

SITE STABILITY REVIEW

To	City of Hobart		
Report No.:	7436A (revision 1)	Date:	22 September 2020
Project:	Wellington Park	Job No.	7436
Attention:	Bree Hunter	Subject:	Mountain Bike Track Stability

1 Introduction

As outlined in the Request for Quotation dated 6 June 2020 issued by the City of Hobart (CoH), a review of the stability of three (3) proposed Mountain Bike Tracks in Wellington Park. The tracks are described as tracks 1, 12 and the Upper Luge. On 14 July 2020 CoH requested an additional track (1b) also be reviewed. The location of Track 1 & 1b is located in Area 1 and Track 12 & The Upper Luge are located in Area 2 as given in the figure below:

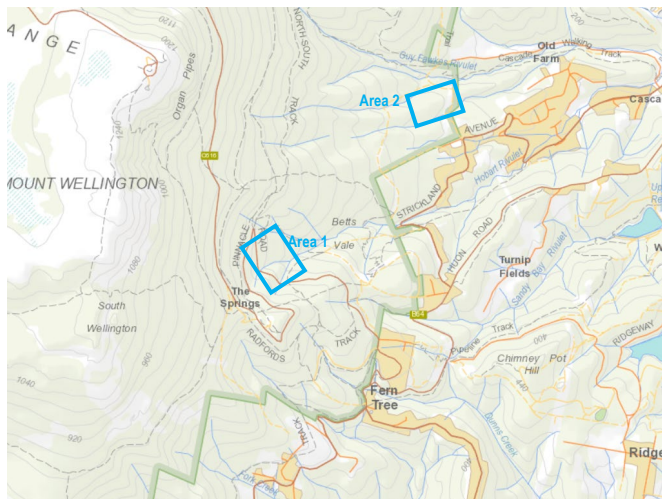


Table 1 - Locations of Study Areas

The purpose of the review as presented in the RFQ is:

Undertake a geotechnical investigation related to the potential impact pertaining to the development of the proposed tracks 1, 12 and the Upper Luge as per Issue A8.1 in the *Wellington Park Management Plan 2013* (Ch 8, p.147). Specifically, a report is required by a qualified geotechnical engineer to determine there is an acceptable risk of instability.

:

2 Investigations

2.1 Desktop Study

A desktop study of the 4 routes has been undertaken using available sources which are:

- a) Topographic maps - DPIPWE
- b) Historical aerial photograph, scale 1:12,772 (1967) - DPIPWE
- c) Mineral Resources inventory of landslides
- d) Mineral Resources Tasmania Shallow Slide & Susceptibility Mappings
- e) Hillshade mapping (DPIPWE)
- f) MRT Landslide Hazard Bands (MRT) **
- g) Geological Maps – Landforms

*** The hazard bands are simply an arbitrary "slope" threshold which is not based on any geological context or field mapping*

The referenced materials for tracks 1 & 1b are given in Appendix A

The referenced materials for tracks 12 & Upper Luge are given in Appendix B

The historical aerial photograph is reproduced in Appendix C.

2.2 Field Survey

A walkover near to the existing tracks within the 2 areas was undertaken in August 2020 by the writer. Note that both areas are covered by thick bush and the entire routes were not traversed, and the field study was a general confirmation of the conditions contained in the desk study. All salient locations were recorded by GPS, photographs & field notes. The photographs & descriptions of the field survey is provided in the Appendices D & E.

3 Assessment

The desktop review of the documents listed above for the area for tracks 1 & 1B and the area for tracks 12 & Upper Luge is presented below:

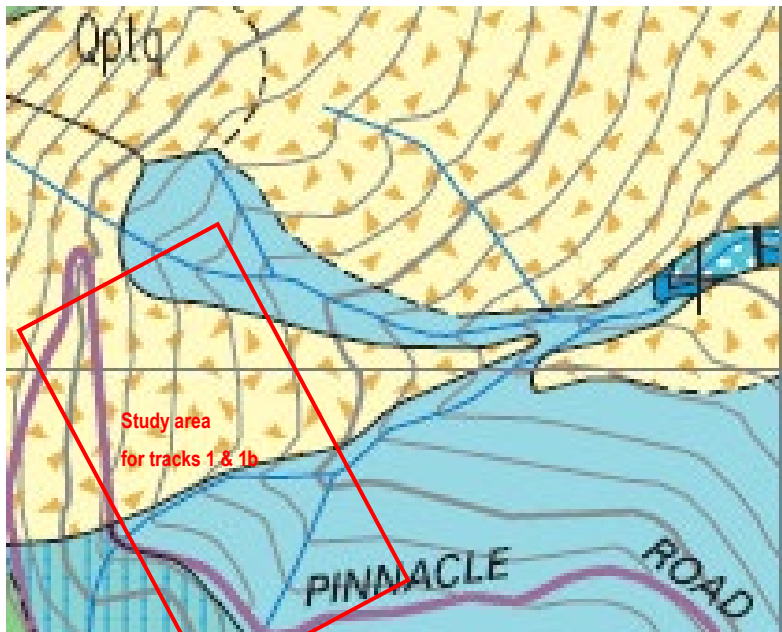
3.1 Tracks 1 & 1B

3.1.1 Area Description

Tracks 1 & 1B will be located in close proximity to Pinnacle Road between Shoobridge Bend and Woods track. As shown in the topography map, the tracks generally follow the contours of the hillside but traverse two creeks/streams. The aerial photograph from 1967 immediately after the bushfires shows the south eastern portion of the tracks area denuded of vegetation which is consistent with the recent site walkover showing smaller vertical trees with some undergrowth and sparse very large tree trunks.

3.1.2 Geology

An excerpt of the mapsheet of Hobart, scale 1:25,000, dated May 2006 produced by Mineral Resources Tasmania (MRT) is shown below.



Qpt	Talus and remobilised talus deposits (Qpt), talus consisting dominantly of dolerite boulders (Qptd), talus dominantly of Lower Parmeener Supergroup rocks and Jurassic dolerite (Qptdp), talus of dolerite with notable amounts of Upper Parmeener quartzose sandstone (Qptdq), talus dominantly Lower Parmeener rocks (Qptp), talus dominantly Upper Parmeener quartz sandstone (Qptq), talus consisting of dolerite and subordinate Upper Parmeener rocks (Qptup).
Pua	Generally unfossiliferous glaciomarine interbedded non-fissile and fissile siltstone and silty sandstone, with common bioturbation and lonestones, rare pebbly beds and fossiliferous beds; top beds of laminated grey to brown siltstone with thin beds of well sorted sandstone (Abels Bay Formation) (Pua), contact metamorphosed by Jurassic dolerite (Puam).

This mapping shows the northern area of the proposed tracks will traverse recent talus consisting of dolerite boulders and the southern portion traversing Permian age siltstone & sandstone and pebble beds (in the creeks). The site walkover confirms these general descriptions with outcropping siltstones visible in the creeks and O'Grady Falls. The talus is generally buried in transported soils and is best described as colluvium.

3.1.3 Landslides

The historical aerial photograph of 1967 does not visibly identify any landslide activity over the study area. The MRT landslide inventory and susceptibility maps (as per appendix) do not indicate any recorded landslides in the study area. The Hillshade map (The List) indicates minor slumping to the upper ridge above the first creek crossing. The brief walkover of the study area did not identify any past or potentially unstable areas with the exception of the Pinnacle Road embankment at Shoobridge Bend, and the down slope area corresponding with the hillshade slumping, where there is very steep fill and boulders downslope (see figure below).

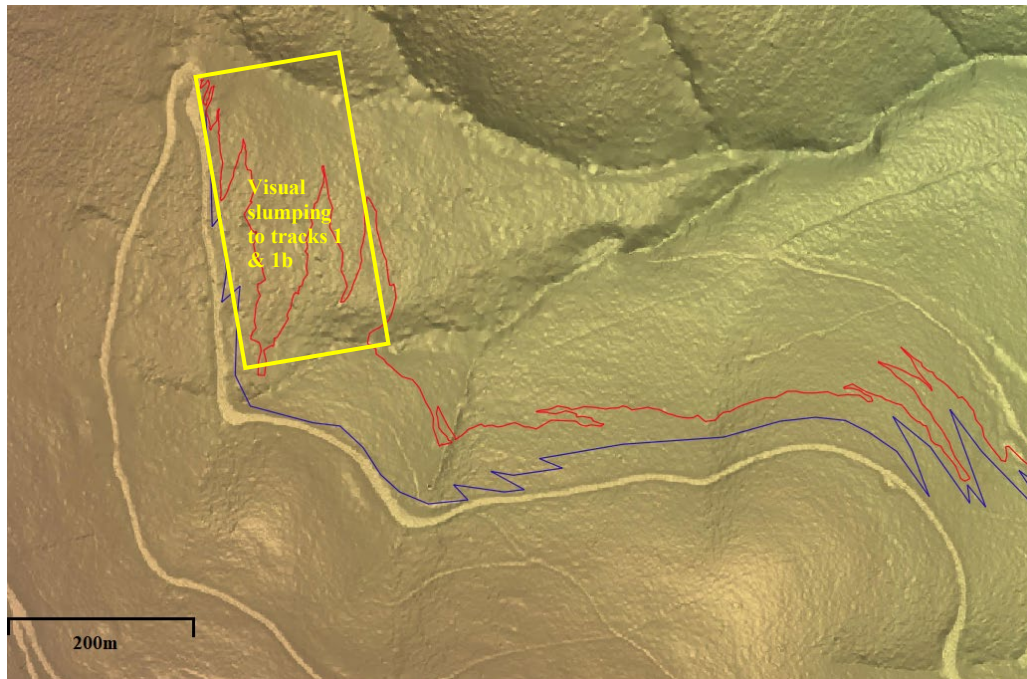


Figure 1 - Visual slumping for tracks 1 & 1b

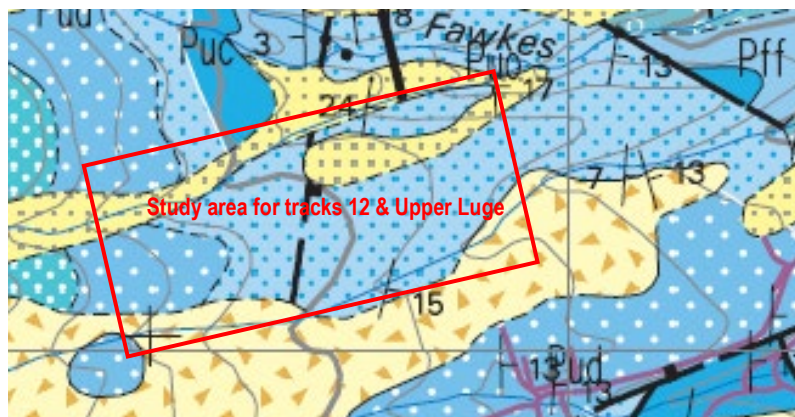
3.2 Tracks 12 & Upper Luge

3.2.1 Area Description

Tracks 12 & the Upper Luge will be located on a ridgeline with some minor areas extending down to the edge of a streams/creek. The ridgeline is characterised by scattered sandstone boulders & cobbles in a sand or clay matrix overlying competent bedrock. The aerial photograph from 1967 immediately after the bushfires shows the study area with loss of undergrowth and some trees remaining. The recent site walkover shows the site with smaller vertical trees and sparse very large trees. The ridgeline has minimal undergrowth but thick undergrowth near the lower slopes toward the stream(s).

3.2.2 Geology

An excerpt of the mapsheet of Hobart, scale 1:25,000, dated May 2006 produced by Mineral Resources Tasmania (MRT) is shown below.



Scherzic

Ground Investigations

Pud	Dominantly interbedded, richly fossiliferous glaciomarine siltstone and subordinate thin beds of granule sandstone, limestones present, thin-to medium-bedded, commonly leached yellow-cream coloured (Deep Bay Formation) (Pud), contact metamorphosed by Jurassic dolerite (Pudx).
Pum	Generally poorly fossiliferous interbedded glaciomarine fine-to medium-grained sandstone, fissile and non-fissile siltstone, limestones and pebble-rich patches, productid bed at top, basal interval commonly with thick beds of coarse-grained sandstone (Maibina Formation) (Pum), contact metamorphosed by Jurassic dolerite (Pumm).
Puo	Undifferentiated fossiliferous glaciomarine sandstone, siltstone and limestone (Deep Bay Formation, Berriedale Limestone, Nassau Siltstone and Rayner Sandstone) (Puo), contact metamorphosed by Jurassic dolerite (Puom).
Qpt	Talus and remobilised talus deposits (Qpt), talus consisting dominantly of dolerite boulders (Qptd), talus dominantly of Lower Parmeener Supergroup rocks and Jurassic dolerite (Qptdp), talus of dolerite with notable amounts of Upper Parmeener quartzose sandstone (Qptdq), talus dominantly Lower Parmeener rocks (Qptp), talus dominantly Upper Parmeener quartz sandstone (Qptq), talus consisting of dolerite and subordinate Upper Parmeener rocks (Qptup).
Qpa	Deeply dissected alluvial fan, proximal alluvial terrace and minor talus deposits containing boulders of weathered dolerite and Parmeener derived rocks in places (Qpa).

This mapping shows the majority of the tracks will traverse Permian age sandstones & siltstones & limestones with some recent talus located near the stream edges. The site walkover confirms these general descriptions with outcropping sandstones and siltstones visible in the existing tracks over the routes.

3.2.3 Landslides

The historical aerial photograph of 1967 does not visibly identify any landslide activity over the study area. The MRT landslide inventory and susceptibility maps (as per appendix) and hillshade maps (The List) do not indicate any recorded landslides in the study area. The brief walkover of the study area did not identify any past or potentially unstable areas. There is an unidentified high landslide risk area further east of the study area which abuts Guy Fawkes Rivulet at Old Farm.

4 Risk Assessment

The *Practice Note Guidelines for Landslide Risk Management*, in Australian Geomechanics Journal, Volume 42, Number 1, March 2007 (LRM-AGS) provides guidance on the methods and criteria for the assessment of the risk to life and property(tracks) for potential landslides. Our semi quantitative assessment is based on the following risk matrix:

Risk Matrix		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Annual Probability	0.5%	5%	20%	60%	100%
Almost Certain	0.1	Low	Moderate	Significant	Extreme	Extreme
Likely	0.01	Low	Low	Moderate	Significant	Extreme
Possible	0.001	Negligible	Low	Moderate	Significant	Extreme
Unlikely	0.0001	Negligible	Negligible	Low	Moderate	Significant
Very Unlikely	<0.000001	Negligible	Negligible	Low	Moderate	Moderate

According to this guideline, our assessment of RISK to LIFE $R_{(LOL)}$, from landslides along the future tracks is determined by:

$$R_{(LOL)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$$

$R_{(LOL)}$ = the risk to life (annual probability)

$P_{(H)}$ = the annual probability of landslide (based on risk matrix) - refer to risk matrix

$P_{(S:H)}$ = the probability of spatial impact by a landslide on future tracks (travel distance)- depends on size of landslide & distance from track

$P_{(T:S)}$ = the temporal spatial probability (the probability of individual on track at time of landslide) – take range of less than 60 sec

$V_{(D:T)}$ = vulnerability of the individuals (probability of loss of life of the individual on track given the impact) – larger landslides will cause greater injury

Our analysis of risk to life for the following situations are:

- Risk to Life Track 1 and 1b area on the upper slope = $0.001 \times 0.5 \times 1.0E-6 \times 0.25 = 1.25 \times 10^{-6}$
- Risk to Life Shoobridge Bend Road Embankment (Track 1 and 1b) = $0.01 \times 0.5 \times 1.0E-6 \times 0.50 = 2.5 \times 10^{-5}$
- Risk to Life Tracks 12 and Upper Luge (General ridge assessment) = $0.000001 \times 0.5 \times 1.0E-6 \times 0.25 = 1.25 \times 10^{-13}$

According to the AGS guidelines, the acceptable risk to life is suggested as 1.0×10^{-4} so therefore the risk to life for the proposed tracks from landslides is determined as acceptable for tracks 1 & 1b and not credible for tracks 12 & Upper Luge.

5 Risk Mitigation Recommendations

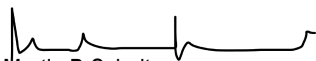
The following guidelines will limit potential landslides, and erosion and lessen the impact on the natural slopes.

- 1) Limit Cut batters (<0.5m)
- 2) Fill Batters (<1m)
- 3) Avoid long lengths of tracks parallel to slopes (particularly any cuttings)
- 4) Creek crossing should avoid alluvium/colluvium (note cross at competent rock – see photos)
- 5) Limit Vegetation removal (no trees >2m)

6 Conclusions

Based on the assessment presented above, there is acceptable risk from landslides to users of the proposed mountain bike tracks, 1, 1b, 12 and the Upper Luge.

Please note the above advice is based on a desktop & visual assessment and should differing conditions or additional information become available, then this advice should be reviewed. For further advice or clarification, contact the undersigned

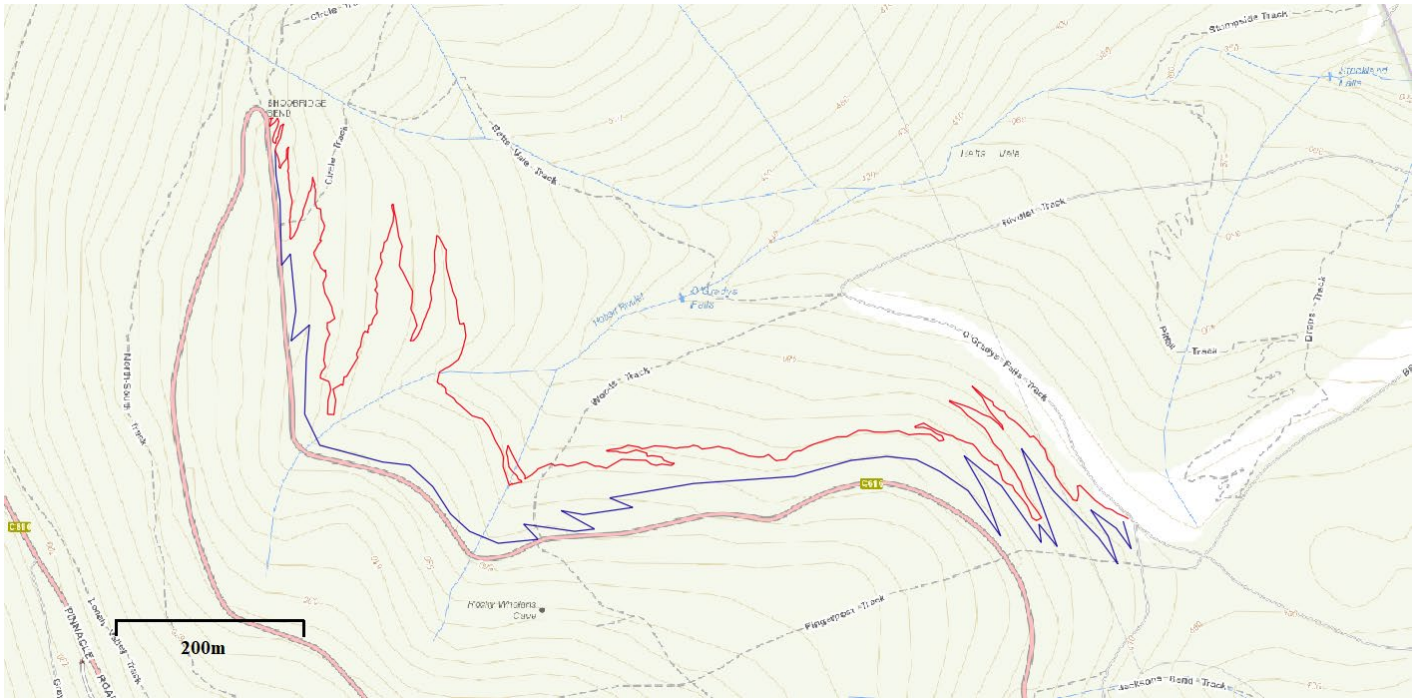


Martin B Schult, BEng., MEngSc., DipGeoSc., MIE(Aust), CPEng., NER

Principal Geotechnical Engineer

Appendix A

Desktop Study Maps – Tracks 1 & 1b



From The List (DPIPWE) Topography map

10m contours

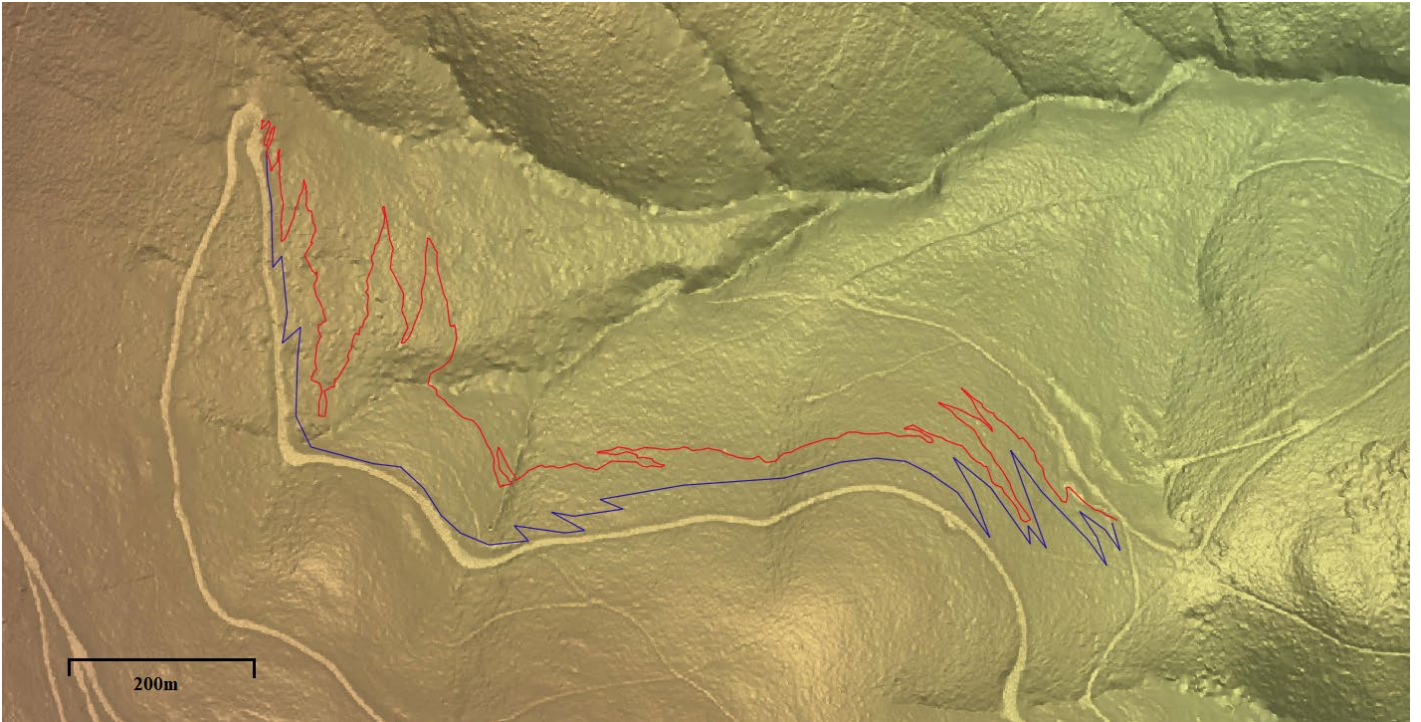
Drawn	SC	<h1 style="margin: 0;">Schertzic</h1> <h2 style="margin: 0;">Ground Investigations</h2>	Client: City of Hobart	
Approved	mbs		Project: Wellington Park	
Date	10/09/2020		Title: Topography 7436 – 01	
Scale			Project No: 7436 Appendix A	
Original size	A4			



Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Aerial photograph 1 & 1b	
Project No: 7436	Appendix A

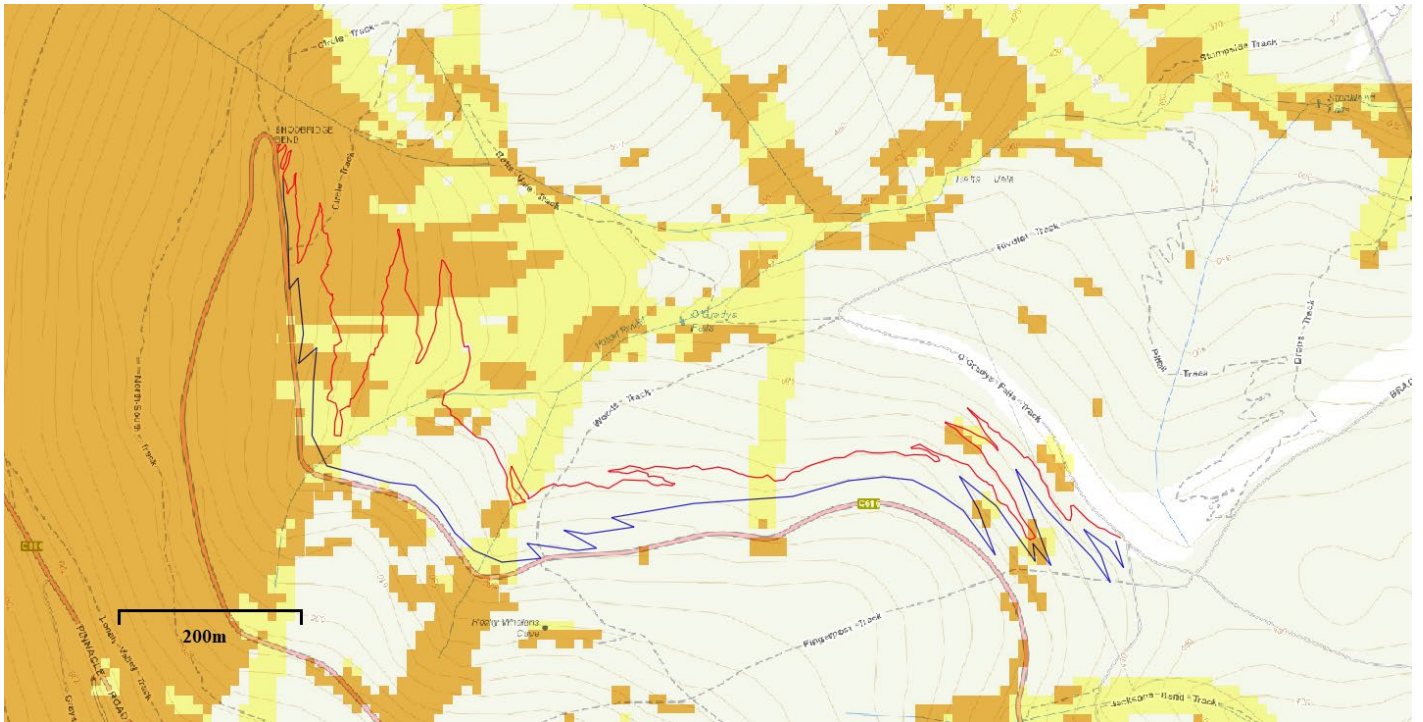


From The List (DPIPWE) Hillshade map

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Hillshade Tracks 1 & 1b	
Project No: 7436	Appendix A



From The List (DPIPWE)

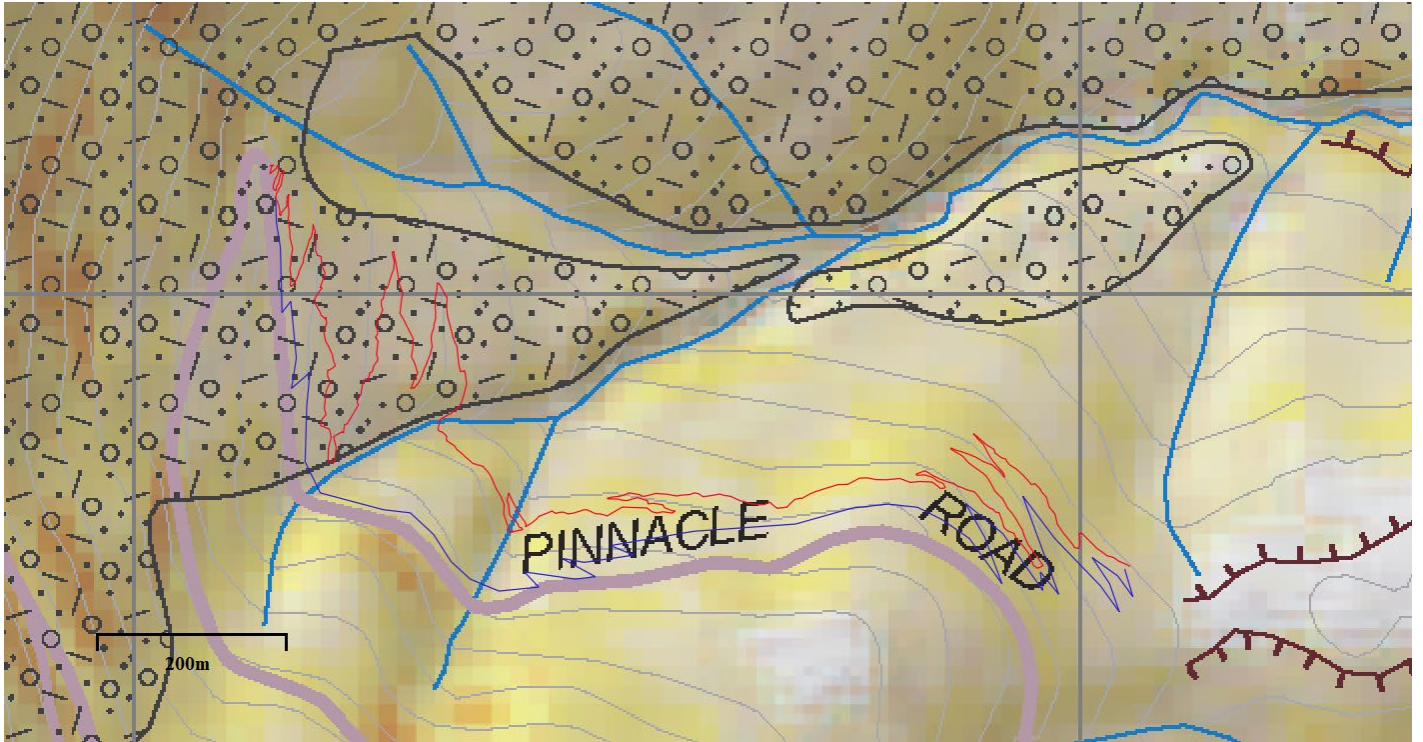
Orange Brown Shade – Medium Risk

Yellow Shade – Low Risk

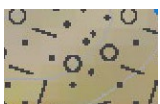
Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Hazard bands Tracks 1 & 1b	
Project No: 7436	Appendix A



Taken from Mineral Resources Tasmania (MRT)



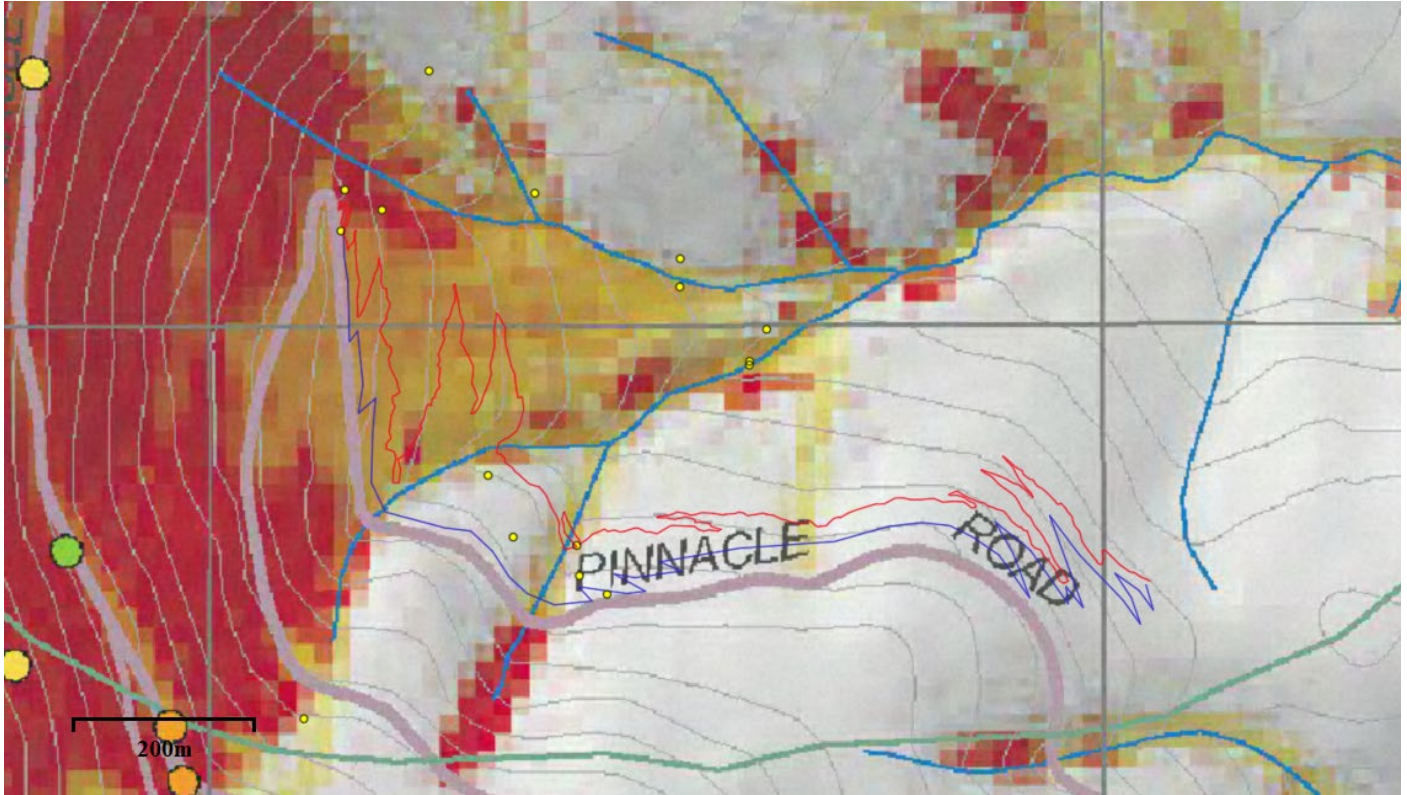
- Colluvium

Shading from Shallow Slide and/ or Flow Susceptibility map (see next)

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Landslide Inventory 1 &1b	
Project No: 7436	Appendix A



Taken from Mineral Resources Tasmania (MRT)

Red Shading – High Susceptibility

Yellow Shading – Moderate



- reported historical slides or failures (MRT)

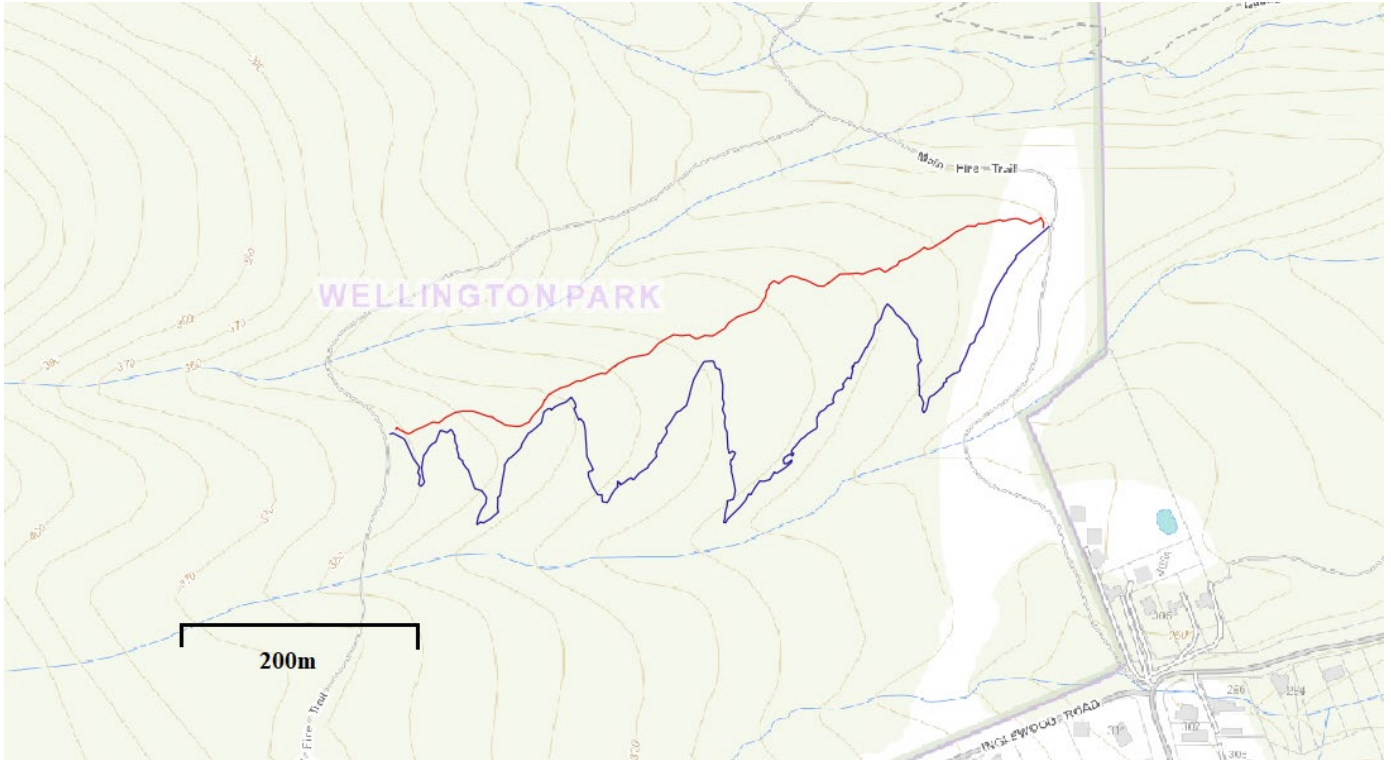
Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Shallow Slide and/ or Flow Susceptibility Tracks 1 & 1b	
Project No: 7436	Appendix A

Appendix B

Desktop Study Maps – Tracks 12 & Upper Luge



From The List (DPIPWE) Topography map

10m contours

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Topography 12 & Luge	
Project No: 7436	Appendix B

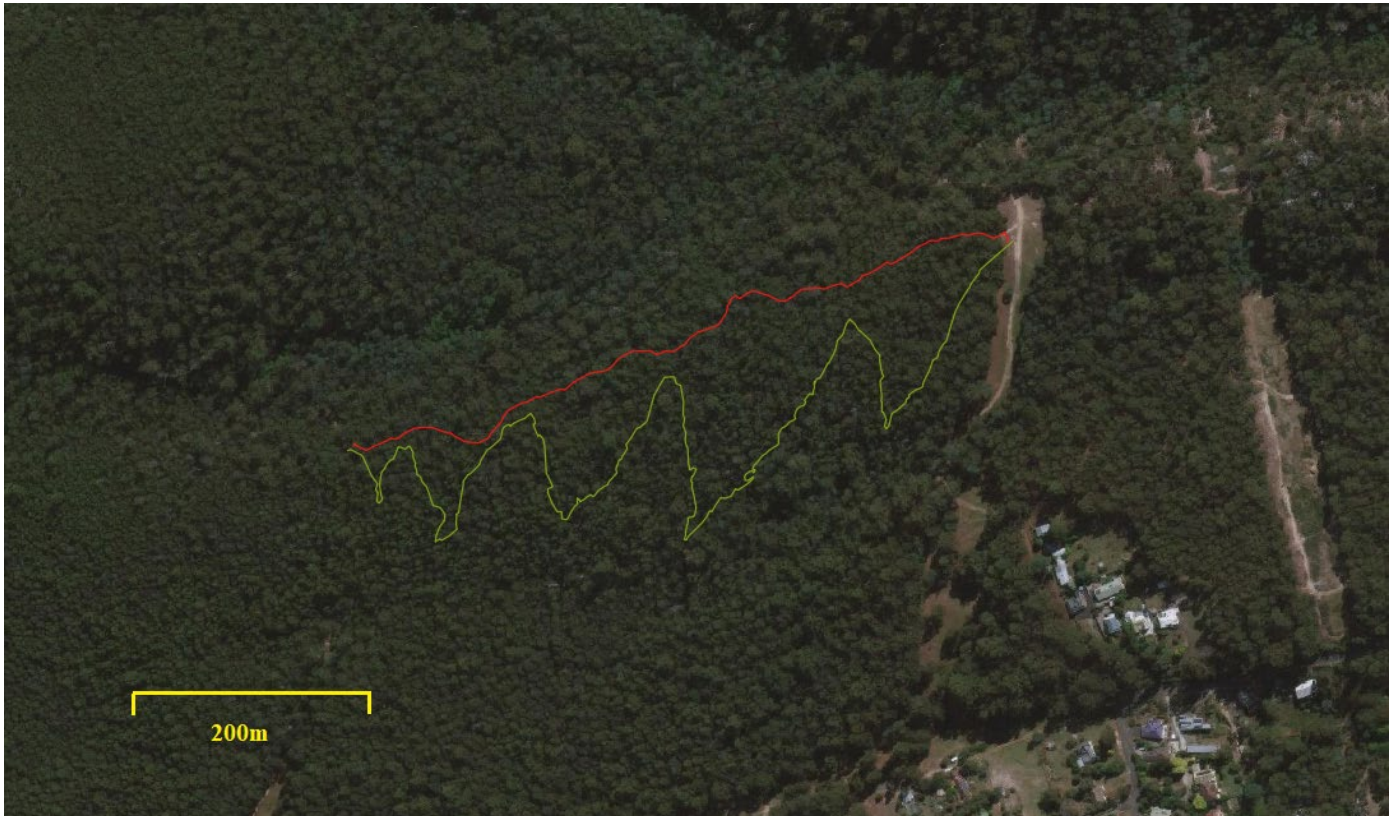
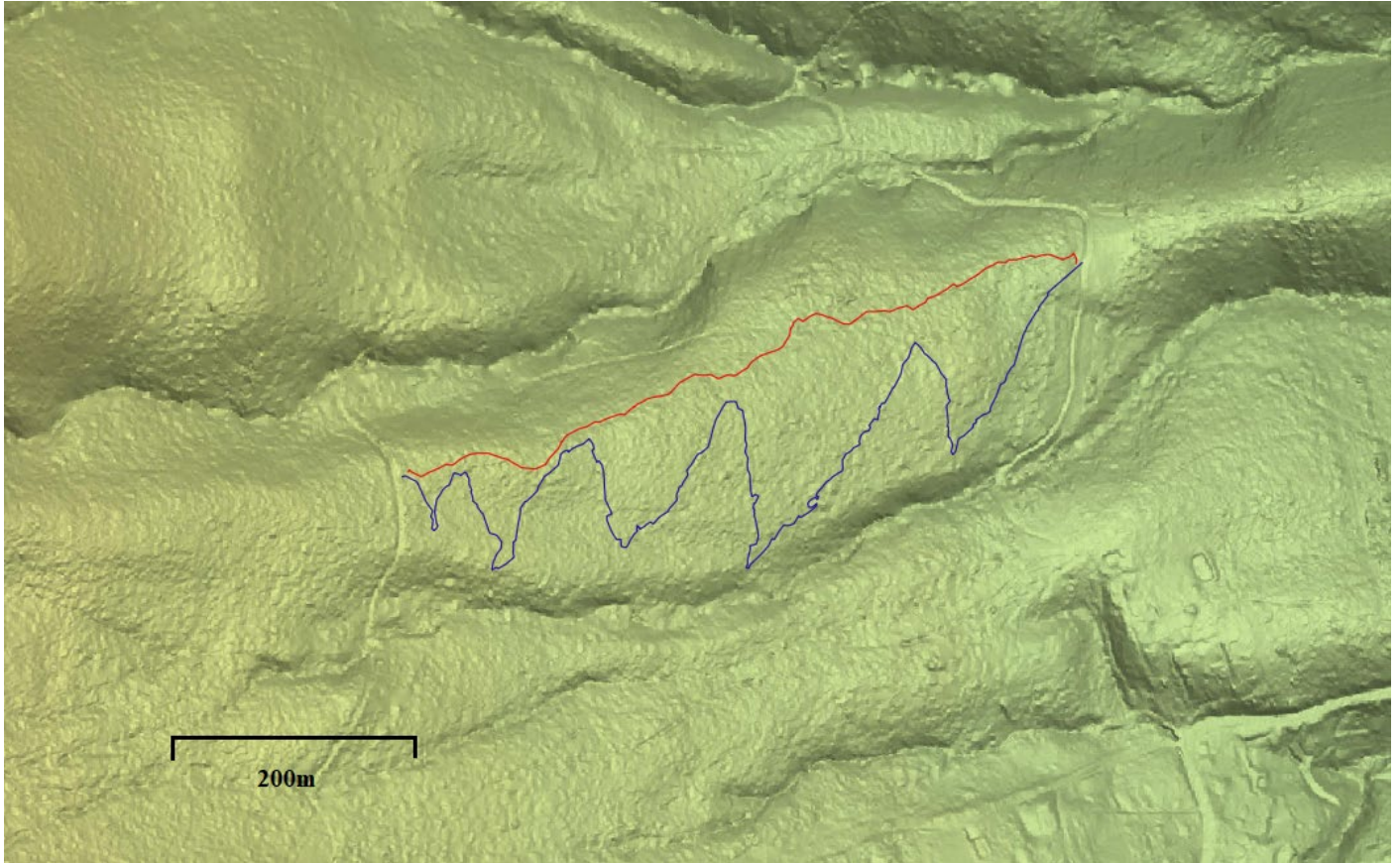


Figure 8 –Aerial photograph for Track 12 and Upper Luge

Drawn	SC	Scherzic <i>Ground Investigations</i>	Client: City of Hobart	
Approved	mbs		Project: Wellington Park	
Date	10/09/2020		Title: Aerial Photo Track 12 & U L	
Scale			Project No: 7436 Appendix B	
Original size	A4			

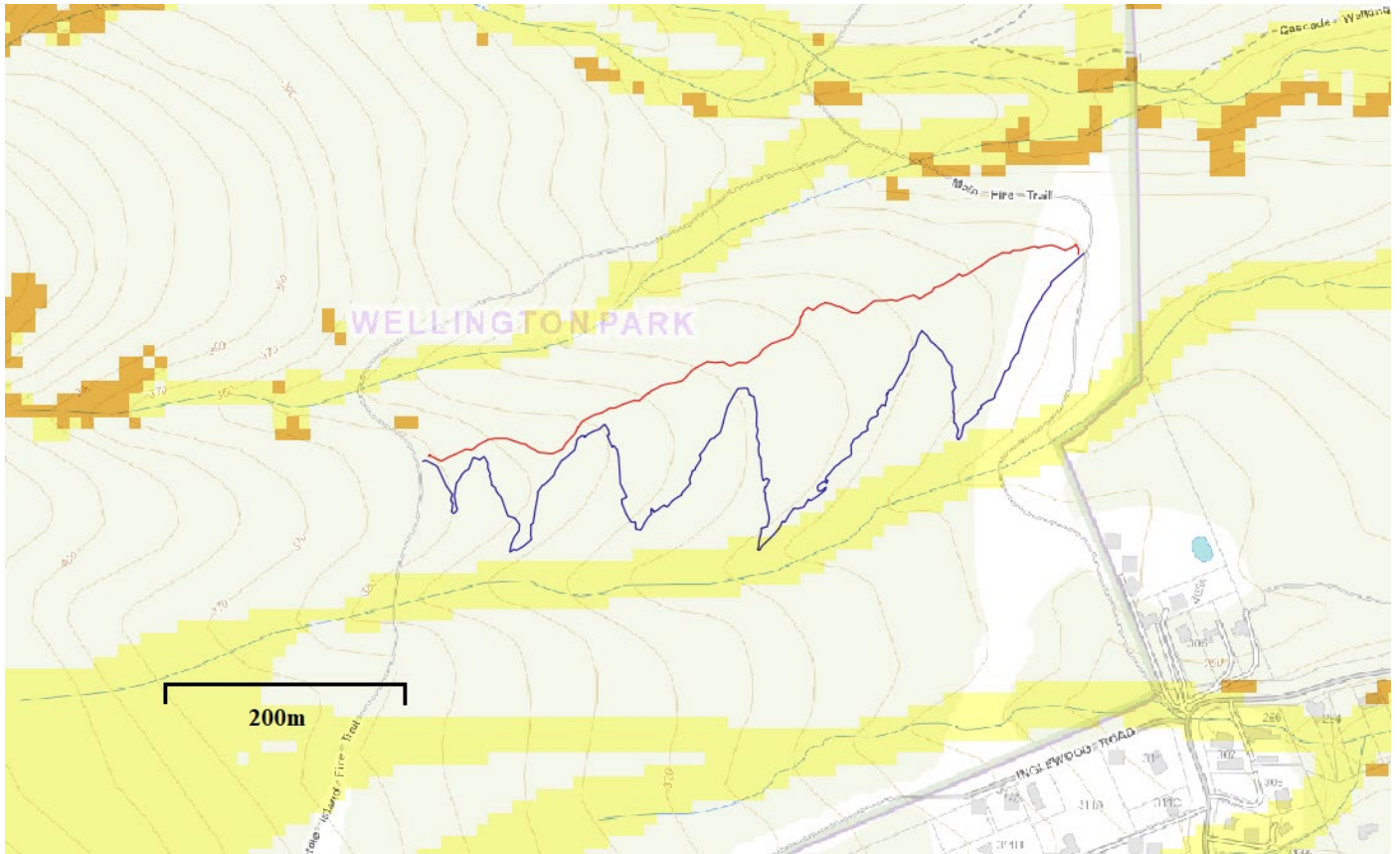


From The List (DPIPWE) Hillshade map

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Hillshade 12 & Upper Luge	
Project No: 7436	Appendix B



From The List (DPIPWE)

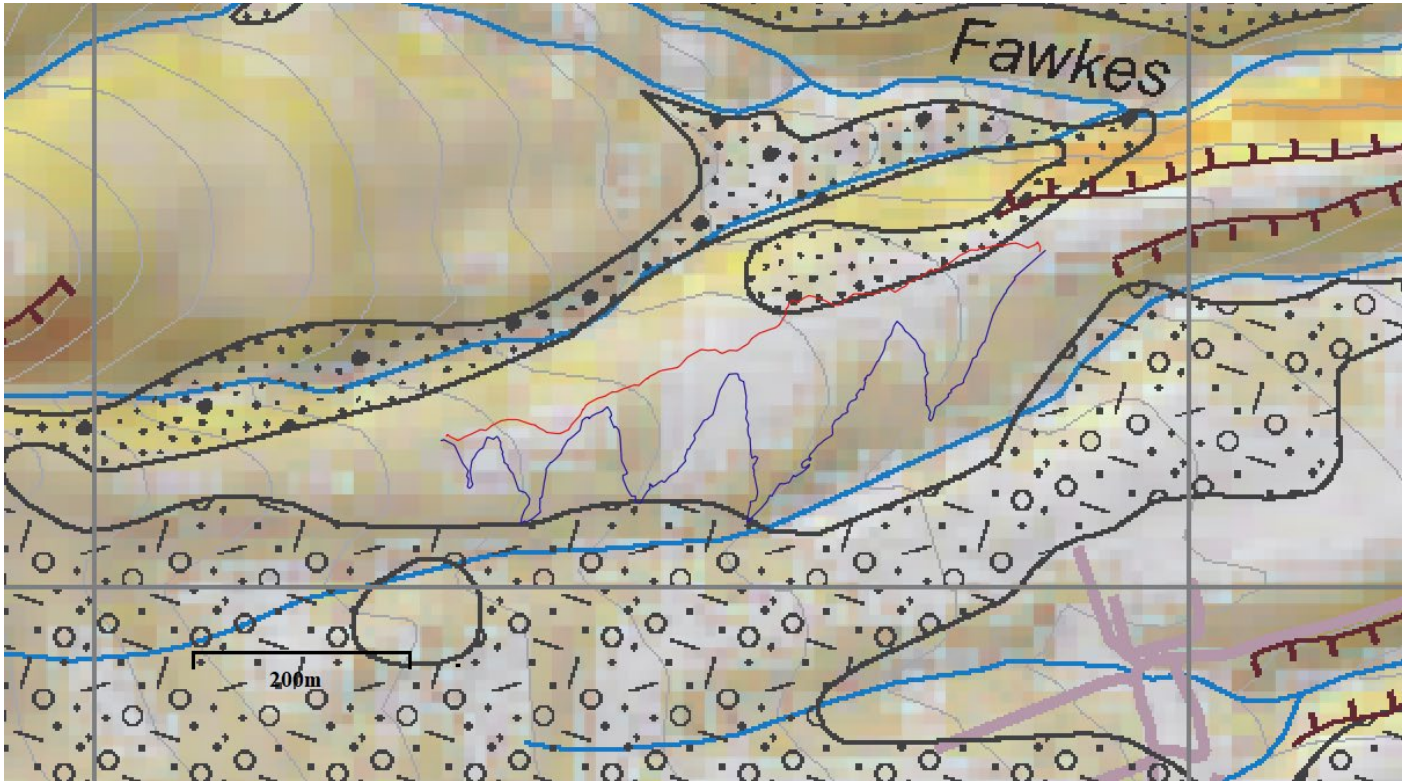
Orange Brown Shade – Medium Risk

Yellow Shade – Low Risk

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Hazard Bands 12 & Upper Luge	
Project No: 7436	Appendix B



Taken from Mineral Resources Tasmania (MRT)



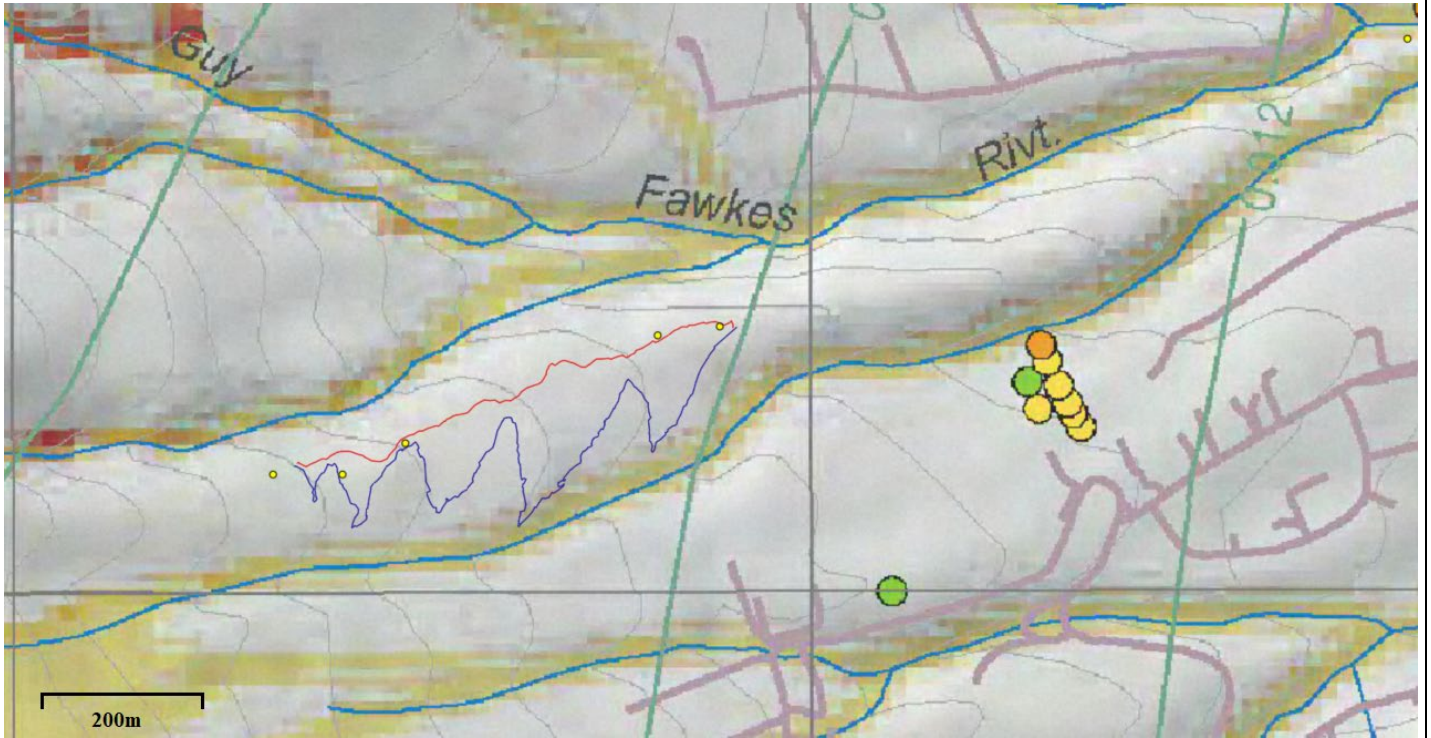
- Colluvium

Shading from Shallow Slide and/ or Flow Susceptibility map (see next)

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Landslide Inventory 12 & UL	
Project No: 7436	Appendix B



Taken from Mineral Resources Tasmania (MRT)

Red Shading – High Susceptibility

Yellow Shading – Moderate



- reported historical slides or failures (MRT)

Drawn	SC
Approved	mbs
Date	10/09/2020
Scale	
Original size	A4

Scherzic
Ground Investigations

Client: City of Hobart	
Project: Wellington Park	
Title: Shallow Slide and/ or Flow Susceptibility Tracks 12 & U Luge	
Project No: 7436	Appendix B

Appendix C

1967 Aerial Photo



Appendix D

Photographic Record Tracks 1 & 1b



Figure 2 - near Shoobridge Bend



Figure 3 - Cobbles & boulders over surface



Figure 4 - O'Grady's Falls



Figure 5 - outcropping rock at creek crossing



Figure 6 - Boulders & Large old tree trunks



Figure 7 - Outcropping rock at stream



Figure 8 - Older large trees with smaller more recent growth



Figure 9 - Angular boulders held by tree roots



Figure 10 - Very large older tree trunk



Figure 11 - Alluvium & Boulders in stream



Figure 12 - Erosion of fine sands



Figure 13 - Boulders on slope below Shoobridge Bend



Figure 14 - Thick recent undergrowth



Figure 15 - Thick undergrowth on slope



Figure 16 - Older track or terracing

Appendix E

Photographic Record Tracks 12 & Upper Luge



Figure 17 - Start of track area



Figure 18 - existing track surface over cobbles



Figure 19 - existing ridgeline



Figure 20 - soils with some cobbles



Figure 21 - end of area/tracks



Figure 22 - Instability at Old Farm