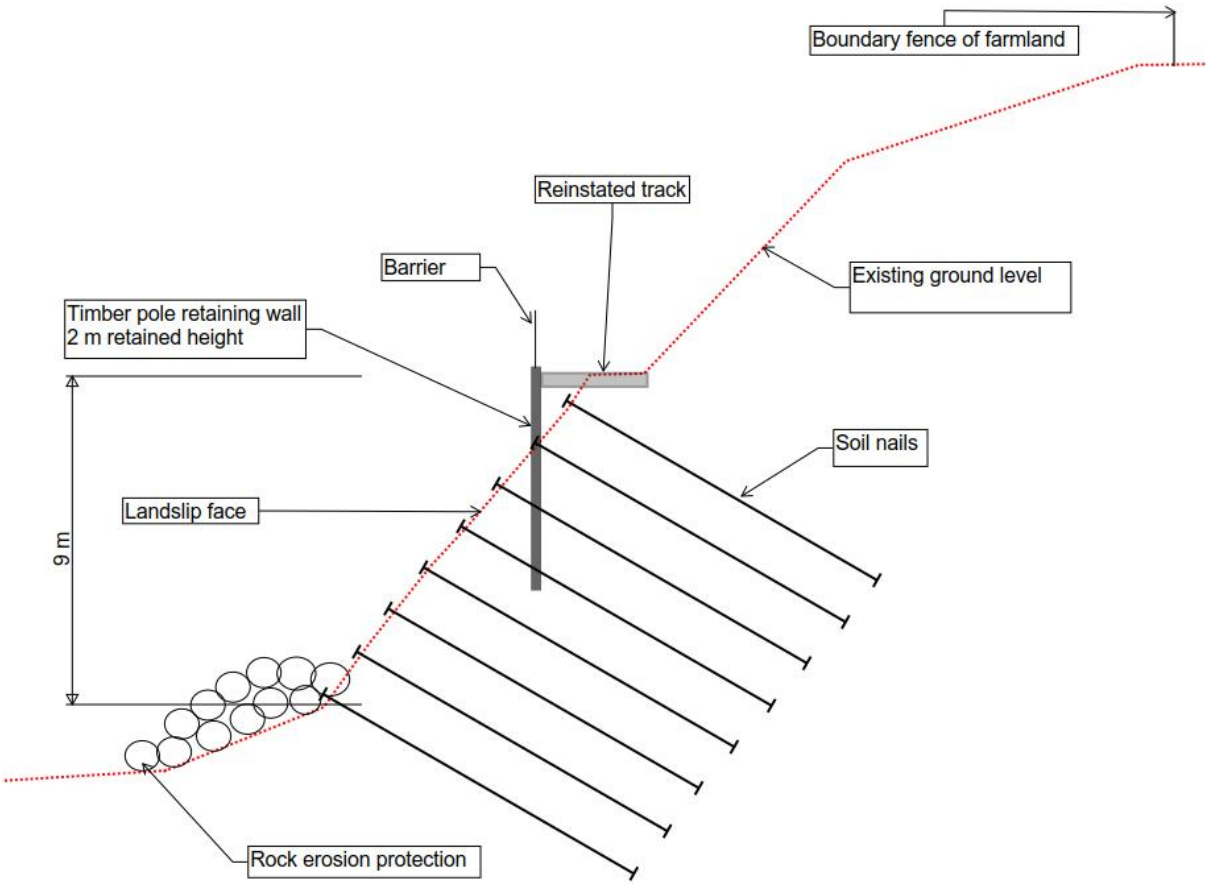
The retaining wall poles would be installed following installation of the soil nails using a small excavator with auger attachment. The contractor would likely need to stage the installation of the timber poles to provide a working platform for the excavator. A barrier would be required along the retaining wall as fall from height protection.

The following indicative retaining wall design has been considered for this report:

- Timber piles, bored and concrete encased;
- 17 m wall length and 2 m max retained height; and
- Additional soil anchors through the top of the retaining wall may be required.

As with Option 3, rock erosion protection would be required at the toe of the slope to reduce the risk of coastal erosion undermining the stabilised slope.

Sketch 3 below details Option 3a.



Sketch 3. Landslip face stabilisation with soil nails plus retaining wall for track reinstatement.

3.4.1 Engineering considerations

Engineering considerations for this option include:

- The soil nail stabilisation will provide a stable long term solution for the landslip face. There is a risk of future landslips on the upper face which would inundate the track. However, reinstatement works would likely be limited to clearing the landslip debris;
- A geotechnical investigation will be required for detailed design including drilling of bore holes to understand the site geology and confirm the wall design parameters. This would likely require an Archaeological Authority;
- Difficult construction of the retaining wall at the top of the landslip. Contractor would need to provide a comprehensive H&S plan and stage the works accordingly;
- Access for machinery and materials for constructing the rock erosion protection will likely be via barge which may be difficult due to the shallow water depths adjacent to the site;
- No vegetation clearance or excavation is required on the upper slope; and
- Consideration should also be given to investigating other landslip prone areas in the vicinity of the site to reduce the risk of future track closures.

3.4.2 High level cost estimate

The high level cost estimate range for this option including detailed design and construction is from s 7(2)(h) – Commercial activities

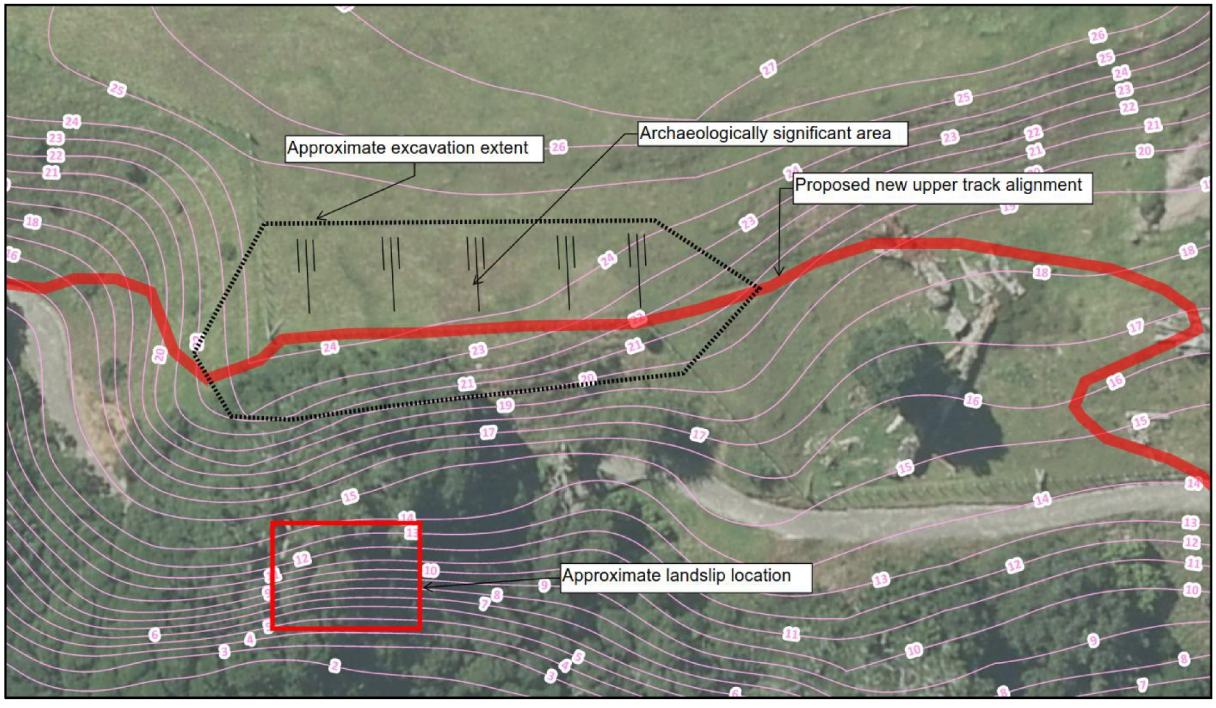
3.4.3 Statutory considerations

The option of reinstating the track with soil nails on the lower slope and construction of a timber retaining wall adjacent to track with rock erosion protection at the base of the structure has the same statutory consenting requirements and considerations as Option 1 discussed in Section 3.1.3 of this report.

3.5 Option 4 – New upper track

Option 4 involves relocating the track to traverse above the landslip area and reconnect to the existing track on either side. The new track is required to be Accessible with a maximum gradient of 1H:12V and we have assumed a track width of 2.5 m.

This option requires significant excavation to create a track profile that satisfies the 1H:12V requirement. Further, we note that the excavation extent would fall within archeologically significant areas including a historic Pa site. The proposed alignment of the track and the excavation extents are shown in Sketch 4 below. In order to achieve the required track gradient while traversing existing slopes, low retaining walls and excavation into the existing slopes would be required.



Sketch 4. Proposed new upper track location and excavation extent.

3.5.1 Engineering considerations

Engineering considerations for this option include:

- Significant volume of earthworks required including excavation within a culturally sensitive area. In order to remove the excavated material a haul road would need to be constructed from the existing 4WD track over the farmland to the site which may cause damage to topsoil layers potentially exposing archaeological remains;

- A significant volume of excess excavated material would be generated and this would need to be stockpiled or placed as landscape fill within Mauao;
- Earthworks would be sensitive to weather conditions; and
- Risk of erosion and sediment control issues with large open excavation adjacent to the coastal marine area. The contractor would need to implement and maintain robust erosion and sediment controls.

3.5.2 High level cost estimate

The high level cost estimate range for this option including detailed design and construction is from s 7(2)(h) – Commercial activities

3.5.3 Statutory considerations

Unlike Options 1-3 set out above, the works do not involve a new 'building'[2] within the Outstanding Natural Feature and Landscape and therefore non complying consent is not likely to be required under the TCC City Plan. Based on the preliminary concept the following statutory approvals are required:

BOPRC consent

Resource consent may be required under the following provision of the WLP as the earthworks within land zoned 20-40 m from the CMA may exceed the area and volume thresholds for a permitted activity;

- Rule 1C discretionary activity - earthworks within land zoned 20-40 m from the CMA which exceed an area of 400 m^2 and a volume of 200 m^3.

TCC consent

Resource consent is required from TCC under the following provisions of the TCC City Plan;

- Rule 6A.4 Restricted Discretionary – Construction of pedestrian track within an Outstanding Natural Feature and Landscape.
- Rule 7C.7 Restricted Discretionary – Construction of pedestrian track within a Significant Maori Area.
- Rule 7E.5 Discretionary – Earthworks within a Significant Archaeological Area.

Dependant on the final design, land use consent may also be required from TCC for the clearance of indigenous vegetation within an outstanding natural feature and landscape area.

Archaeological Authority

An Archaeological Authority should be obtained from Heritage NZ prior to proceeding within any works associated with implementing any option identified in this report. This is discussed in further detail in Section 3.1.3.

Despite the rules in the Plans being slightly different for this option (compared to Options 1-3), the commentary around cultural, archaeological, landscape, natural character, and ecology effects and associated stakeholders set out under Section 3.1.3 of this report remain relevant to this option.

[2] As defined under the TCC City Plan

3.6 Option 5 – New lower track

Option 5 involves constructing a new lower track along the foreshore to bypass the slip area. This could consist of either a board walk or rock revetment to form the track. For the purposes of this assessment the board walk was not considered in detail due to the high anticipated cost in comparison with a revetment.

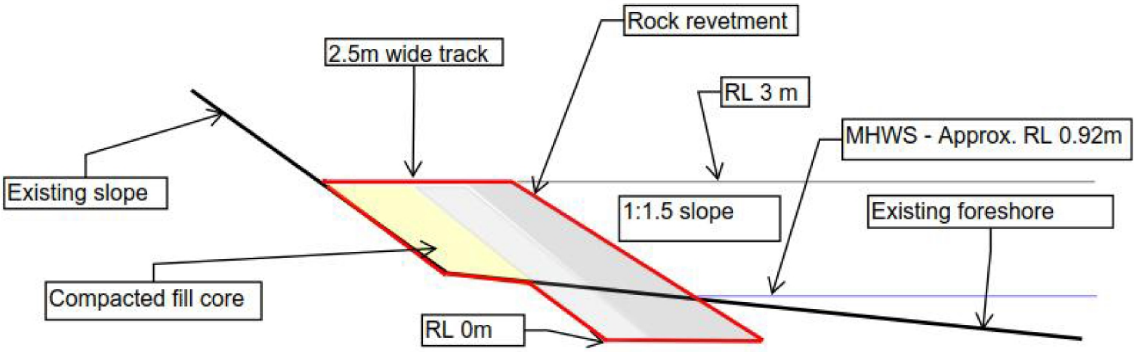
The required length of rock revetment is approximately 250 m and we have assumed a final track elevation of RL 3.0 m which is approximately 2.1m above Mean High Water Springs (MHWS).

Typically a rock revetment consists of the following:

- Excavation into existing ground to ensure the footing is below likely scour levels;
- Geotextile lining of the formation level;
- Compacted granular fill core covered by geotextile; and
- Underlayer and large diameter armour rock on the outside of the revetment with 1V:1.5H slopes.

Sketch 5 below includes a plan and section detailing Option 5.

Sketch 5. New lower track with rock revetment.



Sketch 5a. Cross section 1 through proposed rock revetment.

The revetment track would tie into the existing beach access tracks at either end. These tracks are currently not suitable as Accessible tracks so upgrade works would be required to even out the gradients and widen the track.

3.6.1 Engineering considerations

Engineering considerations for this option include:

- Difficult access to the foreshore for construction equipment. Working hours during the initial phase of the works will be restricted by the tides;
- Delivery of the large volumes of rock fill required to construct the wall will be difficult due to restricted site access. Existing tracks and surrounding areas will likely be negatively impacted by construction traffic;
- The revetment would provide long term coastal erosion protection for the existing lower cliff faces;
- There may be coastal effects due to the construction of a large revetment which would need to be assessed as part of the design process;
- The slopes above the track still have a high risk of instability and the track would be susceptible to damage from inundation by landslips. However, repair and reinstatement of the track will likely be limited to clearance of debris or filling of eroded track areas;
- This option would reduce the risk of extended duration track closures due to future landslip events as the new track would be located below the existing elevated track section which has a higher risk of instability; and
- Longest construction timeframe of the options.

3.6.2 High level cost estimate

The high level cost estimate range for this option including detailed design and construction is from s 7(2)(h) – Commercial activities

3.6.3 Statutory considerations

The option of a new lower track involves both structural works and construction of a new pedestrian track at the site. Therefore the statutory considerations set out under Sections 3.1.3 and 3.5.3 of this report are relevant. Overall, regional consent is required under the PRCEP as a discretionary activity, and the WLP as a discretionary activity. Land use consent for a non complying activity is required under the Tauranga City Council (TCC) City Plan. As with the above options, the non complying status

is a result of the proposed structure being located within a natural feature and landscape area. Therefore, as above, careful consideration of landscape and natural character effects, particularly given the extent of the rock revetment apply.

This option would result in an extensive and new 'hard' structure within the CMA and/or coastal environment, which based on the preliminary concept, is likely to extend approximately 250 m along the coastline at the base of the slope. The rock revetment is therefore likely to occupy a large portion of the CMA and/or coastal environment, and as such, the effects that the structure may have on coastal processes and ecology should be carefully considered throughout the design, consenting and construction process. It is noted that the New Zealand Coastal Policy Statement (NZCPS) *'discourages hard protection structures and promotes the use of alternatives to them, including natural defences'* under Policy 25, therefore consenting extensive hard structures along the coast can be a complex and uncertain process.

The existing foreshore in the proposed revetment location is heavily vegetated with large overhanging Pohutukawa trees and smaller native species. Based on the preliminary concept and likely location of the revetment and walking track, construction of the revetment and walking track would require extensive vegetation clearance initially and as an ongoing maintenance aspect. Given the above, and as the site is located within an Indigenous Biological Diversity Area B under the PRCEP, ecology effects will need to be carefully considered throughout the design, consenting and construction process. Stakeholder engagement will also be important.

4 Additional considerations

4.1 Non-engineered option

There is potential to undertake a lower cost version of Option 3 by excluding the soil nail stabilisation, and installing horizontal drains in observed seepage zones on the landslip face. The lower and upper slopes would have a lower than desirable stability factor compared with an engineered structure, and future instability of the slopes may occur. However, the risk of instability would be similar to existing slopes either side of the landslip.

4.2 Fill disposal

We understand that any material excavated as part of either of the options would need to remain on Mauao. Suitable fill disposal locations would need to be confirmed with the Mauao owners and designed to accommodate the volume of fill generated from the adopted option. If there are no suitable disposal locations within close proximity to the site then additional fill transportation costs may be incurred.

4.3 Landslip debris

Further, the remediation options have not included removal of the landslip debris located on the foreshore. We understand TCC may wish to remove this material and reinstate the previous beach profile. We have noted some considerations for these works below:

- The approximate volume of landslip debris based on our field laser survey is 400 m^3;
- The landslip debris will be eroded over time by the natural beach processes;
- There are currently two large trees within the main debris section which may become a safety hazard to people walking along the beach if the trees die or become unstable due to erosion of the surrounding debris. This risk should be assessed by TCC; and

- We recommend that TCC discuss the methodology and disposal location with a preferred contractor to estimate the cost for these works as the costs will be highly sensitive to these factors.

4.4 Wider area slope stability

The options presented in this report are for repairing a relatively small section of the Mauao base track and we note that other areas of the base track are located on steep slopes with a risk of future instability. TCC should consider the costs of repairing this section of track relative to the overall costs of maintaining tracks on Mauao.

5 Summary

Table 1 below summarises the options assessment above.

Table 1

Option	High level cost estimate range	Advantages	Disadvantages
1 – Structural wall (timber crib)	[redacted] s 7(2)(h) – Commercial activities	• Stable long term solution • Wall shape and terracing can be designed to minimise visual impact on surroundings • Wall structure would not be visible to track users	• Potential for the sides of the wall to be undermined in future landslips • Restricted access for machinery and materials • Upper slope may still fail which would inundate the track with landslip debris • Manmade structures not in keeping with Mauao natural landscape • Repair limited to the current landslip extent only. There is a risk that future landslips may cause track closures adjacent to the repaired area.
2 – Footbridge		• NA	• High risk of damage from future landslips to both foundations and superstructure • Manmade structures not in keeping with Mauao natural landscape • Repair limited to the current landslip extent only. There is a risk that future landslips may cause track closures adjacent to the repaired area.
3 – Stabilising slope with soil nails and excavation into upper slope		• Reduces risk of future landslips on upper slope occurring • Finished vegetated slope is in keeping with Mauao natural landscape • Stable long term solution	• Requires earthworks in culturally sensitive and archaeologically significant area • Restricted access for machinery and materials • Repair limited to the current landslip extent only. There is a risk that future landslips may cause track closures adjacent to the repaired area.
3a – Stabilising landslip face with soil nails plus retaining wall at top of landslip		• No excavation or vegetation removal required on upper slope • Finished vegetated slope is in keeping with Mauao natural landscape • Stable long term solution	• Difficult to construct retaining wall at top of landslip face • Upper slope may still fail which would inundate the track with landslip debris • Restricted access for machinery and materials • Repair limited to the current landslip extent only. There is a risk that future landslips may cause track closures adjacent to the repaired area.
4 – New upper track		• Stable long term solution • No importing of fill material required	• Large volume of earthworks in culturally sensitive and archeologically significant area • Significant vegetation clearance required • Large excavation batters not in keeping with Mauao natural landscape • Construction plant shifting excavated material may damage archeologically significant areas
5 – New lower track (rock revetment)		• Relatively easy to repair or reinstate track in future landslip events • Stable long term solution • Reduces risk of extended duration future track closures due to landslips	• Highest cost • Longest construction period • Relatively difficult consenting process • Potential for adverse effects to existing foreshore • Significant vegetation clearance required including large Pohutukawa • Restricted access for construction equipment and materials • Steep slopes above track still at high risk of instability

5.1 Statutory considerations summary

All options, excluding the option of constructing a new upper track, require non complying TCC land use consent due to the proposed structures being located within an Outstanding Natural Feature and Landscape. Based on the preliminary concept, constructing the new upper track requires discretionary consent under the TCC City Plan.

The options which involve structures within the CMA require discretionary consent under the RCEP. The options which involve earthworks within 20 m of the CMA, or which exceed the volume and/or area specifications within the zone 20-40 m from the CMA require discretionary consent under the WLP. It would be prudent to obtain Archaeological Authority for all options.

A non complying activity status (in this case for the TCC land use consents) is recognised as being capable of generating a wide range of effects and are not anticipated by the plan. Therefore the resource consent applications for the options having a non complying status will need to be particularly detailed and robust. In order to obtain consent, the preferred option will either need to have minor environmental effects or be in accordance with the objectives and policies of the plan.

The option of constructing a new lower track with a rock revetment at the base is likely to have a higher resource consent complexity when compared to the other options. Based on the preliminary concept, the likely extent of the rock revetment is approximately 250 m along the shore line. The rock revetment is therefore likely to occupy a large portion of the CMA and/or coastal environment, therefore the effects of the structure on coastal processes and coastal ecology would need to be carefully considered in the design, consenting and construction process.

6 Applicability

This report has been prepared for the exclusive use of Tauranga City Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

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Authorised for Tonkin & Taylor Ltd by:

s 7(2)(a) ƒ Privacy

tacc
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Appendix A: Photographs 1-3

Photograph 1: View of the head scarp looking north.

Photograph 2: View from the track adjacent to the head scarp looking west.

Photograph 3: Looking west towards the landslip with the debris in the foreground.

Appendix B : Sketch plan and cross section of landslip

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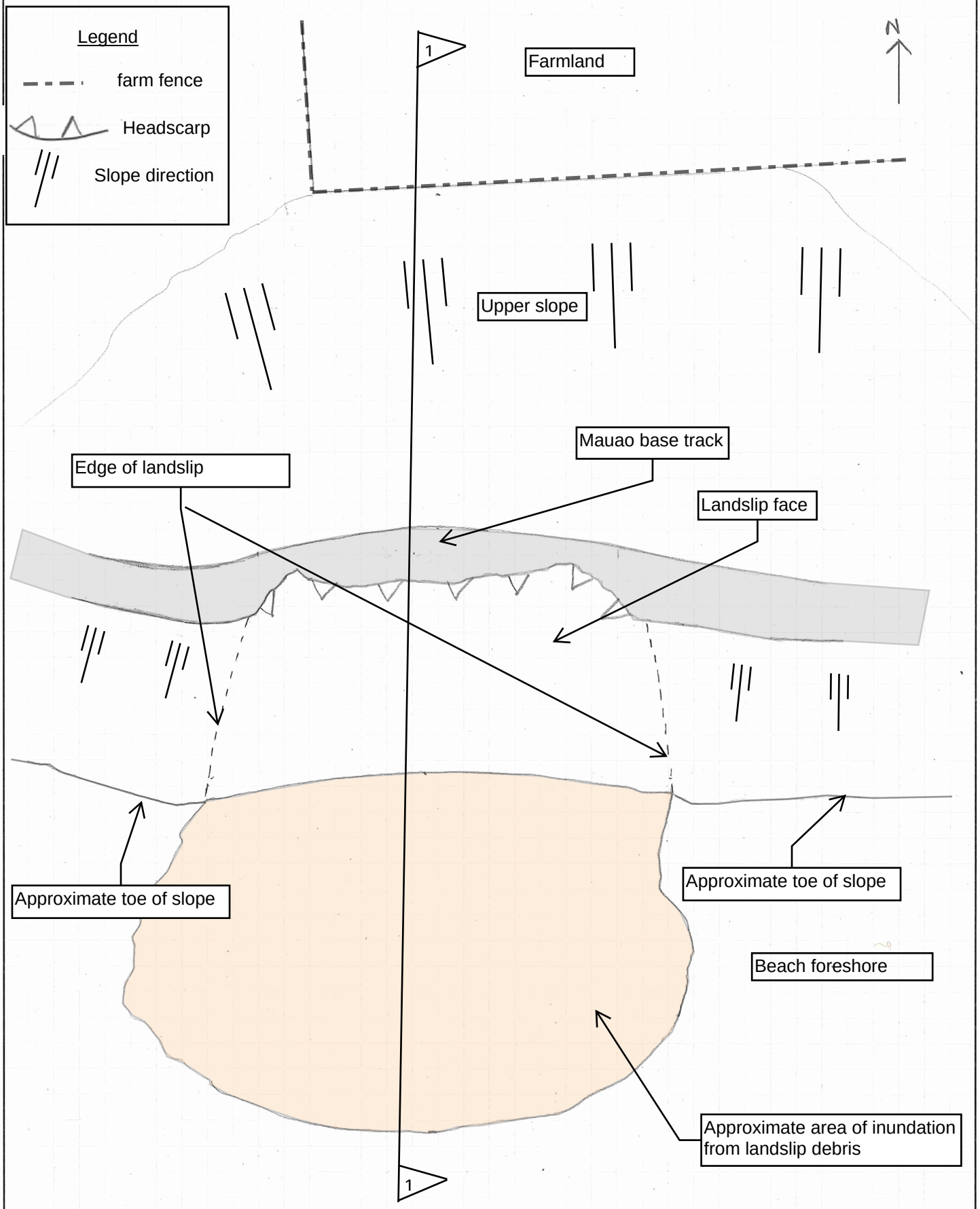
Project:

Description: Mauao Base Track Repair Options Assessment
Job No: 1002819

Computed: TACC	25/5/2017	Office:	
Checked:	20	Job No: 1002819	
Revised:	20	File:	
Checked:	20	Sheet No.	



Sketch 6 - Site Plan

0 5m 10m

Approx scale 1:200 at A4

Note: This Sketch is approximate only and based on a laser range finder survey

Mauao Base Track Repair Options Assessment
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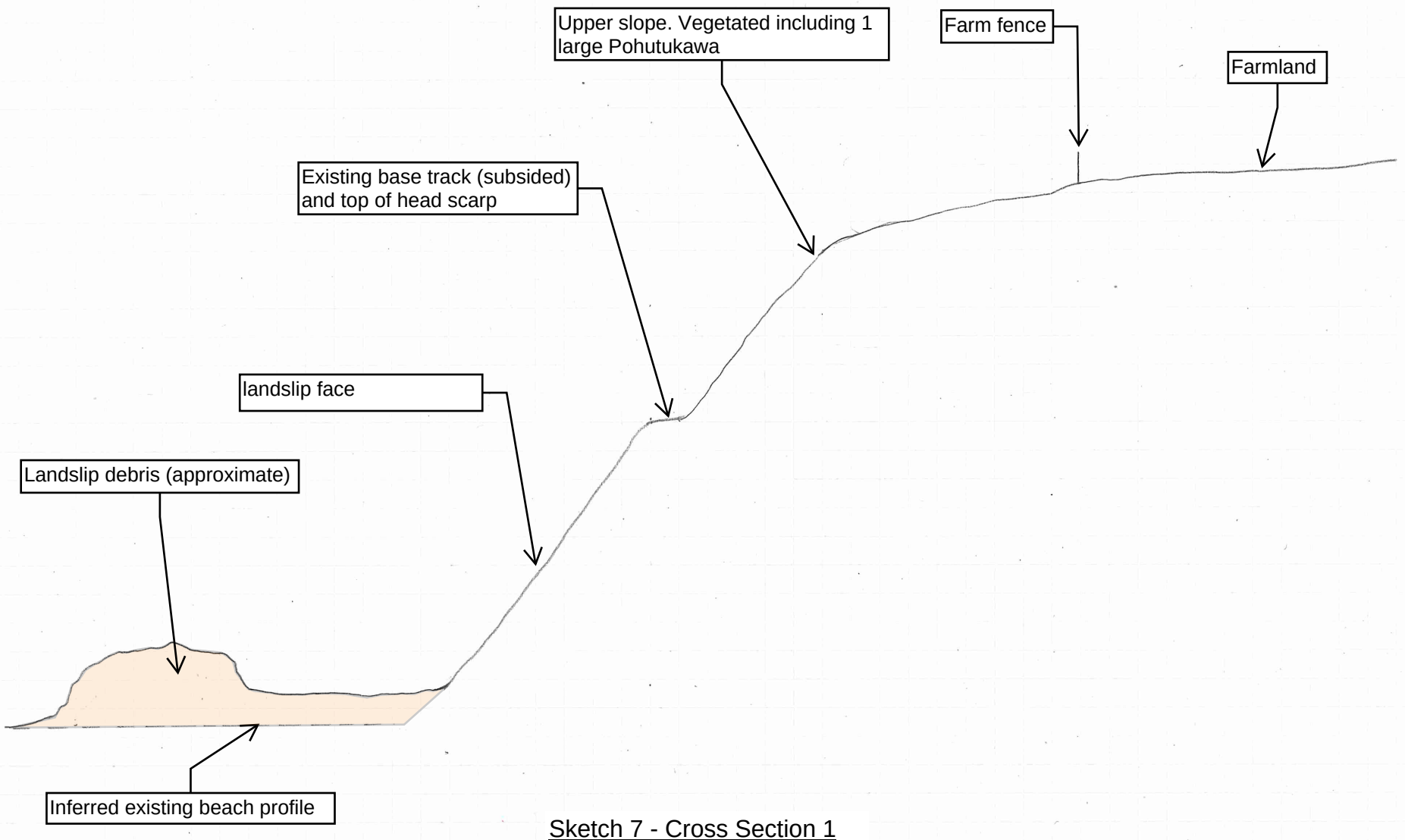

Sketch 7 - Cross Section 1

Note: This Sketch is approximate only and based on a laser range finder survey

0 5m 10m

Approx scale 1:200 at A4

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Description: Cross section

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