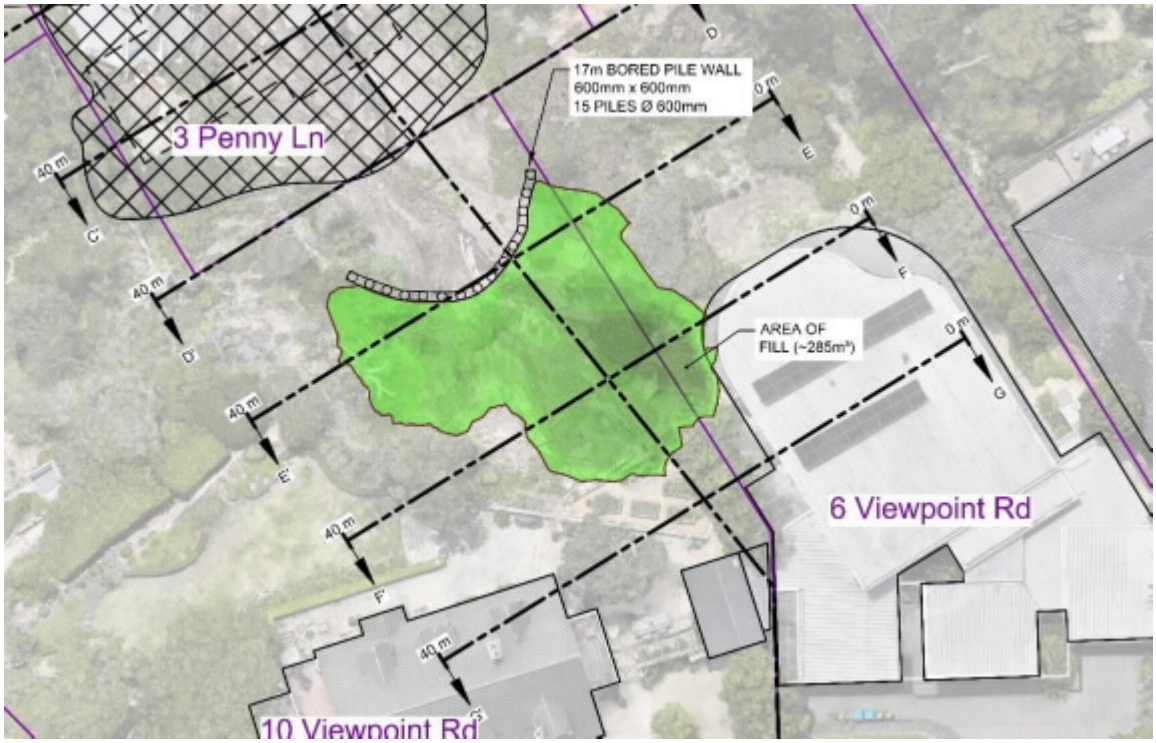
Board of Inquiry into the McCrae Landslide

McCrae Landslide

Remediation and Mitigation Report

12 August 2025

Confidential



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McCrae Landslide
Remediation and Mitigation Report

Board of Inquiry into the McCrae Landslide

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Rev	Date	Details
0	12 August 2025	Report issued to the Board of Inquiry

	Name	Date	Signature
Prepared by:	Darren Paul	12 August 2025	Irrelevant & Sensitive
Reviewed by:	Stuart Colls	12 August 2025	Irrelevant & Sensitive

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We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Our ref: PS224394-WSP-MEL-GEO-REP-003 Rev0

12 August 2025

Confidential

Georgie Austin
Solicitors Assisting
Board of Inquiry into the McCrae Landslide

Dear Madam

McCrae Landslide
Remediation and Mitigation Report

Please find enclosed our report into the potential remediation and mitigation for the McCrae Landslide. We look forward to discussing the contents of this report with you further.

Yours faithfully

Irrelevant & Sensitive

Darren Paul
Technical Director - Engineering Geology

Table of contents

Glossary

Anthropogenic	Caused by humans.
Aquifer	A body of permeable rock or soil that contains water in which pore spaces are sufficiently connected to allow water to flow through the rock or soil matrix.
Causal Factors	Events or circumstances that might trigger a landslide. Causal factors determine when a landslide might occur.
Colluvium	Soils deposited at the base of slopes by gravity driven processes such as soil creep, landslides and surface wash.
Colluvial channel	A channel naturally filled with colluvium.
Discontinuities	A break or defect in a rock mass such as a joint, bedding, fault or bedding parting.
Escarpment	A long, steep slope, especially one at the edge of a plateau or separating areas of land at different heights.
Exfiltration Point	A location at which subsurface water exits to the surface. Also known as a spring.
Hanging Valley	A valley which is cut across by a deeper valley, cliff or escarpment.
Headscarp	A prominent steep slope or cliff like feature that marks the upper boundary of a landslide.
Hydrogeology	The study of subsurface water and movement of water through the subsurface.
Infiltration Point	A location at which surface water enters the subsurface.
Landslide	The movement, or the potential movement of a mass of rock, debris or soil down a slope.
Mitigation	Works undertaken to reduce the risk from landslide.
Partial Saturation	The condition in the ground above the water table where both air and water are present within the pores in the soil or rock as well as soil, or rock.
Pore water pressure	The pressure of water within the space between soil particles that is exerted on the surrounding soil particles.
Preparatory Factors	Features of the landscape that make it susceptible to landslide. Preparatory factors determine where a landslide might occur and what might happen if it does occur.
Remediation	Works undertaken to repair damage caused by landslide.
Saturation	The condition in the ground below the water table where pores are fully filled with water.
Suction	Force developed between soil particles as a result of the surface tension properties of water in the pores of soil.
Surcharge Load	A load applied to the ground surface, for example from heavy plant and machinery or the placement of soil.
Surface of Rupture	The plane along which the displaced soils mass travels from the zone of depletion to the zone of accumulation.
Toe	The base or lowermost point of a slope or landslide.
Zone of Depletion	The area from which soil is removed or detaches in the event of a landslide.
Zone of Accumulation	The area from which soil is deposited in the event of a landslide.

1 Introduction

1.1 The McCrae Landslide

1) A landslide occurred at McCrae on the Mornington Peninsula in Victoria in January 2025 which resulted in the destruction of a house at 3 Penny Lane and the precautionary evacuation of houses within the immediate vicinity of the landslide. Approximately three years prior, in November 2022, a landslide occurred on the property at 10-12 View Point Road McCrae which led to the evacuation of properties downslope of that landslide.

2) These landslides and their causes are discussed in WSP's Causation Report, ref: PS224394-WSP-MEL-GEO-REP-001 Rev0 dated 21 July 2025, noting that establishing the causes of a landslide is an important and necessary step towards designing remedial measures and risk mitigation. In that report, a concept design for remediating the January 2025 McCrae Landslide is presented along with suggested means for providing future risk mitigation. This Remediation and Mitigation report is intended to provide the Board of Inquiry into the McCrae Landslide (BoI) with an indication of the feasibility of remediating the damage caused by the past landslides and of constructing measures to mitigate risks associated with future landslides.

1.2 Summary of Causes of the McCrae Landslide

3) A summary of the causes of the 2022 and January 2025 landslides insofar as they are relevant to the design of remediation and risk mitigation measures is presented below. Further detail is provided in the Causation Report.

4) The steep slopes of the McCrae Escarpment are underlain by soils formed from the insitu weathering of granite, which are overlain by transported soils emplaced by landslide processes originating on the slopes of Arthurs Seat upslope of McCrae and by aeolian (wind blown) deposition of sediment. The escarpment is the surface expression of a fault (the Selwyn Fault) and is a steep slope that is susceptible to landslide. It has an observed history of landslides going back to at least the 1950s and geological evidence of landslides extending further back.

5) The soils comprising the McCrae Escarpment lose strength upon wetting which can lead to them developing into fluid type landslides (debris flows) causing landslide debris to flow downslope with the potential to impact people and property at the toe of the slope or to undermine assets constructed close to the crest of the slope.

6) Development within the vicinity of the escarpment, including the placement of fill on or near the crest of the escarpment and the removal of vegetation is likely to have increased the susceptibility of the escarpment to landslide.

7) Channels infilled with coarse, permeable soils act as subsurface conduits for water that has recharged into the ground on Arthurs Seat and then flows through the subsurface, with water issuing from springs on and around the McCrae Escarpment. Natural springs have been identified on the escarpment prior to modern development.

8) Extreme rainfall can cause surface water infiltration into the escarpment that can cause a loss of soil strength. Based on correlation with an extreme rainfall event, this infiltration is assessed to be a significant cause of the 2022 landslide. However, other water sources, for example leaking underground services can also provide a source of water to the escarpment that can lead to landslide. A leaking underground water main is assessed to have been a significant contributing factor to the January 2025 landslide.

1.3 Summary of Damage Resulting from the McCrae Landslide

9) Based on our site observations, damage caused by the January 2025 landslide includes:

   a. The destruction of the house at 3 Penny Lane.

   b. The deposition of debris including soil, building materials and vegetation at the toe of the slope below 10-12 View Point Road.

   c. The scar formed within the zone of depletion which has caused a subvertical slope below 6 View Point Road and 10-12 View Point Road.

   d. Damage to the retaining wall at 10-12 View Point Road.

   e. Encroachment and near undermining of the patio area at 6 View Point Road.

10) An annotated plan showing the damage observed to have been caused by the January 2025 landslide is presented in Figure 1.1. For refence, the approximate area of remaining debris from the 2022 landslide is also shown on this figure.

Figure 1.1 Annotated plan showing key damage caused by the January 2025 landslide

11) The conceptual remediation and mitigation design set out in this report seeks to repair this damage and to reinstate the area affected by landslide, including returning the associated risks to a similar level they were prior to occurrence of the landslide.

2 Objectives of the Conceptual Design

2.1 Remediation

12) The conceptual remedial design seeks to achieve the following objectives:

    a. To reinstate the zone of depletion arising from the January 2025 landslide and return the landform as far as practical back to the state it was in prior to the landslide.

    b. To reinstate the zone of depletion with materials less susceptible to landslide and debris flow compared to those that detached in the January 2025 landslide.

    c. To allow groundwater to drain freely from the landslide scarp and be directed to the municipal stormwater system.

    d. To achieve a similar level of risk to life and property to that prior to the January 2025 landslide.

13) The conceptual remedial design includes removing the soil and debris that was emplaced by the January 2025 landslide, removing the damaged retaining wall and reinstating the zone of depletion with interlocking, free draining rockfill.

14) Reconstruction of the property that was destroyed at 3 Penny Lane is not part of the conceptual remedial design.

2.2 Mitigation

15) The conceptual mitigation design seeks to achieve the following objectives with respect to the escarpment below 6 View Point Road and 10-12 View Point Road:

    a. To reduce the likelihood of further landslides to a level that is as low as reasonably practical.

    b. To reduce the consequences from further landslides to a level that is as low as reasonably practical.

16) The conceptual mitigation design includes installing a gabion barrier at the toe of the escarpment to reduce the potential for debris arising from future landslides to impact houses on Nepean Highway and the installation of permanent drains or wells installed along View Point Road designed to allow interception and redirection of groundwater away from the escarpment. Planning and building controls discussed in our Causation Report as potential mitigation options are not discussed in this report.

3 Basis of Conceptual Design

3.1 Remediation

17) A conceptual design for remediation of the January 2025 landslide is presented in Appendix A. This design is a concept only prepared for the purposes of estimating the practical and economic feasibility of remediating the January 2025 landslide. The design would need to be refined and updated to a detailed design which could include consideration of alternative designs that meet a similar design objective. All design characteristics and dimensions referred to in the designs set out in Appendix A would likely change through the detailed design process.

18) The following sections set out the basis for the various components of the design. It is assumed that the mitigation described in Section 3.2 would be carried out in conjunction with the remediation. Refer to Section 4 for further comments about constructability considerations and the likely sequence of construction.

3.1.1 Preparatory Works

19) Preparatory works include works intended to make the site ready for the construction of the rockfill buttress and other works described below and would include:

a. The establishment of a staging point and lay down area at a site on Nepean Highway from which the project can be managed.

b. Traffic management on Point Nepean Road to allow access to the site.

c. The mobilisation to site of all plant and equipment needed to undertake the remedial works.

d. Removal of debris arising from the January 2025 landslide including the damaged house at 3 Penny Lane and soil accumulated at the toe of the slope following the 2022 and January 2025 landslides. Removal of this material is required to provide access to the site for the remediation and mitigation works. All debris would need to be removed from site.

e. Construction of a temporary haul road for access and the excavation of a bench within residual soils at the proposed toe of the rockfill buttress. This excavation is intended to provide a platform from which the rockfill buttress can be placed and an area from which piles can be installed to support the ground beam.

3.1.2 Piles and Ground Beam

20) The ground beam, nominally 600 mm high, is proposed to help support the toe of the rockfill buttress and to prevent the detachment of rock blocks and their consequential travel down the slope. The piles are to be installed into residual granite, following placement of the rock fill, to a nominal depth of about 5 m, with the objective of providing the ground beam with lateral support.

3.1.3 Drainage

21) Drainage would need to be provided behind the ground beam to ensure water that flows into the rockfill is collected at the toe of the buttress and is directed to the existing stormwater system along Point Nepean Road.

3.1.4 Rockfill Buttress

22) The rockfill buttress would be formed using angular, interlocking rockfill (high strength, angular crushed quarried rock) that would be placed in an interlocking manner into the zone of depletion remaining after the

January 2025 landslide. Dromana Granite could be used to match as far as practical the appearance of the natural rock underlying the site.

23) Rockfill could be provided that meets VicRoads standard specification for rockfill (Section 205) noting that rock specified in accordance with that document is routinely used for landslide remediation on Victoria's road network and is available as a standard product from quarry suppliers. For this application, the rockfill would need to be coarse such that it can freely convey water through it. Rockfill with a maximum particle size of 500 mm and minimum size of 150 mm is likely to be required, with rockfill placed carefully to maintain interlocking contact between the coarser particles. Rock placed in this way can achieve a maximum slope angle of about 40° which is expected to be sufficient to reinstate the scar remaining after the January 2025 McCrae landslide. However, if a steeper rockfill slope is required, the rockfill can be provided with reinforcement such as a geogrid material to achieve a steeper slope.

3.2 Mitigation

24) Mitigation measures designed to reduce risks associated with further landslides can focus on reducing the likelihood or the consequence of further landslides. The likelihood could be reduced by providing measures intended to intercept groundwater before it infiltrates the soils underlying the escarpment and triggers landslide. The consequence could be reduced by providing a barrier to protect houses that are susceptible to impact from debris arising from a landslide. Each of these measures are discussed subsequently below. It is expected that these mitigation measures would be constructed at an early stage of the remediation works described in Section 3.1 to also reduce the potential likelihood and consequence of landslide during remediation works.

3.2.1 Groundwater Interception

25) Appendix A includes a sketch showing a system of groundwater wells installed on the northern side of View Point Road with the objective of intercepting water that could flow towards the escarpment via colluvial channels or service trenches. This sketch is a concept only, with final selection of the well spacing, diameter and locations requiring a more detailed assessment of site constraints and local hydrogeological characteristics.

26) Groundwater monitoring undertaken to date indicates that the elevated pore water pressure that triggered the January 2025 landslide was associated with a transient event, or temporary elevation of groundwater pressure.

27) A system of this type would be expected to have the following characteristics:

    a. Extraction wells installed to a depth of about 6 m or until they reach to a depth below the transported soils and penetrate into residual granite.

    b. Existing groundwater monitoring instrumentation could be used to detect elevated pore water pressures and to provide an alert once groundwater pressures reach a pre-determined threshold at which time water would be pumped from the extraction wells.

    c. There are a number of options available that could be considered for pumping groundwater from the wells.

        i. Pumps could be brought to site and installed in the wells only if a trigger threshold is reached. This approach is a low maintenance option that would be suitable if there is expected to be an extended period between the times when elevated pore pressures could occur and suitable procedures are in place to raise an alert that pumping is required. This approach would be suited to low frequency pore pressure elevation, for example as might be caused by leaking services from time to time, but might be less effective against an extreme rainfall event due to the time it would take to detect elevated pressures and react.

        ii. A permanent pump installation could be provided. For example, a vacuum pump that would be linked to all of the wells and which could turn on in immediate response to an elevated pore

pressure measurement. This approach would better allow a quick response and might be more suited to handling extreme rainfall events. However, the pump would require ongoing maintenance and there might be several years, potentially decades, between events for which it is called upon for use. A relatively large pump might be required if there is a requirement to draw from every well.

28) Water collected by the pumps would be discharged to the existing point of discharge at the end of View Point Road (Margaret Street drain).

3.2.2 Upgrade of water bearing services

29) Mains water distribution in the area upslope of the McCrae Escarpment is through asbestos cement pipes installed in the 1950s. These pipes are brittle and have seen a higher rate of leakage compared to other areas of McCrae. Works could be undertaken to upgrade the water mains with consideration given to using flexible pipes with a lower likelihood of leakage. The trenches could be provided with means to restrict water that has leaked from pipes from entering into the soils underlying the escarpment by using trench stops or carrier pipes.

30) Similarly, sewer pipes which are comprised of vitreous clay supported on gravel could be upgraded with trenches designed such that they do not form a persistent conduit for subsurface water transfer. This upgrade could include trench stops or impermeable backfill.

3.2.3 Barriers

31) The drawings included in Appendix A show a barrier formed from gabion baskets provided between the toe of the McCrae Escarpment below 6 View Point Road and 10-12 View Point Road and the houses along Point Nepean Road. This barrier is intended to absorb the energy of impact from a landslide that originates on the McCrae Escarpment, reducing the potential for it to cause damage to the houses along Point Nepean Road. For example, if a landslide similar to the 2022 landslide occurred, the energy absorption effected by the barrier is likely to have prevented debris from impacting the houses with sufficient energy to cause damage, or could have completely prevented impact to the houses.

32) There are multiple options that could be considered for the barrier construction including earth bunds and proprietary debris catch fences. The estimates set out here assume the use of stacked gabion baskets 2 m high and 2 m wide placed along Penny Lane and upslope of 607-609 Point Nepean Road.

4 Constructability

Whelans Group (Whelans) is a contractor experienced in landslide remediation, frequently undertaking contract work to remediate landslides on Victoria's road network. Whelans has been engaged to review the concept design and has visited the site to assess the constructability of the concept remediation and mitigation design set out in Appendix A. Whelans' report, including commentary on constructability, costing and schedule is provided in Appendix B.

Whelans has concluded that the rockfill remedial design set out in the concept design can be constructed and indicate a construction time of 9-10 months.

The sequence of construction for works on and below the escarpment involves:

- Forming site access by removing the debris of 3 Penny Lane, trees on 607-609 Point Nepean Road and debris arising from the 2022 and January 2025 landslides.
- Constructing a gabion wall to provide a barrier between the houses at the toe of the escarpment along Point Nepean Road. This wall will provide a safety barrier both during the works and as a permanent risk mitigation measure beyond the works.
- After constructing a temporary haul road to provide access to the slope, progressively placing rockfill as per design to build the rockfill buttress. As the rockfill buttress is raised, debris on the escarpment would be removed and a geofabric separator would be placed over the natural materials forming a barrier between the rockfill and the underlying natural soils. This work would involve locating excavators on the slope such that they can link up as a chain and pass materials between each other in order to remove debris from the slope and to bring up rockfill from the base.
- Constructing a piled wall and ground beam at the toe of the proposed rockfill buttress to provide lateral support in the event that the rockfill creeps downslope.
- Providing landscaping and revegetation over the placed rockfill and other parts of the slope affected by the works using hydromulch.

The installation of wells upslope of the landslide for the purpose of providing access to pump out groundwater from the ground can be undertaken prior to commencing work on the escarpment using a conventional drilling rig. Due consideration would need to be given to service detection prior to ground penetration using a drilling rig.

5 Costing

Whelans has provided an estimate of the cost of remediation which is set out in Table 5.1.

Table 5.1 Costs for Remedial Works (contractor costs only)

Item	Description	Total
	Supply all labour, plant and materials necessary to complete the Landslip Remediation works at **McCrae Landslip**, including but not limited to scheduled items below.	
1	**Ancillary Costs**	$ 6,222,148
2	**Site setup**	$ 425,111
3	**Site Clearing**	$ 1,279,016
4	**Earthworks**	$ 697,693
5	**Rock Placement**	$ 783,092
6	**Gabion Placement**	$ 745,296
7	**Pile Wall Placement**	$ 415,523
8	**Landscape & Reinstatement works**	$ 408,690
9	**Risk and Contingency**	$ 512,345
	Including potential Dayworks, Wet Weather Allowance etc.	
Total	**Total Estimated Cost (Excl. GST)**	**$ 11,488,914**

In addition to the costs of construction, design costs would also be incurred. We estimate geotechnical design costs would in the order of $100,000 (excluding GST) over a period of about 3 months prior to commencing the remediation. The Whelans estimate includes allowances for project management, design management and onsite geotechnical assessment during construction. Depending on the final approach to design and construction there could be other engineering investigation, design and construction phase costs that are not included in the above estimates.

The drilling and installation of 34 groundwater wells installed to a depth of 6m at a spacing of 5 m along View Point Road upslope of the escarpment and for the purposes of intercepting groundwater is estimated to cost in the order of $200,000 (excluding GST), including an allowance for engineering project management and direction of the drilling and depending on factors such as site access and the need for traffic/pedestrian management or overhead electrical service spotting and would take approximately six working weeks to complete. The cost of above ground well headworks for pumping from the wells is not included in this indicative estimate.

The total cost of the mitigation and design set out here is estimated to be in the order of $12 million excluding GST. Notwithstanding this, there would be opportunity to review and refine this cost through the course of detailed design and procurement.

6 Conclusions

Based on our assessment, we consider that remediation and risk mitigation works could be undertaken for the landslide that occurred on the McCrae Escarpment in January 2025. These works include:

- Removing debris arising from the January 2025 landslide to form site access.
- Constructing a gabion wall at the toe of the slope as protection for dwellings between the of the escarpment and Point Nepean Road.
- Constructing a piled ground beam with drainage provisions and placing rockfill upslope of the ground beam within the zone of depletion to reinstate the material that was displaced in the January 2025 landslide.
- Removing debris from on the landslide escarpment and removing it from site.
- Revegetating the area of the landslide remediation using hydromulch.
- Providing groundwater wells upslope of the landslide for the purposes of intercepting groundwater if needed.

These works are estimated to cost in the order of $12 million (excluding GST) to complete and take approximately 12 months.

7 Limitations

This Report is provided by WSP Australia Pty Limited (WSP) for The Board of Inquiry into the McCrae Landslide (Client) in response to specific instructions from the Client and in accordance with WSP's proposal, PP224394-WSP-MEL-GEO-PRP-001 Rev3-DRP dated 23 June 2025 (Agreement).

PERMITTED PURPOSE

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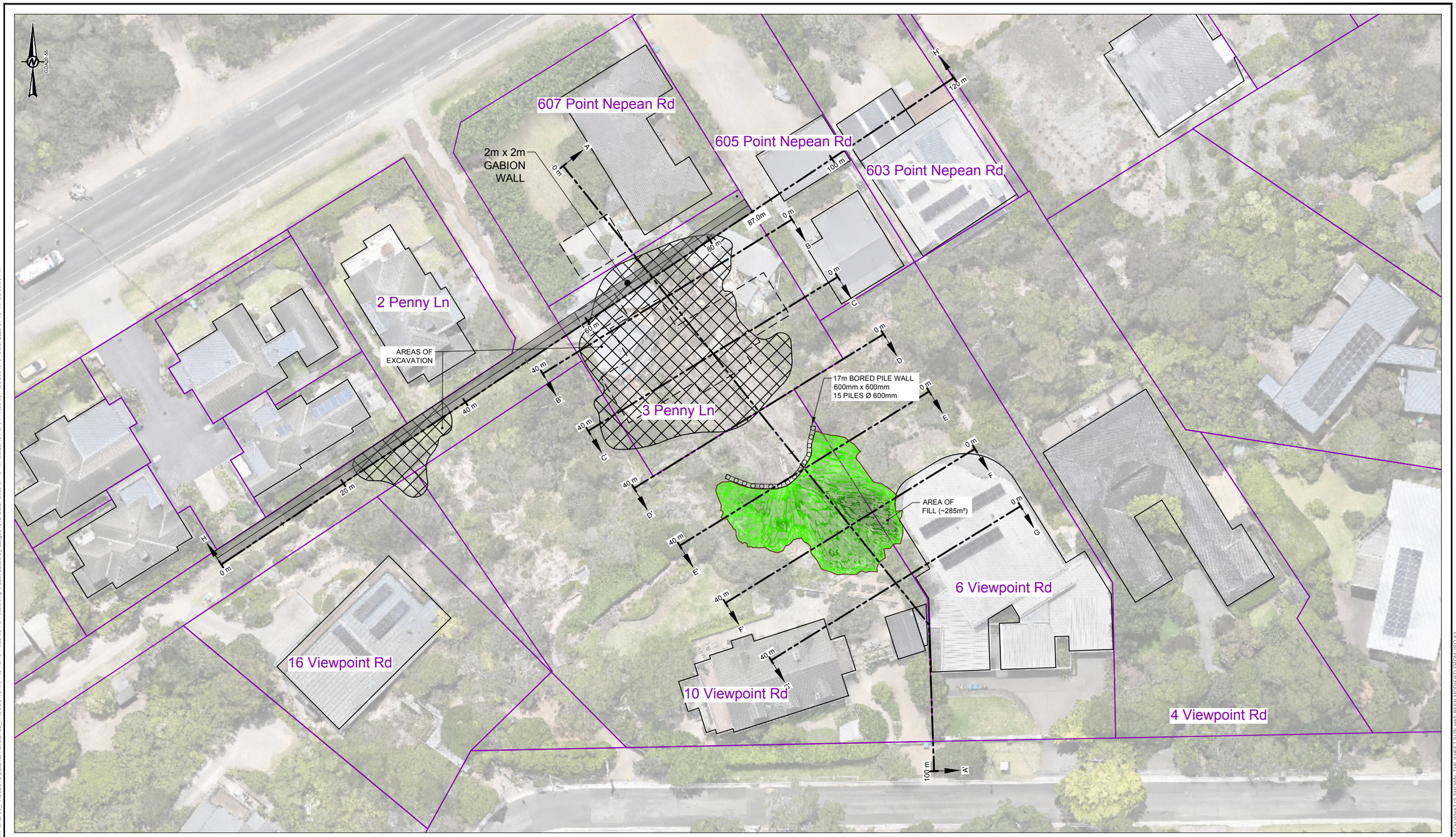
Appendix A

Concept Design for Remediation and Mitigation

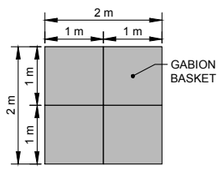


LEGEND

- CADASTRAL BOUNDARY (VICMAP)
- EXISTING SURFACE 2017-11-28 PROFILE
- EXISTING SURFACE 2025-02-05 PROFILE
- ROCKFILL
- GROUND GAINED BETWEEN 2017-2025
- INDICATIVE PROPERTY BOUNDARY
- INDICATIVE CURRENT AND PRE-LANDSLIP BUILDING
- INDICATES ROCK FILL REQUIRED

NOTE(S)

1. ALL LEVELS ARE REFERENCED IN METRES TO AHD.
2. ALL CO-ORDINATES ARE REFERENCED IN METRES TO MGA20-55.
3. AERIAL DATED 2025-01-16.
4. SECTIONS ON SHEET PS224394-001-SK-002b.



Gabion Wall
SCALE 1:100

0 5 10
1:250 METRES

0 5 10
1:250 METRES

NOT FOR CONSTRUCTION

INFORMATION ONLY

CLIENT
McCrae Landslide Board of Inquiry

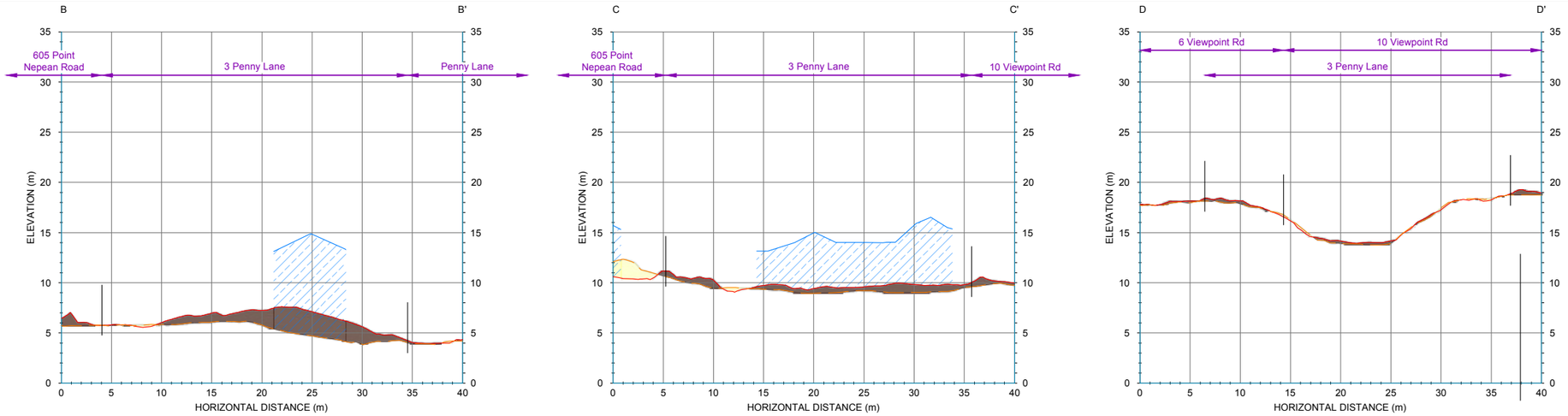
CONSULTANT
wsp

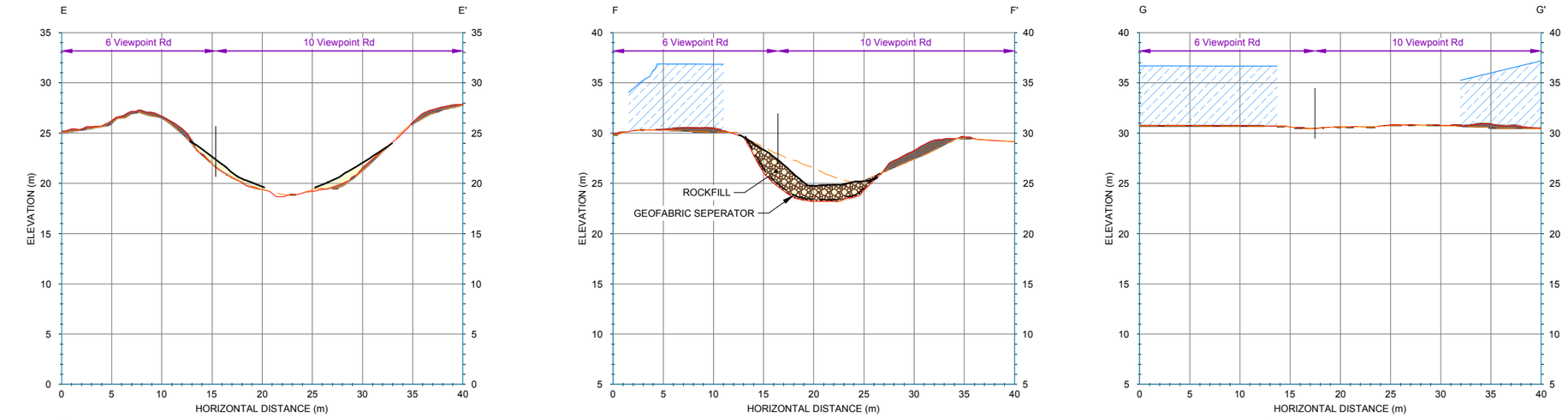
YYYY-MM-DD	2025-07-17
DESIGNED	DRP
PREPARED	CRG
REVIEWED	DRP
APPROVED	

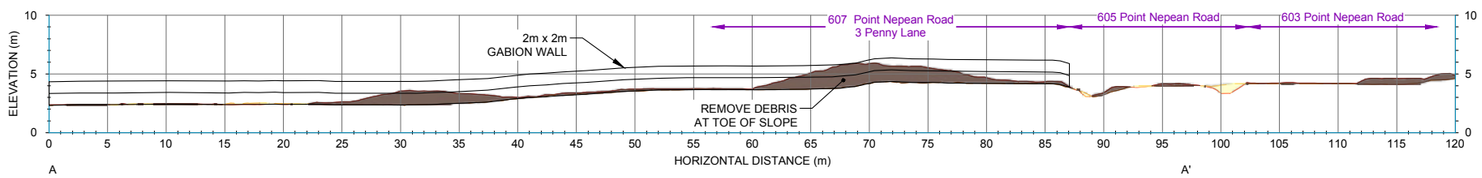
PROJECT
McCrae Landslide Board of Inquiry

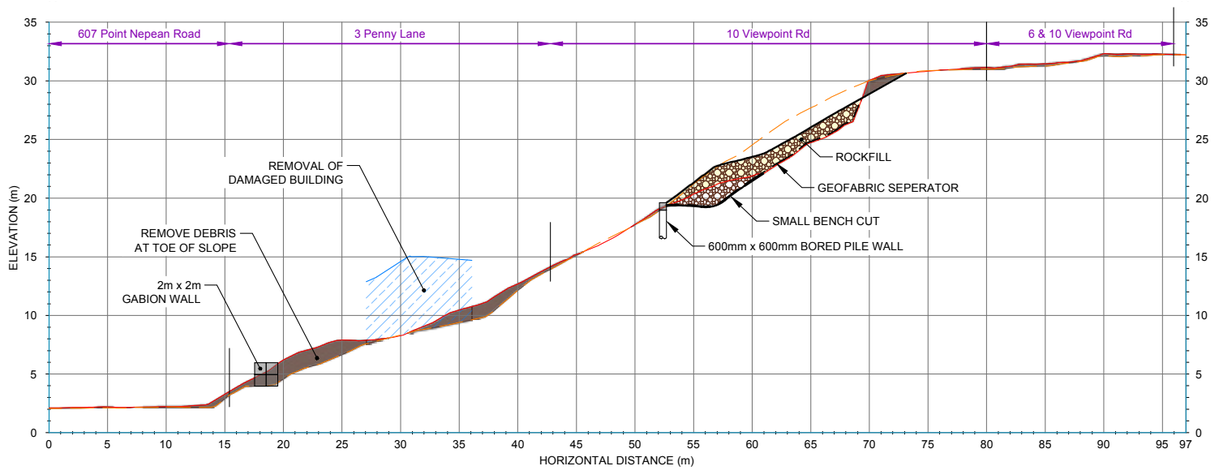
TITLE
REMEDIATION CONCEPT USING ROCKFILL WITH WALL - PLAN VIEW

PROJECT NO.	CONTROL	REV.	FIGURE
PS224394	SK-001	A	003a









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NOTE(S)

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2. ALL CO-ORDINATES ARE REFERENCED IN METRES TO MGA20-55.
3. AERIAL DATED 2025-01-16.
4. LOCATION OF SECTIONS ON SHEET PS224394-001-SK-002a.

0 5 10
1:250 METRES

NOT FOR CONSTRUCTION

INFORMATION ONLY

CLIENT
McCrae Landslide Board of Inquiry

PROJECT
McCrae Landslide Board of Inquiry

CONSULTANT
wsp

YYYY-MM-DD	2025-07-17
DESIGNED	DRP
PREPARED	CRG
REVIEWED	DRP
APPROVED	

TITLE
REMEDIATION CONCEPT USING ROCKFILL WITH WALL - SECTIONS

PROJECT NO.	CONTROL	REV.	FIGURE
PS224394	SK-001	A	003b

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3
25 mm
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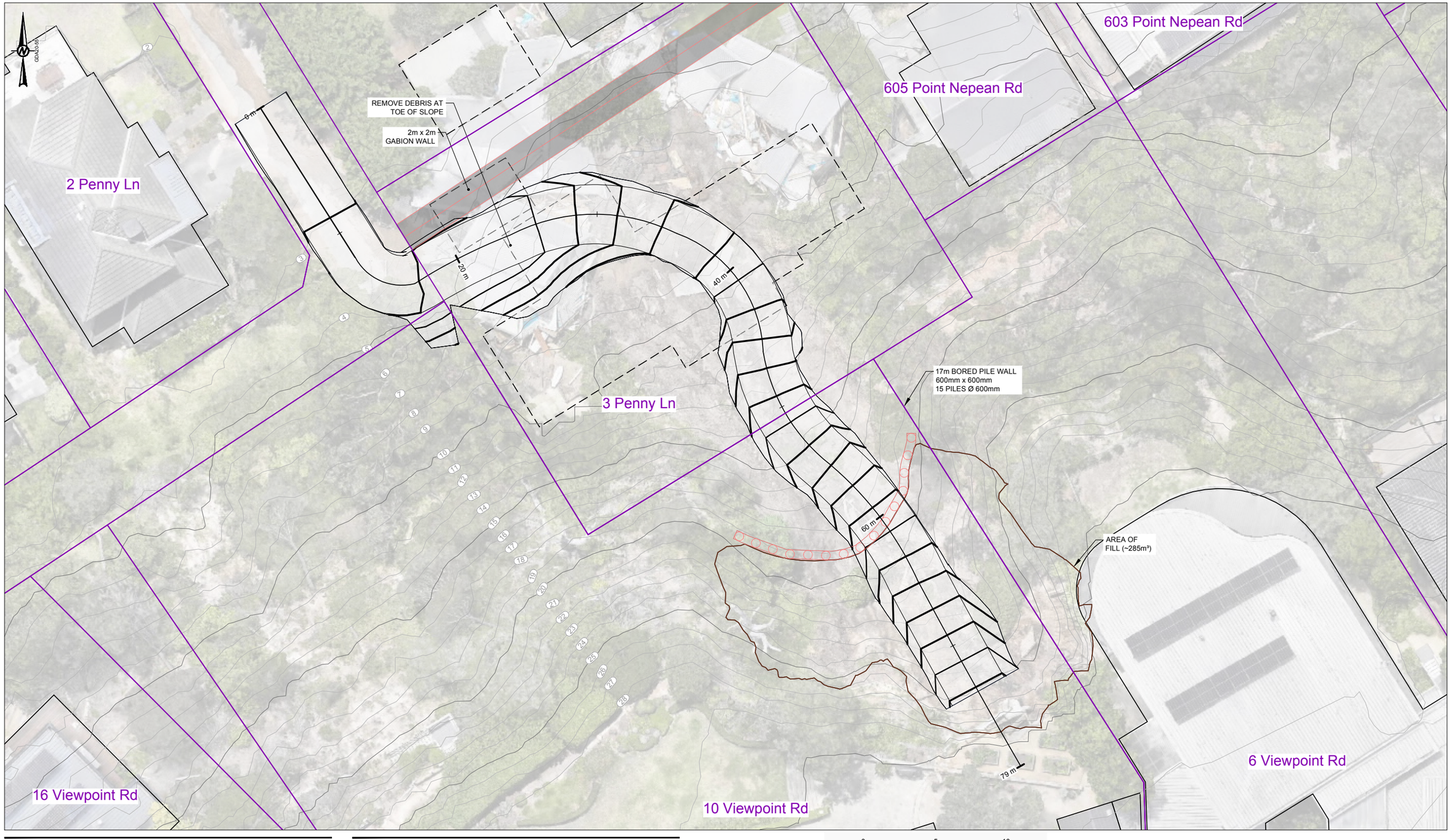
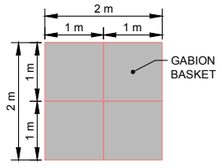


LEGEND

- CADASTRAL BOUNDARY (VICMAP)
- EXISTING SURFACE 2017-11-28 PROFILE
- EXISTING SURFACE 2025-02-05 PROFILE

NOTE(S)

1. ALL LEVELS ARE REFERENCED IN METRES TO AHD.
2. ALL CO-ORDINATES ARE REFERENCED IN METRES TO MGA20-55.
3. AERIAL DATED 2025-01-16.
4. SECTION ON SHEET PS224394-001-SK-004b.



Gabion Wall
SCALE 1:100

0 5 10
1:250 METRES

0 5 10
1:250 METRES

NOT FOR CONSTRUCTION

INFORMATION ONLY

CLIENT
McCrae Landslide Board of Inquiry

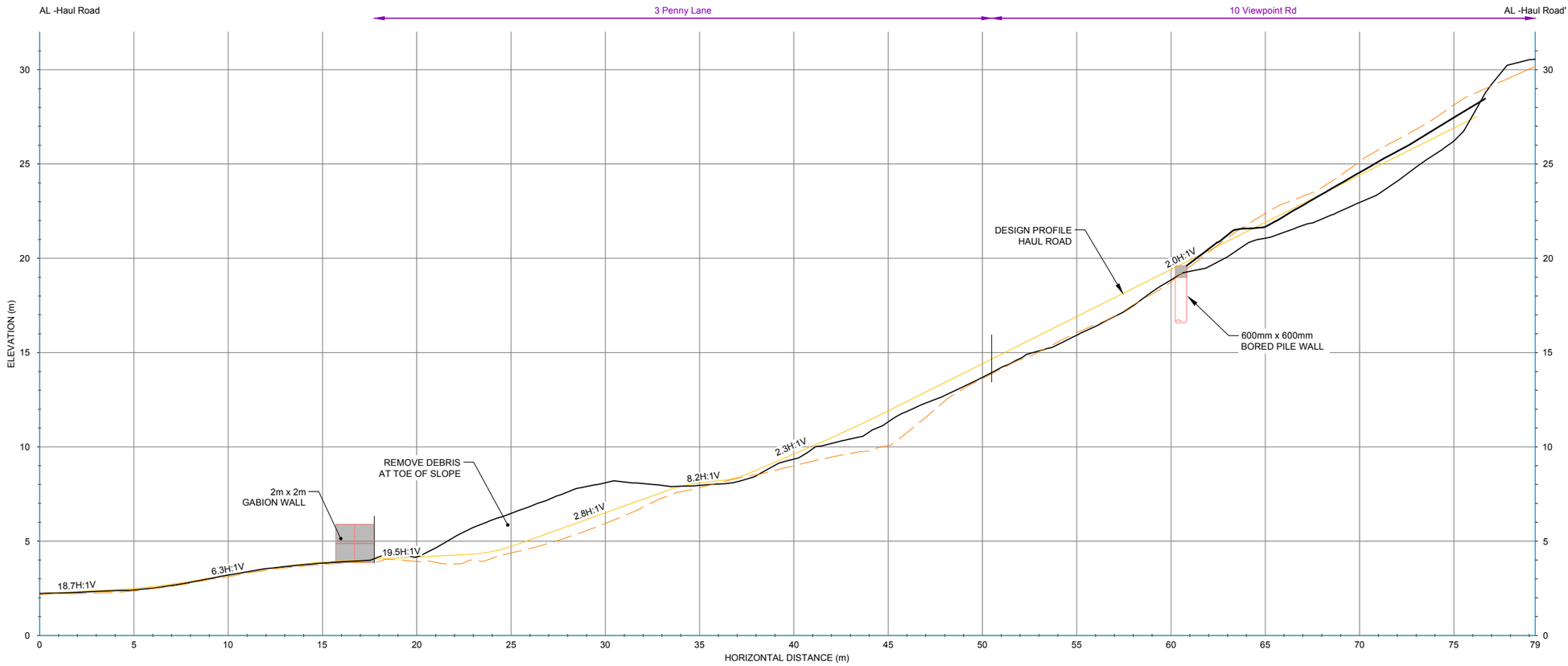
PROJECT
McCrae Landslide Board of Inquiry

CONSULTANT
wsp

YYYY-MM-DD	2025-07-17
DESIGNED	DRP
PREPARED	CRG
REVIEWED	DRP
APPROVED	

TITLE
REMEDIATION CONCEPT USING ROCKFILL WITH WALL - HAUL ROAD - PLAN VIEW

PROJECT NO.	CONTROL	REV.	FIGURE
PS224394	SK-001	A	004a



LEGEND

- CADASTRAL BOUNDARY (VICMAP)
- EXISTING SURFACE 2017-11-28 PROFILE
- EXISTING SURFACE 2025-02-05 PROFILE

NOTE(S)

1. ALL LEVELS ARE REFERENCED IN METRES TO AHD.
2. ALL CO-ORDINATES ARE REFERENCED IN METRES TO MGA20-55.
3. AERIAL DATED 2025-01-16.
4. LOCATION OF SECTIONS ON SHEET PS224394-001-SK-004a.

0 5 10
1:250 METRES

NOT FOR CONSTRUCTION

INFORMATION ONLY

CLIENT
McCrae Landslide Board of Inquiry

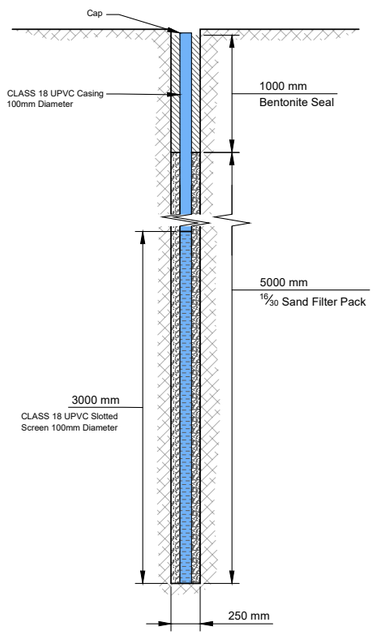
CONSULTANT
wsp

YYYY-MM-DD	2025-07-17
DESIGNED	DRP
PREPARED	CRG
REVIEWED	DRP
APPROVED	

PROJECT
McCrae Landslide Board of Inquiry

TITLE
REMEDIATION CONCEPT USING ROCKFILL WITH WALL - HAUL ROAD - SECTION

PROJECT NO.	CONTROL	REV.	FIGURE
PS224394	SK-001	A	004b



GROUNDWATER MONITORING WELL

LEGEND

- CADASTRAL BOUNDARY (VICMAP)
- EXISTING BUILDING
- OVERHEAD ELECTRICITY
- WATER PIPE
- DRAINAGE PIPE
- SEWER PIPE

NOTE(S)

1. ALL LEVELS ARE REFERENCED IN METRES TO AHD.
2. ALL CO-ORDINATES ARE REFERENCED IN METRES TO MGA20-55.
3. AERIAL DATED 2025-01-16.
4. BASE SURVEY DATED 2017-11-28

NOT FOR CONSTRUCTION

INFORMATION ONLY

0 2.5 5
1:100 METRES

0 10 20
1:500 METRES

CLIENT
McCrae Landslide Board of Inquiry

CONSULTANT
wsp

YYYY-MM-DD	2025-
DESIGNED	DRP
PREPARED	CRG
REVIEWED	DRP
APPROVED	

PROJECT
McCrae Landslide Board of Inquiry

TITLE
groundwater extraction monitoring wells

PROJECT NO.	CONTROL	REV.	FIGURE
PS224394	SK-001	A	010

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

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Appendix B

Constructability and Costing, Whelans

WHELANS GROUP
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ABN 83 143 750 449
103 Rupert Street
Bairnsdale VIC 3875

Memo randum

To: Darren Paul
From: Tim Whelan – Whelans Group
Subject: McCrae Landslide, McCrae
Our Ref: PROF00-05 – McCrae Landslide
Date: 12th August 2025 Revision: B

1. Introduction

Whelans Group (WG) has been engaged by WSP to undertake an assessment of constructability of design accompanied by a construction estimate and high-level program of the McCrae Landslide proposed remedial solution. This information has been reviewed by Darren Paul in a meeting on Friday the 8th of August to affirm the details provided.

2. Background

Whelans Group serve a broad range of clients in both the private and public sector, specialising in civil infrastructure projects throughout Australia. We specialise in construction works for various industries including transport, rail, water, waste management, energy and estate development.

Whelans was established in 1975 in East Gippsland, with over 40 years of industry experience, the name has grown into an East Gippsland icon.
We have successfully delivered projects in Victoria, Northern Territory, NSW, and Western Australia, with works including:

- Airfield construction
- Heavy mining applications
- Major highway re-alignments
- Major landslide restorations
- Railway works
- Waste facility construction
- Ocean entrance sand management
- Sub-divisions
- Sporting complexes
- House sites
- Driveways
- Dams and bush roads.

My background, as detailed in document provided “Whelans CV – Tim Whelan” outlines my experience as a civil engineer and project manager completing a vast array of projects in the above-mentioned categories. I provide this information as a current member of Engineers Australia, NER, however not as a member of Professionals Australia, as such rely on a professional engineer to validate the assessment.

3. Overview

Whelans has assessed the concept designs for landslide remediation provided as well as considered the site conditions based on a site visit conducted on Monday 21 July 2025.

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We have relied upon two high level concept designs presented in the following sketches to prepare the Construction estimate and high-level program:

1. PS224394-SK-001-004a Rev A; and
2. PS224394-SK-001-SK-003

We have established the below key items required to complete the project, noting the key inclusions and exclusions in item 14 and 15 below.

4. Ancillary Costs

Ancillary costs are associated with indirect costs required to complete the project. All direct costs are outlined in the remaining steps 5-11.

5. Site setup

Our assumptions rely on site setup in an adjacent carpark along the point Nepean highway near Penny Lane. This will consist of a full complement of site facilities for the project team to execute the work.

6. Site Clearing

Site clearing works involve the following:

- Clearing of 2 trees directly below the landslide at 607 – 609 Nepean Highway.
- Demolition, removal and disposal of the shed below the landslide at 607 – 609 Nepean Highway.
- Demolition and removal of the debris on 3 Penny Lane and disposal of all debris to a suitable disposal facility.

7. Earthworks

All associated earthworks required to undertake the removal of debris and to install a piles buttress at the toe of the landslide.

These works involve excavating and removing all debris on the site to a suitable disposal facility and will be performed using a series of excavators working from the base of the landslide (Penny Lane) and working up towards the proposed pile wall location. All material will be passed down from the series of excavators to loading out into road trucks for disposal.
This process will be completed in conjunction with the rock placement component and pile wall placement component.

8. Rock Placement

Rock Placement involves all associated works required to complete the placement of rock work as detailed on sketches outlined above. This will involve the series of excavators passing rock between one another, commencing at Penny Lane. This process will follow the Haul Road as indicated on the drawings. A series of rock construction pads will be completed at strategic locations to enable operators a base to pass material to the next machine in the series.
This will be a delicate process of placing the rock as well as removing any loose debris.
The rock placement will be conducted in 2 distinct phases:

1. Rock placement below the pile wall to establish the Haul Road and access route

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2. Rock placement above the pile wall, which will be the most difficult of sections to complete.

Once the rock is placed to the top of the design haul road area the team will utilise a retreat method of removing all machinery and un-needed rock that had been utilised as construction pads.

9. Gabion Placement

Gabion placement involves all associated earthworks and gabion placement activities along the toe of the slope to the east and west of Penny Lane. This will be a pivotal initial step in the project to provide protection to personnel and property located downslope of the works. The gabions are proposed to be prefilled offsite which minimises labour on the ground during construction.

10. Pile Wall Placement

The pile wall placement will be undertaken using specialised drilling equipment that can access the site. The pile wall will be installed after the rock work is installed to the top section of the haul road and the machinery has retreated down past this point. The piles will be bored ready for concrete filling works, which will utilise a concrete pump truck for installation.
The ground beam will be installed once all bored piles have been installed, which will provide a buttress at the tow of the slope to accommodate future downslope creep movement of the rockfill.

11 Landscape & Reinstatement works

The reinstatement works is a whole of site reinstatement including removal and disposal of any remaining debris, construction rock pads, reinstatement of any roads, fences and the like. Decommissioning of the site compound and demobilisation of the site. It also includes hydro mulching the face of the slip for revegetation.

12. Risk, Contingency & Dayworks

Includes a contingency for unforeseen items and an allowance for inclement weather and ground conditions.

13. Summary

Whelans has undertaken an assessment of the concept design for landslide remediation at McCrae provided by WSP. The assessment of the concept design indicates it is able to be constructed using the sequencing and methodology set out above.
This is an opinion only and is subject to further assessment and refinement through subsequent detailed design stages. This report is to be validated by WSP and incorporated into their overall report. It is in no way to be relied upon as a standalone document or as a binding offer to construct.

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14. Inclusions

Assumptions have been made based on previous experience of landslides of a similar scope and prominence, in doing so allowances have been made and included in the estimate for the following activities (noting some requirements may differ once the full design, specification and landowner requirements are finalised):

1. Project management team – including pre-mobilisation work, management plan preparation/updating, risk workshop and management, onsite safety oversight including documentation and system implantation.
2. Plant and labour to complete the works.
3. Design Management capabilities (noting the design fee itself is excluded).
4. Onsite Specialist geotechnical supervision.
3. Onsite traffic management for the duration of the project, including traffic management plan preparation and MOA management.
4. Survey & Setout – including utilising LIDAR/drone technology.
5. Allowance for utility proving and service location – including an allowance for Ground Penetration Permits where required.
6. Continuation of 24-hour security measured onsite – including CCTV and physical patrols.
7. Allowance for a paramedic on standby during high-risk works.
8. Provision of As-Constructed drawings to the relevant landowners/stakeholders.
9. An allowance for maintenance during and defects and liability period.
10. A contingency for Wet Weather and minor scope adjustments throughout.
11. Disposal of known construction waste and materials at Mornington Peninsula Shire landfill facility.
12. Mobilisation and Demobilisation of all plant and equipment from site.
13. Living away from home allowance for specialist operators and management staff.
14. Installation and monitoring of Tilt Sensors detecting landslip movement.
15. Landslide monitoring personnel during high-risk activities.
16. Asphalt reinstatement of Penny Lane surface for affected areas.
17. All delivery activities (including materials, subcontractors and revegetation of Hydro mulch) as required in the proposed construction methodology.
18. Costs based on estimates from previous projects, no formal requests for quote were executed for supplier/subcontractor prices.

15. Exclusions

The provided estimate specifically excludes the following:

- Design Subcontractor fee for detailed design progression.
- Communications and Stakeholder management and any consequential costs of relocation or respite for residents during construction.
- Relocation or protection of Utilities – either contestable or non-contestable.
- Price escalation of input costs prior to and during construction.
- Contaminated materials other than those allowed for in property demolition.
- Any other ancillary requirements not specifically listed in the “Inclusions” section above.

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16. Construction Estimate

Date 12/08/2025
Project McCrae Landslip, 10-12 viewpoint road, McCrae, Victoria, 3938

HIGH LEVEL CONCEPT ESTIMATE
Construction Only - design costs are excluded

Item	Description	Total
	Supply all labour, plant and materials necessary to complete the Landslip Remediation works at **McCrae Landslip**, including but not limited to scheduled items below	
1	**Ancillary Costs**	$ 6,222,148
2	**Site setup**	$ 425,111
3	**Site Clearing**	$ 1,279,016
4	**Earthworks**	$ 697,693
5	**Rock Placement**	$ 783,092
6	**Gabion Placement**	$ 745,296
7	**Pile Wall Placement**	$ 415,523
8	**Landscape & Reinstatement works**	$ 408,690
9	**Risk and Contingency**	$ 512,345
	Including potential Dayworks, Wet Weather Allowance etc.	
Total	**Total Estimated Cost (Excl. GST)**	$ 11,488,914

Regards,

Irrelevant & Sensitive

Tim Whelan

Director of Major Projects and Engineering

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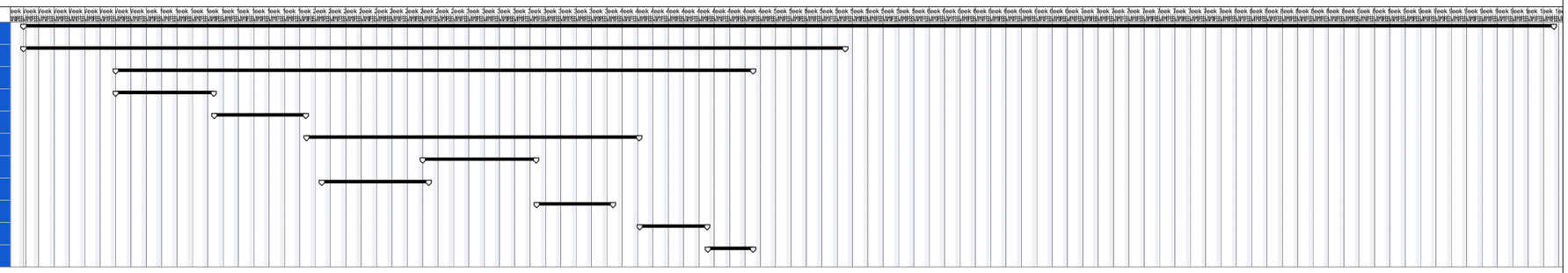
103 Rupert Street
Bairnsdale VIC 3875

Appendix 1:

McCrae Landslide Program – attached as a separate PDF file.

Whelans Group Pty
PROF00-05 McCrae Landslide

ID	Text1	Task Name	Duration	Start	Finish
1		PROF00-05 - McCrae Landslide	497 days	Mon 11/08/25	Fri 9/07/27
5	1	Ancillary Costs	266 days	Mon 11/08/25	Thu 20/08/26
26		Construction	206 days	Mon 22/09/25	Thu 9/07/26
27	2	Site setup	30 days	Mon 22/09/25	Wed 5/11/25
35	3	Site Clearing	30 days	Thu 6/11/25	Wed 17/12/25
39	4	Earthworks	108 days	Thu 18/12/25	Mon 18/05/26
47	5	Rock Placement	38 days	Mon 9/02/26	Wed 1/04/26
52	6	Gabion Placement	35 days	Thu 25/12/25	Wed 11/02/26
56	7	Pile Wall Placement	25 days	Thu 2/04/26	Wed 6/05/26
59	8	Reinstatement works	23 days	Tue 19/05/26	Thu 18/06/26
67	9	Dayworks	15 days	Fri 19/06/26	Thu 9/07/26



Date: Tue 12/08/25

Task, Split, Milestone, Summary, Project Summary, External Tasks, External Milestone, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Critical, Critical Split, Progress, Deadline

Tim Whelan

Director of Major Projects & Engineering

Over 20 years of civil construction experience, with leadership across a variety of major project.

Extensive experience working in earthmoving, quarry production, road projects and civil construction primarily in East Gippsland and extending throughout Victoria and Southern NSW. This foundation has helped developed a strong, hands-on understanding of major projects from the ground up.

More than 10 years as General Manager at Whelans has built a deep understanding on high level business development and mentoring. Known for effectively navigating complex challenges and consistently delivering results, with a track record of earning respect across all levels of the business.

Qualifications and certificates

Bachelor of Engineering (Civil & Infrastructure) – RMIT University, Melbourne

National Engineers Registration (NER) EA 3065010

Member Engineers Australia (MIEAust NER)

Numerous plant operator tickets (including front end loader, backhoe, excavator, skid steer, bulldozer, grader, scraper, roller, haul truck, water cart, stabiliser, compactor, tip truck and trailer and wheel tractor)

Multi Combination drives licence

Control Traffic with a Stop-Slow Bat & Implement a Traffic Management Plan

Rail Industry Worker Card

Senior First Aid

Employment history

Whelans Group Investments Pty Ltd

Director of Major Projects and Engineering: June 2024 – Present

This role essentially encompasses a similar role to the General Manager's role. The key personnel reporting to me in this role is all project managers on major projects, design manager as we develop our consulting/design team, company safety manager as we refine and improve safety across the company and head estimator for co-ordination of all tenders for submission.

Responsibilities:

- High-level business development and networking
- Reporting and liaising with the Chief Operation Officer and other senior management
- Monitoring and management of financial performance

- Monitoring and management of company financial performance
- Monitoring the execution of all projects to ensure correct standards are being adhered to
- Aiding PMT/PLT member requiring extensive problem analysis that are at the core of the project's ability for success or failure
- Ensuring all project management, surveying, data control, tendering standards, subcontractor management and safety controls are adhered to
- Overseeing the assessment of risk and developing management strategies within the project/company and that these are incorporated
- Ensuring all solutions developed within the projects/company incorporate sustainable options

Whelans Group Investments Pty Ltd
Project Manager: January 2023 – June 2024

This was one of the largest landslip remediation projects in Victoria's history and was initially classified as emergency works. The landslip occurred in October 2022, and Whelans began onsite works in February 2023. Separable Portions 1 and 2 reached practical completion in May 2024. The project was delivered ahead of schedule, successfully reopening a key tourist route to Falls Creek just in time for the winter season.

Key aspects of the project:

- 70m heigh, 100m wide, 70m deep
- 88,000 m3 total material removed for interim solution
- further ~335,000 m3 excavated for permanent works
- full time, 7 days a week, presence onsite (February 2023 to May 2024)
- 70+ truckloads of material moved per day
- 30+ specialized machines/vehicles on site
- 20,000 m2 of coir matting installed to prevent erosion and stabilize the slope
- 25 sensors installed across the landslip

Responsibilities:

- Manage the project team, varying from 5-20 staff members
- Laise directly with MRPV at a PMT level escalating to the PLT members
- Key inputs on the design constructability of the project
- Managing information to be incorporated into the scheduling
- Managing the TARP process as the primary contact
- Understanding the local constraints and area for incorporation into the project
- Utilising information gathered from in house survey to influence the design
- Chairing multiple meetings both internally and within MRPV
- Influencing the development of the hydro mulch specification which is now being incorporated into the DTP specifications
- Analysing the problems within the fill disposal sites for consideration at PMT and PLT level
- Managing the comms team to ensure all messaging from the project were accurate
- Undertaking daily site inspections to complete the "go-no-go" process, which essentially created a daily ethical decision between safety and production
- Co-ordinating design manager/onsite surveyor to achieve as constructed drawings
- Liaising with emergency services, in conjunction with MRPV, to enact the TARP and 24-hour response
- Liaising directly with key stakeholders on progress and program
- Relying on information to inform decisions for road opening times for 2023 and 2024 ski seasons
- Achieving this project with no injuries or major safety concerns from Whelans or the client

Whelans Group Investments Pty Ltd

General Manager: 2013 – December 2022

This role was a company-based role whereby I was responsible for all construction across all projects within the newly formed Whelans Group Investments (formerly Whelans Earthmoving). I also took on Whelans' seven quarries for management with quarry managers reporting directly to me. During this period, I was also responsible for the heavy haulage, accounting team, tendering/engineering team, major projects team and farming division. Direct staff reporting to me were eight, with an overall group of 75 under my area of management.

During this time, I also successfully managed the following key project as Project Manager:

- ARTC Adelaide loops: This project required 4 turn our loops to be constructed between Ararat and Nhill, all approximately 1.8kms in length. The tender was successful with an alternative lime treating technique which allowed us to incorporate a sustainable option which was more viable than the conforming. This project was quite successful and linked up with another shut down project over Christmas of 2015. All the skills outlined below were utilized to ensure these works were successful.

Whelans Earthmoving Pty Ltd

Project Manager: June 2011 – 2013

This role was where I reported directly to the Managing Director on more complex projects. This was the first time Whelans created multiple project managers as we commenced a Major Project. My role included all projects excluding Major Projects at that time.

Key projects included:

- V/Line Toolamba – a railway near Shepparton where the embankment had failed. It was a shutdown project involving 24-hour shifts for 14 days to complete. We removed the track, removed the failing material, placed the imported material, replaced the capping layer and replaced the ballast prior to track replacement.
- Falls Creek Road 24 reconstruction – this project involved a failed road on the falls creek resort management land involving a 22,000kva service relocation, gabion wall installation and earth backfill. We utilized lime stabilisation, reno mattress's and geofabric within the works. This project incorporated the prefilled rock gabion featured in the rock gabion case study.
- DSE PLB Culverts – this project was in Mt Beauty area where the road had been washed out 8 times blocking access and creating an issue with a 22,000kva cable being suspended between falls creek and Mt Hotham.

Responsibilities:

- Managing all tenders through the company
- Managing the engineering team of 2-5 across multiple projects
- Co-ordinate all plant and labour for the projects
- Laise with designers for relevant drawings
- Challenge constructability within designs
- Complete all project documents including Project management plans, SWMS, daily prestart, emergency contact forms, EOT forms, Variations, progress claims, invoices, sub-contractor progress claims, subcontractor invoice sign offs
- Completing all quantity take-offs for the projects prior to commencement
- Implementation of case study within gabions into a tender for acceptance
- Work through the simultaneous scheduling across multiple projects
- Implement safety initiatives within the team
- Assist in tendering for new projects
- Create shut down rosters for staff
- Liaising with clients directly for all scheduling on highly critical works
- Co-ordinate all logistics for staff on remove projects
- Setout/survey of the projects with our Trimble equipment
- Implement machine control on our grader/excavator

- data preparation for all 3D data from designers onto the set-out equipment
- Ordering all materials and arranging sub-contractors
- Completing project handovers
- Completing all project meetings

Whelans Earthmoving Pty Ltd
Project Engineer: June 2010 – June 2011

This role was my first as a qualified Civil Engineer. This role was reporting to the company Project Manager and Managing Director as required. During this time, I completed the following key projects:

- V/Line Warragul – Landslip works between two railway lines in Warragul. This project was my first and where the prefilled rock gabion case study was developed. This project was a success and generated further projects for the company with this client.
- Snowy Range Airfield – Airfield works in the alpine region near Licola which consisted of earthworks, pavement construction and a concrete pad. This project utilised our quarry, haulage fleet and onsite team to achieve the work. We completed some minor design work for this project.
- Eastwood sub-divisions – multiple stages – this project was an ongoing project for Whelans thought the mid 2000's to the end of 2015. They were typical kerb and channel, granular pavement with asphalt finish, stormwater pits, pipes and all services.

Responsibilities:

- Co-ordinate all plant and labour for the projects
- Laise with designers for relevant drawings
- Complete all project documents including Project management plans, SWMS, daily prestarts, emergency contact forms, EOT forms, Variations, progress claims, invoices, sub-contractor progress claims, subcontractor invoice sign offs
- Completing all quantity take-offs for the projects prior to commencement
- Work through the simultaneous scheduling across multiple projects
- Implement safety initiatives within the team
- Assist in tendering for new projects
- Setout/survey of the projects with our Trimble equipment
- Commenced data preparation for all 3D data from designers onto the set-out equipment
- Ordering all materials and arranging sub-contractors
- Completing project handovers
- Completing all project meetings

BMD Constructions Pty Ltd,
Student/Graduate Engineer: 2009 – June 2010

In this role I was required to work alongside the project engineer and project manager for the Residential team in Melbourne.

Our projects were between 28-300 Lot subdivisions ranging across multiple municipalities throughout Melbourne.

Responsibilities:

- Completing Project management Plans
- Quantity take offs comparing them from tender to construction
- Checking contracts prior to signing to validate all particulars are correct
- Arranging sub-contractors for projects
- Arranging subcontractor reviews to select the best Value for money contractor
- Arranging suppliers' reviews to select the best Value for money suppliers
- Co-ordinating supplier deliveries to sites in conjunction with foremen
- Completing progress claims for the projects for review from my supervisors
- Undertaking subcontractor statements to validate subcontractor invoices
- Working in partnership with the land development arm of BMD with the design and construction portion of the projects
- Meeting minutes for all relevant project meetings
- Undertaking reviews of sustainability documents
- Liaising with foremen for their requirements onsite and ensuring they were met
- Providing advice on constructability with my knowledge of machinery and previous experience
- Liaising with relevant authorities for co-ordination prior to commencing the project

- Undertaking red-line markups in preparation for the as-constructed drawings

Whelans Earthmoving Pty Ltd

Machine Operator, Leading Hand, Foreman, Logistics Manager: 2004 – 2009 (Part Time)

During this time, I practiced in all machinery operation including but not limited to excavator, dozer, grader, loader, roller, water truck, scraper, dump truck, truck and dog, low loader float trucks and tractors

I completed projects as a Leading hand and progressed into a foreman. Requirements of my role were:

- Onsite set out
- Completing daily prestart
- Crew co-ordination
- Co-ordination of materials and subcontractors
- Arranging plant movements for the projects

At the completion of this time, I commenced the role of Logistics manager, responsibilities included:

- Co-ordination of all company plant
- Booking of all company Haulage fleet
- Managing Haulage Team staffing
- Co-ordinating miscellaneous materials and subcontractors for projects