Project Number: 2-9B497.00

Tauranga City Council – Mauao Base Track

High Level Qualitative Slope Stability Risk Assessment

16 November 2022

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1 Introduction and Project Background

The Mauao base track is one of New Zealand's most popular scenic walks and is of special interest to residents of Tauranga and the wider Bay of Plenty. The approximately 2.5km track wraps around the base of Mauao (Mt Maunganui) and is accessed from the western end at Pilot Bay and the eastern end at the Mt Maunganui main beach.

There has been a history of stability problems on Mauao particularly those associated with the steep colluvial slopes which drape over the underlying volcanic rock and particularly, cuts into this soil, usually associated with high rainfall events. There has also been extensive rockfalls associated with the steep bluffs below the summit.

Most recently, a significant 14m wide landslide occurred on the base track approximately 620m south west from the Pilot Bay carpark following several days of sustained rainfall in April 2017 during the passing of ex-tropical cyclone Debbie. The landslide resulted in the closure of the base track through this section with temporary access via a set of stairs around the slip until the track was repaired and reopened in March 2020.

WSP New Zealand Ltd (WSP) has been engaged by Tauranga City Council (TCC) to undertake a high-level risk assessment of the slope stability of the Mauao Base Track. The purpose of this assessment is to identify the slope stability hazards affecting the track, and determine risk ratings to assess the level of risk posed to the track from slope stability issues which include underslips and overslips. It must be noted that the assessment is based on site observations from a walkover and desktop study only and no detailed slope stability analyses have been undertaken which would be required to determine the factor of safety of the slopes.

For this assessment we have developed qualitative risk matrices to access risk based on the method given by the Australian Geomechanics Society (AGS 2007c) publication for landslide risk management. This is explained in greater detail in Section 3 below.

The scope of this assessment includes the following:

- An initial desktop study, including geomorphological mapping from historic aerial photography and contours, and review of previous reports;
- A site walkover, to refine the geomorphological map, and identify features that contribute to slope instability risk around the base track;
- Creation of a landslide risk map for the base track, with different zones used to identify different levels of risk from slope instability which could have an impact on the track.
- A report, summarising the above works, and including brief recommendations for risk mitigation, management or reduction.

2 Desktop Study

2.1 Geological and Geomorphic Setting

Mauao is a flat topped steep sided rhyolitic lava dome reaching 252m (Hall, 1994). It was formed during the lower Pliocene, approximately 2.35 million years before present (Briggs et al., 2005). Mauao is part of the Minden Rhyolite Subgroup, which includes flow banded rhyolite - dacite lavas. The rhyolite rock when weathered is dense and very strong to extremely strong but weathers to a very weak rock or firm clay (Richards, 1999).

The lava dome has been overlain by successions of ashes from Taupo and Coromandel Volcanic Zones. Hall (1994) notes that the Pahoia Tephra's outcrop along the base of Mauao. Altered tephra deposits such as Pahoia Tephra are highly susceptible to land sliding, especially where the deposits are highly sensitive which is commonly associated with the clay mineral Halloysite (Kluger et al., 2017).

An alluvial terrace with composition similar to Matua Subgroup sediments of the Tauranga Group have been observed overlying ignimbrites at the base of Mauao on the south side by WSP. The ignimbrite deposits at the base of Mauao are non- welded very weak rock to firm clay which is inferred to be weathered Te Puna Ignimbrite deposits.

The lower slopes of Mauao are comprised of colluvium and are studded with landslip scarps. Boulders are commonly embedded into the colluvium and ashes. As recorded in Martin & Brideau (2014), debris flows are likely to reactivate during heavy rainfall within these landslide scarps.

The following figures depict the variable geology encountered along the base track.

Figure 1. Location of 2017 landslide which closed the base track prior to slope stabilisation works. Buff brown ignimbrite resembling Te Puna Ignimbrite is overlain by possible Matua subgroup deposits with thin layers (pale brown/white layers near crest) of Pahoia Tephras.

Figure 2: Weathered ignimbrite exposure at the base of the track comprised of ash and pumice lapilli layers.

Figure 3: Moderately welded ignimbrite with rhyolite boulders incorporated into matrix.

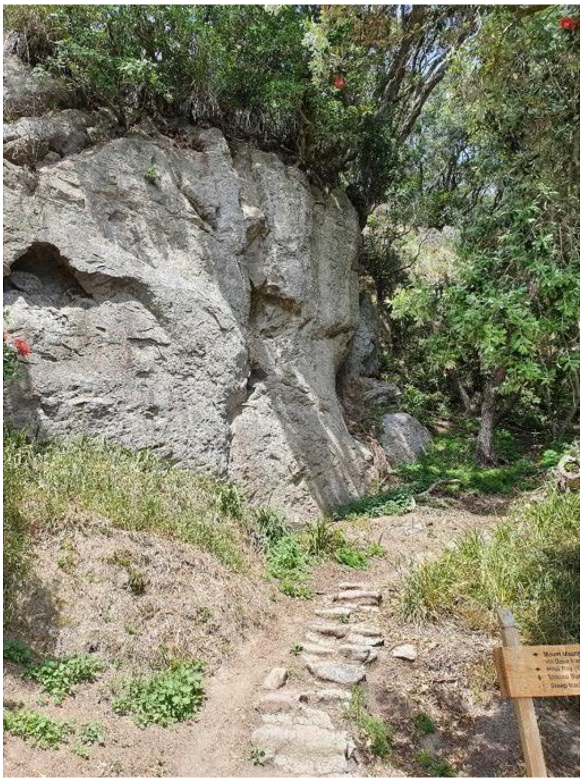

Figure 4: Minden rhyolite flow outcrop with subvertical joint. The Minden rhyolite bluffs are associated with rockfall where there are common cooling joints that can intersect creating release planes.

Figure 5: Landslide scar(overslip) in colluvium deposits located above base track on the western side.

2.2 Geomorphological Map

A high-level geomorphological map was created using the following data sources in conjunction with our field mapping undertaken on site:

- TCC 1m DEM (NZVD16) slope contours.
- 2020 Aerial photography.
- Previous aerial mapping by Martin & Brideau (2014).

Geomorphic features including ridges, landslip scarps, valleys and additional features such as retaining walls were plotted on the map. This map was used as a reference while completing the site walkover. We have also plotted additional information from our site observations and aerial photography. The geomorphological map is located in **Appendix B.**

Additional maps have been produced to summarise the locations of inspection sites during the walkover and risk scores determined from the assessment was used to create a risk map (Figure 7).

2.3 Related Work

As part of our desktop review for this project we reviewed the following reports:

2.3.1 Mauao Stability Assessment - [redacted]

[redacted] presented a study on the stability of the slopes of Mauao. The report considers the stability of the slopes and the risks they posed to the public using the track network. The report included a summary of the geology and geomorphology, identification of different failure mechanisms, including stability analysis of rock cliffs, and a risk analysis, to both the public using the track networks and the camping ground and hot pools on the eastern flanks of Mauao. The key conclusions relevant to this report included:

- The frequency of rockfalls from the summit cliffs was low at the time the report was prepared with no rockfall incidents to date.
- With the noted frequency of rockfall, the risk of accidents to users of Mauao was considered to be at an acceptable level.
- There are a number of failures in the frontal lobes of the landslides along the Base Track which indicate that these are prone to failure when over steepened.
- The slopes are comprised of debris/colluvium and are very sensitive to small changes at the slope toe;
- Over steepened debris fans that outcrop adjacent the base track are prone to failure;
- Some caravan sites in the campground were situated next to steep slopes - these should be removed due to landslide or rockfall risk;
- During heavy rain, debris flows can reactivate and fail at high speeds;

For further detail please refer to the original report.

2.3.2 Spatio-temporal distribution of mass movements on Mount Maunganui, New Zealand - Zach Martin and Marc-André Brideau, 2014

This conference paper reviewed the spatial distribution of landslips by assessing aerial photographs from 1943 to 2011. The study identified several types of mass movements on Mauao, including rotational slides, debris flows, debris avalanches and rock falls. Landslides were spatially concentrated on lower slopes with little to no vegetation present, where there was high sediment availability (i.e., colluvium / debris is present), and slope angles were between 18 - 32°.

In particular, there was a concentration of shallow circular slides on the south western and north eastern sides of Mauao; these made up the majority of slides over the 68-year analysis period. The paper considered intrinsic factors that influenced stability to be land use change, lack of vegetation cover and extrinsic factors to be heavy rainfall events.

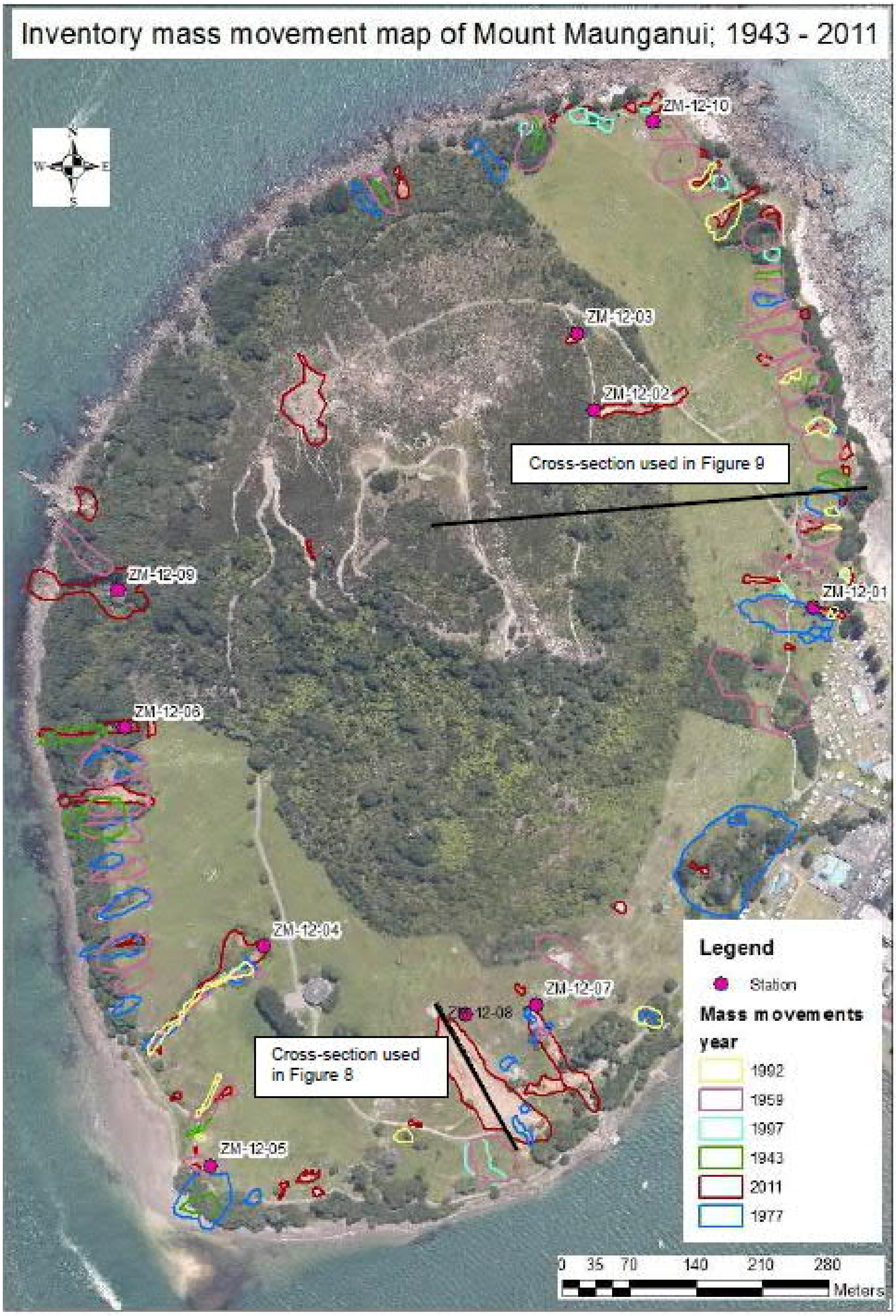

Figure 6: Mass movement (Landslide) map extracted from Brideau & Martin (2014).

3 Site Walkover

A site walkover was completed by two WSP engineering geologists on Monday 7 December 2020 with additional inspections in 2022. The geomorphic map created during the desktop study was used as a guide. Features and observations were added to this map during the site inspection.

Following the field visit, the geomorphic map was created using ArcMap V10.7. Locations were determined by live tracking on Google Maps and matching this up to the geomorphic map. Photos of each site were taken along with notes and observations.

The site data was compiled to inform the risk assessment (Section 5). This information informed the evaluated risk level determined from the risk matrix, which is described in Section 4 below.

4 Geotechnical Risk Assessment

4.1 Methodology

For this assessment we have assessed the risk of instability along the base track route by using a qualitative risk matrix. Qualitative assessments are typically used where there is insufficient information to make quantitative calculations. Our risk assessment matrices have been based on the Australian Geomechanics Society (AGS) property loss risk matrices (2007); however, we have adapted the descriptions to better relate to damage to the base track.

We have not undertaken a rockfall risk assessment or assessed the loss of life risk due to rockfall or landslide debris which was previously assessed by Laurie Richards in 1999.

However, we note that visitor numbers have largely increased since the time of the assessment and we recommend an updated assessment is undertaken in due course which could include mapping of rockfall sources on Mauao.

The following factors were considered when undertaking our assessment of risk to the track from slope instability issues:

- Slope gradients in vicinity of track,
- Geology of the material beneath and above the base track.
- Evidence or records of historic instability at the site, including underslips and overslips.
- Geomorphological features indicating instability such as tension cracks or hummocky topography and debris.
- Groundwater seepage or overland flow paths.
- Track width. A narrower track width means that it is less resilient to underslips and more expensive and time consuming to reinstate. A wider track gives more buffer room in the event of a slip, meaning the base track may remain open during track repairs.
- If any retaining walls were present and their condition.

4.2 Risk Assessment Criteria

The risk assessment score is based on the qualitative assessment of the likelihood of slope failure above or below the track and the consequence of the failure occurring which can affect the functionality of the track. The measure of likelihood of slope failure ranges from almost certain, i.e., the event is on-going, or expected to occur during the next year (100% annual probability) to rare where the event could only occur under extreme conditions with a very low annual probability (0.2%).

The measure of consequence ranges from insignificant (e.g., an overslip that could be cleared in less than a day) to catastrophic (e.g., underslip resulting in long term (years) closure of the track).

The overall score is based on the combination of likelihood and consequence of failure which is assessed on a risk matrix with the risk ranging from very low through to very high.

The risk level can then be used to implement actions for risk management of the route. I.e. if the risk level is very low then the risk is acceptable and can be managed by normal maintenance procedures whereas if the risk is high then investigation, planning and implementation of risk reduction measures should be considered to reduce the risk to low or to a level deemed acceptable to TCC. The risk matrices used for this assessment are provided below.

Table 1: Measures of Likelihood

Level	Descriptor	Description	Annual Probability of Occurrence
A	Almost certain	The event is on-going, or expected to occur during the next year	100%
B	Very likely	The event is expected to occur.	20% to 100%
C	Likely	The event could occur under somewhat adverse conditions.	5% to 20%
D	Possible	The event is expected to occur under adverse - very adverse conditions.	1% to 5%
E	Unlikely	The event is expected to occur under high to extreme conditions.	0.2 to 1%
F	Rare	The event could occur under extreme conditions	Less than 0.2%

Table 2: Measures of Consequence

Level	Descriptor	Example Descriptions (AGS, 2007c)	Example Descriptions (Damage to Base Track)
1	Catastrophic	Structure(s) completely destroyed and/or large-scale damage requiring major engineering works for stabilisation	Slip resulting in closure of the track for extended length of time (years). Major and very expensive remediation work.
2	Major	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works.	Slip causes track to be closed for months to a year. Major and expensive remediation work.
3	Medium	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works	Slips causing damage to track / track closure for up to 1 month.
4	Minor	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	Slips causing damage to track / track closure for up to 1 week.
5	Insignificant	Little damage.	Debris can be cleared in less than 1 day.

Table 3: Risk Matrix

Likelihood	Consequence				
	Catastrophic	Major	Medium	Minor	Insignificant
Almost certain	VH	VH	VH	H	L
Very Likely	VH	VH	H	M	L
Likely	VH	H	M	M	VL
Possible	H	M	L	L	VL
Unlikely	M	L	L	VL	VL
Rare	L	VL	VL	VL	VL

Table 4: Risk Level Implications

Risk level		Implications for risk management
VH	Very High	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive to repair.
H	High	Detailed investigation, planning and implementation of treatment options required to reduce risk to Low.
M	Medium	May be tolerable in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to acceptable levels. Treatment options to reduce to acceptable risk should be implemented as soon as practicable.
L	Low	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required
VL	Very Low	Acceptable. Manage by normal maintenance procedures.

Notes: The risk matrices above are based on those given by AGS 2007c. "Practice Note Guidelines for Landslide Risk Management

5 Summary of Assessment

The results of the risk assessment scores for all sites are summarised in Table 1 with the assessed risk rating scores shown on Figure 7 (Risk Rating Map).

Table 5: Assessed Risk Rating

Site No. Reference	Comments	Assessed Risk Rating
1	Current vehicle access to jetty, greater than 6m width, slope planted out with grasses. Toe protected with rock rip rap. Likelihood of overslip & underslip considered to be possible in very adverse conditions.	Low
2		Low
3		Low
4	Large car park area with concrete mass block wall upslope. Low likelihood of overslip and underslip.	Very Low
5	Underslip likely under moderate to severe conditions. Narrow track width would make reinstatement more difficult and require closure during repairs.	Medium
6		Medium
7	Underslip considered to be rare as the slope is supported by an engineered gabion wall. Based on our observations, the wall/ slope performed well during the 2017 storm event.	Low
8	Underslip and overslip possible under adverse to very adverse conditions. Narrow track width would make reinstatement more difficult and require closure during repairs.	Medium
9		Medium
10	Track width wide at this location, likelihood of underslips low.	Very Low
11	Site located close to major landslip that occurred in 2017. Steep slope. Track width narrow and underslip expected under adverse to very adverse conditions. Ashes exposed on cliff face.	High
12		High

13	Site stabilised with soil nails and drainage. Possible overslips or tree failure still possible.	medium
13b		Low - medium
14	Close to major landslip that occurred in 2017. Steep slope. Track width narrow and underslip expected under adverse to very adverse conditions. Landslides occurred above the site in 1943, 1977.	High
15	Track width narrow and underslip expected under adverse to very adverse conditions. Landslides above track in 1943, 1977.	High
16	Track width narrow and underslip and overslip possible under adverse to very adverse conditions. Landslides in vicinity of site above track in 1943, 2011, 1992.	High
17	Overslip likely under moderate to severe conditions. Underslip possible.	Medium
18	Underslip and overslip possible with medium consequence to track. Annual probability of occurrence anticipated to by 5% with damage causing closure for up to a month.	Low
19	Non-engineered stone wall in good condition. Rock bolts have been installed retrospectively with some drainage installed.	Low
20	Small timber pole retaining wall installed. Overslip possible and underslip unlikely with medium consequence to track.	Low
21	Non engineered stone wall above and below track. Wall in fair condition, bulging slightly outward. Overslip and underslip likely with medium consequence.	Medium
22	Past underslip noted in track. Underslip and overslip likely with medium consequence.	Medium
23	Underslip and overslip likely with medium consequence.	Medium
24	Underslip and overslip likely with medium consequence.	Medium
25	Underslip and overslip likely to possible under somewhat adverse conditions with medium to major consequences leading to track being closed for months to a year. Track exposed to coastal erosion, some portions of track overhanging.	Medium to high
26		Medium to high
27		Medium to high

28	Stone retaining wall in good condition supporting track. Underslip and overslip possible with medium consequence.	Low
29	Underslip and overslip possible with medium to major consequence. Weakly welded ignimbrite noted above and below track.	Medium
30		Medium
31		Medium
32	Underslip possible and overslip likely. Consequence assessed as medium. A debris flow occurred in 2011 due to sustained heavy rainfall.	Medium
33	Underslip possible and overslip likely. Consequence minor to medium.	Low to medium
34	Underslip unlikely and overslip possible. Coastal erosion possible. Medium consequence as overslip could be cleared.	Low
35		Low
36		Low
37		Low
38		Low
39		Low
40		Low
41	Underslip and overslip likely under somewhat adverse conditions with a medium to major consequence to track. Mass movements have occurred along north to north eastern portion of base track in 1943, 1959 and 1977.	Medium to high
42		Medium to high
43	Underslip and overslip likely with estimated 5 to 20% annual probability of occurrence. Expected to medium to major to repair.	Medium to high
44		Medium to high
45	Underslip possible and overslip likely under adverse conditions. Consequence to track rated as medium.	Low to medium
46		Medium
47		Medium
48	Underslips and overslips possible under moderate to very adverse conditions. Consequence to track rated as medium. Landslides noted above the site in 1943, 1959 and 1977.	Low
49		Low
50	Underslips and overslips possible with slips closure for up to a month.	Low
51	Underslips and overslips likely under somewhat adverse conditions. Consequence to track rated as	Medium to high
52		Medium to high

53	medium to major. Landslides in 1943, 1959 and 1977.	Medium to high
54		Medium to high
55		Medium to high

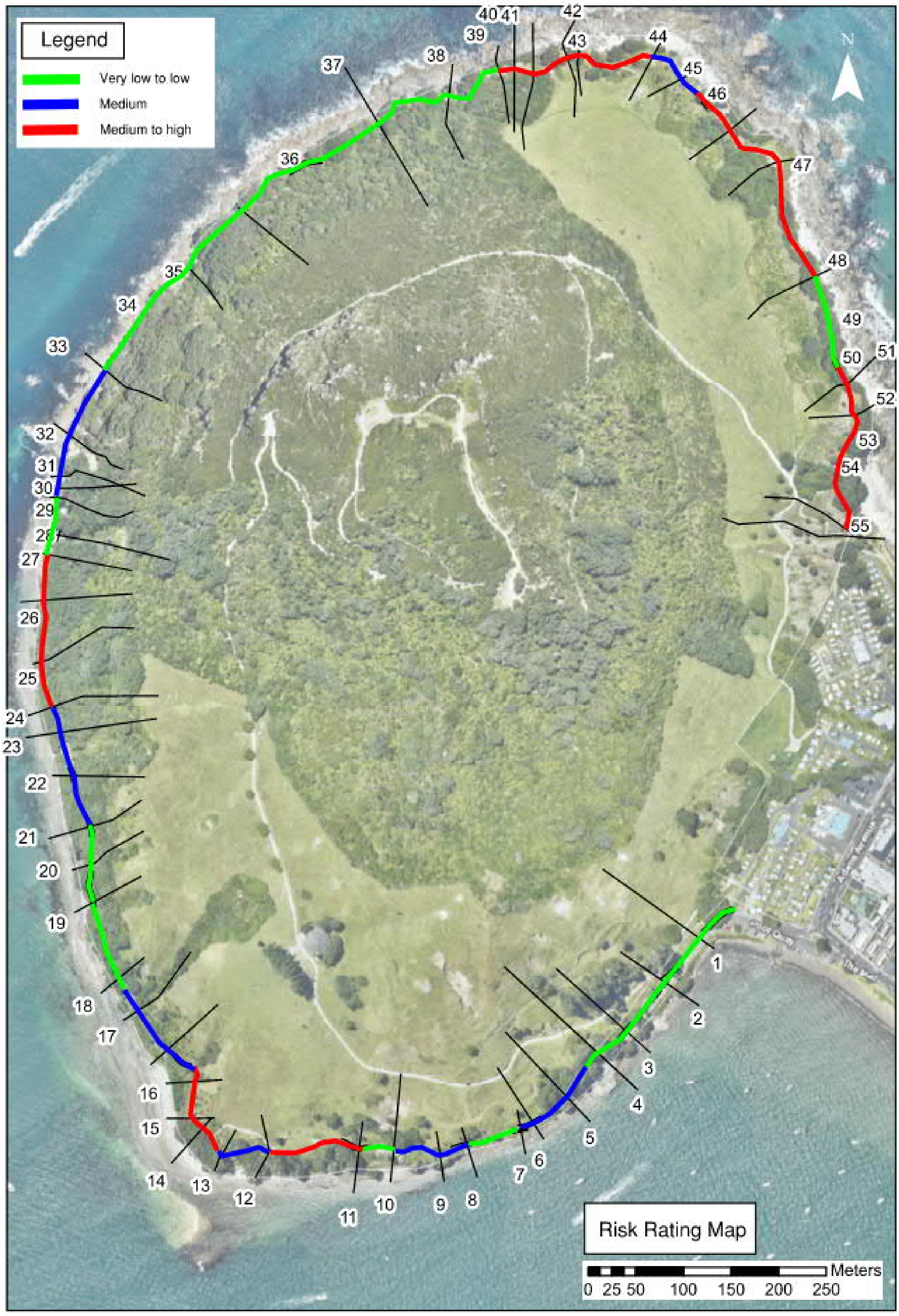

Figure 7: Risk Rating Map

6 Recommendations and Further Work

Based on our assessment, we recommend undertaking further works to manage or reduce the risk to the base track generally based on the risk implications provided above in table 4 above.

This could involve planning of further investigations and planning of risk mitigation options where the risk is considered to be high. This could involve undertaking hand auger borehole investigations and quantitative stability analyses to determine the current stability of high-risk areas. Treatment options could then be implemented to improve the stability of the site if unacceptable factors of safety are obtained. Treatment options could include, drainage improvements, ground retention, stabilisation, or other mitigation options. Options assessments could be undertaken to determine the most cost-effective risk mitigation solution, which could be undertaken in consultation with TCC and the trustees of Mauao.

For low-risk sites, we would recommend continued maintenance procedures, e.g. maintenance of the track condition, drains and swales. For medium risk sites we recommend these are monitored and if practical then works such as drainage improvements in conjunction with regular monitoring may be appropriate.

We would also recommend that the findings of this report are discussed with TCC and a risk management plan is developed for the base track which could include a periodic walkover inspection to determine if any immediate actions are required or sites identified that require attention. Inspections could include the following:

- Inspections to determine the condition of site drainage, including culverts, swales and horizontally bored drains.
- Periodic inspections of cut slopes, noting for signs of erosion or slippage including general track condition.
- We would recommend inspections are undertaken once every three months during the summer months and once a month during winter months or following any high rainfall events (e.g., > 50mm in 24 hours) or following a seismic event or at the request of Tauranga City Council.
- A brief site visit note, or email could be provided to Council following our inspections. Additionally, a GIS monitoring database could be established which could record observations and historic failures. This could be extended to the other tracks on Mauao to form a comprehensive database to assist with asset and risk management.

We would also recommend undertaking an updated quantitative risk assessment to determine the level of risk to users of the track from rockfall or debris slides. This assessment could also involve mapping hazards such as sources of rockfall and other hazards which could be added to the geomorphic map or risk register.

7 Limitations

This report ('Report') has been prepared by WSP exclusively for [Tauranga City Council] ('Client') in relation to [a slope stability appraisal] ('Purpose') and in accordance with the [Offer of service referenced 2-9b497.PP dated 30 October 2020]. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

8 References

Australian Geomechanics Society. 2007. Landslide Risk Management. Australian Geomechanics, Vol. 42, No.1 March 2007.

Briggs RM et al. (1996). Geology of the Tauranga Area. Occasional Report No.22. Department of Earth Sciences, University of Waikato.

Hall GJ (1994). Volcanic geology of the South-eastern Tauranga basin, New Zealand. Master of Science in Earth Sciences thesis, University of Waikato.

Kluger M et al. (2017). A new attraction-detachment model for explaining flow sliding in clay-rich tephras. Geology 45(pp: 131-134).

Martin & Brideau (2014). Spatio-temporal distribution of mass movements on Mount Maunganui, New Zealand. 6th Canadian Geohazards Conference, 2014 Kingston Ontario.

Appendix A

Risk Matrices

MEASURES OF LIKELIHOOD

Level	Descriptor	Description	Annual Probability of Occurrence
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MEASURES OF CONSEQUENCE

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RISK MATRIX

Likelihood	Consequence				
	Catastrophic	Major	Medium	Minor	Insignificant
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Likely	VH	H	M	M	VL
Possible	H	M	L	L	VL
Unlikely	M	L	L	VL	VL
Rare	L	VL	VL	VL	VL

RISK LEVEL IMPLICATIONS

Risk level		Implications for risk management
VH	Very High	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive to repair.
H	High	Detailed investigation, planning and implementation of treatment options required to reduce risk to Low.
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VL	Very Low	Acceptable. Manage by normal maintenance procedures.

Notes: The risk matrices above are based on those given by AGS 2007c. "Practice Note Guidelines for Landslide Risk Management

Appendix B

Drawings


A
B
C
1
2
3
N
Adams Avenue
Pilot Quay
The Mall
Legend
Ridge
Valley
Underslip
Break in slope
Overslip
Geomorphological Map
Meters
0 25 50 100 150 200 250


N
Site Location Map
Meters
0 25 50 100 150 200 250
Pilot Quay
The Mall
Adams Avenue
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3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
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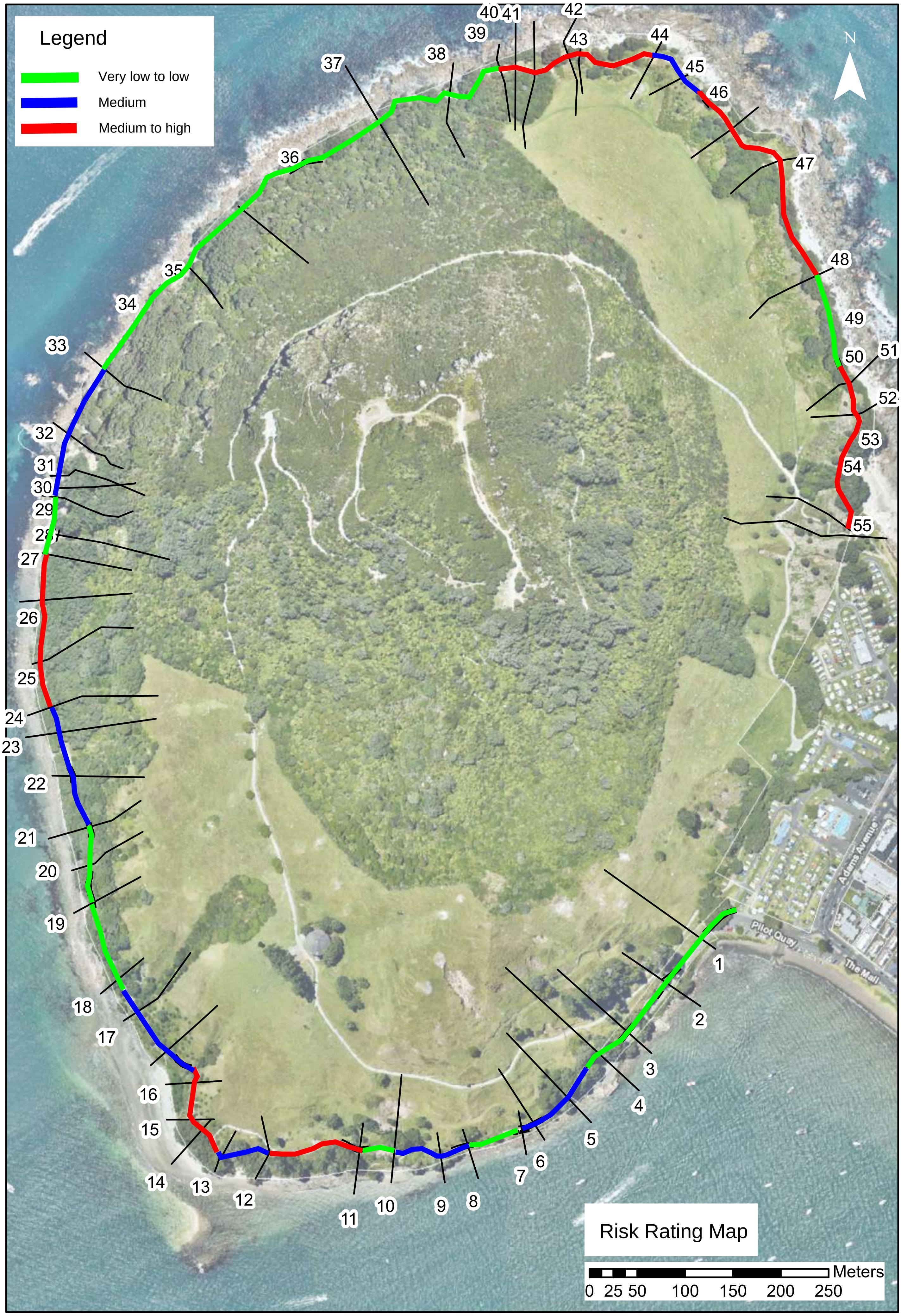

Legend
Very low to low
Medium
Medium to high
N
Risk Rating Map
Meters
0 25 50 100 150 200 250
Pilot Quay
The Mall
Adams Avenue
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

Appendix C
Site Photos

Site Photographic Record - Quadrant C3

Site 1, Photograph 1

Site 1. Photograph 2

	Tauranga City Council	**Photograph 1 & 2**
	Project No: 2-9B497.00	

Mauao Base Track Risk Assessment

Site 1. Photograph 3

Site 2. Photograph 4

WSP	**Tauranga City Council**	**Photograph 3 & 4**
	Project No: 2-9B497.00	
Mauao Base Track Risk Assessment		

Site 3. Photograph 5

Site 4. Photograph 6

	Tauranga City Council	**Photograph 5 & 6**
	Project No: 2-9B497.00	
Mauao Base Track Risk Assessment		

Site 4. Photograph 7

Site 4. Photograph 8

Site Photographic Record

Site 5, Photograph 9

Site 5. Photograph 10

	Tauranga City Council	Photograph 9 & 10
	Project No: 2-9B497.00	

Mauao Base Track Risk Assessment

Site 6. Photograph 11

Site 7. Photograph 12

Site 8. Photograph 13

Site 9. Photograph 14

Site 9. Photograph 15

Site 10. Photograph 16

	Tauranga City Council	**Photograph 15 & 16**
	Project No: 2-9B497.00	

Mauao Base Track Risk Assessment

Site 10. Photograph 17

Site 10. Photograph 18

	Tauranga City Council	Photograph 17 & 18
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Site 11. Photograph 19

Site 11. Photograph 20

	Tauranga City Council	**Photograph 19 & 20**
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Site 12. Photograph 21

Site 12. Photograph 22

Site 13. Photograph 23

Site 13b, Photograph 24

	Tauranga City Council	Photograph 23 & 24
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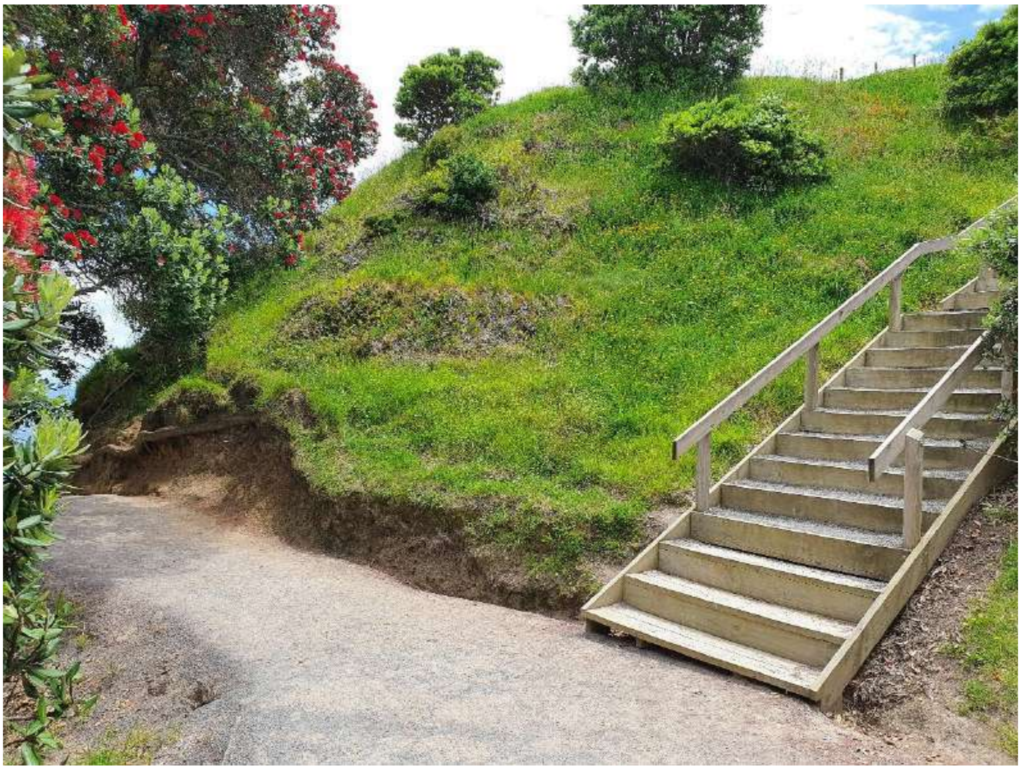
Mauao Base Track Risk Assessment		



Site 14. Photograph 25

Site 14. Photograph 26

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Mauao Base Track Risk Assessment

Site 15. Photograph 27

Site 15. Photograph 28

wsp	**Tauranga City Council**	**Photograph 27 & 28**
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Site 16. Photograph 29

Site 16. Photograph 30

	Tauranga City Council	**Photograph 29 & 30**
	Project No: 2-9B497.00	

Site 16. Photograph 31

Site 16. Photograph 32

	Tauranga City Council	**Photograph 31 & 32**
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Site 16. Photograph 33

Site 16. Photograph 34

	Tauranga City Council	**Photograph 33 & 34**
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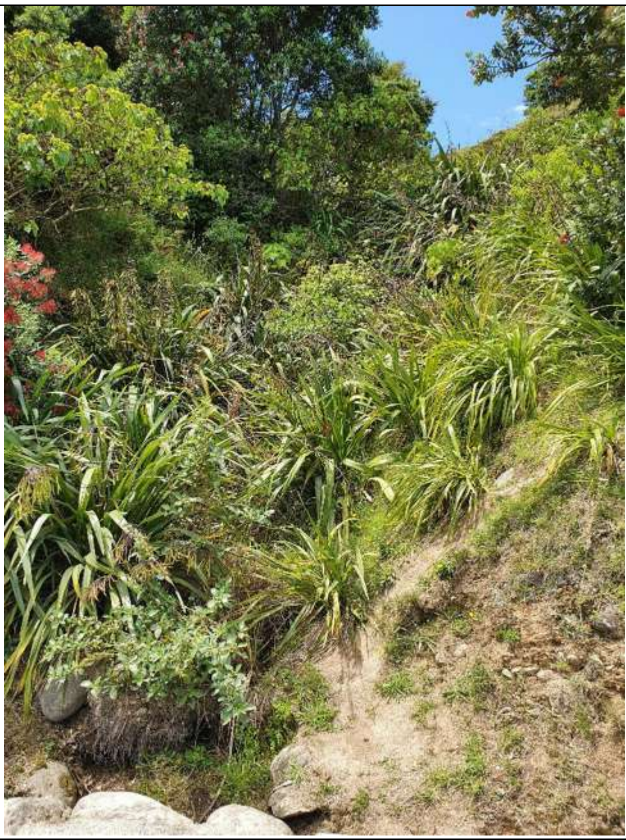

Site 17. Photograph 35

Site 17. Photograph 36

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Site 17. Photograph 37

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Site 18. Photograph 38

Site 18. Photograph 39

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Site 18. Photograph 40

Site 18. Photograph 41

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Site 19. Photograph 42

Site 19. Photograph 43

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Site 19. Photograph 44

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Site 20. Photograph 46

Site 20. Photograph 47

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Site 21. Photograph 48

Site 21. Photograph 49

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Site 22. Photograph 50

Site 22. Photograph 51

	Tauranga City Council	**Photograph 50 & 51**
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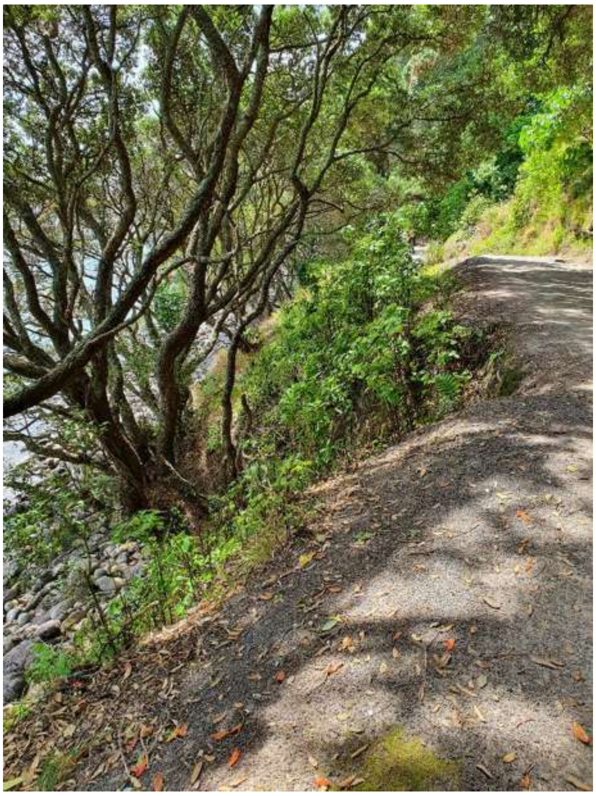
Site 22. Photograph 52



Site 22. Photograph 53

wsp	Tauranga City Council	Photograph 52 & 53
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Site 23. Photograph 54

Site 23. Photograph 55

wsp	**Tauranga City Council**	**Photograph 54 & 55**
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Site 25. Photograph 56

Site 25. Photograph 57

wsp	**Tauranga City Council**	**Photograph 56 & 57**
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Site 25. Photograph 58

Site 25. Photograph 59

Site 26. Photograph 60

Site 27. Photograph 61

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Site 28. Photograph 62

Site 29. Photograph 63

wsp	**Tauranga City Council**	**Photograph 62 & 63**
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Site 29. Photograph 64

Site 29. Photograph 65

wsp	Tauranga City Council	Photograph 64 & 65
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Site 30. Photograph 66

Site 30. Photograph 67

wsp	Tauranga City Council	Photograph 66 & 67
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Site 31. Photograph 68

Site 31. Photograph 69

wsp	**Tauranga City Council**	**Photograph 68 & 69**
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Site 32. Photograph 70

Site 32. Photograph 71

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Site 32. Photograph 72

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Site 32. Photograph 74

Site 33. Photograph 75

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Site 33. Photograph 76

Site 34. Photograph 77

	Tauranga City Council	**Photograph 76 & 77**
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Site 34. Photograph 78

Site 34. Photograph 79

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Site 34. Photograph 80

Site 35. Photograph 81

wsp	**Tauranga City Council**	**Photograph 80 & 81**
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Site 36. Photograph 82

Site 37. Photograph 83

wsp	**Tauranga City Council**	**Photograph 82 & 83**
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Site 38. Photograph 84

wsp	Tauranga City Council	Photograph 84
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Site 39. Photograph 85

Site 40. Photograph 86

Site 41. Photograph 87

Site 41. Photograph 88

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Site 42. Photograph 89

Site 42. Photograph 90

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Site 43. Photograph 91

Site 43. Photograph 92

Site 44. Photograph 93

Site 44. Photograph 94

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Site 44. Photograph 95

Site 44. Photograph 96

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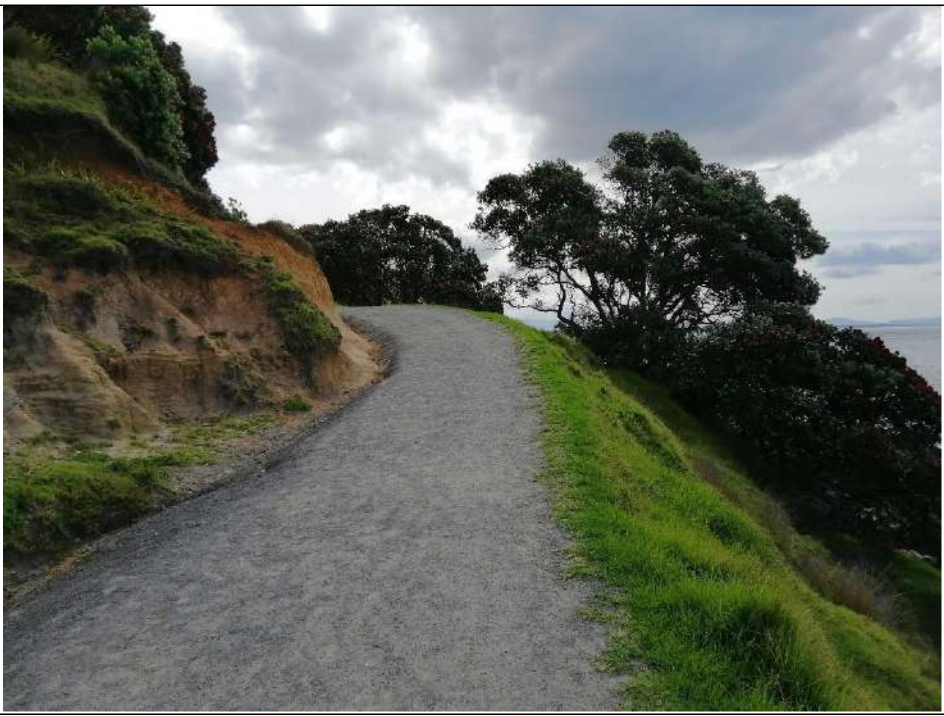

Site 44. Photograph 97

Site 44. Photograph 98

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Site 45. Photograph 99

Site 46. Photograph 100

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Site 47. Photograph 101

Site 48. Photograph 102

wsp	**Tauranga City Council**	**Photograph 101 & 102**
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Site 48. Photograph 103

Site 48. Photograph 104

	Tauranga City Council	**Photograph 103 & 104**
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Site 49. Photograph 104

Site 49. Photograph 105

	Tauranga City Council	**Photograph 104 & 105**
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Site 50. Photograph 106

Site 51. Photograph 107

wsp	Tauranga City Council	Photograph 106 & 107
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Site 51. Photograph 108

Site 51. Photograph 109

wsp	**Tauranga City Council**	**Photograph 108 & 109**
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Site 52. Photograph 110

Site 52. Photograph 111

WSP	**Tauranga City Council**	**Photograph 110 & 111**
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Site 53. Photograph 112

Site 53. Photograph 113

	Tauranga City Council	**Photograph 112 & 113**
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Site 53. Photograph 114

Site 54. Photograph 115

	Tauranga City Council	Photograph 114 & 115
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Site 55. Photograph 116

Site 55. Photograph 117

	Tauranga City Council	**Photograph 116 & 117**
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Site 56. Photograph 118

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