Planning, Industry & Environment

*Issued under the Environmental Planning and Assessment Act 1979*

Approved Application No DA 10115

Granted on the 9 September 2021

Signed MB

Sheet No 1 of 63

dabyneplanning

# STATEMENT OF ENVIRONMENTAL EFFECTS

## REPLACEMENT OF THE MOUNT PERISHER DOUBLE AND TRIPLE CHAIRLIFTS WITH A SIX SEAT DETACHABLE CHAIRLIFT & ASSOCIATED WORKS
## PERISHER SKI RESORT
## KOSCIUSZKO NATIONAL PARK

**Prepared for:**
**Perisher Ski Resort**

perisher

**DECEMBER 2019**
**Project: 10-19**

# STATEMENT OF VALIDITY

## Statement of Environmental Effects prepared by:

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**Applicant:** Perisher Blue Pty Ltd

## Declaration

I certify that I have prepared the contents of the Statement of Environmental Effects in accordance with the requirements of the Environmental Planning and Assessment Act 1979 and Regulations and that, to the best of my knowledge, the information contained in this report is not false or misleading.

Ivan Pasalich
**Principal**
Dabyne Planning Pty Ltd

Nb: If the report is not signed above, it is a preliminary draft.

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## Appendices



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# EXECUTIVE SUMMARY

Dabyne Planning Pty Ltd has been engaged by Perisher Blue Pty Ltd (Perisher), the operator of the Perisher Ski Resort to prepare a Statement of Environmental Effects (SEE) to accompany a Development Application (DA) to the NSW Department of Planning, Industry and Environment (DPIE).

The DA is for the replacement of the current Mount Perisher double chairlift and triple chairlift with a new detachable six seat chairlift plus associated works. The design capacity of the new lift is 3000 persons/hr compared with the current design capacity of both lifts at 1815 persons/hr, an increase of over 60% in lifting design capacity.

The Mount Perisher double chairlift was constructed and first operated in 1961 and represents the oldest lifting infrastructure within the Perisher Ski Resort and is a fixed grip lift. The Mount Perisher triple chairlift was constructed and first operated in 1979 and is a fixed grip lift. Both chairlifts have been planned to be upgraded, as outlined in the Perisher Blue Ski Slope Master Plan (PSSMP).

As the new chairlift will require a large footprint for the chairlift bottom station, chair shed and queuing areas, the highly disturbed area adjacent to the base of the triple chairlift has been chosen.

The proposed alignment is therefore to construct the new chairlift generally along the triple chairlift alignment, however the bottom station will be located approximately 10m to the north of the current bottom station and therefore offset from the current alignment for the lower portion of the chairlift alignment.

As a detachable lift is proposed, a chair shed is required for the storage of chairs when not in use. The chair shed is proposed to be located on the northern side of the bottom station to allow enough space for skiers and snowboarders to reduce speed, congregate and queue for the lift from the south. This provides the best approach and loading of the lift, with a 90-degree load (similar to the Village Eight chairlift, but opposite side).

To provide improved skier and rider access in marginal conditions to the new bottom station, two steel bridges are proposed to provide access across an upper tributary of Perisher Creek. The bridges have been designed to accommodate grooming machines and the significant increase in skiers and snowboarders that will descend towards the bottom station and cross the creek.

The proposed top station is to extend above the current triple chairlift top station and the current double chairlift top station to where the NPWS communications hut is currently located.

This hut, which accommodates emergency services communications will be removed and has been designed to integrate into the new top station building, with antennae equipment to be relocated onto the new building.

A higher lift provides more connectivity options for skiers and snowboarders than the current two top stations located at different elevations. Skiers and snowboarders will be able to choose all the available ski runs in all directions without having to traverse across a slope.

To provide sufficient space for skiers and snowboarders disembarking the new chairlift with a 90-degree offload towards the south, a large area for congregating is required. This will be achieved by undertaking rock removal and/or reduction works below the top station offload area and by relocating the current Eyre T-bar bullwheel return station downslope in the same alignment.

The removal of the existing chairlifts and installation of the new chairlift and relocation of the Eyre T-bar bullwheel return station will require minor changes to the snowmaking system and location of selected snowmaking hydrants.

The new chairlift will require a new up-hill safety line (a communications cable that connects the bottom and top stations and each tower). Due to the extreme weather conditions on Mount Perisher, the only viable method is to install the cable underground to prevent icing. To minimise impacts on the environment, the existing conduit already installed as part of a previous upgrade of the up-hill safety line for the Mount Perisher triple chairlift (around 2011) will be utilised for the new up-hill safety line, which will vastly limit the extent of trenching required for the new lift.

Construction access along the entire chairlift alignment will utilise the existing access road up Mount Perisher, subject to being upgraded. To improve the crossing of the Perisher Creek adjacent to the double chairlift bottom station, a culvert is proposed to be installed to improve construction access, and limit impacts on the watercourse.

With regard to electricity, the lift drive station will be at the bottom of the chairlift. The current two lifts and snowmaking system on Mount Perisher are already serviced by an electrical transformer at the top of the mountain and at the base of the mountain, which will be both replaced and upgraded in the same locations.

In accordance with the Biodiversity Conservation Act, 2016 (BC Act, 2016), the subject site is mapped as comprising high biodiversity values. Accordingly, the removal of native vegetation associated with the development will trigger the Biodiversity Offsets Scheme (BOS) under the BC Act, 2016.

Consequently, a Biodiversity Development Assessment Report (BDAR) has been prepared by Ryan Smithers, Senior Ecologist with Eco Logical Australia who is an Accredited Person under the BC Act, 2016. The BDAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development site during the design, construction and operation of the development. The residual unavoidable impacts of the proposed development were calculated in accordance with the Biodiversity Assessment Method (BAM) by utilising the Biodiversity Assessment Method Credit Calculator (BAMC). The BAMC calculated that a total of ten (10) ecosystem credits and twenty-four (24) species credits are required to offset the unavoidable impacts to the vegetation and habitat present within the development site.

Payment of the offset credits will be made to the Biodiversity Conservation Fund (BCF) prior to works commencing.

Preceding the preparation of the BDAR, the proposed development has been subject to an extensive preliminary operational, planning and environmental analysis. This has included engaging Eco Logical Australia to undertake targeted searches for the Guthega Skink, mainly concentrated around the top station where previous recordings by Eco Logical Australia have been made.

These searches were conducted over the summers of 2017/18 and 2018/19 with recorded sites identified and mapped. These have helped to inform the design of the lift and associated works.

Furthermore, the preliminary operational, planning and environmental analysis of the chairlift alignment and profile also resulted in towers 6 & 7 being relocated, with tower 6 located near a recorded Guthega Skink site and tower 7 located within an Alpine Bog. Consequently, the chairlift has been redesigned with towers 6 & 7 both located further upslope within mostly previously disturbed areas.

Regarding the potential for impacts on Aboriginal Heritage, an 'Aboriginal Cultural Heritage Due Diligence Assessment' was undertaken by Past Traces Heritage Consultants which included a field survey and assessment. This assessment concluded that no areas of potential archaeological deposits or heritage sites have been identified within the development area and the potential for Aboriginal heritage objects within the development area has been assessed as low.

The visual impacts associated with the development have been considered and addressed through the design and siting of the lift and in particular the top station building. The design of the top station building has been driven by the need to provide an enclosed structure that provides the necessary weather protection to prevent snow drifting and icing of the top station and to provide guests and staff protection from prevailing winds whilst unloading the chair. The building also needs to include a chair grip service bay, communications equipment and storage.

The top station building has therefore been carefully designed to integrate with both the summer and winter landscape with the top of the building set lower than the large rock outcrop behind to limit impacts when viewed from the Main Range.

Using natural tone colours and appropriate alpine materials, the visual impacts associated with the buildings and lift components will be further mitigated.

By replacing two existing chairlifts, each with bottom and top stations and a combined total of twenty-seven (27) lift towers with a single six seat detachable chairlift on a similar but extended alignment, with only ten (10) lift towers, the visual impacts associated with the development are considered acceptable.

In accordance with clause 27 of State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007, the proposed lift is 'advertised development' as the proposal is for the 'erection of a new ski-lift line'.

Pursuant to clause 13, Schedule 6 of the Environmental Planning and Assessment Regulations 2000, a statement of environmental effects required by Schedule 1 is to accompany a development application relating to a ski resort area must be prepared in accordance with guidelines issued under this clause if the proposed development is advertised development.

This SEE has been prepared in accordance with the Secretary Guidelines issued by the DPE on the 12 December 2018.

The SEE has concluded that following an extensive operational, planning and environmental analysis, the proposed chairlift and associated works achieves the optimum operational outcome whilst minimising impacts on the environment.

# 1. INTRODUCTION

## 1.1 Purpose of the Report

This report presents a Statement of Environmental Effects (SEE) for a proposal by Perisher for the replacement of the current Mount Perisher double chairlift and triple chairlift with a new detachable six seat chairlift plus associated works.

The purpose of this SEE is to

- describe the land to which the DA relates;
- describe the form of the proposed works;
- define the statutory planning framework within which the DA is to be assessed and determined; and
- assess the proposed development against the matters for consideration listed under Section 4.15(1) of the Environmental Planning and Assessment Act, 1979 (EP&A Act, 1979).

In accordance with Schedule 1 of the Environmental Planning and Assessment Regulations 2000, a statement of environmental effects must indicate the following matters:

- the environmental impacts of the development,
- how the environmental impacts of the development have been identified,
- the steps to be taken to protect the environment or to lessen the expected harm to the environment,
- any matters required to be indicated by any guidelines issued by the Director-General for the purposes of this clause.

The report has been prepared in accordance with the requirements of Schedule 1 and Clause 13 of Schedule 6 of the Environmental Planning and Assessment Regulations 2000.

## 1.2 Justification for the Proposal

The Perisher Blue Ski Resort Ski Slope Master Plan (PSSMP) was developed by Perisher over seven (7) years and contains proposals for the ski slope areas of Perisher, Smiggin Holes, Blue Cow, Guthega and the Link Management Unit of Kosciuszko National Park. The plan was required by the Kosciuszko National Park Plan of Management at the time, which set out the required contents of a ski slope plan and the process for it to be adopted.

The PSSMP was adopted by the NSW Government in 2002 and covers the Mount Perisher Precinct (Precinct 3 - Chapter 8).

The proposed development is located within the Mount Perisher Precinct and the following extract from the PSSMP, provides a summary and history of this precinct and forms the basis for the development:

*'The five lifts on the mountain are relatively old but provide access to some of the best skiing in the resort. It is a popular area with intermediate to advanced skiers who reach it by skiing down from the Perisher Express or working their way across through Front Valley and Centre Valley to either Sun Valley T-bar or the chairlifts at the base of Mount Perisher.*

*The precinct also provides access to the Olympic T-bar in Precinct 2, which is used often by advanced skiers in conjunction with the Sun Valley T-bar.*

*With the exception of International T-bar, lifting within the precinct is often used at over-capacity. Queues of up to 40 minutes can occur on Mount Perisher Double Chair and Eyre T-bar. Queues of up to 30 minutes can occur on the Mount Perisher Triple Chair and the Sun Valley T-bar. Sun Valley T-bar provides the only access to this precinct when the chairlifts are closed due to wind. On these occasions, its usage can be over capacity'.*

Since 2002, Perisher has continually reviewed and prioritised the developments proposed by the PSSMP since its adoption having regard to the relevant operational, guest service and environmental factors.

Between 2007 and 2009, Perisher undertook an extensive snowmaking infrastructure program which included the installation of automated snowmaking on Mount Perisher and Happy Valley.

In 2010, the Happy Valley T-bar bottom station was extended and relocated further down the hill, so that it could be utilised by more skiers and boarders from Mount Perisher.

In 2019, the Leichhardt T-bar was replaced with the Leichhardt chairlift, a four-person (quad) fixed grip chair on the same alignment, together with snowmaking improvements between Happy Valley T-bar and the base of the new chairlift.

This has assisted with reduced queuing at the Happy Valley T-bar, particularly attributed to Ski School groups which can now utilise the new Leichhardt chairlift.

The Leichhardt chairlift also provided a lift replacement which better matched its current ski slope capacity with lift capacity and assisted in providing improved access to popular freestyle facilities, including the current Leichhardt terrain park. The new chairlift together with improved snowmaking requires less natural snow, allowing it to open earlier and remain open later in the season.

All these improvements have been undertaken to improve visitor experiences and the operation of the resort and in particularly to accommodate a new high-speed chairlift for Mount Perisher.

A detachable six seat chairlift that replaces two older fixed grip chairlifts will provide the resort and its customers a large range of benefits, including:

- Replacement of two outdated lifts with a vastly upgraded facility with safety and convenience improvements.
- Increased lift capacity by 60% (1815 people per hour to 3000 people per hour) to better match the current ski slope capacity and reduce queuing times.
- Provision of a wider and safer ski run on Mount Perisher by removing two (2) top stations and twenty-seven (27) lift towers and replacing this with the installation of one (1) top station and ten (10) new towers which have been mostly located out of the main ski run.

- Improve the Mount Perisher precinct, being one of the most popular in the resort for intermediate to advanced skiers and snow boarders with a diversity of terrain, good snow accumulation and a relatively sparse tree cover.
- Improved chairlift wind performance with heavier chairs.
- Provide for the comfortable loading and unloading of passengers through the use of detachable grip technology that enables chairs to separate from the haul rope, travelling slower at the load and unload locations.
- Improving the travel time from the current trip time of approximately 10 minutes down to 5½ minutes.
- Ease congestion on other lifts in the Mount Perisher precinct and across the resort.

Overall the development would represent a significant capital investment by the ski resort operator into modernising the lifting infrastructure and improving efficiency, leading to overall improved visitor experiences.

## 1.3 Objectives of the Proposal

The primary objectives of the proposal have been defined by the five main planning goals that have driven the development of the PSSMP which reflect both operational goals and environmental considerations as follows*:*

- ***Integration:*** *the efficient integration of what were originally four separate resorts.*
- ***Modernisation:*** *replacement of outdated lifts and equipment and the upgrading of other facilities to meet current expectations of safety and convenience.*
- ***Expansion:*** *provision of additional lifts, trails and other facilities to make efficient use of the areas identified in the PoM for alpine skiing and provide skiers of all skill levels with a range of opportunities.*
- ***Enhancement of the visitor experience:*** *creating a safe and attractive environment in all seasons.*
- ***Environmental sustainability:*** *implementation of skiing improvements in a way which maintains or enhances the essential natural processes within the environment of the resort.*

*Factors affecting the quality of the visitor experience include:*

- *ease of access into and out of the resort;*
- *ease and efficiency of circulation within the resort for pedestrians and skiers;*
- *number, capacity and diversity of lifts and trail systems;*
- *extent and quality of snow;*
- *adequacy of public facilities;*
- *public safety;*
- *pricing regime; and*
- *ambience and character of the resort.*

*Ease and efficiency of circulation, adequacy of public facilities, lift and trail capacity and public safety are largely determined by the PSSMP, which can also significantly influence the ambience and character of the resort.*

The proposed development has been guided by these five primary objectives and sets out to achieve the following:

**Increased lift capacity:** The proposed development would result in an increase to the current lift capacity by 60%. By removing the existing two chairlifts and twenty-seven (27) towers and replacing it with a single chairlift with ten (10) towers with an extended length, slope capacity will also be slightly increased.

The development will result in the better utilisation of ski slope capacity within this part of the resort given that the current lifting capacity is lower than the ski slope capacity.

**Increase slope capacity:** The proposed development will allow for the removal of the existing double and triple chairlifts and their combined twenty-seven (27) towers including top stations located on the ski slopes. This will result in a small increase to the ski slope capacity. Ski slope capacity is determined by the area of skiable snow available.

The removal of the double and triple chairlift towers and triple chairlift top station also provide better and safer access and improve the ski run under the lifts.

**Improved ease of use:** The replacement of the double and triple chairlifts, both fixed grip chairlifts with a detached six seat chairlift will result in the improved ease of use of the lift which is faster and less difficult to use. The speed of the lift will nearly halve the current lift trip times, with a designed speed of 4.5 metres per second and expected trip time of 5½ mins.

The provision of a detachable lift allows for easier loading and unloading, as the lift detaches from the main (fast) haul rope onto the slower station tyre conveyors. This makes the use of the lift easier particularly for beginners and children and improves the efficiency of the lift by the efficient loading of chairs.

The proposed chairlift would therefore improve skier/boarder safety and enjoyment.

**Improved performance:** As outlined in the PSSMP, the current chairlifts are prone to closure during high winds, which would also apply to the proposed six-seater chairlift. However, the new chairlift will provide improved wind performance with heavier chairs. The three existing T-bars will remain to ensure alternative lifting on high wind days when the new chairlift may be closed.

**Modernisation of infrastructure:** The installation of a new six seat chairlift will allow for the oldest lifting infrastructure within the Perisher ski resort, the Mount Perisher double chairlift, constructed and first operated in 1961 to be removed. The new lift will also allow for the Mount Perisher triple chair, constructed and first operated in 1979, to be removed.

**Improved visitor experiences:** Ultimately the proposed development will provide a better experience for resort guests by modernising the lifting infrastructure and reducing lift queue times in the Mount Perisher area of the resort.

# 2. THE LOCALITY AND SITE

## 2.1 The Locality

The subject site is located within the Perisher Valley precinct of the Perisher Ski Resort, which is located within the Perisher Range Resorts in South-Eastern NSW as illustrated in figure 1 below:


***Figure 1: Location of the Perisher Range in context with South-Eastern NSW (source: Perisher Range Resorts Master Plan)***

The Perisher Range Resorts is located within the southern part of the Kosciuszko National Park.

A map of Kosciuszko National Park is provided in figure 2 below.

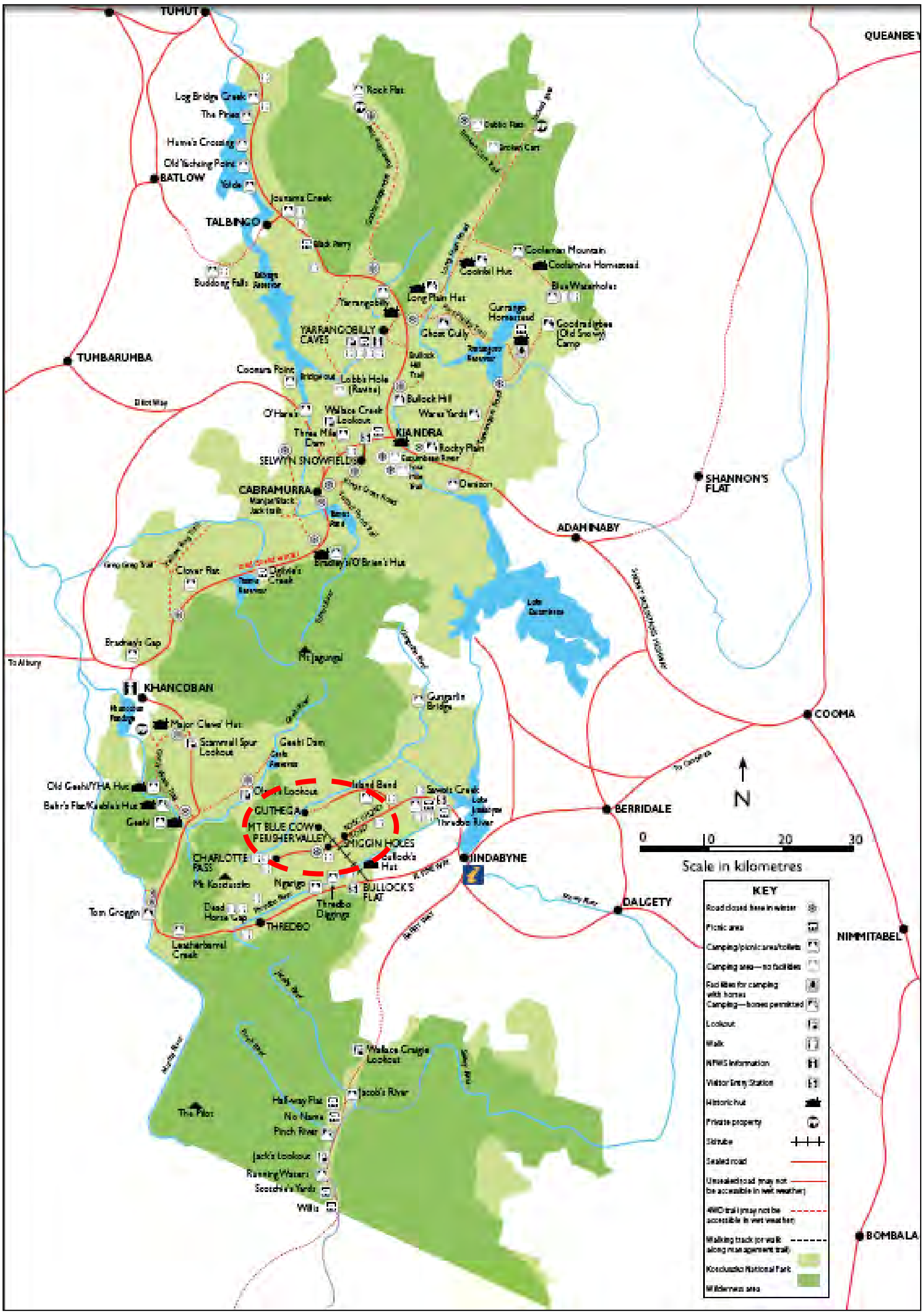


*Figure 2: Location of Perisher Valley in context with Kosciuszko National Park (source: NPWS KNP 2011 Guide)*

The Perisher Valley Precinct is located approximately 35kms from Jindabyne. Vehicle access to the resort is achieved via Kosciuszko Road, while access is also achieved via the Skitube from Bullocks Flat.

The location of the Perisher Valley is illustrated in context with the regional locality in figure 3 below:

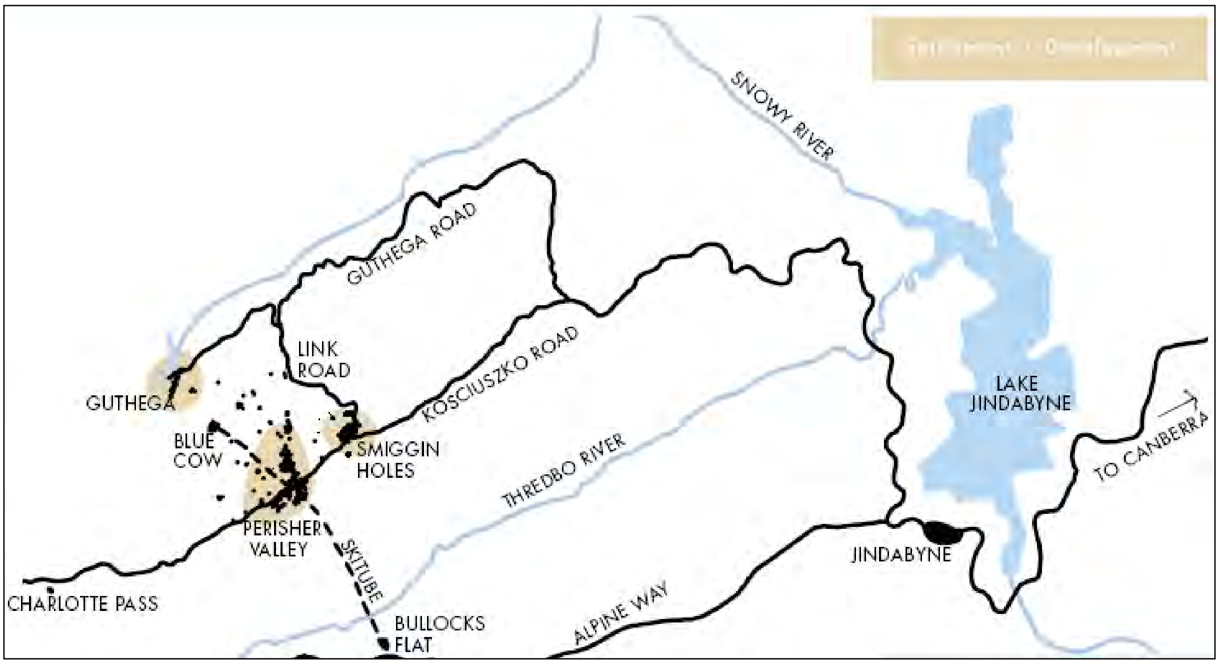


*Figure 3: Location of Perisher Valley in context with the Region (source: Perisher Range Resorts Master Plan)*

## 2.2 The Mount Perisher Precinct

The Mount Perisher Precinct is located at the south-western extremity of the resort and is clearly defined by Mount Perisher and its slopes.

A topographical map of the precinct in relation to the Perisher Range Resorts is provided in figure 4 below.

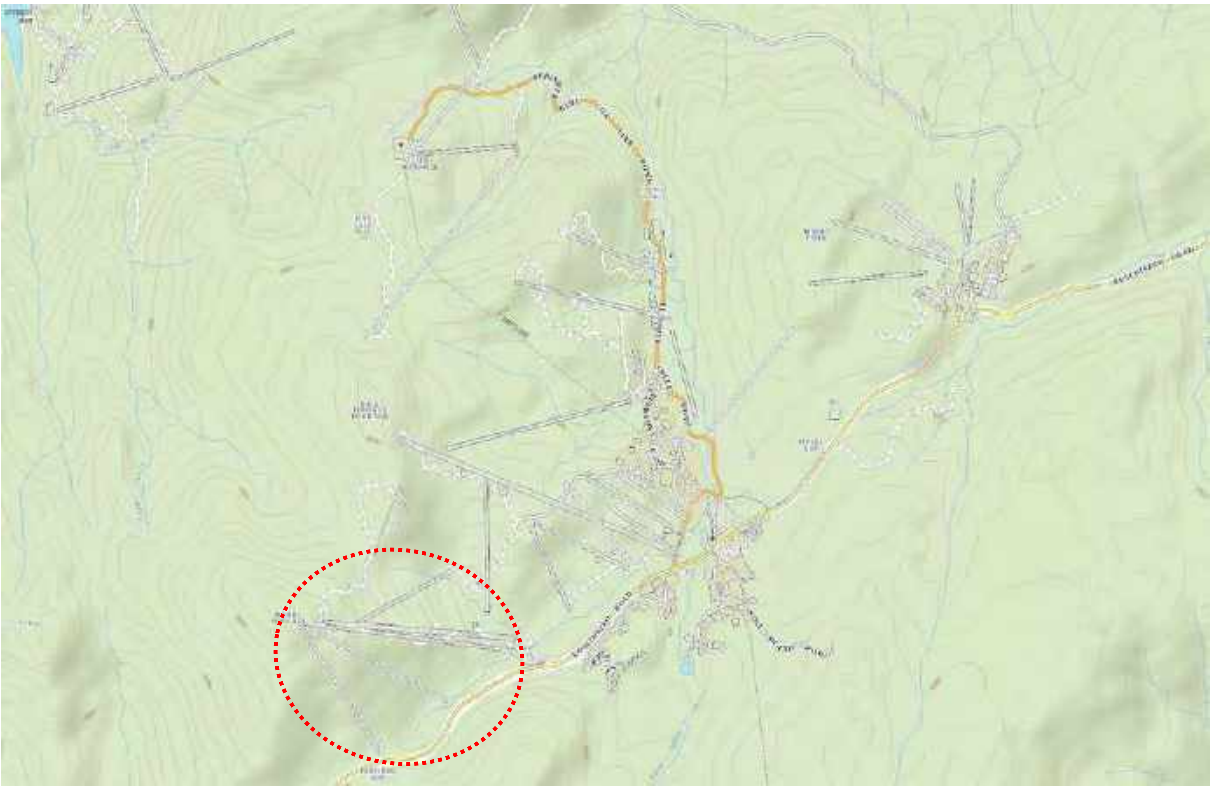

*Figure 4: Location of the Mount Perisher Precinct in context with the Perisher Range Resorts*

The Mount Perisher Precinct is located within the Perisher Valley Smiggin Holes Management Unit identified in the former Kosciuszko National Park Plan of Management (1982) and illustrated in the PSSMP in figure 5 below:

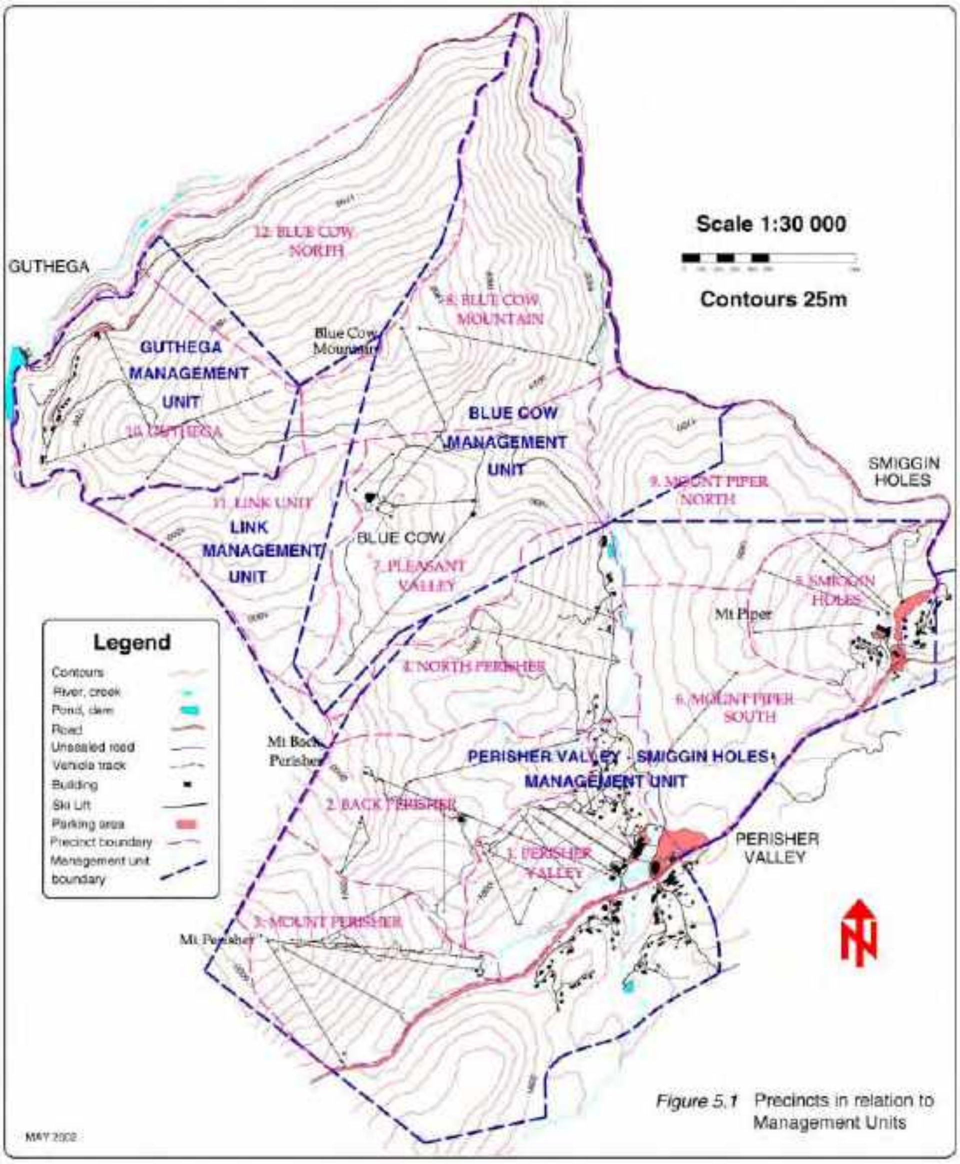


***Figure 5: Management Unit Map for the Perisher Ski Resort (source: PSSMP)***

Under the current Kosciuszko National Park Plan of Management (2006), all the resort precincts sit within the one Perisher Range Management Unit.

## 2.3 The Site

The subject site is located between Kosciuszko Road and the top of Mount Perisher.

An aerial map of the resort is provided in figure 6 with the subject site highlighted.

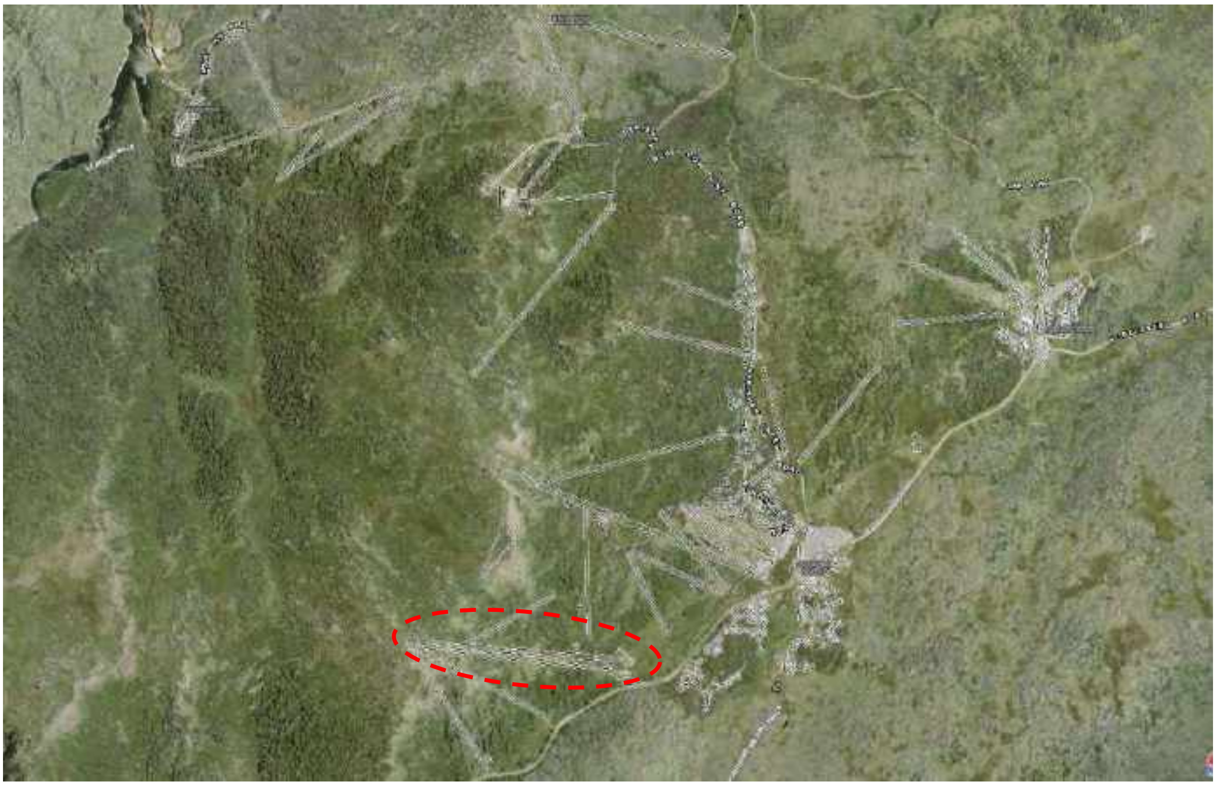

***Figure 6: Location of the subject site in context with the wider locality***

The site is located between an altitude of 1730m (AHD) and 2042m (AHD) with the Perisher Creek and its tributaries located around and below the proposed bottom station, within 40m of the development works, as shown in figure 7 below.

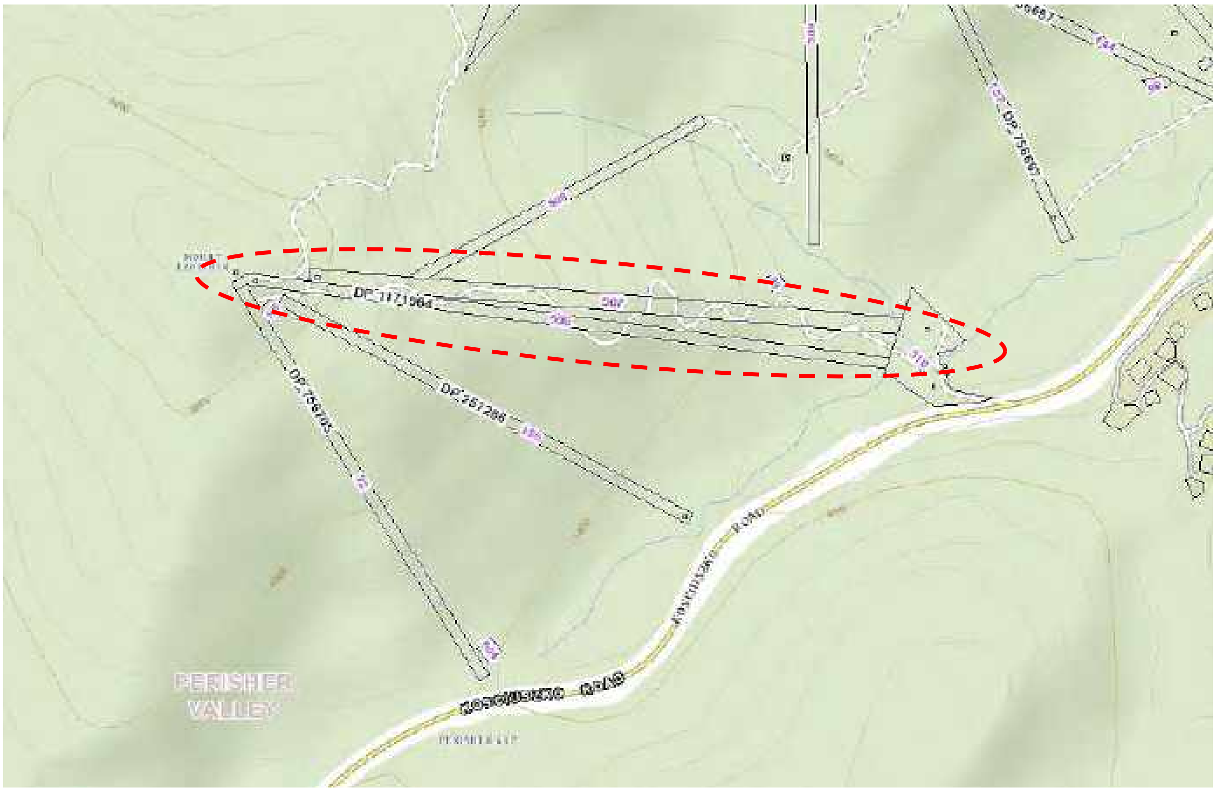


*Figure 7: Topographic map of the subject site in context with the resort*

Perisher Creek has been previously diverted and covered by resort infrastructure with creek bridges and culverts both above and below the subject site.

The location of the bottom station in relation to the watercourses identified on the topographic map is provided below in figure 8.

***Figure 8: Combined aerial and topographic map of the bottom station site***

With five lifts servicing the Mount Perisher Precinct, there has been a moderate amount of development and slope grooming within the precinct, including some major rock removal, surface disturbance and rehabilitation using introduced grasses on the upper slopes. More recently the mountain has been subject to substantial improvements through the installation of automated snowmaking infrastructure.

An aerial map of the site is provided below.

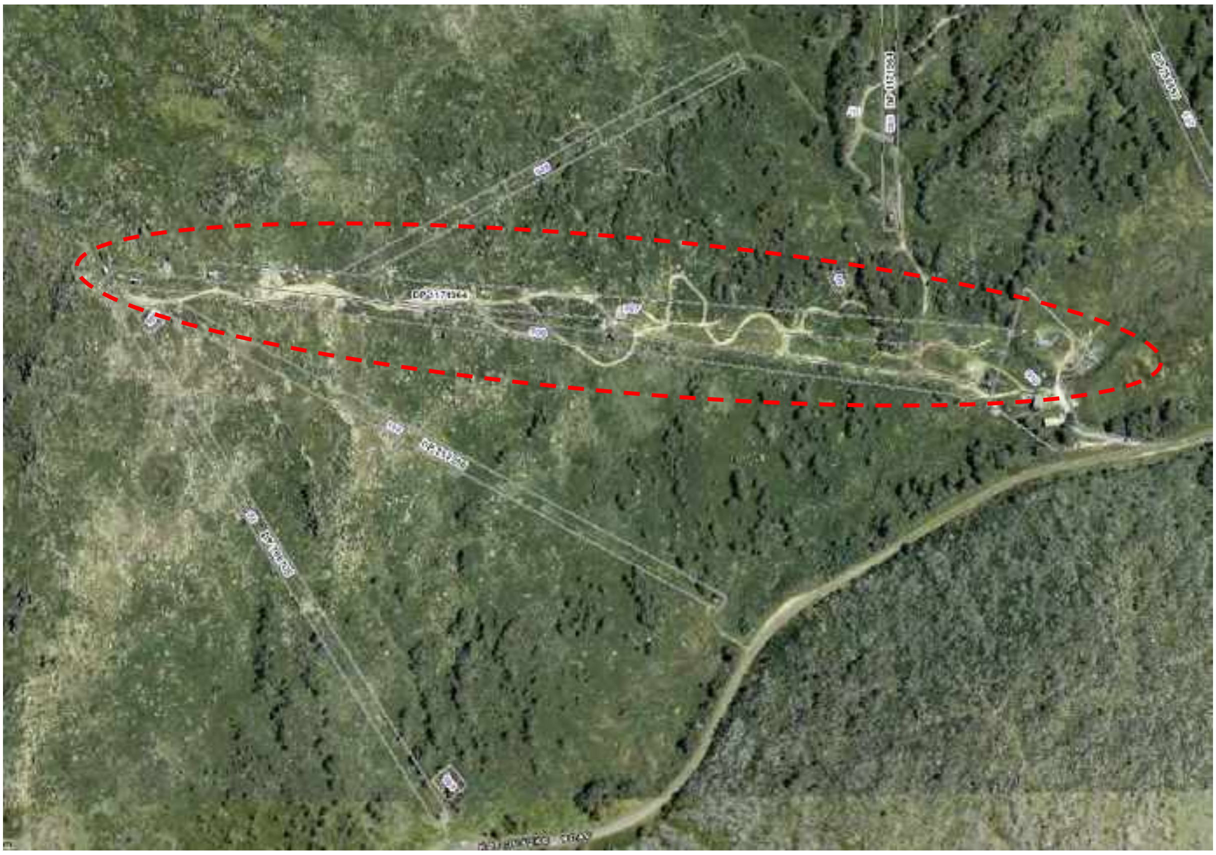

***Figure 9: Location of the subject site in context with the resort***

The site is located along a similar alignment to the current Mount Perisher triple chairlift, adjacent to the Mount Perisher double chairlift as illustrated in the trail map provided below in figure 10 and photo in figure 11.


*Figure 10: Location of the subject site in context with the ski resort (trail map)*

*Figure 11: Location of the subject site in context with the Mount Perisher precinct (photo)*

# 3. SITE ANALYSIS PROCESS

## 3.1 Introduction

The Mount Perisher double chairlift first operated in 1961 and represents the oldest lifting infrastructure within the Perisher Ski Resort. The Mount Perisher triple chairlift was first operated in 1979 and together both lifts have been identified to be replaced with a new six-seat detachable chairlift.

As set out in Section 1.2 above, this would achieve the modernisation of lifting infrastructure by providing a safer, more efficient and convenient mode of lifting transport.

## 3.2 Preliminary Site Assessment

The proposed development has been subject to an extensive preliminary operational, planning and environmental analysis.

This included an extensive operational analysis by Perisher management to determine an appropriate alignment and location for the top and bottom stations.

Following this, Dabyne Planning and Eco Logical Australia were engaged to undertake a preliminary site assessment with input from Doppelmayr Australia.

This included a walkover of the entire lift alignment and review of concept lift replacement plans.

As a result of the preliminary analysis undertaken, proposed tower 6 was relocated as it was in close proximity to a recorded Guthega Skink site. The new tower 6 was relocated upslope within a disturbed corridor, on the edge of the ski run.

The original location for tower 6 is shown below.

***Figure 12: Original tower 6 location***

Tower 7 was also relocated as it was originally located within an Alpine Bog. This tower was relocated upslope to a disturbed corridor associated with the Sun Valley T-bar cat track unload.

The original location for tower 7 is shown below.

***Figure 13: Original tower 7 location***

Other preliminary ecological investigations included Eco Logical Australia undertaking targeted searches for the Guthega Skink, mainly concentrated around the top station where previous recordings by Eco Logical Australia and Dr Zac Atkins, Ecologist have been made.

These searches were conducted over the summers of 2017/18 and 2018/19 with recorded sites identified and mapped. These have also informed the design of the lift and associated works.

## 3.3 Perisher Blue Ski Slope Master Plan (PSSMP)

The PSSMP identified that the existing Mount Perisher double chairlift and triple chairlift be replaced with a six-seat chairlift on the alignment of the double chairlift as identified in figure 14 below:

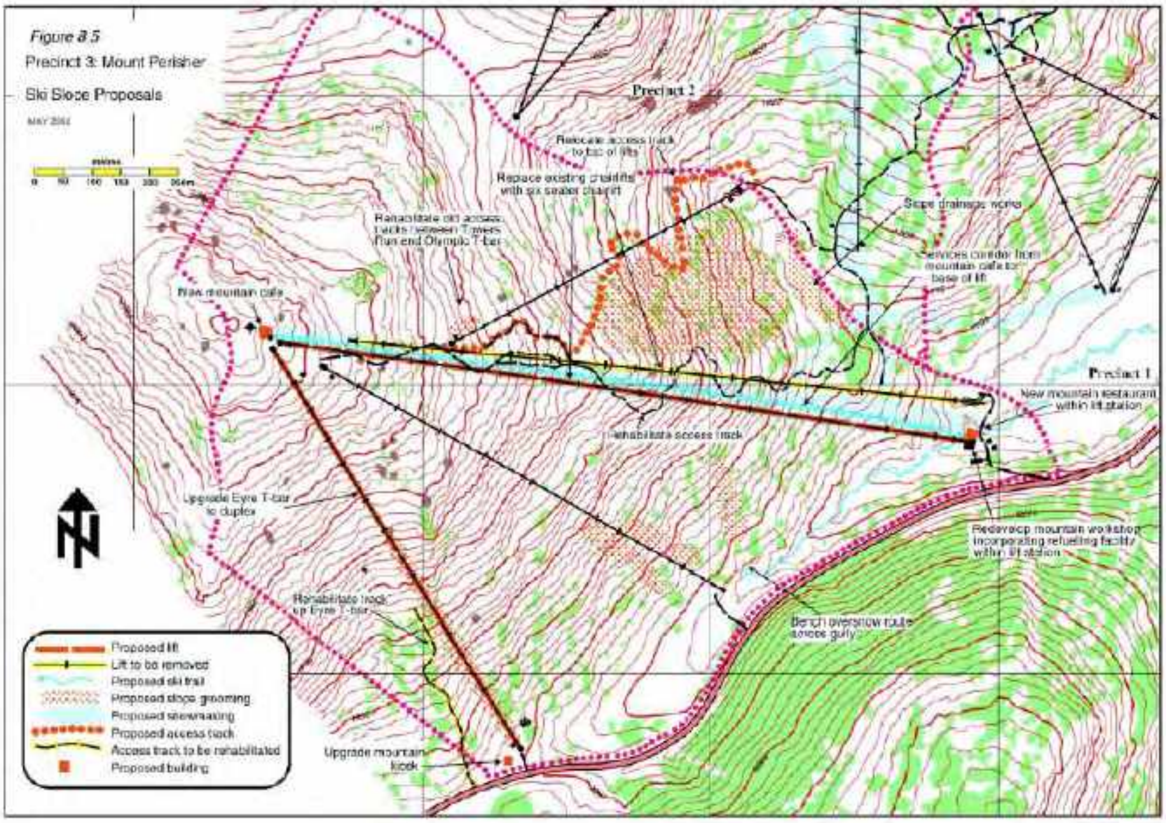


***Figure 14: Ski Slope Proposals for the Mount Perisher Precinct with the replacement lift shown (source: PSSMP)***

The environmental characteristics of the Precinct were mapped in the PSSMP and are provided in figure 15 below:

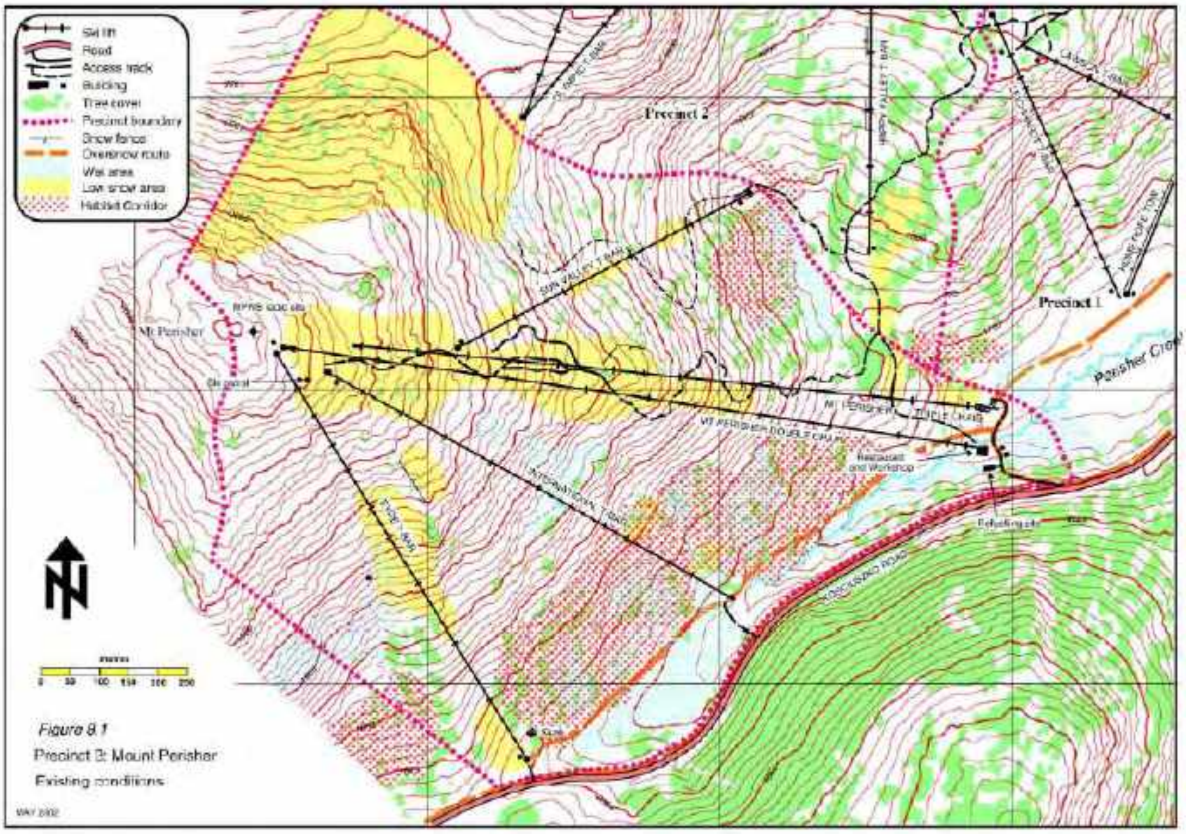


*Figure 15: Existing conditions map for the Mount Perisher Precinct (source: PSSMP)*

The mapping illustrates that the chairlift corridor and Towers ski run is mostly unconstrained.

The vegetation for the precinct was also mapped as part of the PSSMP process.

Other environmental factors that were mapped and considered included the Aboriginal Archaeological sensitivity mapping that was undertaken as part of a predictive model undertaken by Navin Officer for Connell Wagner as illustrated in figure 16 below.

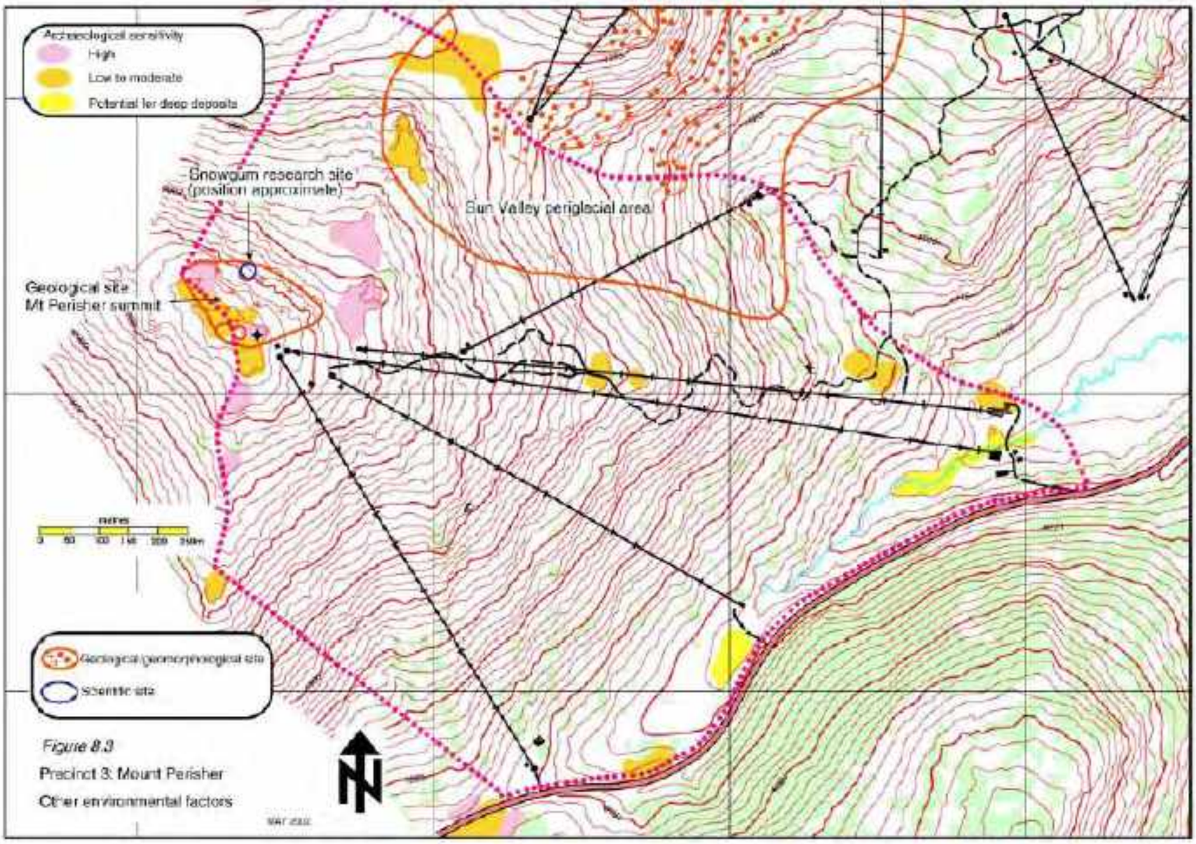


***Figure 16: Other environmental factors map for the Perisher Valley Precinct (source: PSSMP)***

The mapping shows that areas of high sensitivity are located away from the chairlift alignment, beyond the top station site with only small areas comprising of low to moderate sensitivity located within the chairlift corridor.

Based on these environmental characteristics, an operational evaluation of the precinct was undertaken and included the preparation of a slope use and grooming map as provided in figure 17 below.

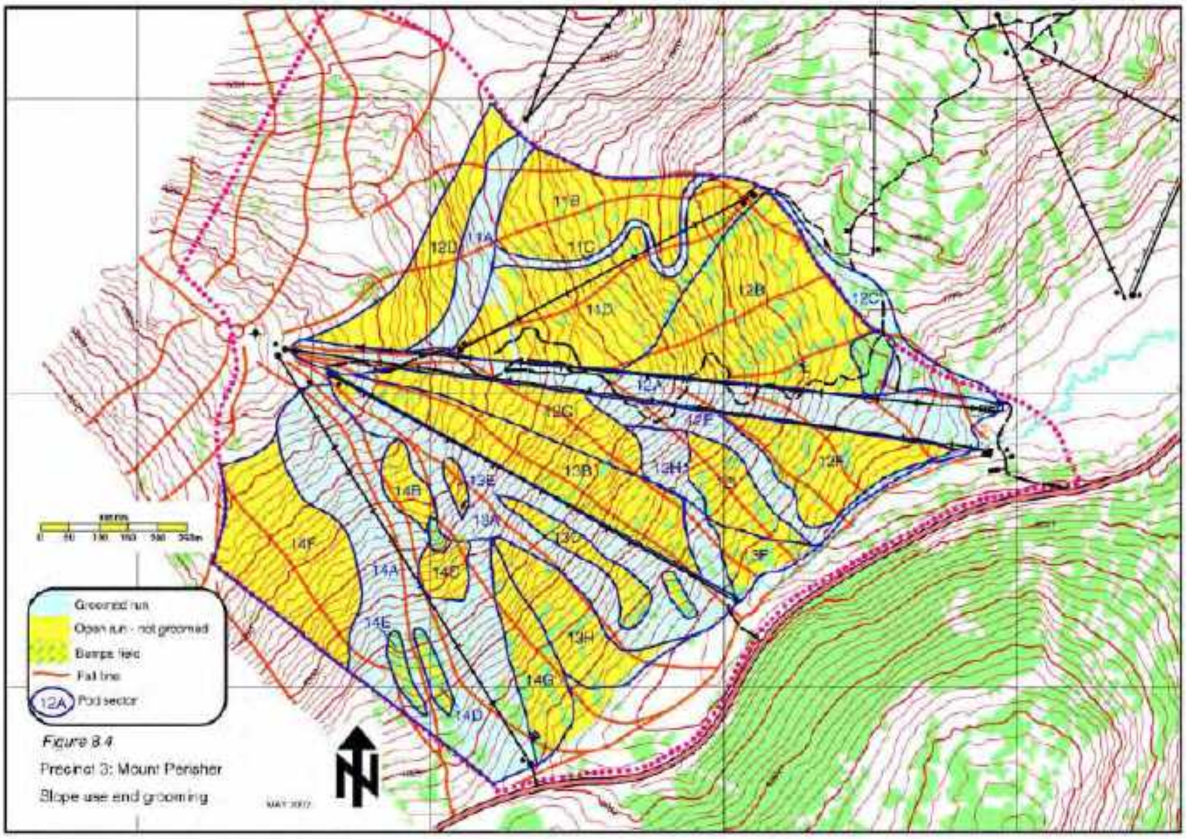


***Figure 17: Slope use and grooming map for the Perisher Valley Precinct (source: PSSMP)***

This map was used to determine the existing skiing capacity for the precinct with slope areas, lift capacity and slope capacity using the SAOT (Skiers At One Time) model as provided in the extracted table below.

***Table 1: Existing skiing capacity for the Mount Perisher Precinct (Table 8.1 in the PSSMP)***

*Table 8.1* Precinct 3 existing skiing capacity

| | Slope area (ha) | Lift capacity | | Slope capacity | | |
|---|---|---|---|---|---|---|
| **Pod** | | **Lift** | **SAOT** | **Pod sector** | **SAOT** | **Notes** |
| 11 | 13.9 | Sun Valley T-bar | 133 | 11A | 100 | a |
| | | | | 11B | 103 | |
| | | | | 11C | 55 | |
| | | | | 11D | 144 | |
| Total | | | 133 | | 401 | |
| 12 | 30.7 | Mt Perisher Triple chairlift | 408 | 12A | 304 | |
| | | Mt Perisher Double chairlift | 206 | 12B | 149 | |
| | | | | 12C | 75 | |
| | | | | 12D | 103 | |
| | | | | 12E | 108 | |
| | | | | 12F | 57 | |
| | | | | 12G | 72 | |
| | | | | 12H | 46 | |
| | | | | 12I | 31 | |
| Total | | | 614 | | 945 | |
| 13 | 17.0 | International T-bar | 313 | 13A | 283 | |
| | | | | 13B | 102 | |
| | | | | 13C | 5 | |
| | | | | 13D | 22 | |
| | | | | 13E | 26 | |
| | | | | 13F | 18 | |
| | | | | 13G | 2 | |
| | | | | 13H | 51 | |
| Total | | | 313 | | 509 | |
| 14 | 21.1 | Eyre T-bar | 292 | 14A | 508 | b |
| | | | | 14B | 15 | |
| | | | | 14C | 14 | |
| | | | | 14D | 2 | |
| | | | | 14E | 2 | |
| | | | | 14F | 92 | |
| | | | | 14G | 39 | |
| Total | | | 292 | | 672 | |
| Total – Precinct 3 | | | 1352 | | 2527 | |

This analysis was used to identify that the slope capacity exceeded the lift capacity and hence replacing the two chairlifts within the PSSMP was identified. The following extract is provided.

***8.4.1 Upgrading of lifts***

*'The combined capacity of the two existing chairlifts located on either side of the Towers Run is less than that of a single modern chairlift. It is proposed to replace this with a single detachable six-seater chairlift, located along the route of the existing double chairlift'.*

## 3.4 Proposed Lift Alignment & Stations

As part of the site analysis process, Perisher identified that the new chair will require a large footprint for the chairlift bottom station, chair shed and queuing areas. Therefore, the highly disturbed area adjacent to base of the triple chairlift has been chosen for the bottom station, rather than the bottom station location at the existing double chairlift, as proposed under the PSSMP.

The double chairlift bottom station was considered to be constrained by the creek, slope above and to the east of the existing building and small development footprint.

The double chairlift alignment would have also required the installation of lift towers within the existing ski run, thus not alleviating the current constrained situation and limiting the ability to provide wider and safer ski runs.

The proposed alignment has therefore been chosen to follow generally along the triple chairlift alignment, however the bottom station will be located approximately 10m (parallel) to the north of the current bottom station and therefore offset from the current alignment for the lower portion of the chairlift alignment.

The offset from the triple chairlift alignment is required to accommodate the large slow down and queuing area needed on the southern approach to the new chair, allowing the chair shed to be located on its northern side.

This still allows for the new lift to be accessed via the existing access road and service the same ski runs, although with lower bottom station and higher top station.

A site analysis of the station locations has been summarised as follows.

**Top Station:**

The proposed top station is to extend well above the current triple chairlift top station and above the current double chairlift top station to where the communications hut is located.

A higher lift provides more connectivity options for skiers and snowboarders than the current two top stations located at different elevations. Skiers and snowboarders will be able to choose all the available ski runs in all directions without having to traverse across a slope.

**Bottom Station:**

To accommodate the large chair shed and provide a large flat area for skiers and boarders to slow down and queue for a high capacity lift, the larger flat disturbed areas associated with the triple chair bottom station was selected.

The proposed bottom station has been located further down the slope than the current triple chairlift bottom station to provide as much slowing and queuing area as possible, as well as providing the lowest load point possible, allowing for guests to traverse across from the ski run (from the International and Eyre T-bar lifts) and/or the Powder Inn building at the bottom of the double chair.

## 3.5 Proposed Lift Capacity

The preliminary lift capacity and profile was based on carrying 3000 persons/hr with a lift speed of 5m/s. An operational review of the lift and its capacity determined that the lift capacity should be retained at 3000 persons/hr, with a more consistent operational lift speed of 4.5m/s.

To achieve this, nine (9) additional carriers (chairs) are required. To accommodate the additional weight, an additional tower is required.

To minimise impacts associated with the additional tower, the tower has been located directly adjacent to proposed tower 9, within a mostly disturbed area. Towers 9 & 10, therefore would form a 'double tower' sharing the same single but enlarged footing.

The chair shed was also extended 5m up the slope within the already disturbed area, to accommodate the additional carriers (chairs).

# 4. PROJECT DESCRIPTION

## 4.1 Project Components

**Lift Type:**

The proposal is for a new detachable six (6) seat detachable lift, with an uphill capacity of approximately 3000 people per hour. The lift is designed with a loading conveyor to assist guests with loading to achieve a high uphill capacity, with a 90-degree load and unload.

A lift manufacturer has yet to be engaged for the manufacture and installation of the chairlift; however, Doppelmayr Australia has been engaged to provide the design for the proposal.

**Lift Alignment & Profile:**

As discussed in Section 3 of this report, the proposed alignment for the chairlift is generally along the triple chairlift alignment, however the bottom station will be located approximately 10m to the north of the current bottom station and therefore offset from the current alignment for the lower portion of the chairlift alignment.

This will minimise environmental impacts and achieve the desired operational outcomes for the project.

Due to the alignment of the proposed lift generally following the existing triple chairlift alignment, tree removal along the lift corridor is minimised. Accordingly, the only trees considered necessary to be removed and/or trimmed are located around tower 3.

The proposed alignment and design will result in the chairlift having a horizontal length of 1254m and inclined length of 1294m with a vertical rise of 309m.

Being a detachable lift, the drive is designed for a maximum speed of 4.5 metres per second (m/s) with an uphill capacity of 3000 people per hour and 88 chairs (carriers). The total trip time would be 5½ minutes.

**Bottom Station:**

The proposed bottom station has been positioned approximately 25m back from the current triple chairlift bottom station with the proposed bullwheel and load setback approximately 60m.

The proposed bottom station has also been located approximately 10m parallel to the north of the current triple chair alignment, to provide as much slowing and queuing area as possible for the increased number of skiers and snowboarders, with the load switched from the current northern side to the southern side, in recognition this will be the only chairlift servicing a wide area as shown below in figure 18.

***Figure 18: Location of the new bottom station in relation to the current triple chairlift bottom station***

The current bottom station, shown below in figure 19 will be removed from the site. This site will be returned to forming part of the ski slope in front of the new bottom station.

***Figure 19: Existing bottom station to be removed and returned to form part of the existing ski slope***

Construction access to the proposed bottom station will utilise the formed access to the current triple chairlift, via the existing road and bridge over Perisher Creek, as shown in figure 20 below.

*Figure 20: Existing access road and bridge used for construction access*

**Chair Shed:**

As a detachable lift is proposed, a chair shed is required. The chair shed is proposed to be located on the northern side of the bottom station to allow for sufficient space for skiers and snowboarders to reduce speed, congregate and queue for the lift from the south. This provides the best approach and loading of the lift, with a 90-degree load.

The shed has been designed to be long and narrow, only accommodating two rows of chairs. This is to allow for the bottom station to be located as far north as possible whilst also limiting the impacts on the partly disturbed Alpine Bog vegetation to the north.

The location of the shed is shown in figure 21 below.

***Figure 21: Proposed chair shed location***

To reduce impacts on the Alpine Bog vegetation to the north, a retaining wall has been included in the design, along the northern edge of part of the building, instead of constructing a batter.

Regarding the design of both the bottom station and chair shed, this has been driven mostly by its operational requirements. However, the buildings have been subject to an Architectural design process.

To ensure compatibility with the natural landscape and consistency across the built environment, the structure includes the use of vertical metal cladding with a two colour skin based on diagonal lines, consistent with the Perisher Quad Express chairlift, shown below in figure 22.

***Figure 22: Perisher Express Quad chair shed and maintenance building***

The Architect has provided the following design statement, summarised below:

*'The bottom station consists of the lift drive, loading platform and a chair storage shed.*

*The functionality of the bottom station facility is the primary driver of the arrangement in plan which is determined by the standard lift machinery and loading procedure.*

*The size of the chair storage shed is determined by the number of chairs being stored and the space available between the lift and sensitive flora to the east.*

*Roof pitch is a response to snow deposition which must provide snow free access for guests and staff and create safe clearable snow deposition zones together with keeping wind blown snow out of the drive mechanism to minimize down time and damage.*

*The built form addresses these functional requirements but results in large span structures and heavy snow loads requiring deep beams. This deep structure, with minimum clearances from the lift determines the height of the building. It is also worth noting that the building structure must be independent of the lift structure.*

*The material and colour selection have been made on the basis of appropriateness, longevity, availability and value.*

*The proposal to wrap the chair shed with a two colour skin is intended to confuse the line between the ground and the plain rectangular form of the building and relates to the location of strategically placed window elements. The recessed lift element projecting out of the structure clearly separates the building from the lift component.*

*The decision to clad the operators hut component in sawn hardwood, which will weather to a grey, is a reference to the contrast of the technology of the lift and the mountain hut structures built by Alpine pioneers such as Ted Winter.*

*It is also a robust material that can withstand the daily grooming requirements in the region of the lift queue'.*

Rendered 3D images of the chair shed and bottom station have been produced by Daryl Jackson Robin Dyke (DJRD) Architects with a sample provided below and full collection provided in Appendix H.

***Figure 23: 3D rendered image of the proposed bottom station***

***Figure 24: 3D rendered image of the proposed bottom station***

**Top Station:**

*Location:*

The proposed top station has been located along the triple chair alignment, however it extends higher than the triple chair top station as well as the double chair top station to where the communications hut is located as shown in figure 25 below.

***Figure 25: NPWS Communications hut***

A higher lift provides more connectivity options for skiers and snowboarders than the current two top stations located at different elevations.  Skiers and snowboarders will be able to choose all the available ski runs in all directions without having to traverse across a slope.

The level benched area at the Communication hut level was selected to minimise impacts and earthworks as shown in figure 26 below.  This site also works with the proposed 90-degree offload, which provides shelter for offloading from the prevailing northerly and westerly winds.

***Figure 26:  Current communications hut and level bench to be used for proposed top station***

*Design:*

The top station structure has been subject to extensive Architectural and operational design process.

Due to its exposed location an enclosed unload is preferred for operational reasons to minimise station icing and drifting snow in the unload. The building will provide shelter for staff operating the lift and for guests disembarking the lift, whilst ensuring adequate snow cover is provided for the offload ramp. Without such cover, the offloading operations could be hampered by exposed windy conditions.

The operational requirements of the lift also require a chair grip service bay, which has been designed into the building.

With the building requiring the removal of the existing communications hut, all the required space for the equipment, including antennae has been incorporated into the design of the building. This includes an internal room that can be accessed both internally and externally on the lower ground level, a separate diesel generator room and an external platform and racks for the antennae equipment.

The building also incorporates the necessary storage which will be lost as a result of the removal of the triple chair top station.

To minimise impacts on the summer and winter landscape, a careful Architectural design has been undertaken. The overall height of the building has been designed with consideration of the large rock outcrop behind, to ensure the roof is located lower than the highest boulders.

The Architect has provided the following design statement, summarised below:

*'The brief for the Top Station was to enclose the lift so that after shutting it down at night and closing the doors it is snow free in the morning and immediately operational without de-icing.*

*The building houses the lift return station and unloading platform, operators enclosure, a maintenance space, emergency services communication equipment and aerials, emergency generator and storage.*

*Similar snow deposition and snow clearing issues to the bottom station have been addressed and due to its prominent location, the enclosure has been minimised in plan and section, while adhering to ropeway clearances.*

*Like the bottom station clear spans and independent structural requirements have determined the height but sloping topography has enabled the ancillary facilities to be located below the unloading platform.*

*The hooded appearance of the perimeter walls, the sloping face and the recessed lift element projecting out of the structure provides additional weather protection to the doors and again separates the building from the lift component like the bottom station.*

*The dark colour of the building is in keeping with the natural rock outcrops at the top of Mount Perisher while the sawn weathered timber base is a robust cladding for the snow accumulation and grooming activities around the station'*

Rendered 3D images of the top station have been produced by DJRD Architects with a sample provided below in figures 27 and 28 and full a collection provided in Appendix H.

***Figure 27: 3D rendered image of the proposed top station***

***Figure 28: 3D rendered image of the proposed top station***

Construction access to the proposed top station will be from the existing mountain access road which is proposed to be upgraded. Where the current access road terminates at the top of the current lifts, a short extension of the road is proposed for both temporary construction access and ongoing permanent vehicle access to the building as shown in figure 29 below.

***Figure 29: Access corridor to the top station***

**Communications hut:**

The communications hut that accommodates both NPWS and emergency services communications (figure 30) is proposed to be removed and has been designed into the new top station building, with antennae equipment to be relocated onto the new building.

***Figure 30: Communications hut and all equipment to be removed and relocated into new top station building***

To facilitate the ongoing operation of the equipment during construction, it is proposed to temporarily house the equipment within a temporary storage container, until the top station construction has been completed.

**Lift Towers:**

Due to detachable lifts, particularly modern lifts, having much greater spans than the existing fixed grip lifts on Mount Perisher, the new lift only requires ten (10) lift towers spanning 1294m, compared to the existing two chairlifts which have a combined twenty-seven (27) towers.

The location and description of the towers is provided as follows.

Towers 1 & 2: These towers will be located close to the bottom station within a highly disturbed area. These towers are 5m and 13m in height respectively.

Tower 3: This tower is located on a knoll, out of the ski run, in close proximity to the existing access road and triple chair, where the current underground up-hill safety line can be extended to the new tower. This tower and section of the chairlift will require tree removal, comprising of approximately thirteen (13) trees. The proposed tower height is around 12m.

Towers 4 & 5: These towers are also located on a knoll, to the side of the existing Towers ski run. These towers will be located close to the existing access road and triple chair, where the current underground up-hill safety line can be extended to the new towers. These towers are 10m and 18m in height respectively.

Tower 6: This tower was re-located from the native vegetation and rocks, including recorded Guthega Skink site to a disturbed flat area. The new tower location is located off the ski run and is approximately 16m in height. The tower can be accessed via the disturbed ski slope from the existing access road.

Tower 7: This tower was re-located up the slope away from the Upland bog vegetation and wetland where it was originally sited. The new location is on a knoll, on the edge of the ski run associated with the Sun Valley T-bar offload and connection to the Towers ski run. The tower can be accessed via the disturbed ski slope from the existing access road. The tower is approximately 18m in height.

Tower 8: This tower is located within the highly disturbed ski slope, close to the existing access road, partly within the existing ski run. The tower is approximately 11m in height.

Towers 9 & 10: These are double towers, sharing the same large footing and are located within a mostly disturbed ski slope, close to the existing access road, partly within the existing ski run. The towers are both approximately 12m in height.

All the tower footings will be similar in dimension, with a maximum disturbance footprint of 12m x 12m (144m$^2$). Most towers are located in partly of fully disturbed areas and require a large excavation due to the limited number of the towers and the capacity of the lift over long spans. Detailed structural design for the footings and lift will be undertaken at the Construction Certificate stage subject to development consent being issued.

Construction access to the tower sites is detailed in the Site Environmental Management Plan provided in Appendix C and the DA plans and has been designed to utilise the existing access road to be upgraded and previous snowmaking and ski slope disturbance corridors, where possible.

A photo of each tower location is provided in Appendix A.

**Removal of Triple Chairlift**

As part of the site analysis process, the proposed chairlift will be mostly located on the same alignment as the existing triple chairlift. This of course requires the existing lift to be removed.

The removal of the triple chairlift will include removing the top and bottom stations, lift towers and haul rope.

The top and bottom stations can be directly removed from the upgraded access road and surrounding highly disturbed ski slope.

***Figure 31: Top station to be removed***

Lift towers will be removed by helicopter or excavator.

The concrete footings supporting the lift towers will also be removed where they protrude above the surface. Where these tower footings are not directly accessible by the upgraded access road or disturbed ski slope (i.e. Towers 4,6,7,8,13 & 14), this will be undertaken by hand (i.e. jackhammer). Otherwise the tower footings will be removed by excavator.

***Figure 32: Example of towers that are accessible from the existing access road***

The excavations left from removing the footings will be backfilled with top soil and revegetated. An example of an existing tower base that will be rehabilitated and revegetated is provided in figure 33 below.

***Figure 33: Example of concrete footings to be removed***

The components of the chairlift that can be re-used and recycled such as the lift haul rope, timber decking, etc will be stored with the other components to be either scrapped and/or taken to Jindabyne landfill.

**Removal of Fuel Tanks**

As part of the removal of the Triple chairlift, the two x 9000 litre underground fuel tanks are proposed to be removed together with the fuel pump, and the site validated.

The fuel tanks are located on the northern edge of the bottom station as shown in figure 34 below.

*Figure 34: Underground fuel tanks to be removed*

**Removal of Double Chairlift**

The removal of the double chairlift will include removing the top station structure and bullwheel, the bottom station equipment, lift towers and haul rope.

***Figure 35: Double chairlift top station***

As the lift towers can be removed in parts, they are proposed to be dissembled in pieces by hand.  The lift towers not located within close proximity to the access road and/or disturbed ski run will be removed by either the use of helicopter or an excavator over snow at the end of the preceding winter.

***Figure 36: Double chairlift tower***

**Relocation of Eyre T-bar Bullwheel:**

To provide sufficient space for skiers and snowboarders disembarking from the new chairlift with a 90-degree offload towards the south, a large area for unloading and congregating is required. This requires the relocation of the current Eyre T-bar bullwheel downslope in the same alignment.

As the same T-bar offload location is required for operational purposes, the extent of shortening of the T-bar is limited by several operational constraints, with a certain minimum distance from the unload to the bullwheel required to allow the T-bars to retract before going around the bullwheel.

The area below the current bullwheel comprises of a number or rocks (both loose and embedded) where Guthega Skinks have been recorded. To minimise impacts on the Guthega Skink, the relocated bullwheel structure and its associated three (3) footings have been located to minimise direct impacts on these rocks. Accordingly, the structure is proposed to be relocated 11.2m down-hill on the same alignment, as shown in figure 37 below.

***Figure 37: Eyre T-bar bullwheel***

Due to the relocated bullwheel site comprising of rocks where previous siting's of Guthega Skink have been recorded, this area is not included in the top station construction footprint and will need to be carefully undertaken, minimising impacts on the rocks. This can be achieved as the location for the bullwheel has been carefully chosen to avoid the rocks with the footings being able to be located on either side.

Further detailed construction methodology will be provided after a lift manufacturer has been contracted and prior to construction.

**Rock Removal and/or Reduction Works:**

The new top station unload will allow skiers and snowboarders to access the ski terrain associated with the Eyre T-bar, particularly Wylie's and Shifty's ski runs, above the relocated Eyre T-bar bullwheel. This will provide unrestricted access to skiers right of the T-bar, without having to cross the T-bar track and unload area.

To achieve this, individual and groups of rocks are proposed to be removed and/or reduced. The rocks that would obstruct the safe grooming and use of this access have been identified to be either removed or reduced where they have not been identified as a Guthega Skink site.

Where these rocks are located outside of the identified construction footprint (rock groups RG2-RG4 and individual rocks R1-R6) they are proposed to be removed oversnow. This minimises the impact associated with the rock removal and/or reduction works, as the removal method will be undertaken on snow, during the latter parts of the ski season (during mid to late September) where machines will access each rock over snow and either remove the rock in full (where they are not embedded) or utilise the snow to cover the rock blast as a mat, which both reduces and controls blast fragments. Rock fragments can then be strategically placed in hollows on the leeward side of the remaining rocks or utilised for the rock habitat located adjacent.

No earthworks are proposed as part of these works and therefore the existing vegetation located adjacent to the rocks can be retained. Overall the only impacts to the vegetation in and around the majority of the rocks are expected to be temporary and allowed to re-grow.

Photos of the rocks to be removed and/or reduced are provided in Appendix A.

**Skier Bridges:**

To provide improved and safer access in marginal conditions to the new bottom station, two new large steel bridges are proposed to provide access across an upper tributary of Perisher Creek. The existing small timber bridges that traverse the upper tributary of Perisher Creek and provide skier access to the triple chair bottom station are inadequate to service the increased traffic associated with the new six-seater chairlift.

Two (2) separate skier bridges are proposed to traverse the creek to provide connectivity to the new chairlift bottom station. The bridges have been designed to accommodate both grooming machines and the significant increase in skiers and snowboarders that will descend towards the bottom station and cross the creek.

Skier bridge 1 provides connectivity from the Powder Inn restaurant, the traverse from International and Eyre T-bar lifts and from the skiers right of the Towers ski run. As skiers using this approach use a flatter grade, an 8m wide bridge is proposed.

Skier bridge 2 provides connectivity from the skiers left of the Towers Run and Happy Valley, where skiers traverse from Centre Valley to Mount Perisher. With a steeper incline and higher volume of traffic, a wider bridge at 12m is proposed.

The bridges need to span a greater distance (than the current timber bridges) due to raising the deck level and being able to not only span the creek and its embankments but the low-level wet areas adjacent.

To minimise impacts on the wet vegetation and creek, the bridges have been carefully designed to include steel mesh decking to allow for sunlight and rainfall to penetrate the vegetation below. In winter, the decking will be covered by conveyor matting or a recycled plastic decking material to hold snow.

The proposed construction is to use screw piles instead of traditional footings to support the bridge beams. The screw piles impact very small areas and are the least obtrusive form of foundation for the structure.

The screw piles can be installed with the beams and decking installed in segments, allowing the machine to traverse the creek using the structure. This minimises impacts associated with its construction. By undertaking this from the eastern side of the creek (triple chairlift bottom station), the machinery can directly access the bridge site from a highly disturbed area.

**Snowmaking:**

The proposal includes minor adjustments to existing snowmaking hydrants and installation of new hydrants to accommodate the new chairlift.

At the bottom station, a new fan gun and retractable hydrant are proposed on the corner of the existing road bridge to provide sufficient coverage for the large queuing area.

These hydrants will need a new lateral to extend from an existing valve pit south of the double chairlift, via the existing access road.

Adjacent to tower 3, the existing lance gun needs to be relocated to make way for the chairlift above. The lance gun will be relocated to a nearby rock, with the pit and underground services remaining in-situ.

Adjacent to tower 6, the three existing lance guns will need to be removed as they will be located directly below the new chairlift. The existing pits and underground services will remain in the ground in-situ and the lance guns will be utilised elsewhere.

Above tower 6, where the ski run diverges, a new fan gun is proposed to provide snowmaking coverage in lieu of the three lance guns to be removed.

At the top of the mountain, the existing lance gun to the north of the Eyre T-bar bullwheel will be in the middle of the new offload and ski run. This hydrant will be located and replaced with a fan gun, adjacent to the relocated Eyre T-bar bullwheel.

**Communications Cabling (Up-hill Safety Line):**

The new chairlift will require a new up-hill safety line (a communications cable that connects the bottom and top stations and each tower). Due to the extreme weather conditions on Mount Perisher, the only viable method is to install the cable underground to prevent icing.

To minimise impacts on the environment, the existing conduit already installed as part of a previous upgrade of the up-hill safety line for the Mount Perisher triple chairlift (around 2011) can be utilised for the new up-hill safety line, which will vastly limit the extent of trenching required for the new lift.

***Figure 38: Existing underground communications cable (Up-hill safety line)***

Therefore, the only trenching required for the up-hill safety line is from the existing conduit to the new towers, where previously disturbed areas will be mostly used in conjunction with the construction access to each tower.

**Electricity:**

The current two lifts and snowmaking system are already serviced by an electrical transformer at the top of the mountain and at the base of the mountain, which will be both replaced and upgraded in the same locations.

*Figure 39: Electrical transformer to be replaced and upgraded*

**RFID Gate:**

As part of the ongoing installation of Radio Frequency Identification Data (RFID) gates throughout the resort, the proposed chairlift will have an RFID gate installed at the bottom station.

The gate will include six access readers as shown in figure 40 below.

The concept of this system is to capture each RFID ski pass as it goes past which means skiers and boarders can access the ski lifts without having to put a ticket into a reader or handle a ski pass. Using RFID tags embedded in lift tickets or season passes allows an access gate to automatically confirm a ticket's authenticity and swing open to admit an authorised skier.

The proposed gate will be similar to the gate installed at the Village Eight chairlift.

*Figure 40. Example of Skidata's Freemotion Open gate model - designed for rapid detection of RFID lift tickets and activation of its single-arm turnstile.*

The gate system to be used will be a gantry type which will include a single footing and mast with the access readers hanging from an arm.

Optical fibre will also need to be installed with the new gate. Connection to the base of the triple chairlift is already provided and therefore can be directly connected into the new lift gate.

The proposed gate will be gantry mounted and includes a single footing with a single mast that can be lowered or raised depending on the depth of the snow base. The mast pivots into position during operation and can be swung out of position to allow grooming operations around the lift base. An arm is attached to the mast holding the required access readers.

The gate is proposed to be located 12m to the south of the bottom station, to allow for 90-degree loading.

An exploded view of a typical gantry gate is provided in figure 41 adjacent.

An example of a similar gantry gate installed at the base of the Village Eight Chairlift on Front Valley is provided in figure 42 below.

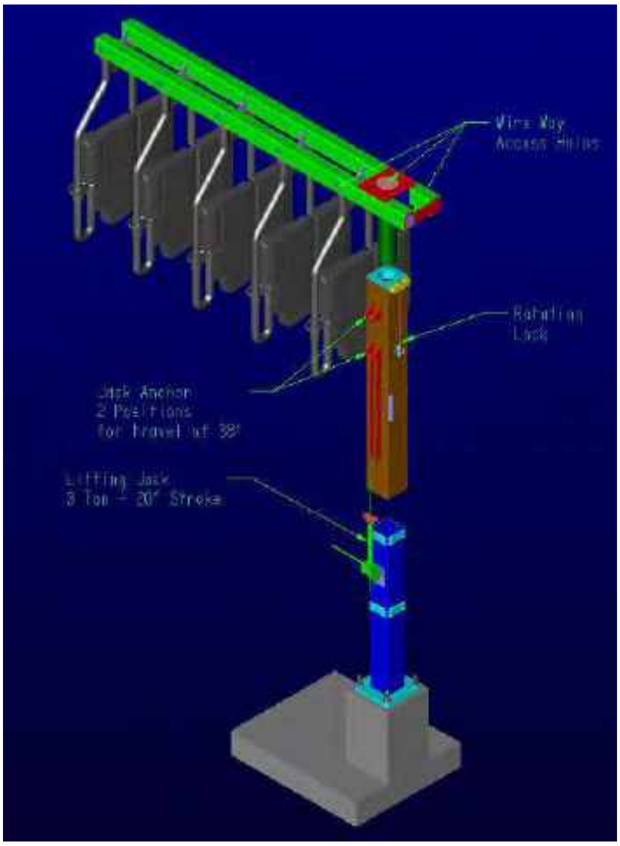


*Figure 41. Exploded view of a typical Ski Data gantry gate*

*Figure 42: Similar RFID gantry gate installed at the base of the Village Eight Chairlift*

**Bottom Station Drain:**

Similar to the Leichhardt Chairlift, water from around the base of the footings and conveyor pit associated with the bottom station will need to be drained.

The drain will allow for underground water that could impact on the footings/conveyor pit to be drained via gravity, towards the Perisher Creek.

The drain will also capture the roofwater from both the bottom station and chair shed structures, via the drip drains along the perimeter of the buildings.

This will require a trench and installation of a poly-pipe with a rip-rap rock outlet. These works will be undertaken within 40m of the Perisher Creek.

*Figure 43: Perisher Creek and location for the bottom station drain outlet*

Additional photos of the lift and associated components are provided in Appendix A.

## 4.2 General Construction

**Construction Staging:**

With a short construction season, further limited by the snow that usually remains on Mount Perisher and its exposure to extreme weather, the construction of the development may be staged over two (2) summers.

This will be dependant on the contracted lift manufacturer, budget and timing.

If the construction is proposed over more than one summer, it is proposed a staging plan be provided prior to Construction Certificate.

**Construction Method:**

A comprehensive manual for chairlift construction and the various components associated with the development has been prepared and provided in Appendix A of the PSSMP. The manual provides an 'Environmental Best Practice' for Construction Practices specifically tailored for the resort, which has been adopted by the NPWS.

The construction methods prescribed in Appendix A of the PSSMP are to be read in conjunction with the Site Environmental Management Plan (Appendix C).

**Construction Footprint for Top and Bottom Stations:**

The top and bottom stations will require large machinery and vehicle movements to remove the existing structures and construct their respective buildings. The landform immediately around the building will need to be shaped to accommodate them.

An array of services will also be required to be installed to each station. Each site will also require stockpiles and parking of construction vehicles as well as site sheds for workers.

To achieve this, both the top and bottom station sites include an overall construction footprint, whereby all areas within have been assessed as being proposed to be disturbed. These areas are already mostly disturbed. Only the top station includes a no-go zone associated with a Guthega Skink site, which is shown in figure 44 below and identified on the DA plans.

*Figure 44: Top station no-go zone*

**Construction Access:**

To minimise impacts on the environment, the existing access road will be upgraded and utilised to access both the top and bottom stations and associated infrastructure.

The upgrade of the road is to enable all construction vehicles to access the top station. The road is intended to be upgraded similar to the road upgraded to the top of the Freedom Chair at Guthega, shown in figure 45 below.

*Figure 45: Upgraded access road to the Freedom Chairlift top station, Guthega*

This will also improve drainage and erosion sedimentation issues associated with the current access and will also improve the ongoing access to the new lift and communications equipment, when completed. Figure 46 below illustrates the need to upgrade the access road.

*Figure 46: Existing access road requires upgrading for construction and operation of the new lift*

The bottom station will be accessed from the existing bridge to the triple chairlift bottom station, which crosses Perisher Creek and connects with Kosciuszko Road.

A culvert is proposed to be installed to cross the Perisher Creek at the location adjacent to the Mount Perisher double chairlift bottom station, rather than driving through the creek. The culvert has been designed to be similar in size and scale as the culvert installed for the Leichhardt Chairlift access, downstream, shown in figures 47 and 48.

***Figure 47: Culvert constructed downstream for access to the Leichhardt Chairlift***

***Figure 48: Culvert constructed downstream for access to the Leichhardt Chairlift***

**Construction Machinery:**

The type, size and number of machines to be used for the proposed development is largely unknown as a lift manufacturer and contractor has yet to be engaged for the project.

To calculate the areas of disturbance for the development and particularly the extension of the communications cable and excavation of footings, the maximum width of a 30-tonne excavator were used for this process.

It is proposed that specific details of the machinery to be used for the project be provided as a condition of consent prior to the issue of a Construction Certificate.

**Construction Staging Areas:**

One primary staging area, with two secondary staging areas are proposed to be used for the development.

The primary staging area where the bulk of the equipment to be removed and installed will be temporarily stored in the main Perisher car park, which has been previously used for staging for other projects including the Village Eight and Leichhardt chairlifts.

This area will be fenced off for storage of the lift components (e.g. existing lift components to be removed plus new lift top and bottom stations, towers, tower heads, sheave assemblies etc.). The existing road through the car park will not be obstructed to ensure that access through the car park to North Perisher is not restricted.

The first of the two secondary staging areas surrounds the proposed bottom station, where temporary storage of materials and construction vehicle parking will be located. This area has been identified by way of the construction footprint shown on the plans and comprises mostly a highly disturbed area associated with the triple chairlift bottom station.

The second staging area is located to the east and south of the proposed top station, where temporary storage of materials and construction vehicle parking will be located. This area has been identified by way of the construction footprint shown on the plans and comprises mostly a disturbed area associated with the communications hut, double chairlift top station and separate bullwheel and snowmaking infrastructure.

**Waste Management:**

Waste generated from the proposed development will principally comprise of the general construction waste (eg concrete form work, excess steel), domestic waste (eg litter) and parts of the existing lifts (eg concrete footings) which will not be re-used. Waste will be reused or recycled where possible.

Further waste management details are included in the SEMP provided in Appendix C.

# 5. KEY MATTERS FOR CONSIDERATION

## 5.1 Biodiversity

The proposed chairlift will replace two existing chairlifts and will primarily be located within previously disturbed areas.

The development however will be located within the area mapped as comprising high biodiversity values (as per the BC Act, 2016) that covers the entire mountain except for the access road, as shown in the extract provided below in figure 49.

***Figure 49: Biodiversity Values Map associated with the subject site (Source: OEH)***

Consequently, the Biodiversity Offsets Scheme (BOS) is triggered under the BC Act, 2016. A Biodiversity Development Assessment Report (BDAR) is therefore required and has been prepared by Ryan Smithers, Senior Ecologist with Eco Logical Australia, who is an Accredited Person under the BC Act, 2016.

The BDAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development site during the design, construction and operation of the development. The residual unavoidable impacts of the proposed development were calculated in accordance with the BAM by utilising the BAM Calculator (BAMC). The BAMC calculated that a total of ten (10) ecosystem credits and twenty-four (24) species credits are required to offset the unavoidable impacts to the vegetation and habitat present within the development site.

As a result of payment to the BCF for these offset credits, the physical implementation of offsets within the resort is not required.  Furthermore, payment of these offset credits is an alternative to the retirement of biodiversity credits in accordance with Division 6 of the BC Act, 2016.

Serious and irreversible impacts values were also considered as part of the assessment under the BDAR and the report concluded that the proposal will not result in any serious and irreversible impacts.

A copy of the BDAR is provided in Appendix B.

## 5.2 Rehabilitation and Monitoring

As outlined above and in the BDAR, the proposed chairlift will replace two existing chairlifts and will primarily be located within previously disturbed areas.

Therefore, the extent of rehabilitation and the methodology used will be based on the current level of disturbance and the intended use of the area.

Despite the BDAR and the credit calculations having been determined to achieve a zero vegetation integrity score post development, the proposal still includes the following rehabilitation outcomes:

- Rehabilitation of current lift towers 3-9 & 13 (not located within a highly disturbed ski slope) associated with the triple chairlift by removal of above ground concrete footings and covering with top soil and planting of low heath and poa.
- Rehabilitation of current lift towers 4-7 (not located within a highly disturbed ski slope) associated with the double chairlift by removal of above ground concrete footings and covering with top soil and planting of low heath and poa.
- Rehabilitation of the entire proposed bottom & top station construction footprints, which also includes proposed towers 1,2,9 & 10 which are areas that are mostly disturbed and include the following structures to be removed:
    - the bottom station of the triple chair
    - top station of the double chair and separate bullwheel
    - the communications hut
    - current Eyre bullwheel site

  These areas will be used as part of a ski slope and include a mix of 50:50 poa/fescue seed mix.
- Rehabilitation of the triple chair top station to be used as part of the ski slope by way of a mix of 50:50 poa/fescue seed mix.
- Rehabilitation of the disturbance area associated with the construction of proposed towers 3-8, including construction access and trenching for the extended up-hill safety line which are mostly undisturbed, by way of planting of low heath and poa.
- Rehabilitation of the trenching required for the bottom station drain by way of sod replacement.

General rehabilitation techniques and monitoring are also covered in the SEMP provided in Appendix C, with further technical details to be provided within a Detailed Rehabilitation & Monitoring Plan prior to construction, based on the current best practice initiatives within the DECCW (OEH) Rehabilitation Guidelines.

## 5.3 Visual Impacts

The proposed development involves removal of the existing double chairlift which incorporates the bottom station equipment, eleven (11) towers, a haul rope and top station as well as the removal of the existing triple chairlift which incorporates a bottom station, sixteen (16) towers, a haul rope and the top station.

The replacement six-seat detachable lift comprises a combined bottom station and chair shed, ten (10) lift towers, a haul rope, and top station.

The proposed lift is located on a similar alignment to the triple chair, therefore the overall additional visual impacts can be quantified and are discussed below.

**Existing Visual Character:**

The aerial based photograph of the resort with the existing double and triple chairlifts, ski slopes and access road (taken from a helicopter) provided below in figure 50 demonstrates that the existing visual character of the landscape along the lift alignment and immediately adjacent to and surrounding the proposed replacement lift can be described in terms of landform and surrounding land uses that combine to give the physical appearance of a highly developed ski resort.

***Figure 50: Aerial view of Mount Perisher***

The landscape has been highly modified including the creation of ski runs, installation of ski lifts, snowmaking, a restaurant, workshops and other facilities.

**Landform & Visual Accessibility:**

The proposed development is located between the base of Mount Perisher and the top on an east-west axis, within the southern part of the resort.

When entering the resort along the primary access road, Kosciuszko Road, Mount Perisher is visible as a backdrop to the wider resort, with Front and Centre Valleys in the foreground.

This is shown in figure 51 below.

***Figure 51: View of Mount Perisher from Kosciuszko Road***

This is the primary entry to the resort for most visitors and therefore where visitors first view the resort and the mountain.

A closer view (zoomed in) from the Perisher View saddle (between Smiggin Holes and Perisher Valley) illustrates the location of the two parallel lifts on Mount Perisher in context with the wider resort and extensive number of other ski lifts and ski resort infrastructure.

*Figure 52: Closer (zoomed in) view of Mount Perisher from Kosciuszko Road*

Being the highest mountain in the resort and therefore the highest lift, careful attention to the lifts top station location and design has been undertaken.

A survey of the top station site was undertaken, which included recording the height (levels) of some of the larger boulders within the rocky outcrop at the top of the mountain.

As outlined above, the top station building was positioned to achieve the optimal access for skiers and boarders to the wide range of runs available to the north (i.e. Vista ski run) through to the south (i.e. Shiftys ski run). The location selected was a level benched area where the current NPWS communications hut is located to minimise the extent of earthworks required.

This location also allows for the building to be mostly screened by the higher rocky outcrop behind, which will assist in screening the building when viewed from the Main Range, located behind from the north-west through to the south-west.

The extent of where the top station can be viewed from in relation to the Main Range is shown in the view shed analysis undertaken and provided in Appendix G. The series of maps provided in the analysis illustrate the areas in the locality where the proposed top station could be potentially viewed from (called a visibility cloak).

**Visual Assessment:**

The proposed lift will replace two existing lifts with ten (10) towers, instead of twenty-seven (27) towers on a similar alignment to the existing triple chairlift. The overall visual mass between the bottom and top stations on the mountain will therefore be reduced.

The visual impacts associated with the new chairlift will therefore mostly be restricted to the new top and bottom stations, including chair shed.

The design of the enclosed top station has been undertaken to incorporate all the necessary operational components, whilst ensuring its bulk and scale do not dominate the top of the mountain and skyline.

To achieve this, the buildings roof profile has been designed to be a low profile skillion, which will shed snow to the rear of the building. The overall height of the building has been designed with its highest point at RL2052.0m at the front and RL2050m at the rear.

The rocky outcrop directly behind the structure includes rocks with an RL of 2053m and 2054m, which are higher than the roof level of the top station building.

This is illustrated by the lift profile and extract of the top station and 3D rendered images provided below.

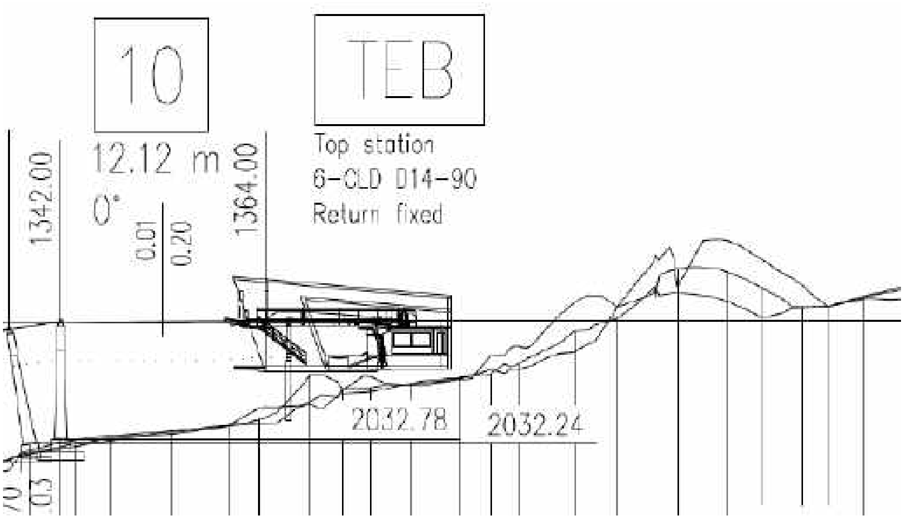


*Figure 53: Lift profile and location of top station building in relation to Mount Perisher*

*Figure 54: 3D rendered image of the top station in relation to Mount Perisher*

***Figure 55: 3D rendered image of the top station in relation to Mount Perisher***

The building will therefore be mostly obstructed when viewed from the Main Range, due to the rocky outcrop behind.  The building will therefore not dominate the skyline.

As shown in the view shed analysis maps provided in Appendix G, the closest areas located out of the resort and considered to form part of the Main Range where the building could potentially be visible from include Mount Twynam to the west and Mount Tate to the north.

As part of the visual impact analysis undertaken by Dabyne Planning for the Guthega Chairlift (Freedom Chairlift) project in 2010 (DA 005-02-2012), photos from both Mount Tate and Mount Twynam were taken of Guthega and the resort, which included the backside of Mount Perisher.

This analysis determined that the top of the Guthega chairlift was located a long distance away where it was not highly visible from the naked eye and that a dark natural tone (i.e grey) colour palette would ensure its visibility was very limited, ensuring minimal visual impacts.

Photos of Mt Perisher from both Mount Tate to the north and Mount Twynam to the west are provided below.

***Figure 56: View of the Perisher Ski Resort and backside of Mount Perisher (arrow) from the top of Mount Tate***

***Figure 57: View of the Perisher Ski Resort and backside of Mount Perisher (arrow) from the top of Mount Twynam***

These mountains are located over 6.5km from the top of Mount Perisher and due to their orientation, most of the top station and the chairlift would be screened by the topography, including large rocky outcrops on top of the mountain.

To minimise any potential impact, the building colours and materials have been carefully selected to ensure the development is not visually prominent or even discernable by the naked eye.

The dark natural tone colours match the rocky outcrop behind in both summer and winter as illustrated in the photomontage provided below.

***Figure 58: Photomontage of the top station in context with the ski slopes at the top of Mount Perisher***

As for the bottom station and chair shed, the structures have been designed to achieve their operational requirements, however skillion roof forms with the use of vertical two tone metal cladding in conjunction with timber cladding will ensure the built form is consistent with other lift structures in the resort.

A photomontage and 3D rendered images of the bottom station and chair shed are provided below.

*Figure 59: Photomontage of the bottom station in context with the ski slopes at the base of Mount Perisher*

*Figure 60: 3D rendered image of the bottom station*

The replacement of the two chairlifts with one chairlift and reduction from twenty-seven (27) lift towers to ten (10) will result in less structures on the mountain. The built form of the top and bottom stations will be larger than the existing lift structures, however these have been carefully located and designed to minimise visual impacts. Being a detachable lift, the chairs are removed each day in winter and permanently in summer, stored within the chair shed. This somewhat further reduces the visual impacts associated with the development.

Overall, visual impacts associated with the proposed development are considered acceptable and are compatible with the existing built environment, commonly found within an alpine resort.

**Colours and Materials:**

The top and bottom station plans include a colours and material schedule which will ensure that the buildings are compatible with both the summer and winter landscapes and existing built environment.

The lift towers will use the industry standard galvanising for the towers and tower cross heads, similar to that used for previous lifts, which has proven over time to lose its reflectivity and dulls to a gun metal grey like finish.

In conclusion, the use of the proposed colours and materials for the lift components together with the placement of the lift on a similar alignment as the existing lift, has enabled the visual impacts associated with the proposal to be acceptable in context of its location within an alpine resort, including impacts from the Main Range.

## 5.4 Aboriginal Cultural Heritage

An 'Aboriginal Cultural Heritage Due Diligence Assessment' has been undertaken by Past Traces Heritage Consultants, which is provided in full in Appendix D.

The assessment was undertaken following the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* produced by the NSW Office of Environment and Heritage (OEH). The Due Diligence process was followed to ensure compliance with the code.

This process included a search of the AHIMS database covering 1km surrounding area centred on the project area, a review of previous studies, a landscape assessment and a site visit.

Based on the assessment the impacts from the project were identified as follows:

- No known Aboriginal objects or places will be impacted by the proposed works.
- No known Aboriginal objects or places are present in the project area.
- No areas of high potential to contain Aboriginal objects or places are present in the project area.

In conclusion, the report determined that the proposal can proceed with no additional archeological investigations and that no area of potential archeological deposits or heritage sites have been identified within the development area and the potential for Aboriginal objects within the development area has been assessed as extremely low.

## 5.5 Ecologically Sustainable Development

The principles which would assist in the achievement of Ecologically Sustainable Development have been clearly set out in Schedule 2 of the EP&A Regulation 2000. These principles are:

*a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

*b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*

*c) Conservation of biological diversity and ecological integrity – namely, that a full and diverse range of plant and animal species should be maintained.*

*d) Improved valuation, pricing and incentive mechanisms – these mechanisms would enable environmental factors to be included in the valuation of assets and services.*

The four principles are interrelated. For instance, inter-generational equity can only be achieved in many instances if biodiversity is conserved for the use and enrichment of future generations. The linkage of the four principles means that they must be considered both individually and collectively when assessing whether a proposed project would contribute to ESD in Australia.

The EPBC Act 1999 adopted the definition of ESD above, adding a fifth principle namely:
*"decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations."*

Sustainability now has a broader meaning with a strong focus on the integration of environmental, social and economic goals through society and economic development activity.

The fifth principle set out in the EPBC Act together with those defined by the EP&A Regulation 2000, form the basis of sustainability against which the proposal is assessed.

As set out in this SEE report and its conclusions, the proposed development will generate positive social and economic impacts for the resort whist minimising impacts on the natural and built environment. These impacts have been offset by:

- Undertaking a comprehensive site analysis process.
- Aligning the new lift on a similar alignment to the existing triple chair.
- Utilising where possible, existing disturbed areas, access roads and infrastructure for the new lift and associated works.
- Rehabilitating disturbed areas associated with the construction of the new lift.
- Payment of biodiversity offset credits, even though rehabilitation of disturbed areas is proposed.
- Applying construction and environmental management practices as set out in the SEMP.

Overall, this assessment has concluded that the development can achieve compliance with the accepted principles of ecologically sustainable development and therefore it is considered that the proposal is clearly not contrary to the public interest in relation the principles of ecologically sustainable development.

## 5.6 Geotechnical Engineering

A comprehensive Geotechnical Risk Assessment of the proposed development has been undertaken by Asset Geotechnical Engineering Pty Ltd. The report was prepared in accordance with the requirements of the Department of Planning Geotechnical Policy for Kosciuszko Alpine Resorts (2003) and the Australian Geomechanics Society *'Practice Note Guidelines for Landslide Risk Management'*.

The assessment included a review of available reports and maps, walkover observations of site conditions at the existing lift towers and subsurface investigations at selected locations.

The report including the *Form 1 - Declaration and certification made by geotechnical engineer or engineering geologist in a geotechnical report'* is provided in full in Appendix F.

## 5.7 Water Resources

An assessment of the potential impacts of the proposed development on water resources in relation to the three key issues described below has been undertaken:

1. Watercourses and Riparian Land
2. Wetlands
3. Groundwater and Groundwater Dependant Ecosystems (GDEs)

A comprehensive assessment carried out by Eco Logical Australia (Appendix E) has identified that the impacts on water resources will be minor and will be restricted primarily to temporary disturbances associated with the proposed culvert where the existing access road crosses Perisher Creek; the proposed chair shed where it encroaches on the bog associated with Perisher Creek; and the footings for the skier bridges where they encroach on bog associated with a tributary of Perisher Creek.

Impacts on water resources will be limited to minor temporary changes in sub-surface and surface flows during the construction phase of the proposal. Water resources beyond the proposed disturbance footprint are considered highly unlikely to be affected by the proposal.

The proposal is not anticipated to result in any changes in surface or subsurface hydrology which may lead to the adverse modification of any watercourses or other water resources.

Given the relatively minor impacts on water resources associated with the proposal and the proposed mitigating measures, it is considered that the proposal meets the outcomes for water resources identified in the NSW Office of Water guidelines.

## 5.8 Communications Hut

The removal of the communications hut and the relocation of the communication equipment including antennae equipment has been subject to extensive consultation with the Perisher Municipal Services Unit (MSU) of NPWS, which included internal consultation with the various emergency service agencies.

The top station building has been designed to satisfy the NPWS requirements.

## 5.9 People Movement

The ski slope capacity and lift capacity, including volumes associated with the proposed development has already been documented in the PSSMP and discussed above in Section 3.3.

The overall skier circulation around the resort and associated lift upgrades has been identified in figure 5.4 of the PSSMP.

The replacement of the two chairlifts on Mount Perisher with a new single chairlift in a similar alignment is not intended to greatly change skier movements around the resort.

The lift will reduce pressure on other areas of the resort, including the existing T-bars within the Mount Perisher precinct.

The lift will predominantly improve the efficiency of lifting within the Mount Perisher precinct by moving skiers faster and more safely. The volumes of the increased lift capacity are documented in Section 3.5 above.

# 6. ENVIRONMENTAL AND PLANNING LEGISLATION

## 6.1 NSW Environmental Planning and Assessment Act, 1979

### 6.1.1 Section 4.15 EP&A Act, 1979 – Matters for Consideration

SECTION 4.15(1)(a)(i) – ENVIRONMENTAL PLANNING INSTRUMENTS

**State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007**

The only applicable Environmental Planning Instrument to the proposed development and site is State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007 (SEPP Alpine Resorts). The relevant clauses contained within SEPP Alpine Resorts are addressed below:

**Clause 11 - Land Use Table:**

The land use table for the Perisher Range Alpine Resort specifies that 'Lifting facilities' is a land use permitted with consent. The proposed development is for the purpose of replacing an existing double chairlift and triple chairlift with a new six seat chairlift with associated works and therefore the development is permissible with consent.

**Clause 14 - Matters for consideration:**

| Matter for Consideration | Response |
|---|---|
| Cl.14 (1) In determining a development application that relates to land to which this Policy applies, the consent authority must take into consideration any of the following matters that are of relevance to the proposed development: | |
| (a) the aim and objectives of this Policy, as set out in clause 2, | *The proposed development is considered to be consistent with the aims and objectives of the Policy as the development will be providing replacement ski lifting infrastructure with environmental impacts having been minimised.*<br><br>*These impacts will be further mitigated through the implementation of the rehabilitation and environmental offsets proposed and the Site Environmental Management Plan provided in Appendix C.*<br><br>*The proposed development is expected to generate significant positive social and economic impacts.* |
| (b) the extent to which the development will achieve an appropriate balance between the conservation of the natural environment and any measures to mitigate environmental hazards (including geotechnical hazards, bush fires and flooding), | *The proposed development does not require undertaking any measures to mitigate environmental hazards such as flooding, bush fires or geotechnical hazards that would impact on the conservation of the natural environment.* |

| | |
|---|---|
| c) having regard to the nature and scale of the development proposed, the impacts of the development (including the cumulative impacts of development) on the following:<br><br>(i) the capacity of existing transport to cater for peak days and the suitability of access to the alpine resorts to accommodate the development,<br><br>(ii) the capacity of the reticulated effluent management system of the land to which this Policy applies to cater for peak loads generated by the development,<br><br>(iii) the capacity of existing waste disposal facilities or transfer facilities to cater for peak loads generated by the development,<br><br>(iv) the capacity of any existing water supply to cater for peak loads generated by the development, | *See comments provided below the table.* |
| (d) any statement of environmental effects required to accompany the development application for the development, | *This Statement of Environmental Effects satisfies this sub-clause.* |
| (e) if the consent authority is of the opinion that the development would significantly alter the character of the alpine resort—an analysis of the existing character of the site and immediate surroundings to assist in understanding how the development will relate to the alpine resort, | *The proposed lift will be located within a ski resort, replacing two existing chairlifts. The chairlift will be situated amongst other ski resort related infrastructure including ski runs, ski lifts and buildings.*<br><br>*The proposed lift would therefore not significantly alter the character of the alpine resort.*<br><br>*With regard to the potential visual impacts of the lift, this has been addressed in Section 5.3 of the Report.* |
| (f) the Geotechnical Policy—Kosciuszko Alpine Resorts (2003, Department of Infrastructure, Planning and Natural Resources) and any measures proposed to address any geotechnical issues arising in relation to the development | *A Geotechnical Assessment of the proposal and Form 1 Certification has been provided in Appendix F by Asset Geotechnical in accordance with the Department's Geotechnical Policy.* |
| (g) if earthworks or excavation works are proposed—any sedimentation and erosion control measures proposed to mitigate any adverse impacts associated with those works, | *Earthworks and excavations works are required as part of the development and appropriate erosion and sedimentation control measures as outlined in the Site Environmental Management Plan provided in Appendix C will mitigate any adverse impacts associated with such works.* |

| | |
|---|---|
| (h) if stormwater drainage works are proposed—any measures proposed to mitigate any adverse impacts associated with those works, | *The only roofed areas proposed for the lift are the top and bottom stations, including chair shed.*<br><br>*The top station roofwater will be managed by a dripline drain at the rear of the building.*<br><br>*The bottom station roofwater, including chair shed will be managed by a dripline drain, connected to a stormwater pit which will also collect the drainage associated with the conveyor pit and footings, via a new single drainage outlet to Perisher Creek.* |
| (i) any visual impact of the proposed development, particularly when viewed from the Main Range, | *A visual impact assessment has been undertaken as discussed in Section 5.3.* |
| (j) the extent to which the development may be connected with a significant increase in activities, outside of the ski season, in the alpine resort in which the development is proposed to be carried out, | *The proposed replacement lift and associated infrastructure is only intended to be utilised during the ski season and will therefore not increase activities outside of the ski season.* |
| (k) if the development involves the installation of ski lifting facilities and a development control plan does not apply to the alpine resort:<br><br>(i) the capacity of existing infrastructure facilities, and<br><br>(ii) any adverse impact of the development on access to, from or in the alpine resort, | *See comments provided below the table.* |
| (l) if the development is proposed to be carried out in Perisher Range Alpine Resort:<br><br>(i) the document entitled Perisher Range Resorts Master Plan, as current at the commencement of this Policy, that is deposited in the head office of the Department, and<br><br>(ii) the document entitled Perisher Blue Ski Resort Ski Slope Master Plan, as current at the commencement of this Policy, that is deposited in the head office of the Department, | *The Perisher Blue Ski Resort Ski Slope Master Plan (PSSMP) applies to the site and proposed development.*<br><br>*As discussed in Section 3 of the report, the proposed development is generally consistent with the PSSMP.* |

| | |
|---|---|
| (m) if the development is proposed to be carried out on land in a riparian corridor:<br><br>(i) the long term management goals for riparian land, and<br><br>(ii) whether measures should be adopted in the carrying out of the development to assist in meeting those goals. | *The proposed bottom station buildings and works plus access road upgrades, culvert installation and skier bridges are all located within 40m of the Perisher Creek or its tributary.*<br><br>*Consideration of the long-term management goals for riparian land are addressed in the Water Resources Assessment provided in Appendix E.* |
| (2) The long term management goals for riparian land are as follows: | |
| (a) to maximise the protection of terrestrial and aquatic habitats of native flora and native fauna and ensure the provision of linkages, where possible, between such habitats on that land. | *As documented in the Water Resources Assessment provided in Appendix E, and BDAR provided in Appendix B, the proposed development has been designed to minimise impacts and conserve the integrity and on terrestrial and aquatic habitats of native flora and fauna.*<br><br>*Soil erosion will be minimised through the implementation of the erosion and sediment controls identified in the SEMP.* |
| (b) to ensure that the integrity of areas of conservation value and terrestrial and aquatic habitats of native flora and native fauna is maintained, | |
| (c) to minimise soil erosion and enhance the stability of the banks of watercourses where the banks have been degraded, the watercourses have been channelised, pipes have been laid and the like has occurred. | |
| (3) A reference in this clause to land in a riparian corridor is a reference to land identified as being in such a corridor on a map referred to in clause 5. | |

**Clause 14(1)(c):**

**14 (1) (c) having regard to the nature and scale of the development proposed, the impacts of the development (including the cumulative impacts of development) on the following:**

The development is not intended to increase the peak capacity of the resort, nor is it likely to. The proposed chairlift would result in a 2% increase to the current uphill lift capacity of the Perisher Ski Resort of 55,716 skiers per hour to 56,901 skiers per hour. The following table shows the impact of replacing the existing two chairlifts with the proposed chairlift on the resort's uphill lift capacity.

***Table 2: Uphill Lift Capacity***

| Uphill Lift Capacity (persons per hour) | Existing | Proposed | Change | Percentage Change |
|---|---|---|---|---|
| Eyre T-Bar | 1101 | 1101 | | |
| International T-bar | 1094 | 1094 | | |
| Mt Perisher Double | 548 | 0 | -548 | |
| Mt Perisher Triple | 1267 | 0 | -1267 | |
| Sun Valley T-bar | 700 | 700 | | |
| Proposed Mt Perisher Six | | 3000 | 3000 | |
| **TOTAL MT PERISHER PRECINCT** | **4710** | **5895** | **1185** | **25%** |
| **TOTAL RESORT** | **55,716** | **56,901** | **1185** | **2%** |

The proposed lift is therefore not likely to create additional peak demand that is greater than peak demand created by favourable snow and weather events that occur from time to time.

**(i) the capacity of existing transport to cater for peak days and the suitability of access to the alpine resorts to accommodate the development,**

The peak visitation capacity of the resort is generally governed by three factors. These being the capacity of resort day car parking, the number of beds in the resort and the capacity of the Skitube for day visitors. The development will not lead to capacity issues having regard to any of these factors with resort uphill lift capacity only increasing by 2% and a very small increase in the overall ski slope capacity.

As such the development is unlikely to impact the capacity of existing transport to cater for peak days.

**(ii) the capacity of the reticulated effluent management system of the land to which this Policy applies to cater for peak loads generated by the development,**

The proposed development will not generate additional peak visitation to the resort. Therefore, it is not necessary to consider the capacity of the reticulated effluent management system on a resort wide basis. It is noted that the reticulated effluent management system is not currently at operating capacity. Although it is more likely that skiers and boarders will use the lift, it is unlikely that the increase in the amount of effluent generated would be significant and would be matched with an equal reduction in effluent generated in other parts of the resort.

**(iii) the capacity of existing waste disposal facilities or transfer facilities to cater for peak loads generated by the development,**

The proposed development will not generate additional peak visitation to the resort. Therefore, it is not necessary to consider the capacity of existing waste disposal facilities or transfer facilities on a resort wide basis

**(iv) the capacity of any existing water supply to cater for peak loads generated by the development,**

The proposed development will not generate additional peak visitation to the resort. Therefore, it is not necessary to consider the capacity of the existing water supply on a resort wide basis.

**<u>Clause 14(1)(k):</u>**

**14(1)(k) if the development involves the installation of ski lifting facilities and a development control plan does not apply to the alpine resort:**

**(i) the capacity of existing infrastructure facilities, and**

The capacity of existing infrastructure has been generally addressed above. Existing infrastructure including electricity supply is sufficient for the proposed development, noting that the existing electricity transformers at the bottom and top of the proposed chairlift will be upgraded.

**(ii) any adverse impact of the development on access to, from or in the alpine resort,**

There are no known likely impacts of the development on access to, or from or in the alpine resort.

**Clause 26 – Heritage conservation:**

In accordance with clause 26 of the Alpine Resorts SEPP, consideration of the effect of the proposed development on the heritage significance of a heritage item is to be undertaken. This only relates to those items listed in Schedule 3 of the SEPP.

The Mount Perisher double and triple chairlifts and their associated structures are not listed within Schedule 3 of the Alpine Resort SEPP and therefore are not statutory heritage items.

## SECTION 4.15(1)(a)(ii) – DRAFT ENVIRONMENTAL PLANNING INSTRUMENTS

There are no draft Environmental Planning Instruments that are applicable to the site or proposed development.

## SECTION 4.15(1)(a)(iii) – DEVELOPMENT CONTROL PLANS

There are no Development Control Plans applicable to the Kosciuszko Alpine Resorts under State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007.

## SECTION 4.15(1)(a)(iiia) – PLANNING AGREEMENTS

There are no Planning Agreements applicable to the Kosciuszko Alpine Resorts under State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007.

## SECTION 4.15(1)(a)(iv) – REGULATIONS

The development application has been made in accordance with the requirements contained in Clause 50(1A) and clause 13 of Schedule 6 of the Environmental Planning and Assessment Regulations 2000.

## SECTION 4.15(1)(a)(v) – COASTAL MANAGEMENT ZONE

The proposed development and site is not located within any coastal zone management plan (within the meaning of the Coastal Protection Act, 1979).

## SECTION 4.15(1)(b) – LIKELY IMPACTS

**Natural Environment:**

Impacts on the natural environment and in particular biodiversity have been assessed as part of the BDAR provided in Appendix B.

This assessment determined that the proposal will not result in severe and irreversible impacts and includes mitigation measures as well as payment of credits to offset the unavoidable impacts to the vegetation and habitat present within the development site.

Along with the payment of offset credits and the mitigation measures outlined in the BDAR and SEMP, the likely impacts on the natural environment have been mitigated.

**Built Environment:**

The impacts on the built environment are expected to be minimal as the proposal is for the replacement of an existing lift on a similar alignment, which has been subject to an extensive Architectural design process in relation to the lift stations.

**Social and Economic impacts in the locality:**

The social and economic impacts from the development are expected to be positive as the development will result in existing lifting infrastructure being replaced with new lifting infrastructure with all the associated benefits as outlined in Section 1.3 of this SEE.

Furthermore, the construction and employment generated will add to the overall positive economic impacts generated by the development with construction jobs being created.

#### SECTION 4.15(1)(c) – SUITABILITY OF THE SITE

The site is currently occupied by double and triple chairlifts, installed in the 1960's and 70's respectively. The proposal will replace the existing chairlifts with a new chairlift on a similar alignment to the triple chairlift, utilising the existing access and ski slopes already in place.

The subject site is therefore considered suitable for the proposed development.

#### SECTION 4.15(1)(d) –SUBMISSIONS

The subject Development Application will be required to be advertised and any submissions received will be considered as part of the development assessment process.

#### SECTION 4.15(1)(e) – THE PUBLIC INTEREST

The above assessment has demonstrated that the proposal satisfies the objectives and relevant clauses prescribed under State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007.

Consequently, the proposed development is considered to be within the public interest.

## 6.2 NSW National Parks and Wildlife Act, 1974

The NSW National Parks and Wildlife Act, 1974 (NPW Act, 1974) governs the establishment, preservation and management of national parks, historic sites and certain other areas. The NPW Act also provides the basis for the legal protection of Aboriginal sites within NSW.

As detailed in Section 5 of the SEE, the proposed development will result in acceptable impacts, which will ensure the development is consistent with the provisions of the NPW Act, 1974.

## 6.3 NSW Biodiversity Conservation Act, 2016

The Biodiversity Conservation Act 2016 and Local Land Services Amendment Act 2016 together with the Biodiversity Conservation Regulations 2017 were enacted on the 25 August 2017.

The proposed development is located within the mapped high biodiversity area in accordance with the latest version of the Biodiversity Values Map under the BC Act, 2016.

Accordingly, a BDAR has been prepared by Ryan Smithers, Senior Ecologist with Eco Logical Australia and an Accredited Person under the BC Act, 2016.

The BDAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development site during the design, construction and operation of the development. The residual unavoidable impacts of the proposed development were calculated in accordance with the BAM by utilising the BAMC. The BAMC calculated that a total of ten (10) ecosystem credits and twenty-four (24) species are required to offset the unavoidable impacts to the vegetation and habitat present within the development site.

The payment for these credits to the BCF is the only offset obligation available to the Applicant, given that the retiring of credits is not available with no ability to create offset sites under a Biodiversity Stewardship Agreement within a National Park.

As a result of payment to the BCF for these offset credits, the physical implementation of offsets within the resort is not required. Furthermore, payment of these offset credits is an alternative to the retirement of biodiversity credits in accordance with Division 6 of the BC Act, 2016.

The BDAR fulfils the obligations under the BC Act, 2016 and is provided in Appendix B.

## 6.4 NSW Water Management Act, 2000

Under Section 91 of the Water Management Act, 2000 a controlled activity approval is required for the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979) on waterfront land, being land within 40m of a river.

The proposed development includes works within 40m of the Perisher Creek, which is within 'waterfront land'.

This approval will be sought through the Integrated Development provisions of the Environmental Planning and Assessment Act, 1979 (S.4.46).

## 6.5 Commonwealth Environment Protection and Biodiversity Act, 1999

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, 1999) provides for the protection of the environment, especially matters of national environmental significance (NES). Under the EPBC Act, 1999 a person must not take an action that has, will have, or is likely to have a significant impact on any of the matters of NES without approval from the Australian Government Environment Minister or the Minister's delegate.

A referral must be made for actions that are likely to have a significant impact on the following matters protected by Part 3 of the EPBC Act, 1999:

- World Heritage properties (sections 12 and 15A)
- National Heritage places (sections 15B and 15C)
- Wetlands of international importance (sections 16 and 17B)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A)
- Protection of the environment from nuclear actions (sections 21 and 22A)
- Commonwealth marine environment (sections 23 and 24A)
- Great Barrier Reef Marine Park (sections 24B and 24C)
- The environment, if the action involves Commonwealth land (sections 26 and 27A), including:
    - actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land);
    - actions taken on Commonwealth land that may have a significant impact on the environment generally;
- The environment, if the action is taken by the Commonwealth (section 28)
- Commonwealth Heritage places outside the Australian jurisdiction (sections 27B and 27C)

A search of the matters of national environmental significance database for Perisher was undertaken and identified that two of the above matters are relevant to the proposed development as addressed below.

**National Heritage Listing**

Under the EPBC Act, 1999, the 'Australian Alps National Parks and Reserves – Kosciuszko National Park' was included on the National Heritage List on the 7 November 2008. The Alps were listed for their outstanding natural and cultural heritage significance to the nation.

Under the EPBC Act, 1999 a referral must be made for actions that are likely to have a significant impact on a National Heritage Place, such as the Australian Alps.

To determine whether an action is likely to have a significant impact, the significant impact criteria provided in the Commonwealth Department of Environment and Heritage 'EPBC Act Policy Statement 1.1: Significant Impact Guidelines for Matters of National Environmental Significance, May 2006' applies.

The Guidelines state that an action is likely to have a significant impact on the National Heritage values of a National Heritage place if there is a real chance or possibility that it will cause:

- one or more of the National Heritage values to be lost;
- one or more of the National Heritage values to be degraded or damaged; or
- one or more of the National Heritage values to be notably altered, modified, obscured or diminished.

An assessment of impact against the National Heritage List Criteria and the National Heritage values of the Australian Alps has been undertaken and provided in the following table below:

**National Heritage Assessment Table**

| Criterion | Impact on Values |
|---|---|
| (a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history | *The Australian Alps National Parks (AANP) is listed under this criterion for its glacial and periglacial features; fossils; karst areas; biological heritage; moth feasting; transhumant grazing; scientific research; water harvesting; and recreation.*<br><br>*The proposed development would not conflict with any of the above values of the AANP.*<br><br>*Importantly, the proposed development would enhance one of key values in regard to recreation, which is described below:*<br><br>*'The AANP has outstanding heritage value for the longevity and diversity of its recreational use. Snow sports commenced in Kiandra in 1861 with the establishment of the Kiandra Snowshoe Club and expanded from an ad hoc activity by enthusiasts to a multi-million dollar snow sport and tourism industry characterised by the groomed ski slopes, ski lift infrastructure and substantial village resorts'.*<br><br>*The proposed lift and associated infrastructure will significantly enhance the ski slope and infrastructure within the Perisher Ski Resort and represents a direct improvement to the visitor experience to the resort, whilst representing an economic investment in the resort and industry.* |
| (b) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history | *The Australian Alps is listed under this criterion for its landscape and topography; glacial and periglacial features; fossils; alpine and sub-alpine systems; and eucalypt flora communities.*<br><br>*The proposed development would generate minimal impacts on the overall landscape of the Australian Alps and would not conflict with any of the above heritage values.* |
| (c) the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history | *Not Applicable.* |

| | |
|---|---|
| (d) the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places, or (ii) a class of Australia's natural or cultural environments | *The Australian Alps are listed for the North-East Kosciuszko Landscape values.*<br><br>*The subject site is located within the Perisher Ski Resort and is not located within the North-Eastern area of Kosciuszko National Park.* |
| (e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group | *The Australian Alps are listed under this criterion for their powerful, spectacular and distinctive landscape that is highly valued by the community.*<br><br>*These aesthetic characteristics include the KNP main range for its mountain vistas, panoramas, snow covered crests, slopes and valleys, alpine streams and rivers and lakes.*<br><br>*The proposed development would not directly impact on any of these heritage values.* |
| (f) the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period | *Not Applicable.* |
| g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons | *The Australian Alps have a special association with the Australian community because of their unique landscapes, the possibility of experiencing remoteness and as the only opportunity for broad-scale snow recreation in Australia. The AANP is widely recognised by Australians as the 'high country' and many community groups have a special association with the AANP for social and cultural reasons.*<br><br>*The proposed development will result in a replacement lift being installed within a ski resort and therefore would not impact on the above values.* |
| (h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history | *The place is listed under this criterion for its association with the life or works of prominent people such as Baron Ferdinand Von Mueller, Eugen Von Guerard, writers 'Banjo' Patterson, Elyne Mitchell and David Campbell.*<br><br>*The proposed development would not have any impact on the life or works of people with importance to the AANP.* |
| (i) the place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition. | *Not Applicable.* |

The above assessment has concluded that the proposed development will not have a significant impact on the values of the Australian Alps National Park.

**Listed threatened species and communities:**

An assessment of the impact of the proposed development on all listed threatened species and communities has been undertaken and provided in the BDAR in Appendix B.

The assessment has concluded that the proposal is unlikely to have a significant impact on matters of National Environmental Significance or Commonwealth land, and a referral to the Commonwealth Environment Minister is not necessary.

# 7. CONCLUSION

The replacement of the Mount Perisher double chairlift and triple chairlift with a new six seat detachable chairlift has been identified in the PSSMP, adopted by the NSW Government in 2002.

Since 2002, Perisher has continually reviewed and prioritised the developments proposed by the PSSMP having regard to the relevant operational, guest service and environmental factors.

Between 2007 and 2019, Perisher has undertaken a range of ski slope and lifting upgrades including the installation of an extensive snowmaking program on Mount Perisher and Happy Valley, the extension of the Happy Valley T-bar bottom station and more recently, the replacement of the Leichhardt T-bar with a quad chair.

All these improvements have been undertaken to improve visitor experiences and the operation of the resort and in particular to accommodate a new high-speed chairlift for Mount Perisher.

A detachable six seat chairlift that replaces two older fixed grip chairlifts will provide the resort and its customers a large range of benefits. These include an increase in lift capacity; a safer, more comfortable and faster mode of transport; provision for a wider and safer ski run below; improved operational performance; and easing of congestion on other lifts in the Mount Perisher precinct and across the resort.

Overall the development would represent a significant capital investment into the resort by modernising the lifting infrastructure and improving efficiency and lead to overall improved visitor experiences.

To achieve this, a comprehensive site analysis process was undertaken including an extensive preliminary operational, planning and environmental analysis. This has included undertaking targeted searches for the Guthega Skink over two summers, relocating towers 6 & 7 away from constrained areas and incorporating an additional tower adjacent to tower 9.

To minimise impacts on the environment and achieve the desired operational outcomes for the project, the proposed lift will be located in a similar alignment as the existing triple chairlift, therefore located mostly within a disturbed corridor with an existing access road servicing the lift. This also allows for the use of the existing conduit for the up-hill safety line (communications line) therefore limiting the extent of trenching required.

Other mitigation measures incorporated into the design include the installation of two steel mesh bridges on screw piles for the skier bridges, installation of a retaining wall on the northern edge of the chair shed over the use of batters, certain rock removal and/or reduction works being undertaken over snow and the placement of rock to create additional fauna habitat.

The replacement of the two existing fixed grip chairlifts with a new detachable six seat chairlift lift will result in a vastly upgraded facility that would meet current expectations of safety and convenience by providing modern lifting infrastructure that is faster and more reliable.

All these benefits can be achieved whilst ensuring the environmental impacts associated with the development are minimised, particularly through the implementation of the rehabilitation program as proposed.

Where impacts on native vegetation are unavoidable, payment of offset credits will be made to the BCF.

To ensure that all the environmental and associated legislation is complied with and fulfilled, the proposed development has been considered with regard Section 4.15 of the NSW Environmental Planning and Assessment Act, 1979, NSW Biodiversity Conservation Act, 2016, Commonwealth Biodiversity Conservation Act, 1999, and State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007.

The proposal has been found to be consistent with the above legislation and relevant Environmental Planning Instrument, as detailed in this SEE.

On balance, the proposed development will generate significant positive social and economic impacts for the resort and wider region whilst minimising impacts on the natural environment including biodiversity, aboriginal heritage, visual amenity & water resources.

# APPENDIX A

## PHOTOGRAPHS

*Figure 1: Existing communications hut to be removed for the proposed top station building. Antennae equipment to be relocated into the new top station building.*

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*Figure 3: Top station building location*

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*Figure 14: Rock Group RG3*

*Figure 15: Rock Group RG4*

*Figure 16: Rock Group RG5*

*Figure 17: Rock R1*

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*Figure 19: Rock R3*

*Figure 20: Rock R4*

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*Figure 23: Existing transformer to be replaced and upgraded*

*Figure 24: Proposed Towers 9 & 10 location*

*Figure 25: Towers 9 & 10 construction access and trenching corridor*

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*Figure 32: Proposed Tower 6 location*

*Figure 33: Tower 6 construction access and trenching corridor, to follow disturbed ski slope*

*Figure 34: Proposed Tower 5 location*

*Figure 35: Tower 5 to be directly accessed from the road*


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*Figure 37: Construction access and trenching corridor to Tower 4*

*Figure 38: Proposed Tower 3 location*

*Figure 39: Construction access and trenching corridor to Tower 3*

*Figure 40: Trees adjacent to Tower 3 to be removed for chairlift alignment*

*Figure 41: Lance gun to be relocated to the rock (pit and underground services to remain)*

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*Figure 44: Proposed bottom station chair shed location*


*Figure 45: Proposed bottom station location*

*Figure 46: Proposed Skier Bridge 1 location*

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*Figure 48: Existing bridge to be used for construction access*

*Figure 49: New fan gun and retractable hydrant location*

*Figure 50: Existing transformer to be removed and replaced with a larger transformer*

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*Figure 52: Existing Triple Chair bottom station to be removed*

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*Figure 54: Snowmaking lateral corridor to service new fan gun and retractable hydrant*

# APPENDIX B

## BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

APPENDIX B

# Mount Perisher Chairlift
# Biodiversity Development Assessment Report

**Perisher Blue Pty Ltd**

Planning, Industry & Environment

*Issued under the Environmental Planning and Assessment Act 1979*

Approved Application No DA 10115

Granted on the 9 September 2021

Signed MB

Sheet No 2 of 63

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## DOCUMENT TRACKING

| | |
|---|---|
| **Project Name** | Mount Perisher Chairlift |
| **Project Number** | 18HNG-9801 |
| **Project Manager** | Ryan Smithers |
| **Prepared by** | Ryan Smithers |
| **Reviewed by** | Frank Lemckert |
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# Executive Summary


Eco Logical Australia Pty Ltd was engaged by Perisher Blue Pty Ltd to prepare a Biodiversity Development Assessment Report for the proposed construction of a new chairlift and associated works on Mount Perisher. The new chairlift will replace the Mount Perisher double chairlift and the Mount Perisher triple chairlift, which were constructed in the 1960's and 1970's respectively. The existing lifts will be removed. The new chairlift will increase lifting capacity by more than 60% and will reduce the number of lift towers on Mount Perisher from 27 to ten.

The alignment of the new chairlift approximates the alignment of the Mount Perisher triple chairlift with the bottom station being slightly lower and approximately 10 m to the north. The top station is slightly higher, on a bench just below the Mount Perisher summit. The selected alignment of the new chairlift minimises disturbance to native vegetation and associated habitats as the bulk of the works and construction access are located within the existing disturbance corridor. It also enables the use of existing electrical and communications infrastructure. As such, whilst the development site is approximately 1.11 ha in size, the impact of the proposed works on native vegetation and associated habitats has been reduced to 0.36 ha, all of which is located on the edge of existing disturbed areas and consequently is already disturbed to varying degrees.

The remnant native vegetation within the development site is mapped on the NSW Environment, Energy and Science Biodiversity Values Map. This report has been prepared to meet the requirements of the Biodiversity Assessment Method 2016 (BAM) established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act).

The development site supports four Plant Community Types (PCT) in various condition states:

- PCT 641 Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion
- PCT 643 Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion
- PCT 637 Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion
- PCT 645 Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion.

PCT 637 is considered to comprise the *Montane Peatland and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions* endangered ecological community (EEC) (hereafter referred to as the Montane Peatland and Swamps) which is listed on the BC Act. It also comprises the *Alpine Sphagnum Bogs and Associated Fens* EEC (hereafter referred to as the Alpine Sphagnum Bogs and Associated Fens) which is listed as an EEC on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Targeted surveys within the development site and immediate surrounds identified three threatened fauna species, *Liopholis guthega* (Guthega Skink), *Mastacomys fuscus* (Broad-toothed Rat), and *Petroica phoenicea* (Flame Robin), as occurring within the development site. The cryptic *Cyclodomorphus praealtus* (Alpine She-oak Skink) was assumed to be present given the presence of suitably open and grassy habitats within the development site and surrounds. One individual of the threatened flora species *Ranunculus anemoneus* (Anenome Buttercup) was also detected within the development site.

The Guthega Skink has been detected on Mount Perisher, including near the summit, by ELA (ELA 2015) and others. As such, the assessment of a suitable location for the top station included extensive targeted surveys for the Guthega Skink. The targeted Guthega Skink surveys demonstrated that the footprint of the top station does not provide important habitat for the species with no observations of any Guthega Skinks within the top station footprint despite surveys on 13 separate occasions over two summers. The species does occur to the immediate south, west and north of the top station location, where there were many observations of Guthega Skinks and some burrow locations identified. The species was also detected near the original location of Tower 6, which was subsequently moved, and has been recorded in several locations near Tower 5.

Whilst the proposal will result in temporary disturbances to foraging habitats during the construction phase of the proposal, it will not affect any known Guthega Skink burrow systems. Excavations such as those that will be required for the towers, top station and T-bar bullwheel support footings, and other major disturbances associated with the proposal, will be at least 10 m from the nearest known Guthega Skink burrow (near the top station) and typically 20-30 m away. Guthega Skink burrows are not thought to extend more than 2-3 m underground (Z. Atkins pers. Comm 2019), so it is not expected that the excavations associated with the proposal will encroach upon any of the species burrows.

Whilst the proposal will involve disturbances in known Guthega Skink habitat, the extensive surveys undertaken for this assessment have demonstrated that the proposal is unlikely to involve any direct impacts on the species' burrow networks and is expected to only involve temporary impacts on a small area of the species foraging habitat. Impacts are predominately associated with the proposed rock reduction and removal for the top station offload, the relocation of the Eyre T-bar bullwheel, and for the Tower 5 footing. The potential impacts on the Guthega Skink have been further reduced by mitigation measures such as creating NO GO areas around known burrows or other locations where Guthega Skinks have been recorded, undertaking the rock removal and reduction below the top station during spring using the over-snow method, adjusting the location of the Eyre T-bar bullwheel, and moving the location of the lift towers where that was possible.

Guthega Skinks appear to be quite disturbance resilient as indicated by the healthy populations which remain in parts of the Perisher Resort that have experienced considerable development over the years, including Mount Perisher. They also remain locally abundant at the junction of the Kosciuszko Road, Summit Road and Main Range walking track at Charlotte Pass despite extensive historic development and ongoing human activity during the winter and summer months. Given the measures that have been incorporated into the proposed development to avoid, minimise, mitigate and offset the potential impacts on the Guthega Skink, and the species demonstrated capacity to thrive in habitats that have had similar and greater levels of disturbance than that which is proposed, it is considered unlikely that the proposal will have any substantial adverse impacts on the species. On the contrary it is considered likely that the Guthega Skink population around the Mount Perisher summit and elsewhere surrounding the development site will continue to thrive after the proposed chairlift is constructed and in operation.

This BDAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development site. The residual unavoidable impacts of the proposed development were calculated in accordance with the BAM by utilising the Biodiversity Assessment Method Credit Calculator (BAMC). The BAMC calculated that a total of ten ecosystem credits and 24 species credits are required to offset the unavoidable impacts to the vegetation and habitats present within the development site.

Serious and Irreversible Impact (SAII) values have been considered as part of this assessment. The proposal will not result in any SAII.

Following consideration of the administrative guidelines for determining significance under the EPBC Act, it is concluded that the proposal is unlikely to have a significant impact on matters of National Environmental Significance (MNES) or Commonwealth land, and a referral to the Commonwealth Environment Minister is therefore not recommended as being required.

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# Abbreviations

| Abbreviation | Description |
|---|---|
| BAM | Biodiversity Assessment Method |
| BAMC | Biodiversity Assessment Method Credit Calculator |
| BC Act | NSW Biodiversity Conservation Act 2016 |
| BDAR | Biodiversity Development Assessment Report |
| BSSAR | Biodiversity Stewardship Site Assessment Report |
| CEEC | Critically Endangered Ecological Community |
| DNG | Derived Native Grassland |
| DoEE | Commonwealth Department of Environment and Energy |
| DPIE | NSW Department of Planning, Industry and Environment |
| EEC | Endangered Ecological Community |
| ELA | Eco Logical Australia Pty Ltd |
| EP&A Act | *NSW Environmental Planning and Assessment Act 1979* |
| EPBC Act | Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* |
| FM Act | NSW *Fisheries Management Act 1994* |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| IBRA | Interim Biogeographic Regionalisation for Australia |
| LGA | Local Government Area |
| LLS | Local Land Service |
| NSW | New South Wales |
| NOW | NSW Office of Water |
| OEH | NSW Office of Environment and Heritage |
| PCT | Plant Community Type |
| SEPP | State Environmental Planning Policy |
| SSD | State Significant Development |
| SSI | State Significant Infrastructure |
| TEC | Threatened Ecological Community |
| VIS | Vegetation Information System |
| WM Act | NSW *Water Management Act 2000* |

# 1. Stage 1: Biodiversity assessment

## 1.1 Introduction

This Biodiversity Development Assessment Report (BDAR) has been prepared by Ryan Smithers, who is an Accredited Person under the NSW *Biodiversity Conservation Act 2016* (BC Act).

The proposed development comprises a new six seat detachable chairlift and associated works on Mount Perisher, within the Perisher Ski Resort and Kosciuszko National Park. The new chairlift will replace the Mount Perisher double chairlift and the Mount Perisher triple chairlift, which were constructed in the 1960's and 1970's respectively. The existing lifts will be removed.

### 1.1.1 General description of the development site

The development site is located on Mount Perisher, within the Perisher Ski Resort. The bulk of the development site is already heavily disturbed in association with the existing development on Mount Perisher, including both the bottom and top station locations. The development site only extends into small areas of generally disturbed vegetation on the edge of existing more extensive disturbed areas.

This report includes a base map, the Location and Development Site (Figure 1), which identifies the location of the proposed development and the extent of the development site.

### 1.1.2 Development site footprint

The development site footprint is approximately along the alignment of the existing Mount Perisher triple chairlift. However, the bottom station will be slightly lower and approximately 10 m to the north, such that the alignment will be slightly offset to the north of the triple chairlift at the bottom, becoming progressively closer to the alignment towards the top station. The bottom station also includes a chair shed.

To improve access to the bottom station in marginal snow conditions two steel bridges are proposed to cross the tributary of Perisher Creek, which is just to the west of the bottom station. The bridges will be constructed of a steel mesh on piers with removable decking that will be removed at the end of each winter. This construction technique will mitigate impacts on the vegetation beneath the bridges and ensure that the bridges do not present a barrier to fauna species.

The top station will be above the top stations of the double and triple chairlifts, approximately in the location of the NPWS communications hut. The top station location has been chosen to utilise a bench just below the Mount Perisher summit. The top station will integrate with the bench enabling offloading to the south onto a relatively flat area. A rock outcrop in front of the bench will need to be cut back to accommodate the top station.

The location of the top station has been accompanied by extensive targeted surveys for the Guthega Skink, which is well known from Mount Perisher, including around the summit. Extensive surveys over two summers demonstrated that the footprint of the proposed top station does not provide important habitat for the species, with no observation being made of any Guthega Skinks within the top station footprint despite surveys on 13 separate occasions.

The species does occur to the immediate south, west and north of the top station location. However, the proposal has been designed such that it is considered unlikely that there will be any impacts on the species burrow networks and only temporary impacts during construction on a relatively approximately 0.3 ha of foraging habitat.

The location of the top station will necessitate the moving of the Eyre T-bar bullwheel approximately 11.2 m further downhill, to enable sufficient room for offloading. To enable sufficient space for offloading and the dispersal of skiers and snowboarders some rock reduction and removal works are proposed to the south of the top station offload. These works will be done during spring using the over-snow rock reduction / removal technique, which minimises impacts on vegetation by avoiding the need for machinery to access over vegetation, and also insulates or protects surrounding vegetation from any impacts associated with the rock reduction / removal process. Larger pieces of rock are able to be removed over-snow. Rock fragments created during the top station construction and proposed rock removal and reduction works will be used in the supplementary Guthega Skink habitat that is proposed in the disturbed depression just below the proposed offload. The supplementary habitat was an idea that was developed during a site visit with NPWS and DPIE. NPWS proposed the supplementary habitat to provide additional rock habitat in the area and to improve connectivity to the north and south of the proposed top station.

Construction access will be via the existing access road. A culvert is proposed to be installed where the existing road crosses Perisher Creek to improve construction access and limit impacts on the watercourse. Construction access to some of the proposed ten towers will require short construction access tracks.

Minor modifications to the existing snowmaking system and the location of hydrants and laterals are also proposed.

The proposal is further described in Figures 2-7 and Photos 1-20.

### 1.1.3 Sources of information used

The following data sources were reviewed as part of this report:

- Ecology Australia (2002)
- McDougall and Walsh (2007)
- OEH (2018)
- Guthega Skink records on Mount Perisher provided by Zac Atkins and OEH.
- Additional GIS datasets including cadastre, contours, imagery and drainage.
- BioNet Vegetation Classification
- BioNet Atlas.

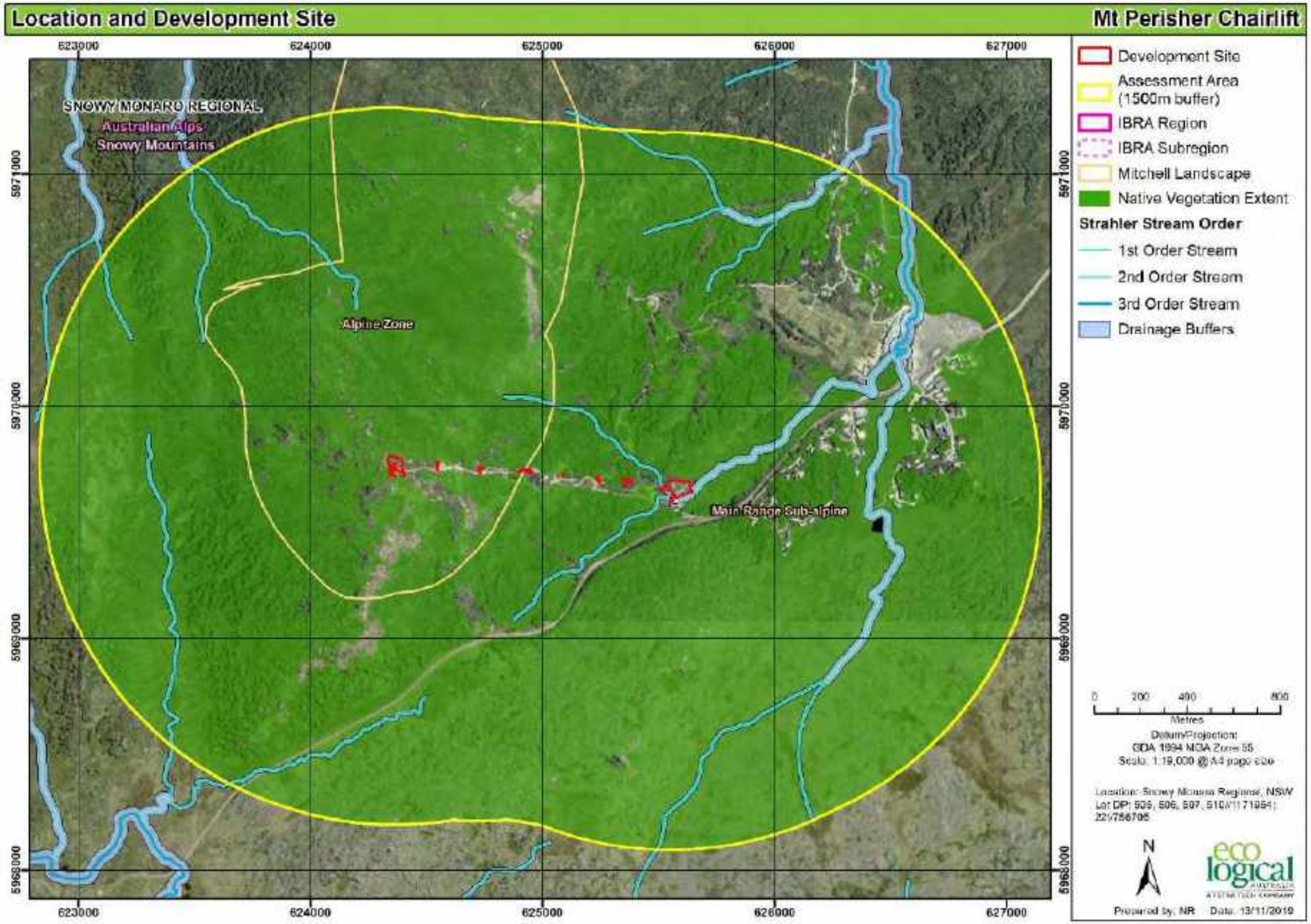


**Figure 1: Location and Development Site Map**

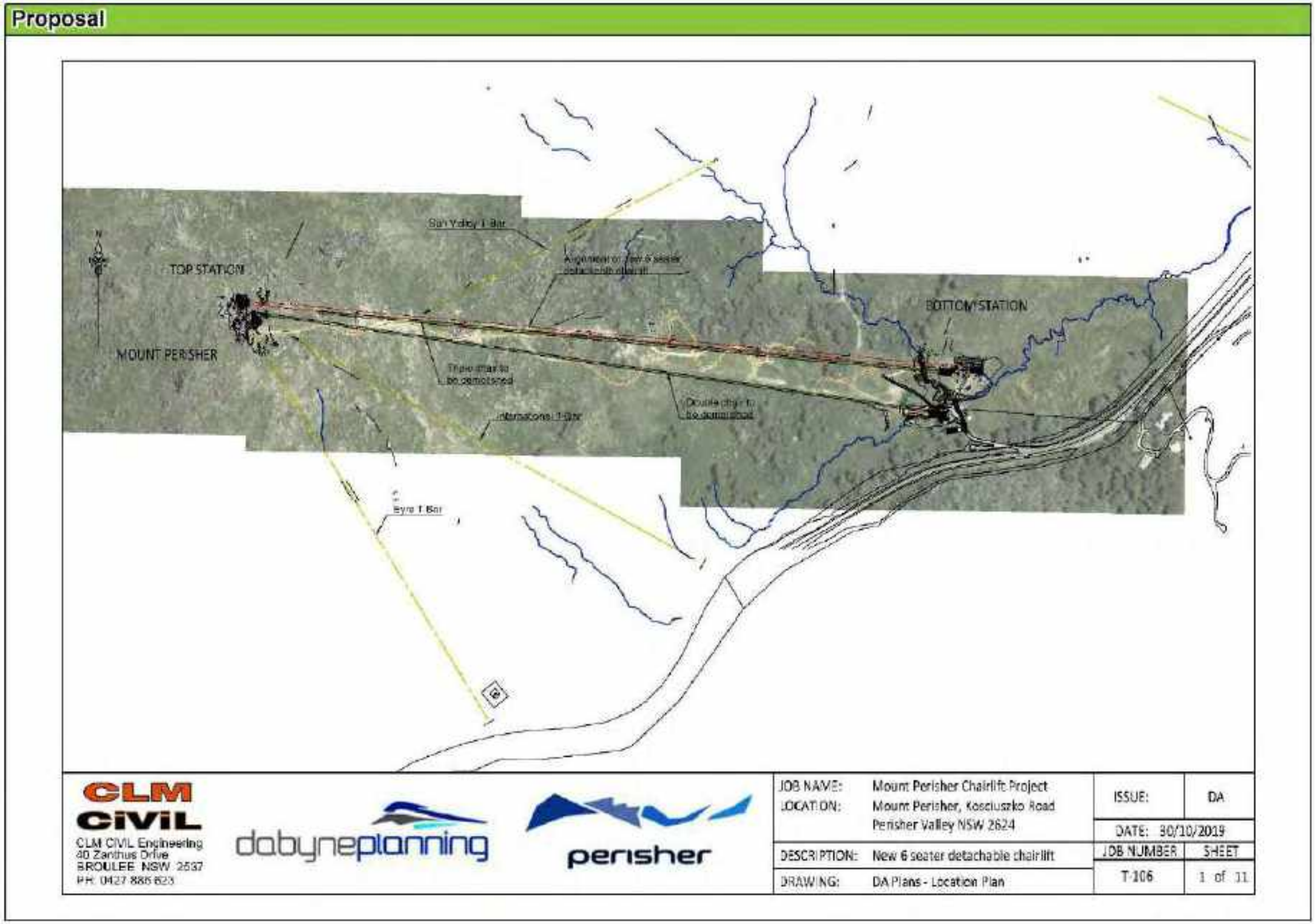


**Figure 2: The overall proposal showing the proposed bottom and top stations and the lift alignment**

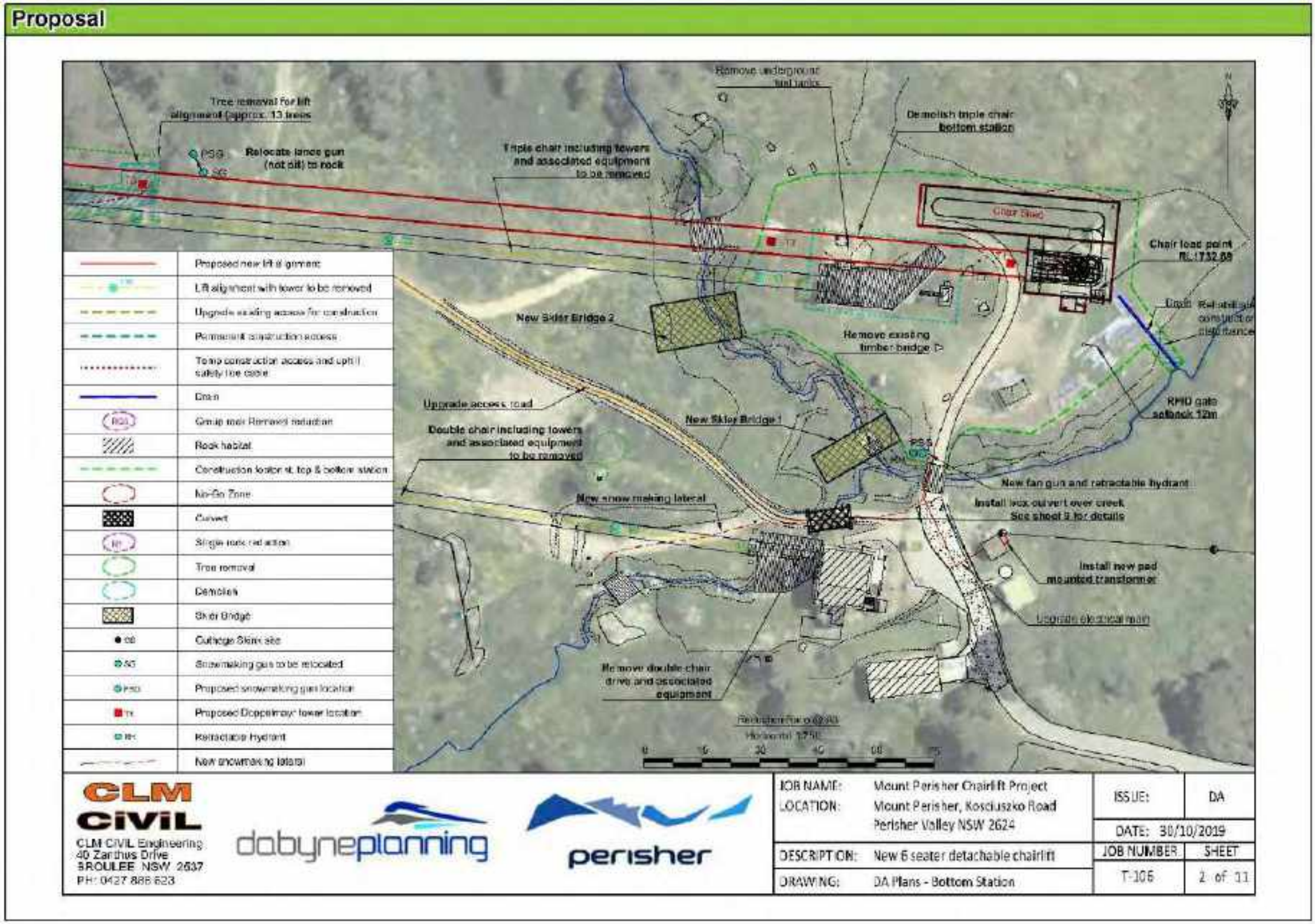


**Figure 3: The bottom station and associated works**

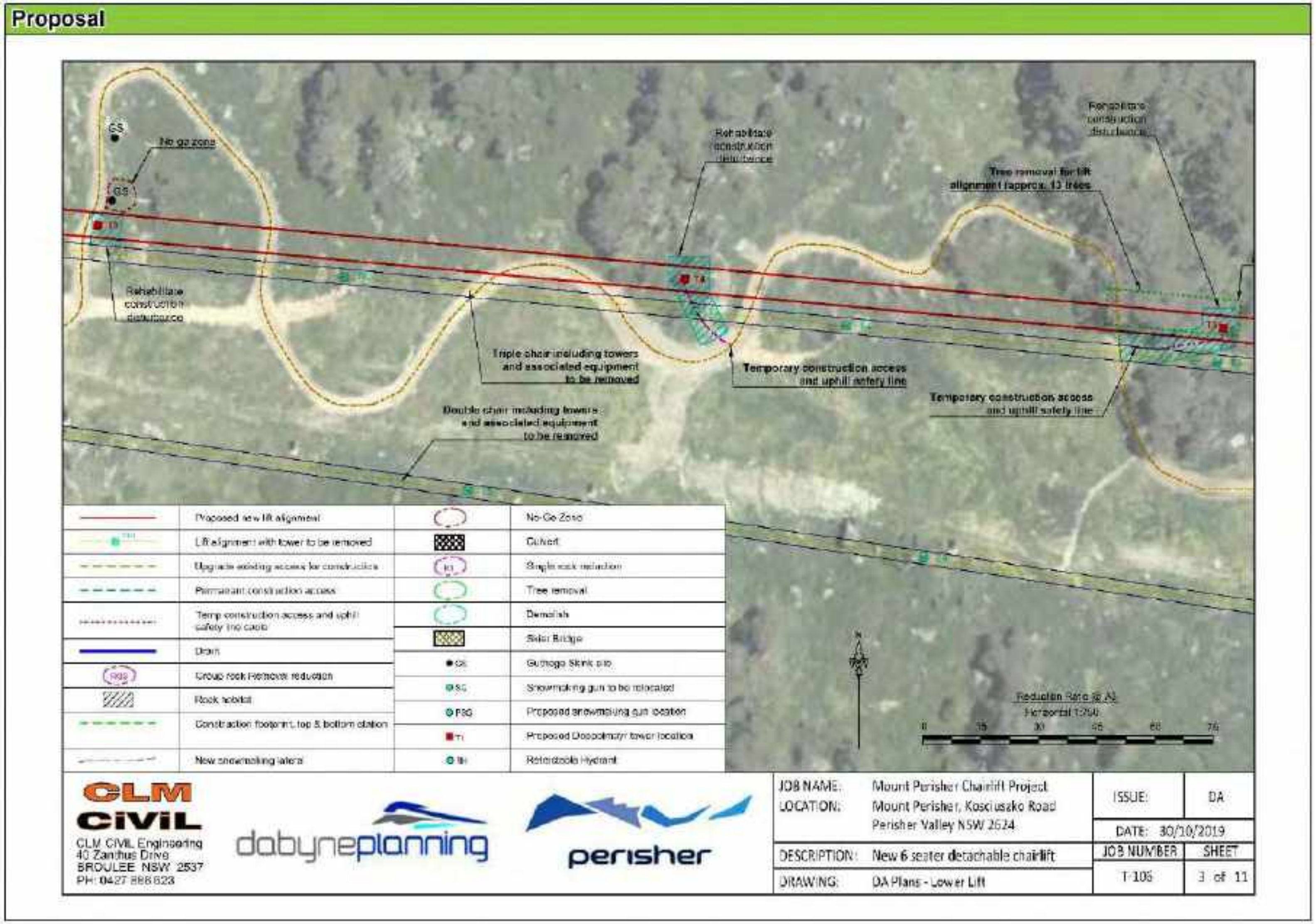


**Figure 4: Towers 3-5 and associated works**

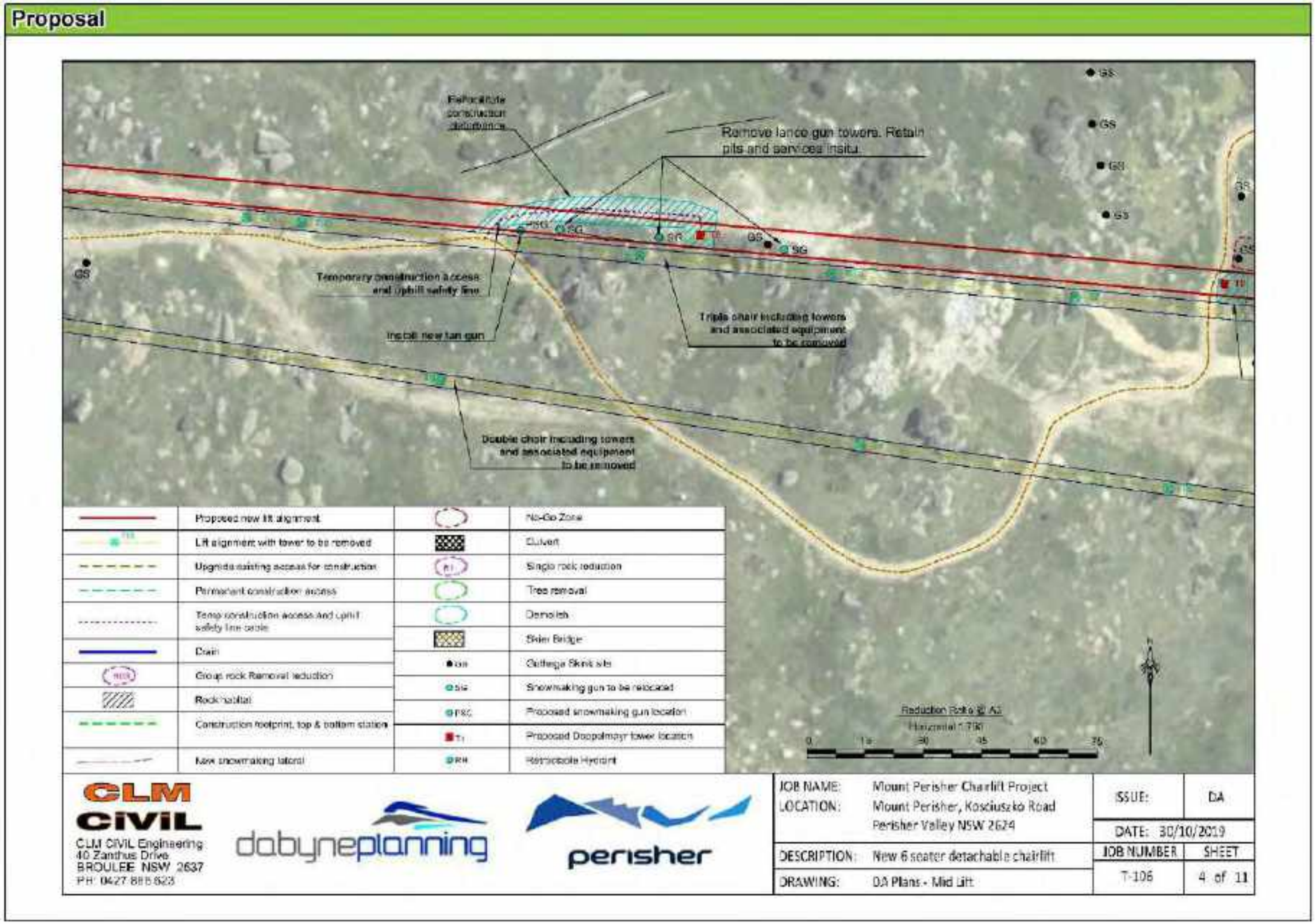


**Figure 5: Tower 6 and associated works**

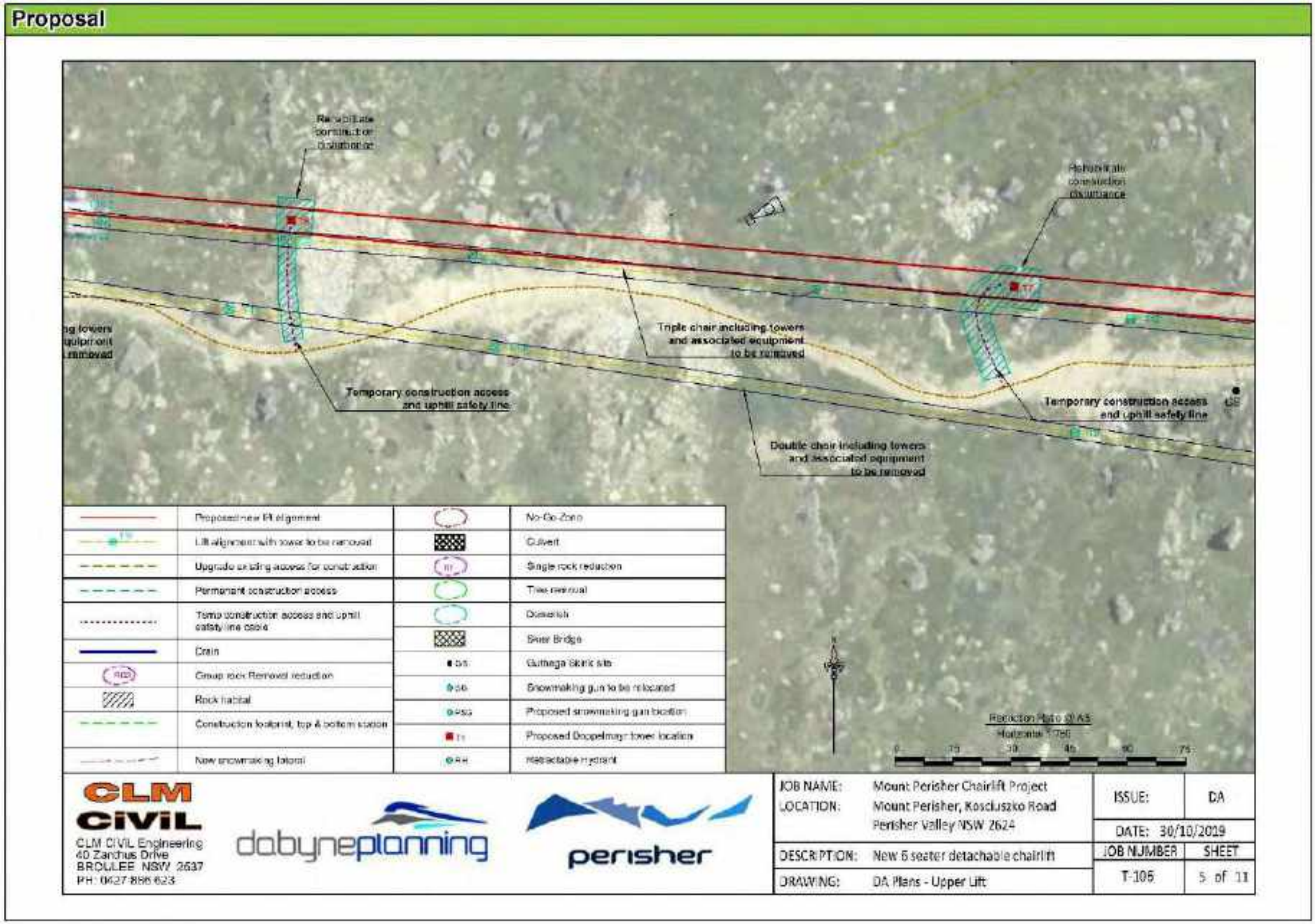


**Figure 6: Towers 7 and 8 and associated works**

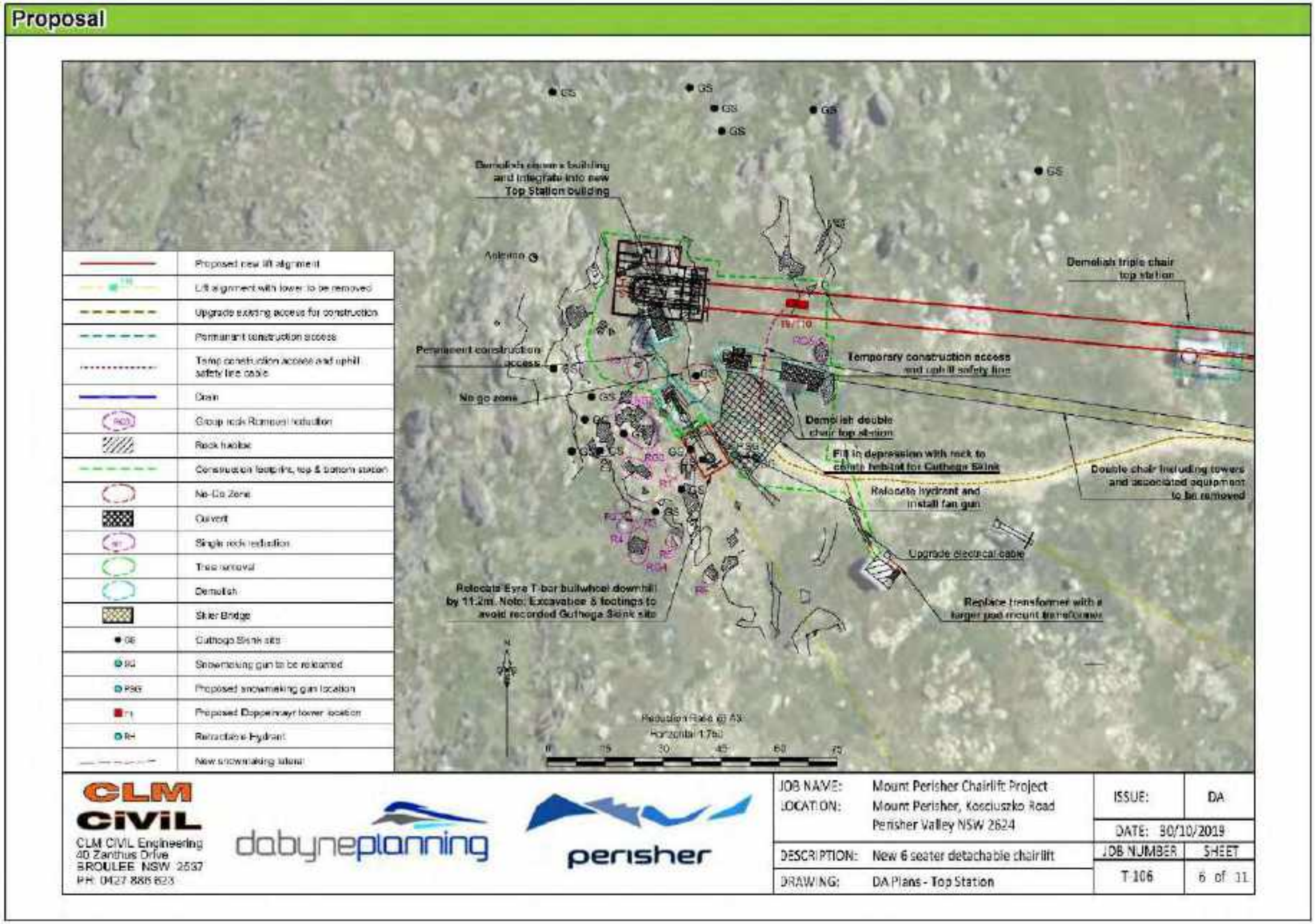


**Figure 7: The top station and associated works**

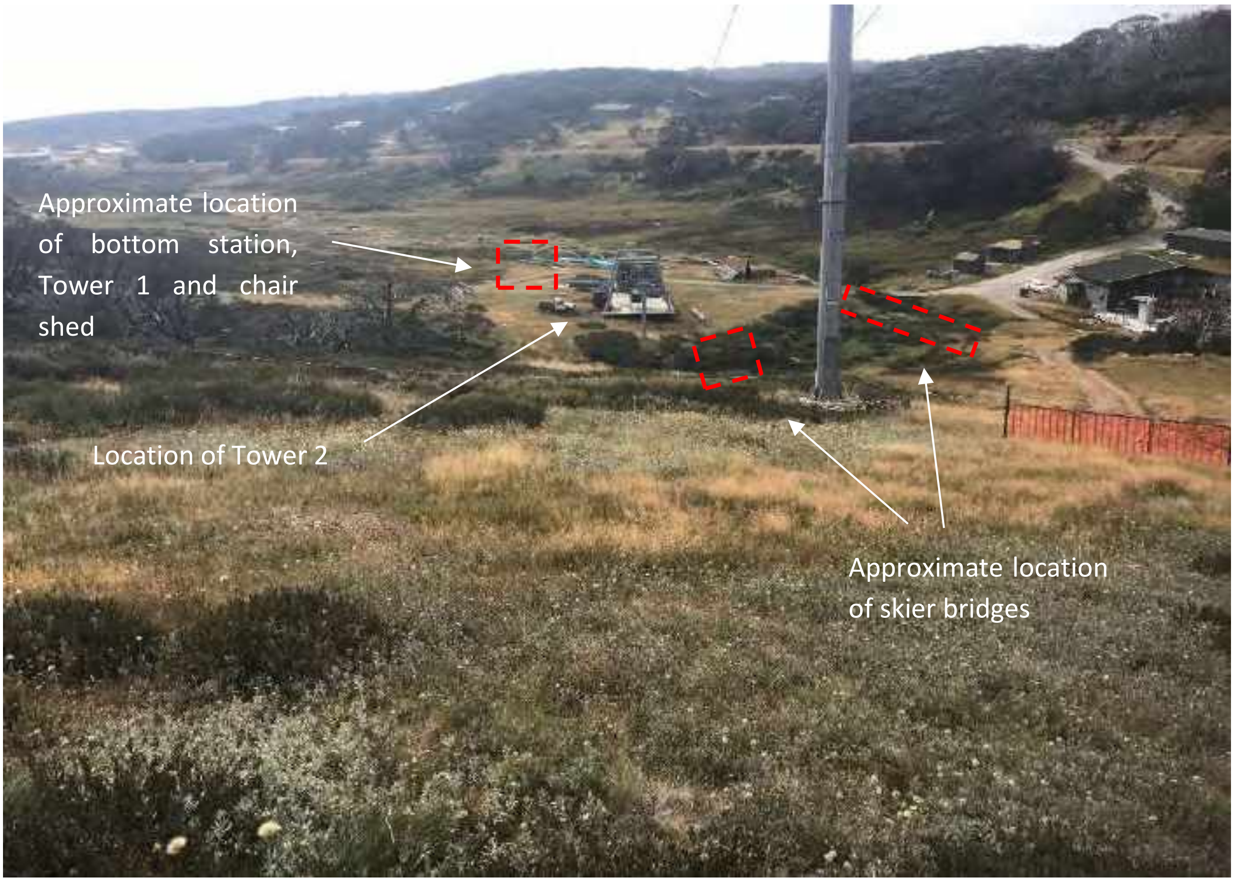


**Photo 1: The bottom station will be below and slightly 10 m to the north of the existing Triple Chairlift bottom station and located largely in the already heavily disturbed area.**

**Photo 2: The chair shed and associated pad will encroach slightly into the disturbed margins of the extensive bog associated with Perisher Creek.**

**Photo 3: The proposed skier bridges will affect remnant bog and heath that has been subject to historic disturbances and is already weedy in places. The location of skier bridge 2 is shown above.**

**Photo 4: The location of skier bridge 1 is shown above. The bridge location has been selected to take advantage of existing disturbance associated with an old access track and bridge.**

**Photo 5: The crossing of Perisher Creek will be upgraded to improve construction access and reduce water quality impacts that would otherwise be associated with construction access. The upgrade will be similar to existing crossings further downstream (i.e. near the Quad Express Chairlift).**

**Photo 6: The construction access will use the existing access road. The access road, which traverse an already heavily disturbed corridor, will be upgraded.**


**Photo 7: Tower 3 will require the removal of some heath and a few Snow Gum saplings.**

**Photo 8: As the proposed lift alignment is slightly offset from the existing Triple Chairlift, the removal and pruning of the mature Snow Gums adjacent to Tower 3 will be required. Approximately 13 trees will be affected.**


**Photo 9: Tower 4 will require the disturbance of some heath for construction and access.**


**Photo 10: Tower 5 will be located on a high point just below the existing access road and will require the removal of a small amount of Heath. A No Go zone will be established to the immediate north to avoid the location of a Guthega Skink siting.**


**Photo 11: Tower 6 will be located in a disturbed area of grassland/herbfield. The Tower location was moved uphill approximately 8 m to avoid a site where a Guthega Skink was observed.**

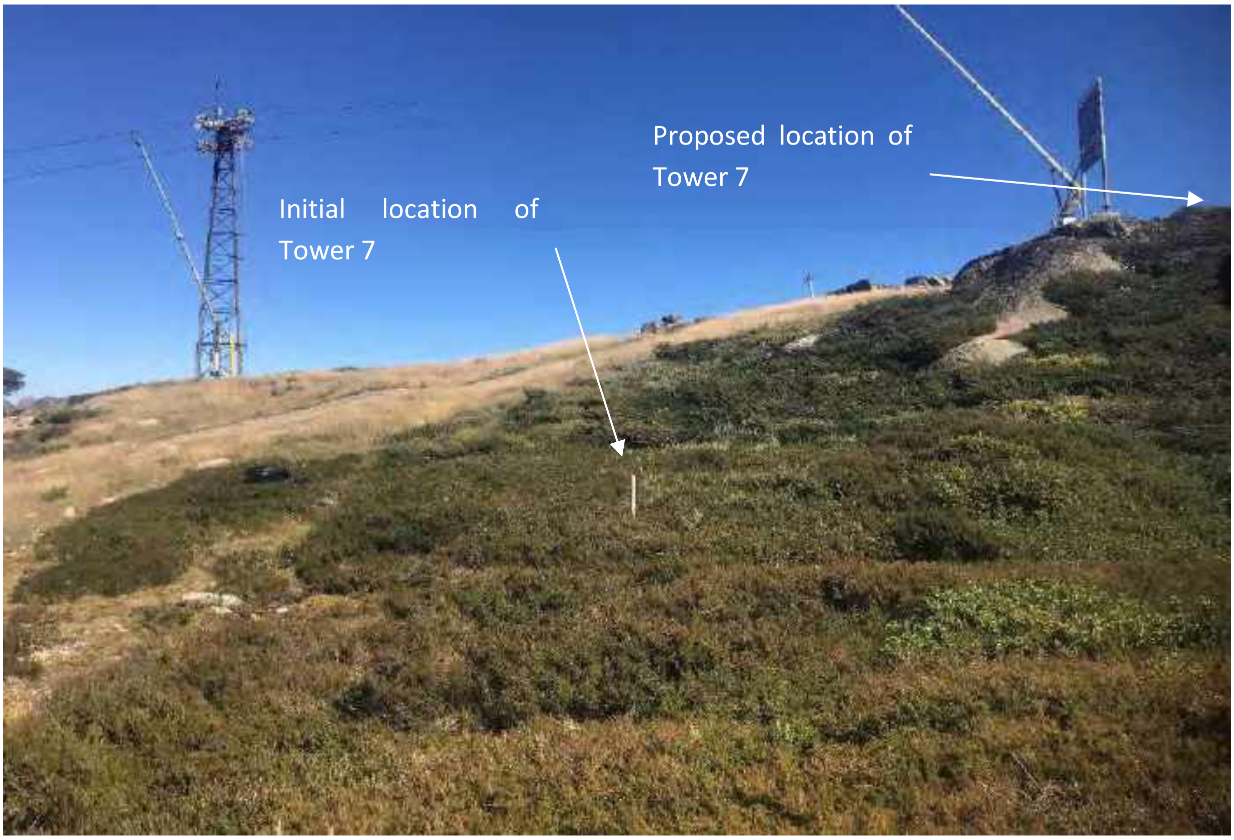


**Photo 12: The location of Tower 7 was moved higher to avoid a small patch of bog.**


**Photo 13: Tower 8 will affect a small area of grassland/herbfield**

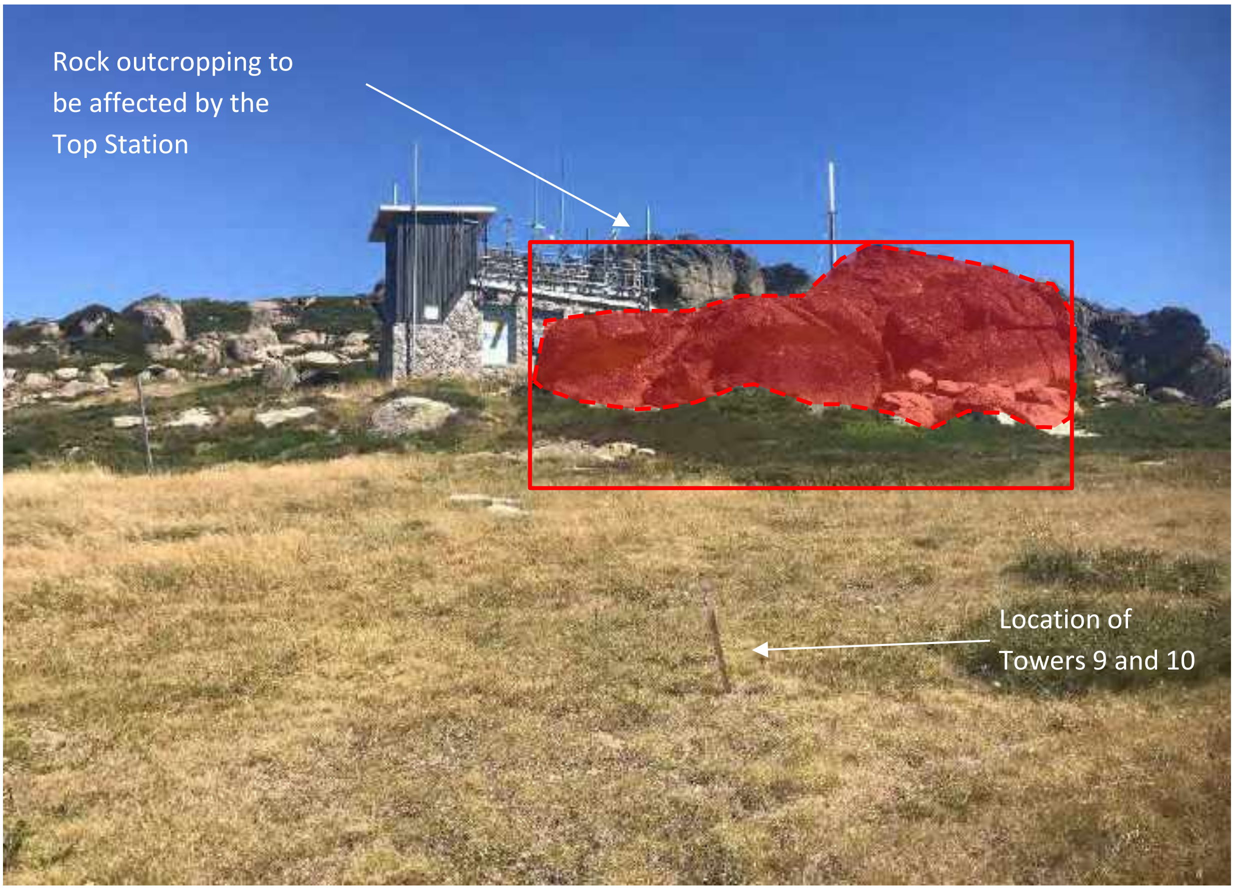


**Photo 14: Towers 9 and 10 will be located in an already heavily disturbed area.**

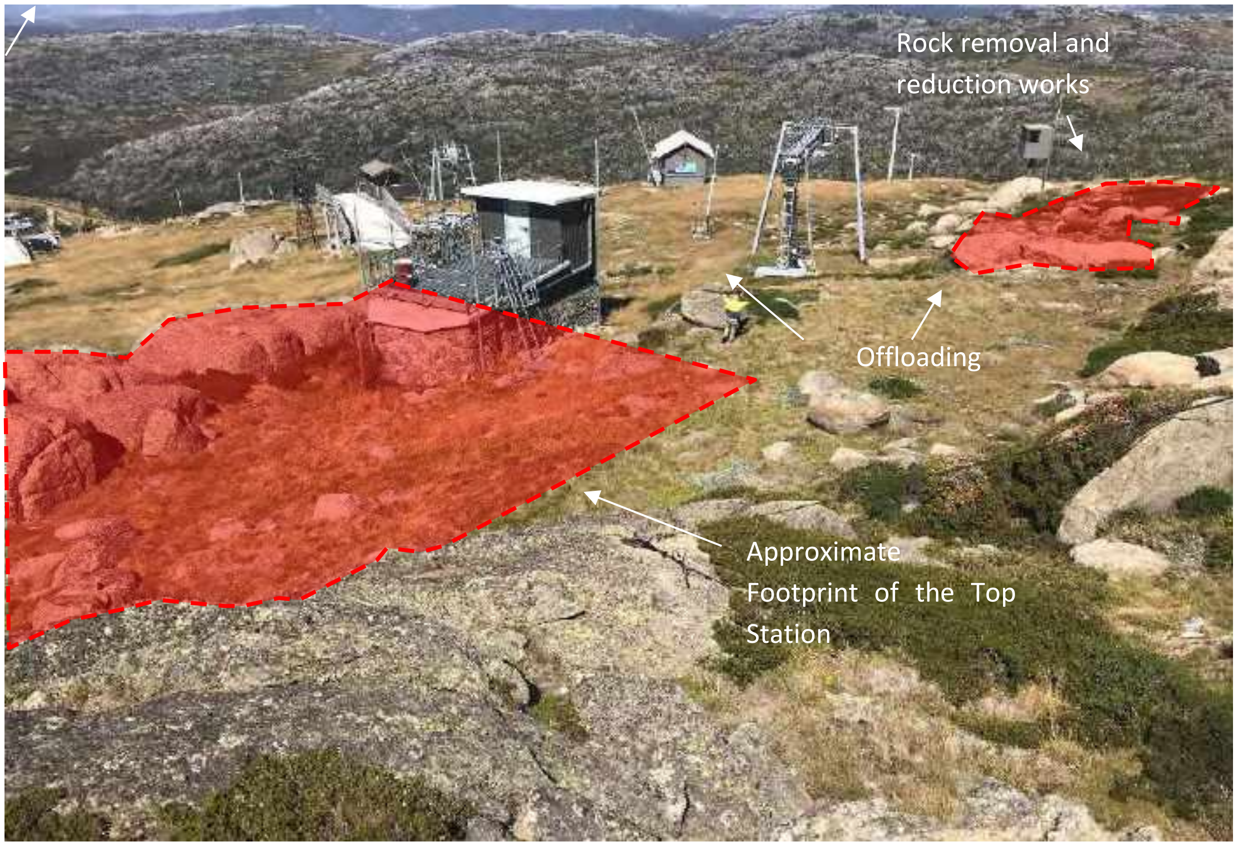


**Photo 15: The top station and offload will be located in an already disturbed area.**


**Photo 16: The Eyre T-bar Bullwheel will be moved approximately 11.2 m downslope. The forward supports will straddle a location where a Guthega skink was observed on one occasion.**


**Photo 17: A No Go area will be established to avoid the location of a Guthega Skink burrow. The disturbed depression below the lift and offload will be filled with rock to provide supplementary Guthega Skink habitat.**


**Photo 18: The higher protruding rocks in the foreground will be removed or reduced to improve dispersal of skiers and snowboarders from the chairlift offload.**

**Photo 19: Rock group 2 comprises a number of large boulders which appear to have been excavated as part of historic development and placed at their current location.**

**Photo 20: Other rocks, such as Rock 4 above, which are embedded, will have their upper parts, which protrude above the surrounding vegetation, reduced. The scratch marks on the top of the boulder attest to multiple impacts with groomers.**

## 1.2 Legislative context

**Table 1: Legislative context**

| Name | Relevance to the project | Report Section |
|---|---|---|
| Commonwealth | | |
| *Environment Protection and Biodiversity Conservation Act 1999* | Matters of National Environmental Significance (MNES) have been identified on or near the development site. This report assesses impacts to MNES and concludes that the development is unlikely to have a significant impact on MNES. An assessment of the proposal against relevant significant impact criteria is provided in Appendix C. | App C |
| State | | |
| *Environmental Planning and Assessment Act 1979* | The proposed development requires consent and is to be assessed under Part 4 of the EP&A Act. The EP&A Act places a duty on the determining authority to adequately address a range of environmental matters including the maintenance of biodiversity and the likely impact to threatened species, populations and communities. | 1 and 2 |
| *Biodiversity Conservation Act 2016* | The proposed development involves clearing of vegetation identified as high conservation value on the Biodiversity Values Land Map and thus requires submission of a Biodiversity Development Assessment Report. | 1 and 2 |
| Planning Instruments | | |
| SEPP Alpine Resorts - Kosciuszko National Park—Alpine Resorts | State Environmental Planning Policy (Kosciuszko National Park—Alpine Resorts) 2007 (SEPP 73) identified the Minister for Planning as the determining authority for development within the NSW Alpine Resorts. SEPP 73 requires the Minister for Planning to refer for comment any development application in the Alpine Resorts to the Director General of the NSW Office of Environment and Heritage (OEH). | 1 and 2 |
| Snowy River Shire Local Environment Plan 2013 | The subject site is zoned E1 National Parks and Nature Reserves under the Snowy River Shire Local Environment Plan 2013. | - |

## 1.3 Landscape features

### 1.3.1 IBRA regions and subregions

The development site falls within the IBRA region and subregions as outlined in Table 2 and Table 3.

**Table 2: IBRA regions**

| IBRA region | Area within development site (ha) |
|---|---|
| Australian Alps | 1.11 |

**Table 3: IBRA subregions**

| IBRA subregion | Area within development site (ha) |
|---|---|
| Snowy Mountains | 1.11 |

### 1.3.2 Native vegetation extent

The extent of native vegetation within the development site and buffer is identified in Figure 1 and in Table 4.

**Table 4: Native vegetation extent**

| Area within the development site (ha) | Area within the 1,500 m buffer area (ha) |
|---|---|
| 0.36 | 1021 |

There are no significant differences between the mapped vegetation extent and the aerial imagery.

### 1.3.3 Rivers and streams

The development site contains rivers and streams as outlined in Table 5.

**Table 5: Rivers and streams**

| River/stream | Order | Riparian buffer |
|---|---|---|
| Perisher Creek | 2 | 20 m |
| Perisher Creek tributary (unnamed) | 1 | 10 m |

### 1.3.4 Wetlands

The development site includes areas of bog which are considered local wetlands as defined by the BAM. The development site does not contain any Important Wetlands.

### 1.3.5 Connectivity features

The development site is part of an extensive area of habitat in the locality for a range of native animals and plants.

### 1.3.6 Areas of geological significance and soil hazard features

The development site does not contain areas of geological significance or soil hazard features.

### 1.3.7 Site context

#### *1.3.7.1 Method applied*

The site-based method has been applied to this development.

#### *1.3.7.2 Percent native vegetation cover in the landscape*

The current percent native vegetation cover in the landscape was assessed in a Geographic Information System (GIS) using aerial imagery sourced from SIX Maps and the mapping of Ecology Australia (2002). The results of this analysis are shown in Table 6.

**Table 6: Percent native vegetation cover in the landscape**

| Area within the development site (ha) | Cover within the 1,500 m buffer area (%) |
|---|---|
| 0.36 | 91 |

#### *1.3.7.3 Patch size*

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site (Table 7).

**Table 7: Patch size**

| Patch | Patch size area (ha) |
|---|---|
| NA | >101 |

## 1.4 Native vegetation

### 1.4.1 Survey effort

Vegetation surveys were undertaken within the development site by Ryan Smithers between March and May 2019.

A total of eight full-floristic vegetation plots were surveyed to identify PCTs and TECs on the development site (Table 8). A total of eight vegetation integrity plots were undertaken on the development site in accordance with the BAM (Table 9).

Field data collected at the full-floristic and vegetation integrity plots is included in Appendix B.

**Table 8: Full-floristic PCT identification plots**

| PCT ID | PCT Name | Number of plots surveyed |
|---|---|---|
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | 1 |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | 3 |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | 1 |
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | 3 |

**Table 9: Vegetation integrity plots**

| Veg Zone | PCT ID | PCT Name | Condition | Veg Zone Name | Area (ha) | Plots required | Plots surveyed |
|---|---|---|---|---|---|---|---|
| 1 | 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Excellent | Excellent | 0.15 | 1 | 1 |
| 2 | 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Moderate | Moderate | 0.04 | 1 | 1 |
| 3 | 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Moderate | With Trees | 0.02 | 1 | 1 |
| 4 | 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Good | Good | 0.06 | 1 | 1 |
| 5 | 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Disturbed | Disturbed | 0.02 | 1 | 1 |
| 6 | 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Disturbed | Disturbed | 0.01 | 1 | 1 |
| 7 | 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Excellent | Excellent | 0.01 | 1 | 1 |
| 8 | 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Excellent | Excellent | 0.05 | 1 | 1 |

### 1.4.2 Plant Community Types present

A total of four PCTs were identified on the development site (Table 10, Figures 8-11). Of these, one is a listed TEC under the BC Act and EPBC Act (Table 11 and Figure 12). Justification for the selection of PCTs occurring on the development site is based on a quantitative analysis of full-floristic plot data and is provided in Table 12.

PCT 637 - *Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion*, is considered to comprise the *Montane Peatland and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions* endangered ecological community (EEC) (hereafter referred to as the Montane Peatland and Swamps), which is listed on the BC Act. It also comprises the *Alpine Sphagnum Bogs and Associated Fens* EEC (hereafter referred to as the Alpine Sphagnum Bogs and Associated Fens) which is listed on the EPBC Act.

**Table 10: Plant Community Types**

| PCT ID | PCT Name | Vegetation Formation | Vegetation Class | Area | Percent cleared |
|---|---|---|---|---|---|
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Herbfields | 0.07 | 5 |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Heaths | 0.18 | 0 |
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Alpine Complex | Alpine Bogs and Fens | 0.06 | 5 |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Grassy Woodlands | Subalpine Woodlands | 0.05 | 5 |

**Table 11: Threatened Ecological Communities**

| PCT ID | BC Act | | | EPBC Act | | |
|---|---|---|---|---|---|---|
| | Listing status | Name | Area (ha) | Listing status | Name | Area (ha) |
| 637 | Endangered | Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions | 0.06 | Endangered | Alpine Sphagnum Bogs and Associated Fens | 0.06 |

**Table 12: PCT selection justification**

| PCT ID | PCT Name | Selection criteria | Species relied upon for identification of vegetation type and relative abundance |
|---|---|---|---|
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | IBRA region, landform, soils vegetation formation, vegetation class and quantitative analysis | *Celmisia costiniana, Craspedia spp., Euphrasia collina* subsp. *diversicolor, Microseris lanceolata; Poa fawcettiae, Rytidosperma nudiflorum, Senecio pinnatifolius, Trisetum spicatum, Oreomyrrhis eriopoda.* |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | IBRA region, landform, soils vegetation formation, vegetation class and quantitative analysis | *Grevillea australis, Nematolepis ovatifolia, Oxylobium ellipticum, Acaena novae-zelandiae, Asperula gunnii, Carex breviculmis, Prostanthera cuneata, Olearia phlogopappa* var. *flavescens, Luzula novae-cambriae, Poa fawcettiae, Polystichum proliferum, Oreomyrrhis eriopoda; Viola betonicifolia.* |
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | IBRA region, landform, soils vegetation formation, vegetation class and quantitative analysis | *Baeckea gunniana, Richea continentis, Carex gaudichaudiana, Empodisma minus, Luzula modesta, Oreobolus distichus, Oreomyrrhis ciliata; Poa costiniana, Sphagnum cristatum.* |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | IBRA region, landform, soils vegetation formation, vegetation class and quantitative analysis | *Eucalyptus niphophila, Hovea montana, Olearia phlogopappa, Oxylobium ellipticum, Ozothamnus secundiflorus, Poa fawcettiae, Tasmannia xerophila* subsp. *xerophila.* |

In determining the PCTs for the development site, various attributes were considered in combination to assign vegetation to the best fit PCT. Attributes included dominant species in each stratum, community composition, soils and landscape position. Plot data was analysed in a quantitative analysis tool developed by ELA using the characteristic species present in each structural layer for all PCTs in the region sourced from the Bionet Vegetation Information System (VIS). This quantitative analysis was used to assist in determining PCTs that may be present. The tool uses positive characteristic species of PCTs and matches them to the flora species collected in plots. The tool then provides a total number of characteristic species present in the canopy, mid-storey and ground-layer and matches those communities that fit most strongly with the PCTs available. The higher the number of characteristic species the greater the fit for that community. It can be the case that a community matches strongly floristically with a PCT, however does not match well with other characteristics such as structure, landscape position or region. Therefore, this tool assists in the decision-making process, but is not the sole determining factor. Rather the tool assists expert judgement.

ELA considered the vegetation within the development site to comprise the following PCTs:

PCT 641 - *Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion*: PCT 641 occurs predominately in the upper half of the development site, around the proposed top station location (Photo 21) and Towers 6 (Photo 11) and Tower 8 (Photo 13). The community is extensive in alpine and subalpine areas in the locality including on Mount Perisher. There is a patch of vegetation below the Eyre T-bar bullwheel (Photo 22) that is ecotonal between PCT 641 and other alpine PCTs i.e. PCT 643 and PCT 642 *Alpine short snowpatch herbfield of the Kosciuszko Main Range, Australian Alps Bioregion*.

The community is not considered to comprise PCT 642 or the associated Snowpatch Herbfield in the Australian Alps EEC, which is listed under the BC Act. The community is not consistent with Community 13 *Neopaxia australasica – Ranunculus niphophilus snowpatch herbfield* of McDougall and Walsh (2007), and does not support most of the characteristic species of that community and the EEC. Whilst the site does hold snow, given the elevation, aspect, and sheltered location, it is not covered by snow for 8-9 months and it not abundantly irrigated. It is most closely aligned to Community 17 *Poa fawcettiae – Celmisia costiniana snowpatch grassland* of McDougall and Walsh (2007) but is ecotonal and has affinities with Community 23 *Grevillea australis – Nematolepis ovatifolia open heathand* and Community 39 *Kosciuszko alpine Epacris – Kunzea open Heathland*. It is considered to be most appropriately classified as PCT 641.

PCT 643 - *Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion*: PCT 643 occurs throughout the development site (Photo 23 and Photo 24) and surrounds and is the most common vegetation community within the Perisher Resort Area. It varies considerably structurally, and to a lesser extent floristically, throughout the development site but is generally in good condition. In places there are scattered low *Eucalyptus niphophila* (Snow Gums).

PCT 637 - *Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion*: The proposal has been designed to largely avoid direct impacts on PCT 637, primarily through the selected alignment, but also by modifying the original location of Tower 7 and also through the design of the skier bridges. A small area of PCT 637 will be affected where the pad for the bottom station chair shed will extend into the extensive area of bog associated with Perisher Creek (Photo 2) and where the proposed skier bridges traverse the creek to the south and west of the bottom station area (Photo 3 and Photo 4).

PCT 645 - *Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion*: PCT 645 occurs in the lower parts of the development site, around Tower 3 (Photo 8) where tree removal will be required to achieve the required clearances to the chairlift. The community has a considerably higher than benchmark shrub cover, however it best fits PCT 645.

### 1.4.3 Vegetation integrity assessment

A vegetation integrity assessment using the BAMC was undertaken and the results are outlined in Table 13.

### 1.4.4 Use of local data

Use of local data instead of benchmark integrity scores is not proposed.

**Photo 21: PCT 641 occurs on the bench where the top station and offload will be located. It is quite weedy in places as a result of historic disturbances.**

**Photo 22: PCT 641 below Eyre T-bar Bullwheel showing the heavily disturbed land dominated by exotic grasses just downhill.**

**Photo 23: PCT 643 occurs around the top station and where some of the rock removal and reduction is proposed.**

**Photo 24: PCT 643 occurs in a narrow band on the short slope above the creek, on the western, southern and eastern margins of the bottom station site.**

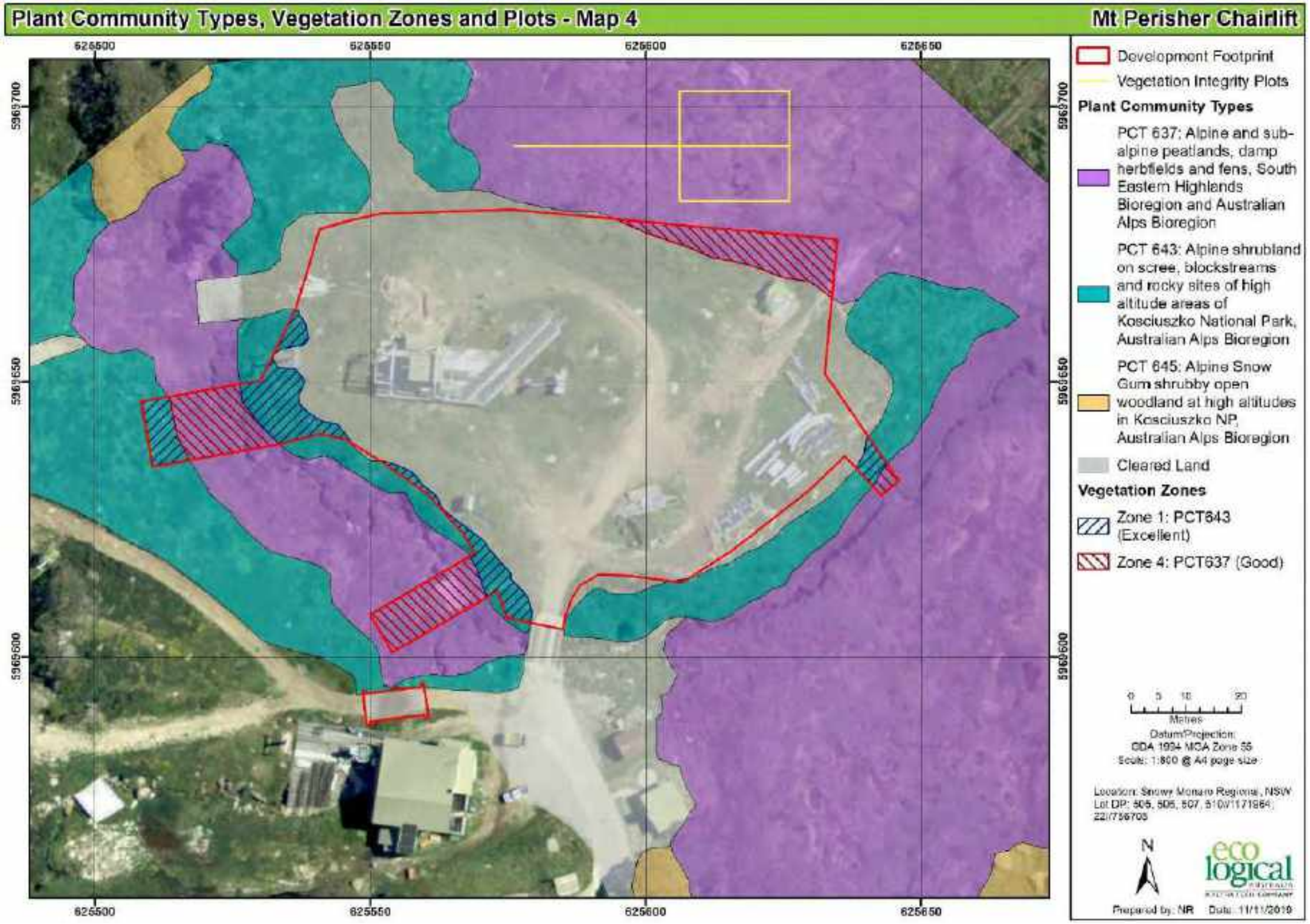


**Figure 8: Plant Community Types, vegetation zones and plot locations – bottom station.**

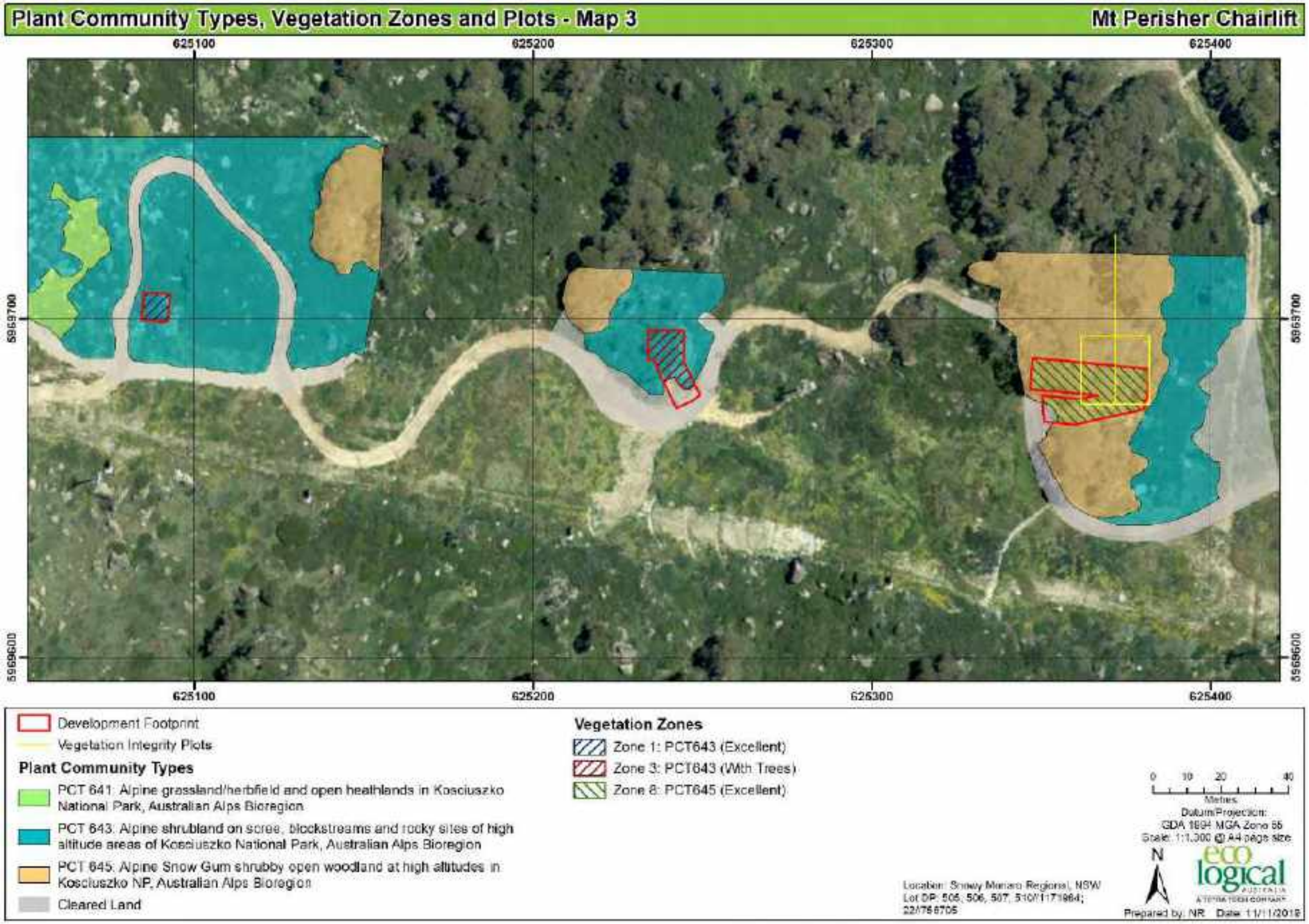


**Figure 9: Plant Community Types, vegetation zones and plot locations – towers 3-5.**

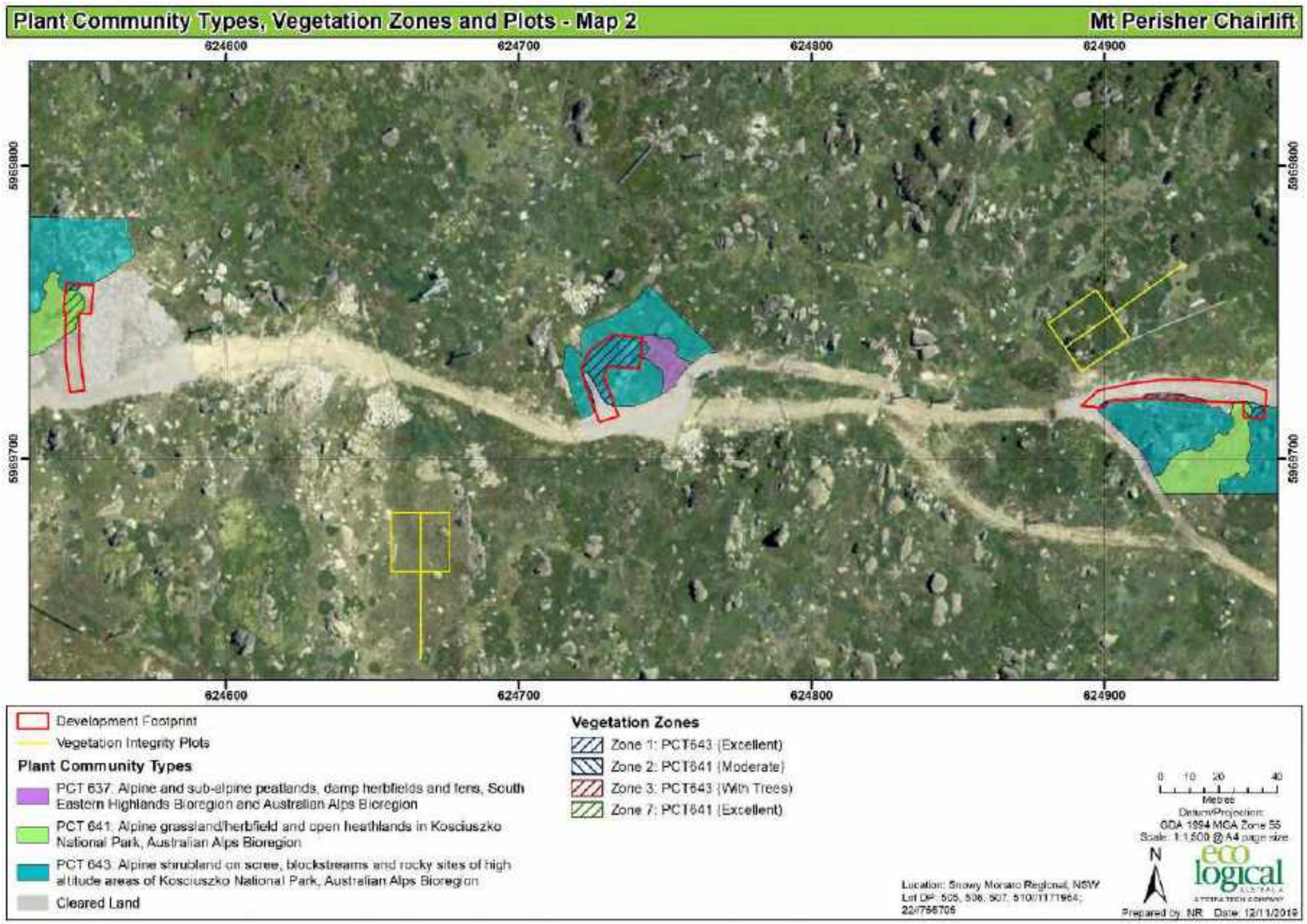


**Figure 10: Plant Community Types, vegetation zones and plot locations – towers 6-8.**

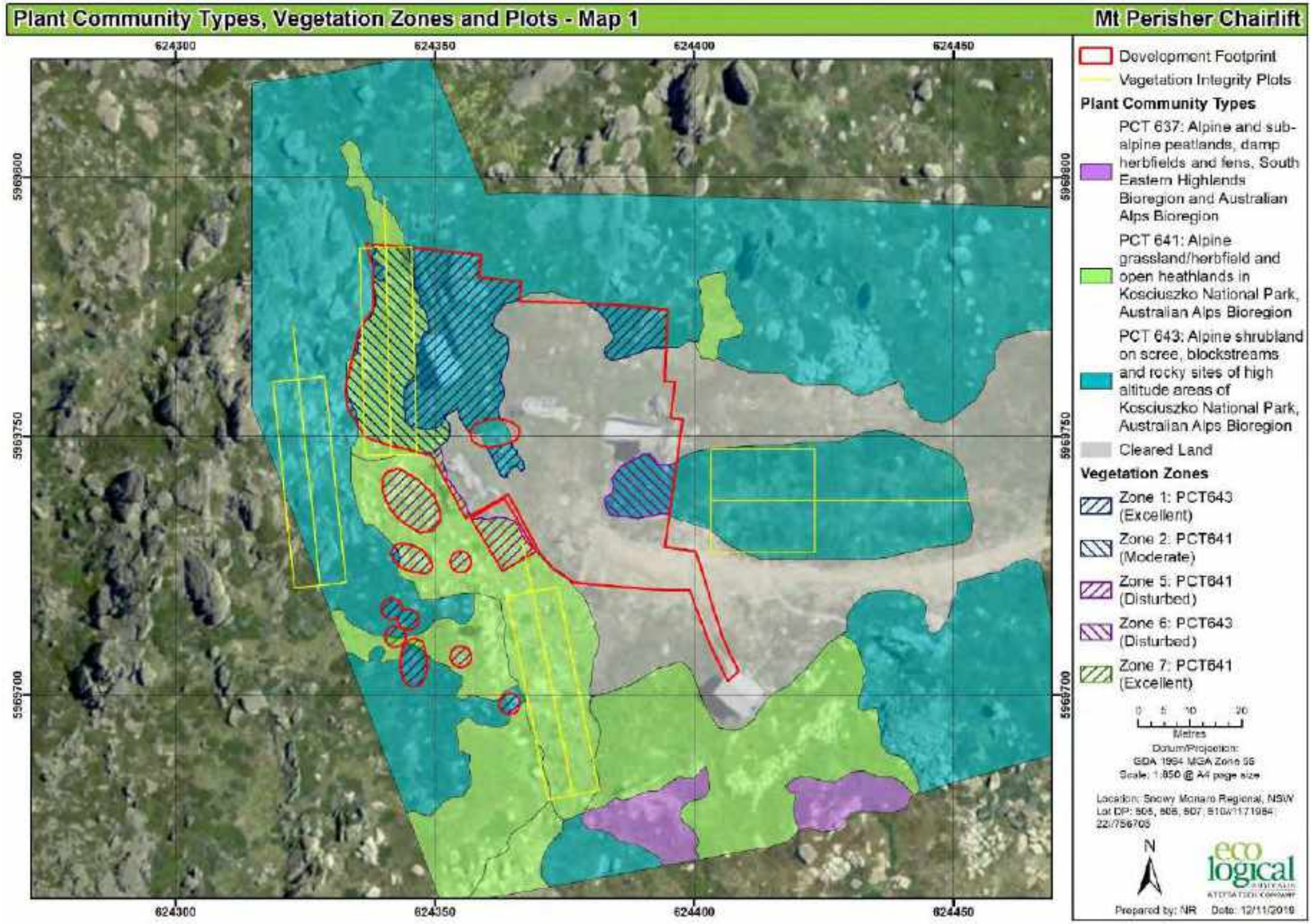


**Figure 11: Plant Community Types, vegetation zones and plot locations – top station.**

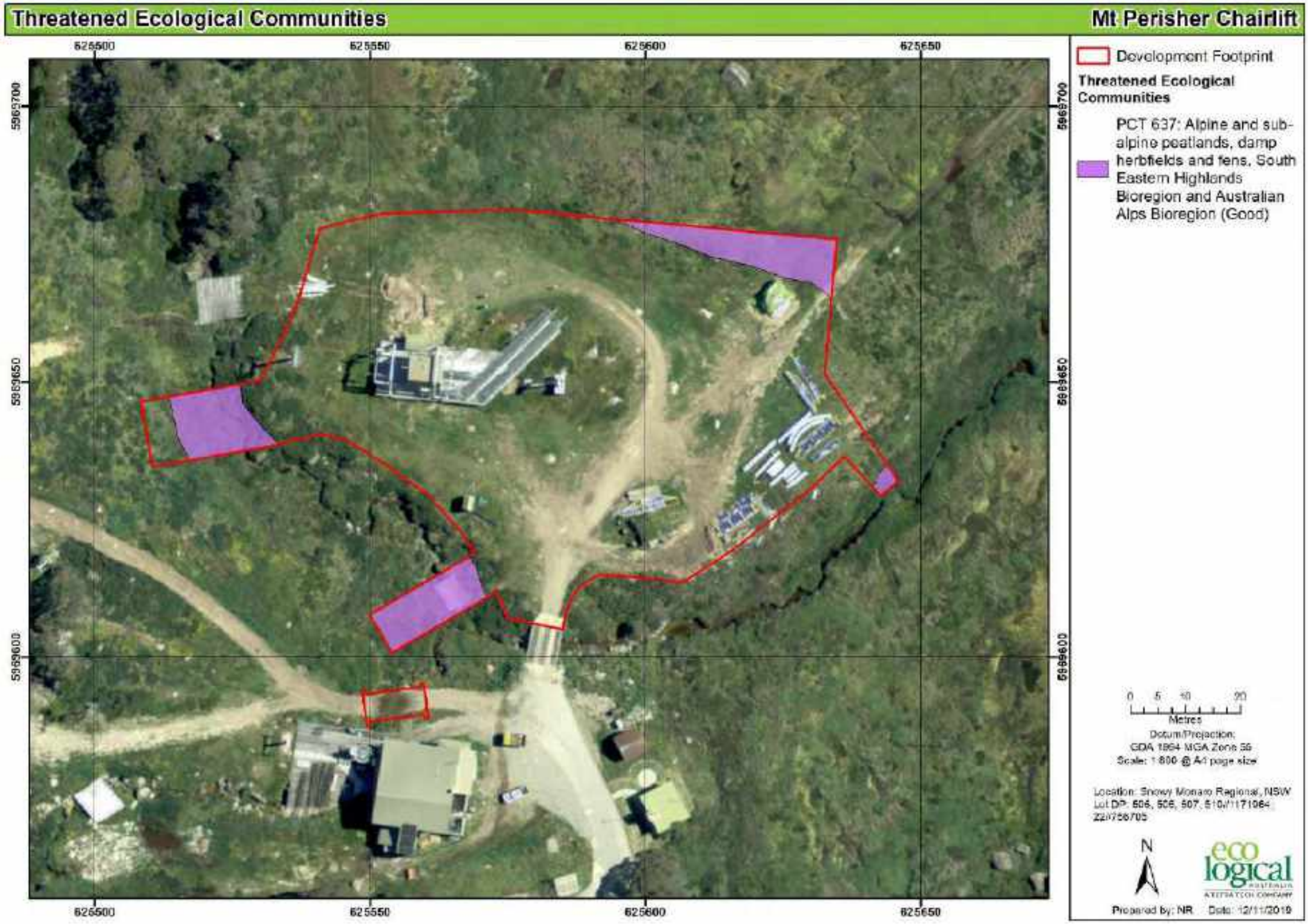


**Figure 12: Threatened ecological communities within the development site.**

**Table 13: Vegetation integrity**

| Veg Zone | PCT ID | Condition | Area (ha) | Composition Condition Score | Structure Condition Score | Function Condition Score | Current vegetation integrity score |
|---|---|---|---|---|---|---|---|
| 1 | 643 | Excellent | 0.15 | 86.8 | 51 | - | 66.5 |
| 2 | 641 | Moderate | 0.04 | 95 | 30.8 | - | 54.1 |
| 3 | 643 | With Trees | 0.02 | 58.2 | 58.5 | - | 58.3 |
| 4 | 637 | Good | 0.06 | 80.1 | 38.7 | - | 55.7 |
| 5 | 641 | Disturbed | 0.02 | 80.5 | 9.3 | - | 27.4 |
| 6 | 643 | Disturbed | 0.01 | 62.6 | 12.8 | - | 28.3 |
| 7 | 641 | Excellent | 0.01 | 83.2 | 65.6 | - | 73.9 |
| 8 | 645 | Excellent | 0.05 | 48.8 | 60.2 | 66.3 | 58 |

## 1.5 Threatened species

### 1.5.1 Ecosystem credit species

Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 14.

**Table 14: Predicted ecosystem credit species**

| Common Name | Species | Habitat Constraints | Geographic limitations | Sensitivity to gain class | NSW listing status | EPBC Listing status |
|---|---|---|---|---|---|---|
| Dusky Woodswallow | *Artamus cyanopterus cyanopterus* | - | - | Moderate | Vulnerable | Not Listed |
| Gang-gang Cockatoo (Foraging) | *Callocephalon fimbriatum* | - | - | Moderate | Vulnerable | Not Listed |
| Varied Sittella | *Daphoenositta chrysoptera* | - | - | Moderate | Vulnerable | Not Listed |
| Eastern False Pipistrelle | *Falsistrellus tasmaniensis* | - | - | High | Vulnerable | Not Listed |
| Little Eagle (Foraging) | *Hieraaetus morphnoides* | - | - | Moderate | Vulnerable | Not Listed |
| Olive Whistler | *Pachycephala olivacea* | - | - | Moderate | Vulnerable | Not Listed |
| Scarlet Robin | *Petroica boodang* | - | - | Moderate | Vulnerable | Not Listed |
| Flame Robin | *Petroica phoenicea* | - | - | Moderate | Vulnerable | Not Listed |

Ecosystem credit species which have been excluded from the assessment and relevant justification is included in Table 15.

**Table 15: Justification for exclusion of predicted ecosystem credit species**

| Species | Common Name | NSW listing status | EPBC Listing status | Justification for exclusion of species |
|---|---|---|---|---|
| Olive Whistler | *Pachycephala olivacea* | Vulnerable | Not Listed | This species is associated with taller forests and subalpine woodlands with a dense understory, particularly in more substantial gullies than those which occur within the development site and immediate surrounds. |

## 1.6 Species credit species

Species credit species predicted to occur at the development site (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 16.

**Table 16: Candidate species credit species**

| Common Name | Species | Habitat Constraints | Geographic limitations | Sensitivity to gain class | NSW listing status | EPBC Listing status |
|---|---|---|---|---|---|---|
| Shining Cudweed | *Argyrotegium nitidulum* | Other<br>Treeless vegetation above 1000 m in altitude | Above 1400 m, above 1500 m | Moderate | Vulnerable | Vulnerable |
| Mountain Pygmy-possum | *Burramys parvus* | - | sth - nth range between Dead Horse Gap and Mt Jagungle | High | Endangered | Endangered |
| Gang-gang Cockatoo (breeding) | *Callocephalon fimbriatum* | - | - | High | Vulnerable | Not Listed |
| Archer's Carex | *Carex archeri* | Other<br>Treeless vegetation above 1000 m in altitude | Above 1400 m | High | Endangered | Not Listed |
| Raleigh Sedge | *Carex raleighii* | Other<br>Treeless vegetation above 1000 m in altitude | Above 1100 m | High | Endangered | Not Listed |
| Alpine She-oak Skink | *Cyclodomorphus praealtus* | - | - | High | Endangered | Endangered |
| Leafy Anchor Plant | *Discaria nitida* | Other<br>Riparian areas above 1000 m in altitude | Upstream from Jindabyne | High | Vulnerable | Not Listed |
| Rough Eyebright | *Euphrasia scabra* | - | - | High | Endangered | Not Listed |
| Little Eagle (Breeding) | *Hieraaetus morphnoides* | - | - | Moderate | Vulnerable | Not Listed |
| Guthega Skink | *Liopholis guthega* | Granite substrate and decomposing granite soils<br>Rocky areas including sub-surface boulders | - | High | Endangered | Endangered |
| Alpine Tree Frog | *Litoria verreauxii alpina* | - | above 1000 m asl | High | Endangered | Vulnerable |

| Common Name | Species | Habitat Constraints | Geographic limitations | Sensitivity to gain class | NSW listing status | EPBC Listing status |
|---|---|---|---|---|---|---|
| Broad-toothed Rat | *Mastacomys fuscus* | - | - | High | Vulnerable | Vulnerable |
| Smoky Mouse | *Pseudomys fumeus* | - | - | High | Critically Endangered | Endangered |
| Southern Corroboree Frog | *Pseudophryne corroboree* | NA/Swamps<br>Within 200 m of high montane and sub-alpine bog or ephemeral pool environments | above 1000 m asl | Very High | Critically Endangered | Critically Endangered |
| Northern Corroboree Frog | *Pseudophryne pengilleyi* | - | above 700 m asl | Moderate | Critically Endangered | Critically Endangered |
| Blue-tongued Greenhood | *Pterostylis oreophila* | - | - | High | Critically Endangered | Critically Endangered |
| Anemone Buttercup | *Ranunculus anemoneus* | Treeless vegetation above 1000 m in altitude | Above 1400 m | High | Vulnerable | Vulnerable |
| Perisher Wallaby-grass | *Rytidosperma vickeryae* | - | - | High | Endangered | Not Listed |

### 1.6.1 Targeted surveys

Targeted surveys for species credit species were undertaken at the development site on the dates outlined in Table 17. The location of targeted surveys are shown on Figure 15, with the results of the surveys shown as individual species polygons on Figure 17.

**Table 17: Targeted surveys**

| Date | Surveyors | Target species |
|---|---|---|
| 9 March 2018 | Ryan Smithers | Guthega Skink |
| 15 March 2018 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 16 March 2018 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 29 March 2018 | Alicia Scanlon | Guthega Skink |
| 11 April 2018 | Alicia Scanlon | Guthega Skink |
| 5 December 2018 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 6 December 2018 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 10 January 2019 | Alicia Scanlon | Guthega Skink |
| 28 February 2019 | Alicia Scanlon | Guthega Skink |
| 7 March 2019 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 8 March 2019 | Ryan Smithers and Alicia Scanlon | Guthega Skink |
| 8 March 2019 | Ryan Smithers | Broad-toothed Rat, Perisher Wallaby Grass, Shining Cudweed, Archer's Carex, Raleigh Sedge, Leafy Anchor Plant, Rough Eyebright and Anenome Buttercup. |
| 15 March 2019 | Alicia Scanlon | Guthega Skink |
| 17 April 2019 | Ryan Smithers | Guthega Skink |

Weather conditions during the targeted surveys are outlined in Table 18.

**Table 18: Weather conditions**

| Date | Rainfall (mm) | Minimum temperature $0^{C}$ | Maximum temperature $0^{C}$ |
|---|---|---|---|
| 9 March 2018 | - | 14 | 16 |
| 15 March 2018 | - | 10 | 12 |
| 16 March 2018 | - | 9 | 12 |
| 29 March 2018 | - | 11 | 15 |
| 11 April 2018 | - | 11 | 15 |
| 5 December 2018 | - | 14 | 16 |
| 6 December 2018 | - | 14 | 16 |
| 10 January 2019 | - | 10 | 14 |
| 28 February 2019 | - | 9 | 17 |
| 7 March 2019 | - | 9 | 11 |
| 8 March 2019 | - | 8 | 11 |
| 15 March 2019 | - | 8 | 12 |
| 17 April 2019 | - | 11 | 15 |

Survey effort undertaken at the development site is outlined in Table 19.

**Table 19: Survey effort**

| Method | Habitat (ha) | Stratification units | Total effort | Target species |
|---|---|---|---|---|
| Target Searches | 0.5 | Suitable habitats within and immediately surrounding the site | 52.75 person hours | Guthega Skink |
| Remote camera traps | 0.01 | Two cameras at different locations at the top station | 20 days/nights | Guthega Skink, Broad-toothed Rat, Mountain Pygmy-possum, Alpine She-oak Skink |
| Tiles | 0.03 | In grassland/herbfield around the top station | 5 tiles checked on ten occasions | Alpine She-oak Skink |
| Targeted cryptic flora searches | 0.06 | Bog around bottom station | 1.5 person hours | Perisher Wallaby-grass, Raleigh Sedge, Archer's Carex, Rough Eyebright |
| Targeted searches for non-cryptic flora | 0.5 | Throughout the development site | 3 person hours | Shining Cudweed, Anenome Buttercup, Rough Eyebright and Leafy Anchor Plant |

The targeted surveys resulted in the detection of three species credit species, the Broad-toothed Rat, Guthega Skink and Anenome Buttercup.

The characteristic scats of the Broad-toothed Rat were scattered in low densities throughout the development site and surrounds, as they are in suitable habitats throughout much of the locality.

The Guthega Skink has been detected on Mount Perisher, including near the summit, by ELA (ELA 2015) and others (Zac Atkins pers.comm. 2015). As such, the assessment of a suitable location for the top station included extensive targeted surveys for the Guthega Skink over two summers. The Guthega Skink survey effort was concentrated around the top station and offload, however the surveys also included the other parts of the development site, particularly those towers that were close to existing records or suitable habitat. Surveys for the Guthega Skink largely comprised the visual inspection method which involves ecologists remaining stationary or moving slowly through potentially suitable habitat searching, with the aid of binoculars, for reptiles basking, primarily on rocks. The use of remote cameras at the top station resulted in the detection of one Guthega Skink, however was not deemed as a particularly effective method given the very many more photos of *Anthus novaeseelandiae* (Australasian Pipits) and *Lepus europaeus* (Brown Hare) that were taken, and the relatively small area that could be surveyed by each camera.

The targeted Guthega Skink surveys demonstrated that the footprint of the top station does not provide important habitat for the species with no observations of any Guthega Skinks within the top station footprint, despite surveys on 13 separate occasions over two summers. The species does occur to the immediate south, west and north of the top station location, where there were many observations of Guthega Skinks and a number of burrow locations identified (shown in Figure 13 and Photos 25-32). The species was also detected near the original location of Tower 6, which was subsequently moved, and has been recorded in several locations near Tower 5, as shown in Figure 14 and Photos 25-32.

Whilst the Alpine She-oak Skink was not detected within the development site, despite targeted surveys using tiles around the top station, it has been assumed to be present given the presence of potentially suitable habitat in most of the native vegetation within the development site. This species is very difficult to survey for comprehensively given its highly cryptic nature. Whilst the Alpine She-oak Skink could occur within development site from time to time, Alpine She-oak Skink individuals would not be restricted to the development site, nor considered likely to be adversely affected by the proposed development.

Targeted surveys were not undertaken for the Mountain Pygmy-possum, Alpine Tree Frog, or Southern Corroboree Frog given the absence of important or suitable habitats for these species.

A single individual of the Anemone Buttercup was detected within the access to the proposed Tower 4. The Anemone Buttercup occurs extensively on Mount Perisher and elsewhere in the locality.

Following completion of targeted surveys, the species credit species included in the assessment are outlined in Table 20.

**Table 20: Species credit species included in the assessment**

| Species | Common Name | Species presence | Geographic limitations | Habitat (ha) | Biodiversity Risk Weighting |
|---|---|---|---|---|---|
| Alpine She-oak Skink | *Cyclodomorphus praealtus* | Assumed | - | 0.30 | 2 |
| Anemone Buttercup | *Ranunculus anemoneus* | Yes | Other<br>Treeless vegetation above 1000 m in altitude<br>Above 1400 m | 0.01 | 2 |
| Broad-toothed Rat | *Mastacomys fuscus* | Yes | - | 0.36 | 2 |
| Guthega Skink | *Liopholis guthega* | Yes | - | 0.30 | 2 |

Given that Broad-toothed Rat scats were scattered in low densities throughout the development site all the native vegetation within the development site was defined as a Broad-toothed Rat species polygon.

Similarly, as the Guthega Skink and Alpine She-oak Skink could potentially forage or occur throughout most of the development site from time to time, all the native vegetation within the development site, with the exception of the bog, was defined as a Guthega Skink and Alpine She-oak Skink species polygons.

As only one individual of the Anemone Buttercup was detected within the development site, a species polygon was created around this site using the minimum area allowable within the BAMC - 0.01 ha.


**Photo 25: Guthega Skinks were regularly observed in the upper parts of the rock outcropping to the immediate southwest of the proposed top station and in the mix of rock, heath and herbfield to the south of the top station.**


**Photo 26: Guthega Skinks were not observed on the bench where the proposed top station and offload will be located. They appear to prefer locations where there is an abundance of rock habitat, earth to burrow into, and a mosaic of heath ane more open areas.**

**Photo 27: The rock outcrop that will be affected by the top station (in front and to the right of the communications hut) does not appear to provide habitat for the Guthega Skink possibly as a result of the absence of suitable crevices and earth for burrowing. No Guthega Skinks were observed on or in close proximity to this rock outcrop.**


**Photo 28: A Guthega Skink was observed on multiple occasions approximately 10 m to the southeast of the existing communications tower suggesting that a burrow is located in the surrounding heath. A No-Go zone will be created around this site during construction**

**Photo 29: Typical Guthega Skink habitat 30 m to the immediate southwest of the top station. Guthega Skinks were observed on multiple occasions at this location suggesting that a burrow is located in the surrounding heath. The habitat to southwest of the top station location will not be impacted by the proposed development.**

**Photo 30: Guthega Skink at the location identified in Photo 29.**

**Photo 31: The habitat to the immediate north of the top station also provides habitat for the Guthega Skink and there were multiple observations in this area despite limited survey beyond the development footprint. The species occurs through the top of Sun Valley and to Mount Back Perisher and beyond where there are extensive areas of suitable habitat.**

**Photo 32: Guthega Skinks have been observed basking on this pile of rock fragments just above the top station of the Mt Perisher Triplechair over a number of years. The rock fragments are the result of historic rock reduction.**

**Photo 33: There are records of the Guthega Skink surrounding the location of the proposed Tower 5 which will be located on the lower edge of the access road. No Guthega Skinks were observed in the immediate vicinity of the Tower 5 location during the targeted surveys undertaken for this assessment.**

**Photo 34: Excellent Guthega Skink habitat extends to the north-west of Tower 5 towards Sun Valley and there are multiple records of the species in this location.**

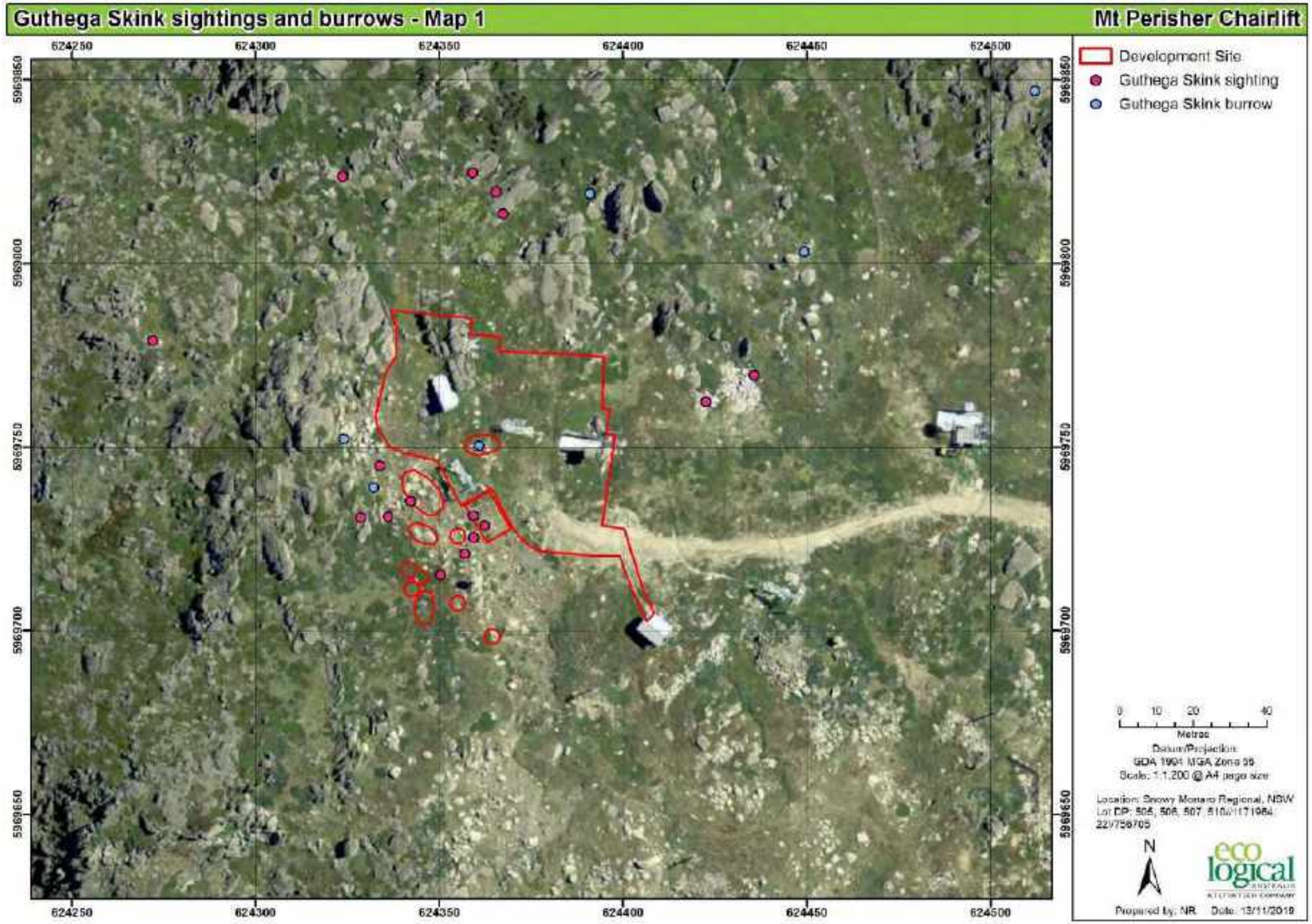


**Figure 13: Location of Guthega Skink sightings around the proposed top station**

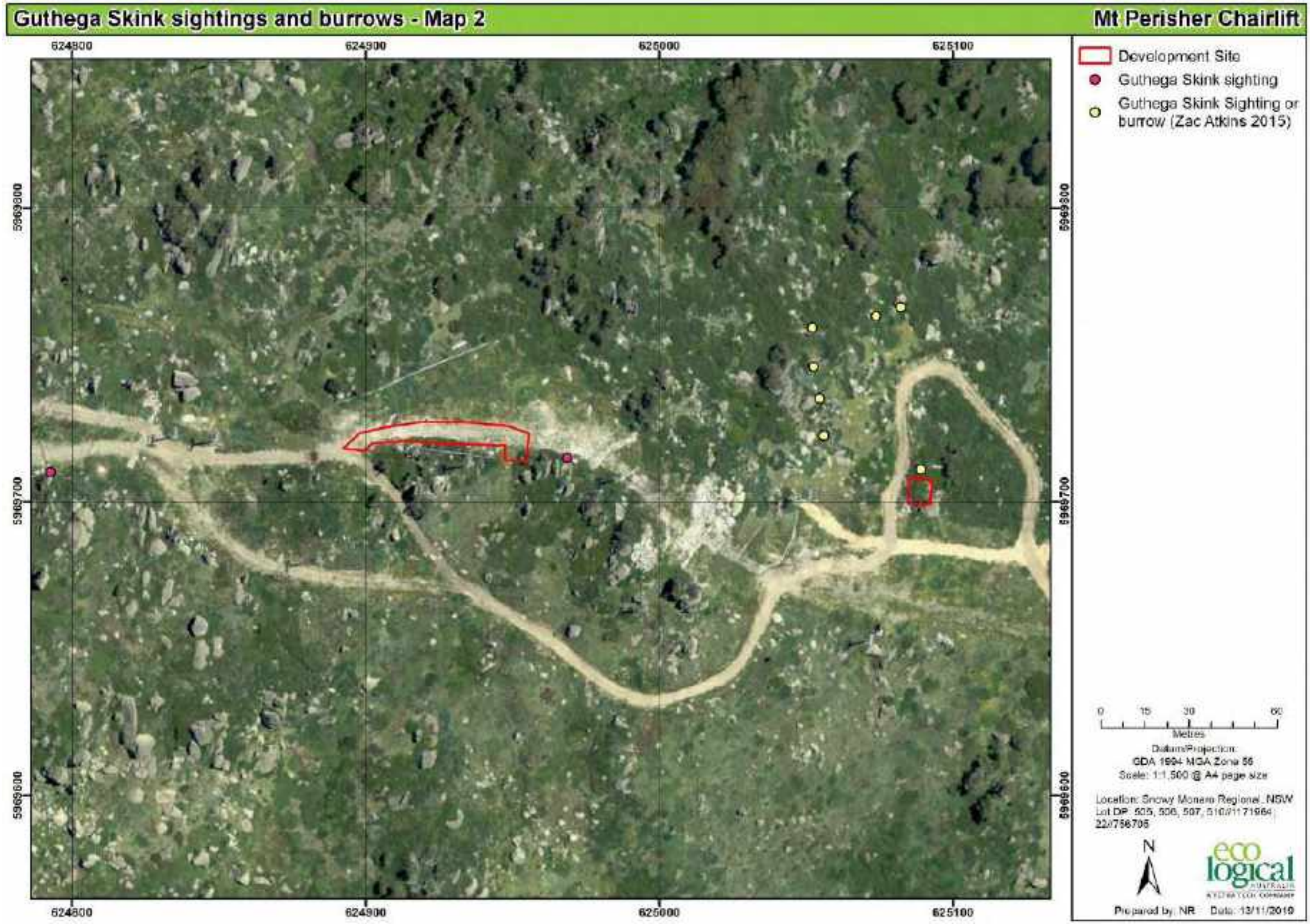


**Figure 14: Location of Guthega Skink sitings around the proposed Tower 5**

**Table 21: Justification for exclusion of candidate species credit species**

| Common Name | Species | NSW listing status | EPBC Listing status | Justification for exclusion of species |
|---|---|---|---|---|
| **Shining Cudweed** | *Argyrotegium nitidulum* | Vulnerable | Vulnerable | There is only a very small amount of potential habitat for the species in the development site. The potential habitat was searched for the species, which was not detected. It is considered highly unlikely that it occurs there. |
| **Mountain Pygmy-possum** | *Burramys parvus* | Endangered | Endangered | The nearest core habitats are at Blue Cow Mountain. Given the absence of preferred sheltering or foraging habitat within the development site or immediate surrounds it is considered unlikely that the species would occur there. |
| **Gang-gang Cockatoo (breeding)** | *Callocephalon fimbriatum* | Vulnerable | Not Listed | No hollow-bearing trees suitable for breeding occur within the development site or immediate surrounds. |
| **Archer's Carex** | *Carex archeri* | Endangered | Not Listed | There is only a very small amount of potential habitat for the species in the development site. The potential habitat was searched for the species, which was not detected. It is considered highly unlikely that it occurs there. |
| **Raleigh Sedge** | *Carex raleighii* | Endangered | Not Listed | There is only a very small amount of potential habitat for the species in the development site. The potential habitat was searched for the species, which was not detected. It is considered highly unlikely that it occurs there. |
| **Leafy Anchor Plant** | *Discaria nitida* | Vulnerable | Not Listed | The species, which is quite conspicuous, was not detected within the development site or immediate surrounds despite targeted surveys. |
| **Rough Eyebright** | *Euphrasia scabra* | Endangered | Not Listed | The species was not detected within the development site or immediate surrounds despite targeted surveys. |
| **Little Eagle (Breeding)** | *Hieraaetus morphnoides* | Vulnerable | Not Listed | No raptor nests were detected within the development site or immediate surrounds despite targeted surveys. |
| **Alpine Tree Frog** | *Litoria verreauxii alpina* | Endangered | Vulnerable | The species has suffered historic declines, although it is showing some signs of recovery, within 15 known populations in NSW (Hunter et.al. 2018). Breeding sites are restricted to a few still ponds and swamps. There is no known breeding habitat for the species within the development site or within the Perisher Resort area and it is highly unlikely that it would occur within the development site. |
| **Smoky Mouse** | *Pseudomys fumeus* | Critically Endangered | Endangered | There are no recent records of Smoky Mouse in the locality or evidence of a local population despite considerable survey effort in the locality in recent decades. The species has recently been detected in the northern parts of Kosciuszko National Park in Mountain Gum – Snow Gum forests. It is considered highly unlikely that the species would occur within the development site given its small size, the rarity of the Smoky Mouse and the nature of the habitats there. |
| **Southern Corroboree Frog** | *Pseudophryne corroboree* | Critically Endangered | Critically Endangered | The Southern Corroboree Frog is limited to sphagnum bogs of the northern Snowy Mountains, in a strip from the Maragle Range in the northwest, through Mt Jagungal to Smiggin Holes in the south. Its range is entirely within Kosciuszko National Park. This species is all but extinct in the wild. It is no longer present at its former southern limit at Smiggin Holes. It is considered highly unlikely that it would occur within the development site. |

| Common Name | Species | NSW listing status | EPBC Listing status | Justification for exclusion of species |
|---|---|---|---|---|
| **Northern Corroboree Frog** | *Pseudophryne pengilleyi* | Critically Endangered | Critically Endangered | The Northern Corroboree Frog does not occur within the locality, being limited to the northern parts of the Snowy Mountains and Brindabella Range. |
| **Blue-tongued Greenhood** | *Pterostylis oreophila* | Critically Endangered | Critically Endangered | In NSW the Blue-tongued Greenhood is known from a few small populations within Kosciuszko National Park and a population of about 40 plants (possibly now extinct) in Bago State Forest and adjoining Crown Leases south of Tumut. It is considered highly unlikely that it would occur in the marginal potential habitat within the development site. |
| **Perisher Wallaby-grass** | *Rytidosperma vickeryae* | Endangered | Not Listed | There is only a very small amount of marginal potential habitat for the species in the development site, around the bottom station. The species is known from a number of sites along Perisher Creek within the Perisher Resort area. The potential habitat was searched for the species, which was not detected. *Rytidosperma* specimens collected near the bottom station were sent to the Australian National Herbarium and confirmed as *Rytidosperma nivicolum*. It is considered highly unlikely that the Perisher Wallaby-grass occurs within the development site. |

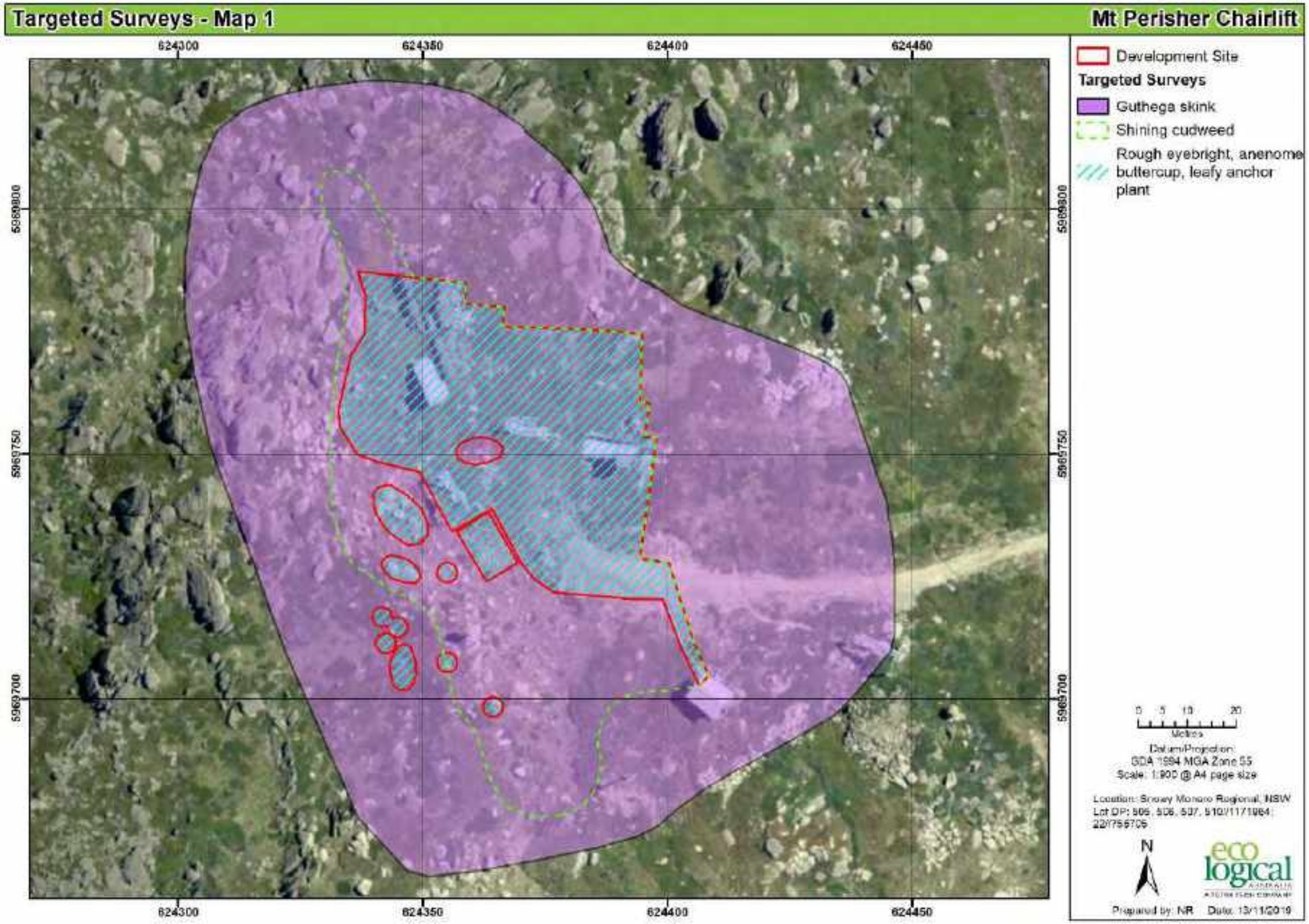


**Figure 15: Targeted surveys around the top station.**

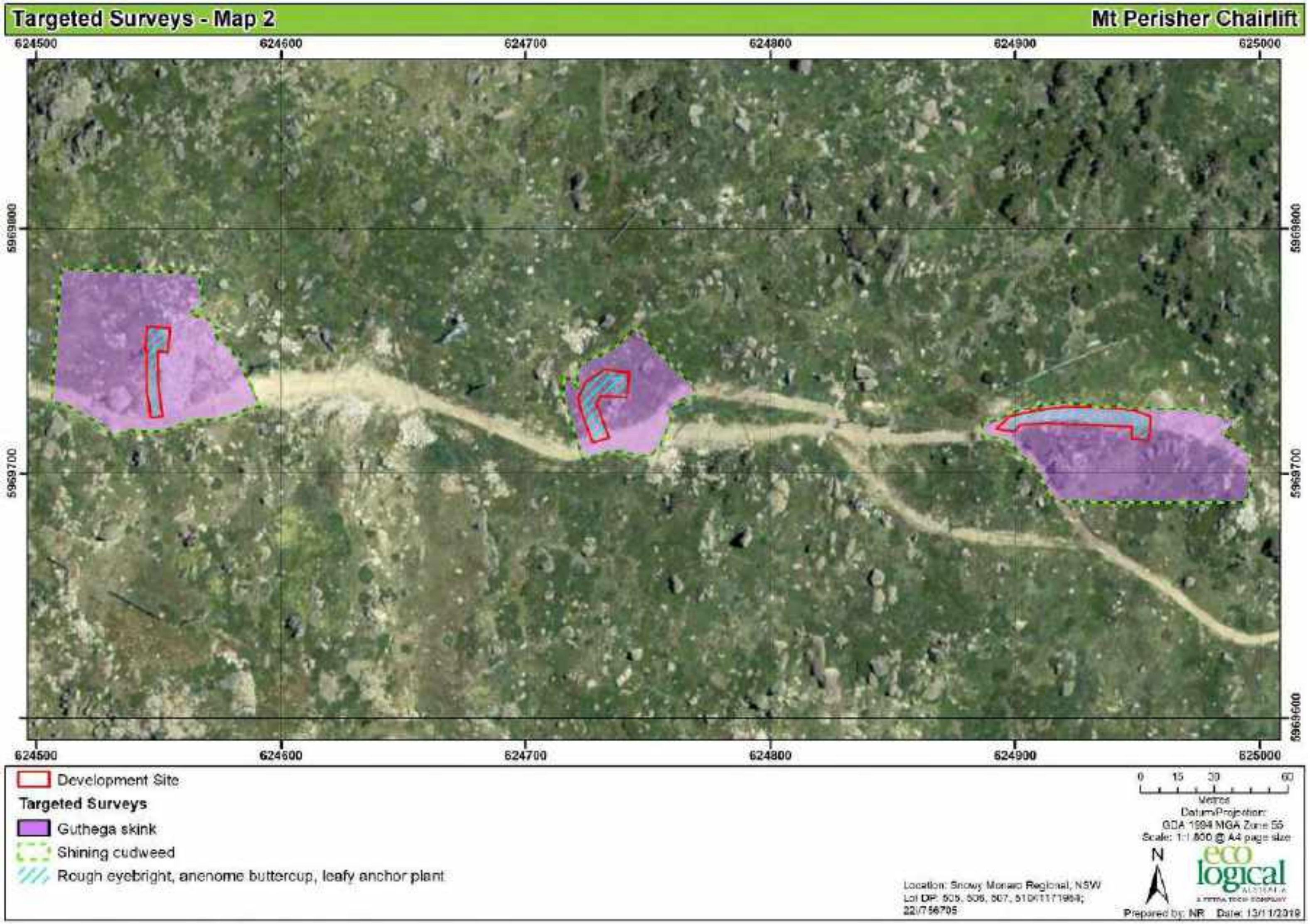


**Figure 16: Targeted surveys around towers 6-8.**


**Figure 17: Targeted surveys around towers 3-5.**

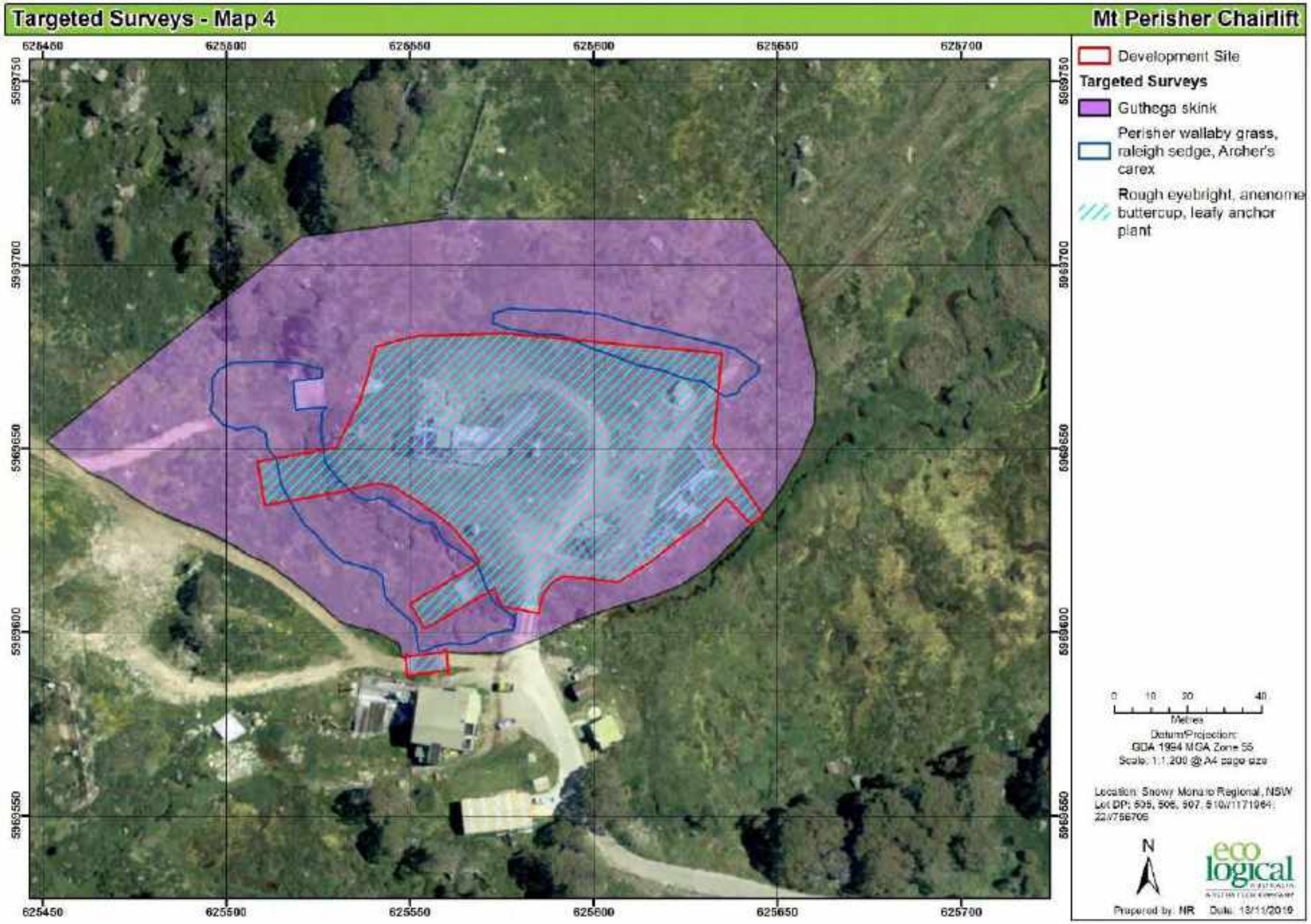


**Figure 18: Targeted surveys around the bottom station**

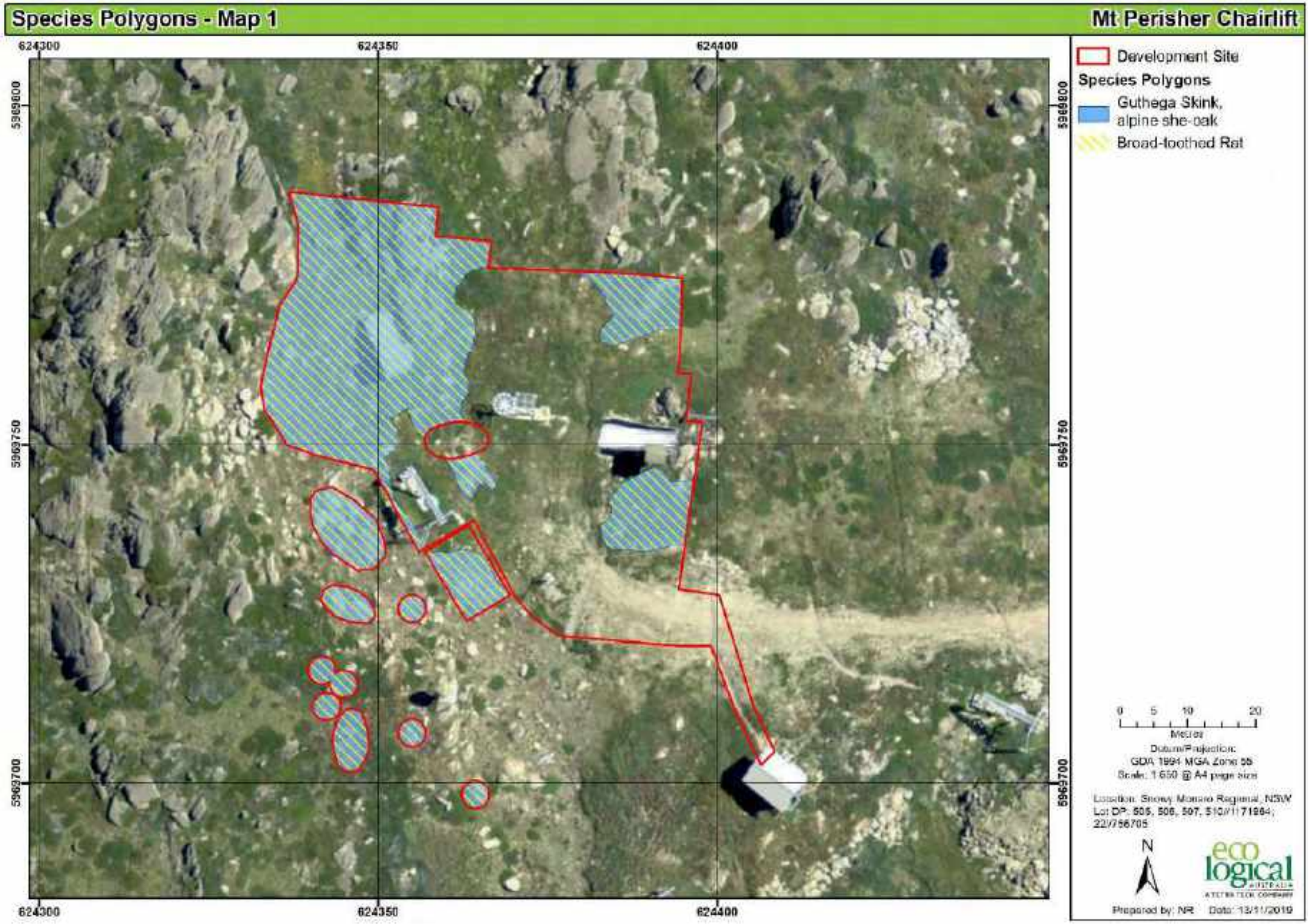


**Figure 19: Species polygons around the top station.**

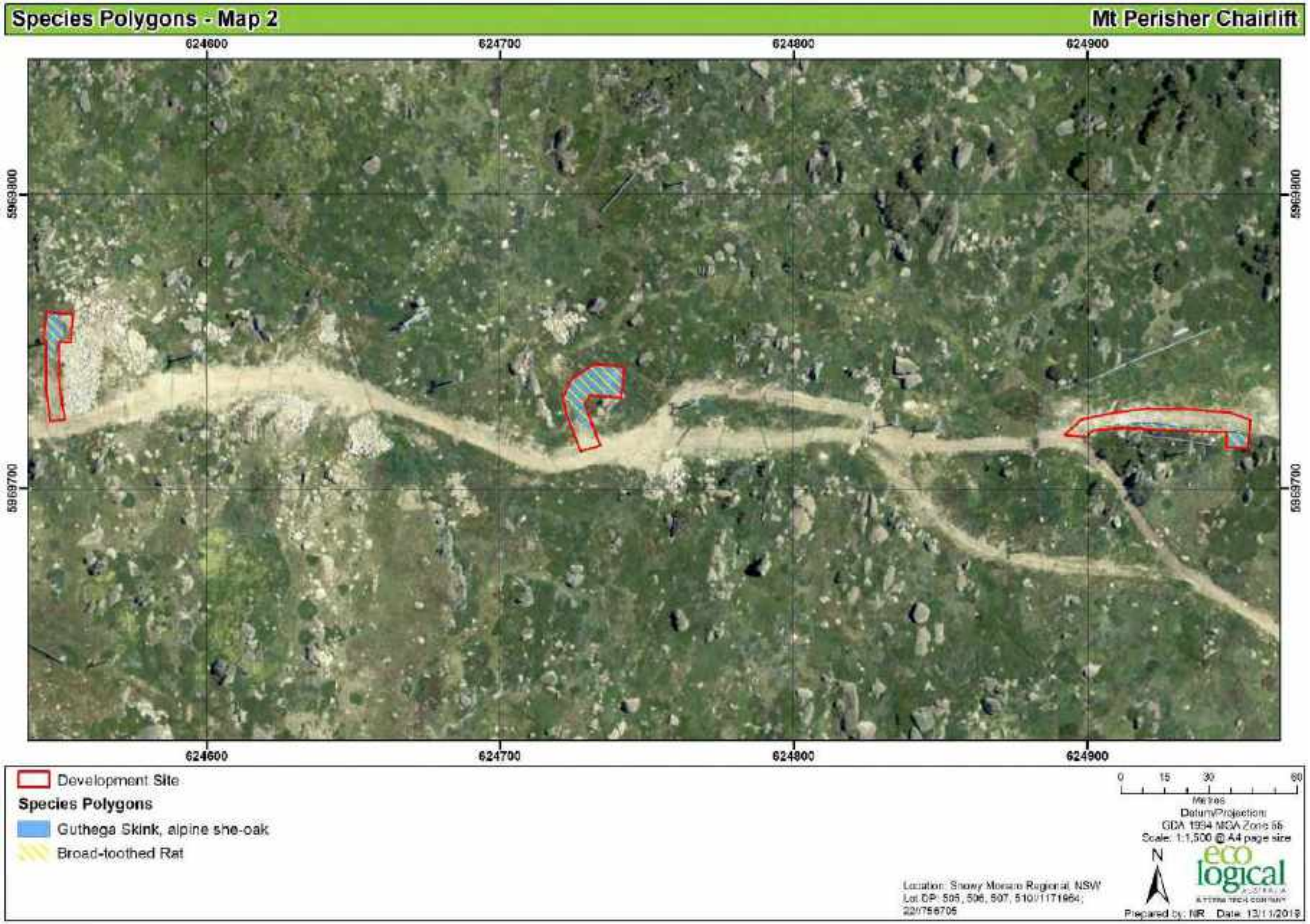


**Figure 20: Species polygons towers 6-8.**


**Figure 21: Species polygons towers 3-5.**


**Figure 22: Species polygons around the bottom station.**

# 2. Stage 2: Impact assessment (biodiversity values)

## 2.1 Avoiding impacts

### 2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The development has been located in a way which avoids and minimises impacts as outlined in Table 22.

**Table 22: Locating a project to avoid and minimise impacts on vegetation and habitat**

| Approach | How addressed | Justification |
|---|---|---|
| **locating the project in areas where there are no biodiversity values** | The proposal has largely been located in heavily modified areas with low biodiversity values. In several instances, the proposal has been modified to change the location of towers, or other features, so that they are located in less sensitive areas, from a biodiversity value perspective. In particular, the top station has been located to avoid areas that are used by the Guthega Skink or which support known burrows. | It is not possible to locate the proposal in an area where there is no biodiversity value, however the proposal has been designed from the outset to avoid and minimise impacts on biodiversity values. In particular, the chairlift alignment has been kept close to the existing triple chair alignment to reduce impacts on native vegetation and associated biodiversity values. |
| **locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition** | The proposal has been located to take advantage of existing disturbances associated with the existing ski slopes and ski infrastructure. | The proposal has made use of existing disturbed areas as far as is possible. The impacts associated with the proposal are small given the scale of the proposal and the potential impacts if some alternative lift alignments had been proposed. |
| **locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species** | The proposal has been located to take advantage of existing disturbances associated with the existing ski slopes and ski infrastructure. Lift Tower 6 was moved to avoid known Guthega Skink habitat and Lift Tower 7 was moved to avoid a patch of bog. The relocation of the Eyre T-bar bullwheel was adjusted to avoid a location where a Guthega Skink had been sighted. The top station location and construction impacts have been designed to avoid impacts on known Guthega Skink burrows and preferred habitats. | The proposal has made use of existing disturbed areas as far as is possible. The impacts associated with the proposal are small given the scale of the proposal and the potential impacts if some alternative lift alignments had been proposed. Extensive targeted Guthega Skink surveys have been undertaken and considerable proposal design and redesign efforts have been made to avoid direct impacts on Guthega Skink burrows and to avoid and minimise impacts on native vegetation and associated habitats generally. |
| **locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained** | Selecting an alignment approximating the alignment of the existing triple chairlift.<br><br>Minimising the disturbance footprint and post construction rehabilitation. | The proposal will only result in a very small disturbance footprint and is not expected to adversely impact on connectivity for any fauna species. |

### 2.1.2 Designing a project to avoid and minimise impacts on vegetation and habitat

The development has been designed in a way which avoids and minimises impacts as outlined in Table 23.

**Table 23: Designing a project to avoid and minimise impacts on vegetation and habitat**

| Approach | How addressed | Justification |
|---|---|---|
| reducing the clearing footprint of the project | The proposal will utilise construction techniques such that the disturbance of native vegetation will be limited to a maximum of 0.36 ha. Some of the vegetation that will be affected will be rehabilitated post construction. In addition, supplementary rock habitat for the Guthega Skink will be created in a cleared area below the proposed top station. | The development footprint will be very small given the scale of the proposed development. |
| locating ancillary facilities in areas where there are no biodiversity values | The proposed bottom station, top station, and as many of the towers as possible, have been located so as to limit impacts on remnant native vegetation and associated biodiversity values. Construction equipment will be located in the disturbed areas associated with the existing ski slopes. | This approach minimises the disturbance footprint and avoids and minimises impacts. The bulk of the disturbances associated with the proposal will be limited to already highly disturbed areas. |
| locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score) | The proposed bottom station, top station, and as many of the towers as possible have been located so as to limit impacts on remnant native vegetation and associated biodiversity values. Construction equipment will be located in the disturbed areas associated with the existing ski slopes. | This approach minimises the disturbance footprint and avoids and minimises impacts. The bulk of the disturbances associated with the proposal will be limited to already highly disturbed areas. |
| locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC) | Construction equipment will be located in the disturbed existing ski slopes. Only a very small area of EEC will be affected, approximately 600 $m^2$. The impacts on the EEC have been reduced by moving towers to avoid the EEC and by the design of the skier bridges, which have been designed to minimise impacts on the bog beneath the proposed bridges. | This approach minimises impacts. |
| providing structures to enable species and genetic material to move across barriers or hostile gaps | The proposal will not create any barriers or hostile gaps between habitats. The proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for the Guthega Skink. | The proposal will improve connectivity for the Guthega Skink between habitats to the north and south of the proposed top station. |
| making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site | The proposal will utilise construction techniques, including marking the extent of the development site prior to the commencement of works, such that the disturbance footprint will not extend beyond the proposed footprint. Perisher has extensive experience with constructing chairlifts in similarly sensitive environments including the recent construction of the Leichhardt Chairlift and Freedom Chairlift. | The impact minimisation and rehabilitation techniques to be used have been developed by Perisher in conjunction with OEH and DPIE over many years. The rehabilitation will be consistent with the rehabilitation guidelines for KNP. |
| Efforts to avoid and minimise impacts through design must be documented and justified | The proposal has been located to take advantage of existing disturbed areas, and will use a range of other techniques, as described above, to minimise impacts. | The techniques have been developed by Perisher in conjunction with OEH and DPIE over many years. |

### 2.1.3 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 24.

**Table 24: Prescribed biodiversity impacts**

| Prescribed biodiversity impact | Description in relation to the development site | Threatened species or ecological communities effected |
|---|---|---|
| impacts of development on the habitat of threatened species or ecological communities associated with:<br>karst, caves, crevices, cliffs and other geological features of significance, or<br>rocks, or<br>human made structures, or<br>non-native vegetation | The proposal will result in the removal or reduction of some rock outcropping in association with the proposed top station, some towers, and the top station offload. | The proposal will potentially have minor impacts on the Broad-toothed Rat, Guthega Skink, and Alpine She-oak Skink, which may utilise the shelter provided by the rocks and vegetation to be affected. However, there is extensive rock outcropping surrounding the development site that will not be affected by the proposed development, and the long-term impacts on threatened species are expected to be minor. The proposal has been designed to avoid direct impacts on Guthega Skink burrows. |
| impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range | The proposal has been designed such that the disturbance footprint will be limited primarily to existing ski runs and associated disturbed areas, with only very minor incursions into the vegetation on the edge of the disturbed areas. | The proposal will not have adverse impacts on connectivity for any threatened species or ecological community. Notwithstanding, the proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for the Guthega Skink between habitats to the north and south. |
| impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining) | The proposal will not adversely affect any waterbodies. Similar projects have been undertaken throughout the resort area over many years without substantial adverse impacts on water quality, waterbodies, hydrological process of dependent threatened species or EECs. Appropriate safeguards will be incorporated into the proposal to avoid adverse impacts on watercourses. | The proposed works are not anticipated to have any substantial or long-term adverse impacts on waterbodies or hydrological processes or any bog that may be located downslope of the development site. |
| impacts of vehicle strikes on threatened species or on animals that are part of a TEC | The proposal is not likely to result in any vehicle strikes on fauna species. It is likely that any animals sheltering within the development footprint will move to adjoining habitats as a result of the noise and vibration associated with the proposed works. Notwithstanding, exclusion fencing will be used to prevent access to the sites of known Guthega Skink burrows and habitat surrounding the development site. | The proposal will potentially have minor impacts on the Broad-toothed Rat, Guthega Skink, Alpine She-oak Skink, which may utilise the shelter provided by the rocks and vegetation to be affected. |

#### 2.1.3.1 Locating a project to avoid and minimise prescribed biodiversity impacts

The development has been located in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 25.

**Table 25: Locating a project to avoid and minimise prescribed biodiversity impacts**

| Approach | How addressed | Justification |
|---|---|---|
| locating the envelope of surface works to avoid direct impacts on the habitat features | The proposal has been located to take advantage of existing disturbances. However, the proposal will result in further disturbance to a relatively small area of vegetation and rock outcropping on the edge of existing disturbed areas. | There is extensive areas of similar vegetation and rock outcropping surrounding the development site that will not be affected by the proposed development. The proposal has been designed to have minimal adverse impacts on the environment, whilst significantly enhancing lifting capacity and the experience of snowriders. The proposal will result in the reduction of the amount of lift towers on Mount Perisher by approximately 60%. |
| locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating long wall panels away from geological features of significance or water dependent plant communities and their supporting aquifers | The proposal avoids geological features of significance. It will only have minor impacts on water dependent plant communities and is not expected to have adverse impacts on the extensive area of bog along Perisher Creek. | Similar developments, such as the Leichhardt Chairlift and Freedom Chairlift, which both had bottom stations located in areas of bog, did not result in adverse impacts on the surrounding water dependent plant communities. |
| locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or preferred local movement pathways | The chairlift alignment has been kept close to the existing triple chair alignment to reduce impacts on native vegetation and associated biodiversity values. The proposal will result in the reduction of the amount of lift towers on Mount Perisher by approximately 60%. The proposal is not expected to adversely impact on connectivity for any fauna species. It is expected to improve connectivity for the Guthega Skink between habitats to the north and south of the proposed top station. | The proposal has been designed such that the disturbance footprint will be limited primarily to existing ski runs and associated disturbed areas, with only very minor incursions into the vegetation on the edge of the disturbed areas. Notwithstanding, the proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for the Guthega Skink between habitats to the north and south. |
| optimising project layout to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies | The proposal has been designed as far as is possible to avoid and minimise impacts to vegetation and threatened species habitats. The proposal will result in the reduction of the amount of lift towers on Mount Perisher by approximately 60%. | The proposal will result in the reduction of the amount of lift towers on Mount Perisher by approximately 60%. It will not result in any direct impacts on known Guthega Skink burrows and will improve connectivity for the species between habitat surrounding the top station. |
| locating the project to avoid direct impacts on water bodies | The proposal will not result in any direct impacts on waterbodies. | NA |

### 2.1.3.2 Designing a project to avoid and minimise prescribed biodiversity impacts

The development has been designed in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 26.

**Table 26: Designing a project to avoid and minimise prescribed biodiversity impacts**

| Approach | How addressed | Justification |
|---|---|---|
| engineering solutions, e.g. proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers; proven engineering solutions to restore connectivity and favoured movement pathways | The proposal will not result in any fracturing of geological features of significance or adverse impacts on water dependent plant communities and their supporting aquifers.<br>The over-snow rock removal technique will be used to remove and reduce rocks below the proposed top station offload. | Perisher has undertaken many similar developments, such as the Leichhardt Chairlift and Freedom Chairlift, which both had bottom stations located in areas of bog, but did not result in adverse impacts on the surrounding water dependent plant communities. The over-snow rock removal technique has been proven to minimise impacts on vegetation and habitats. |
| design of project elements to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbines to dissuade perching and minimise the diameter of the rotor swept area, designing fencing to prevent animal entry to transport corridors | The proposal has been designed such that the disturbance footprint will be limited primarily to existing ski runs and associated disturbed areas, with only very minor incursions into the vegetation on the edge of the disturbed areas. The over-snow rock removal technique will be used to remove and reduce rocks within the proposed top station offload, limiting potential impacts on Guthega Skink habitat. | The proposal will not have adverse impacts on connectivity for any threatened species or ecological community. Notwithstanding, the proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for the Guthega Skink between habitats to the north and south. |
| design of the project to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation | The proposal will not jeopardise any critical environmental processes. | NA |
| design of the project to maintain hydrological processes that sustain threatened species and TECs | The proposal will not affect any hydrological processes that sustain threatened species and TECs. | Similar developments, such as the Leichhardt Chairlift and Freedom Chairlift, which both had bottom stations located in areas of bog, did not result in adverse impacts on the surrounding water dependent plant communities. |
| design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site | The proposal will include sediment controls to limit the potential for sedimentation and water quality impacts downstream during construction, particularly in the event of major rainfall. | Similar techniques have been used to good effect for many years in association with similar developments within the Perisher Resort Area. |

## 2.2 Assessment of Impacts

### 2.2.1 Direct impacts

The direct impacts of the development on:

- native vegetation are outlined in Table 27
- threatened ecological communities are outlined in Table 28
- threatened species and threatened species habitat are outlined in Table 29
- prescribed biodiversity impacts are outlined in Section 2.1.3.

**Table 27: Direct impacts to native vegetation**

| PCT ID | PCT Name | Vegetation Class | Vegetation Formation | Direct impact (ha) |
|---|---|---|---|---|
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Herbfields | 0.07 |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Heaths | 0.18 |
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Alpine Complex | Alpine Bogs and Fens | 0.06 |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Grassy Woodlands | Subalpine Woodlands | 0.05 |

**Table 28: Direct impacts on threatened ecological communities**

| PCT ID | BC Act | | | EPBC Act | | |
|---|---|---|---|---|---|---|
| | Listing status | Name | Direct impact (ha) | Listing status | Name | Direct impact (ha) |
| 637 | Endangered | Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions | 0.06 | Endangered | Alpine Sphagnum Bogs and Associated Fens | 0.06 |

**Table 29: Direct impacts on threatened species and threatened species habitat**

| Species | Common Name | Direct impact habitat (ha) | NSW listing status | EPBC Listing status |
|---|---|---|---|---|
| Guthega Skink | *Liopholis guthega* | 0.3 | Endangered | Endangered |
| Alpine She-oak Skink | *Cyclodomorphus praealtus* | 0.3 | Endangered | Endangered |
| Broad-toothed Rat | *Mastacomys fuscus* | 0.36 | Vulnerable | Vulnerable |
| Anemone Buttercup | *Ranunculus anemoneus* | 0.01 | Vulnerable | Vulnerable |

### 2.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 30. A very conservative approach has been taken to the change in vegetation integrity score. For example, whilst it is likely that the vegetation below the skier bridges will largely be relatively unaffected, given the design, construction and operational techniques proposed, the assessment assumes that the vegetation will be cleared. Similarly, the post construction rehabilitation is likely to ensure that the post construction vegetation integrity score will be much higher than zero throughout a significant proportion of the development site.

The only location where a future vegetation integrity score above zero has been assumed within the assessment is where tree removal is proposed around Tower 3. Where trees will be removed and pruned within PCT 645, the composition, structure and function condition scores have been reduced to reflect the removal of the canopy tree cover. However, it has been assumed that the understorey and groundcover vegetation will remain unchanged. As a result, the vegetation integrity score will be reduced post construction by 15.

**Table 30: Change in vegetation integrity**

| Veg Zone | PCT ID | Condition | Area (ha) | Current vegetation integrity score | Future vegetation integrity score | Change in vegetation integrity |
|---|---|---|---|---|---|---|
| 1 | 643 | Excellent | 0.15 | 66.5 | 0 | -66.5 |
| 2 | 641 | Moderate | 0.04 | 54.1 | 0 | -54.1 |
| 3 | 643 | With Trees | 0.02 | 58.3 | 0 | -58.3 |
| 4 | 637 | Good | 0.06 | 55.7 | 0 | -55.7 |
| 5 | 641 | Disturbed | 0.02 | 27.4 | 0 | -27.4 |
| 6 | 643 | Disturbed | 0.01 | 28.3 | 0 | -28.3 |
| 7 | 641 | Excellent | 0.01 | 73.9 | 0 | -73.9 |
| 8 | 645 | Excellent | 0.05 | 58 | 43 | -15 |

### 2.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 31. Given the nature of the proposed development, and the proposed mitigation measures, indirect impacts are only anticipated to extend a maximum of 2 m into vegetation surrounding the proposed development site.

**Table 31: Indirect impacts**

| Indirect impact | Project phase | Nature | Extent | Frequency | Duration | Timing |
|---|---|---|---|---|---|---|
| **sedimentation and contaminated and/or nutrient rich run-off** | Construction | Minor potential for sedimentation during and immediately post-construction. However, the proposed sediment control measures have been effective during the many other similar developments that have been undertaken within the resort in recent years. | minor | During and after any heavy rainfall | 18 month maximum | Intermittently during construction phase |
| **noise, dust or light spill** | Construction | Minor during construction. | minor | Intermittently during construction phase | 18 month maximum | Intermittently during construction phase |
| **inadvertent impacts on adjacent habitat or vegetation** | Construction | Minor. The limit of the proposed development site will be marked by flagging tape prior to the commencement of construction. This has been effective at preventing impacts on adjacent vegetation during the many other similar developments that have been undertaken within the resort in recent years. | minor | Not expected but possible | 18 month maximum | Not expected |
| **transport of weeds and pathogens from the site to adjacent vegetation** | Construction | Not expected. The development site includes and abuts areas that are already heavily modified and which support weeds which are common within the Perisher Resort area and elsewhere within the NSW Alps. The proposal will include post construction rehabilitation and weed control. | Not expected | Not expected | Not expected | Not expected |
| **vehicle strike** | Construction | Minor. It is considered unlikely that the proposal will include vehicle strike impacts. Vehicles will be travelling at very slow speeds within the development site and the noise and vibration associated with vehicle movements is expected to deter any fauna within or adjoining the development site from the path of any vehicles. Vehicle strike has not been an issue with any of the recent similar developments, such as the Leichhardt Chairlift construction. | Not expected | Not expected but possible | 18 month maximum | Not expected |

| Indirect impact | Project phase | Nature | Extent | Frequency | Duration | Timing |
|---|---|---|---|---|---|---|
| **trampling of threatened flora species** | Construction | Not expected. There are no threatened flora species within the development site apart from a single individual of the Anemone Buttercup. This individual will be impacted be the proposed development and the impact will be offset. | Not expected | Not expected | 18 month maximum | Not expected |
| **rubbish dumping** | Construction | Not expected | Not expected | Not expected | Not expected | Not expected |
| **wood collection** | Construction | Not expected | Not expected | Not expected | Not expected | Not expected |
| **bush rock removal and disturbance** | Construction | Not expected. A relatively small amount of rock will be removed as part of the development, much of which will be used to create a supplementary rock habitat below the top station. No additional indirect impacts are expected. | Not expected | Not expected | Not expected | Not expected |
| **increase in predatory species populations** | Construction | Not expected. The proposed development occurs on the edge of an already disturbed area and will not increase the populations of predatory species such as foxes and cats. | Not expected | Not expected | Not expected | Not expected |
| **increase in pest animal populations** | Construction | Not expected. | Not expected | Not expected | Not expected | Not expected |
| **increased risk of fire** | Construction | Minor potential for increased risk of fire during construction. | minor | Intermittently during construction phase | 18 month maximum | Intermittently during construction phase |
| **disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.** | Construction | Minor indirect impacts on Guthega Skink habitat during construction particularly around the top station. However, the use of the over-snow rock removal technique to remove and reduce rocks within the proposed top station offload, limiting potential impacts on Guthega Skink habitat. | minor | Intermittently during construction phase | 18 month maximum | Intermittently during construction phase |

### 2.2.4 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 32.

**Table 32: Direct impacts on prescribed biodiversity impacts**

| Prescribed biodiversity impact | Nature | Extent (ha) | Frequency | Duration | Timing |
|---|---|---|---|---|---|
| impacts of development on the habitat of threatened species or ecological communities associated with:<br>karst, caves, crevices, cliffs and other geological features of significance, or<br>rocks, or<br>human made structures, or<br>non-native vegetation | Removal or reduction of a small area of rock outcropping. | 0.02 | One off | Permanent | During construction |
| impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range | No adverse impacts expected. The proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for the Guthega Skink between habitats to the north and south. | 0.01 | One off | Permanent | During construction |
| impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining) | The proposal will not affect any hydrological processes that sustain threatened species and TECs. Similar developments, such as the Leichhardt Chairlift and Freedom Chairlift, which both had bottom stations located in areas of bog, did not result in adverse impacts on the surrounding water dependent plant communities. | - | - | - | - |
| impacts of vehicle strikes on threatened species or on animals that are part of a TEC. | Not expected. Known habitat for the Guthega Skink will be fenced out during construction and it is anticipated that the noise and vibration associated with the proposed works will encourage any animals sheltering within the development footprint to move to adjoining habitats and avoid vehicle strike. | - | - | - | - |

### 2.2.5 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 33.

**Table 33: Measures proposed to mitigate and manage impacts**

| Measure | Risk before mitigation | Risk after mitigation | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|---|---|
| **Displacement of resident fauna** | High | Low | Prior to construction the development site around the top station, bottom station and towers should be marked with exclusion tape to identify the limit of the development site and proposed works.<br>Exclusion fencing should be erected around the Guthega Skink habitat surrounding the top station to ensure that it is not inadvertently disturbed during construction.<br>Immediately prior to any impacts on rocks, the affected rocks should be tapped or nudged with the excavator to encourage any fauna that may be sheltering beneath or within the rock to move away. | Fauna within the disturbance footprint should move and thus any injury to fauna species during construction should be avoided.<br>Fauna beyond the development footprint will be protected from inadvertent direct and indirect impacts. | During construction | Perisher |
| **timing works to avoid critical life cycle events such as breeding or nursing** | Low | Low | None proposed | NA | NA | NA |
| **instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events** | Medium | Low | Structures should be placed at regular intervals in any trenches or pits that are left open overnight, to enable fauna to exit the trench/pit. Trenches/pits should be inspected in the morning and late afternoon and any animals that have fallen into the trenches/pits removed. Similarly, trenches/pits should be checked for animals immediately prior to back-filling. | Injury to fauna species during construction should be avoided. | During construction | Perisher |
| **installing artificial habitats for fauna in adjacent retained vegetation and habitat or human made structures to replace the habitat resources lost** | Low | Low | The proposal includes the creation of rock habitat in the depression below the top station which will improve connectivity for | Connectivity between habitats to the north and south of the top station will | During construction | Perisher |

| Measure | Risk before mitigation | Risk after mitigation | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|---|---|
| **and encourage animals to move from the impacted site, e.g. nest boxes** | | | the Guthega Skink between habitats to the north and south. | be improved and the extent of rock habitat for reptiles and mammals such as the Broad-toothed Rat and Mountain Pygmy Possum will be increased. | | |
| **clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed** | Medium | Low | Prior to construction the development site around the top station, bottom station and towers should be marked with exclusion tape to identify the limit of the development site and proposed works.<br>Exclusion fencing should be erected around the Guthega Skink habitat surrounding the top station to ensure that it is not inadvertently disturbed during construction. | Risk of disturbance beyond proposed disturbance corridor is reduced. | Prior to construction | Perisher |
| **sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment** | Low | Low | Sediment control measures as necessary such as fencing and hay bales. | Risk of sedimentation and water quality impacts substantially reduced. | During and post-construction | Perisher |
| **noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise** | Low | Low | Restrict work to daylight hours. | Noise impacts mitigated. | During construction | Perisher |
| **light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill** | Low | Low | Restrict work to daylight hours. | Light impacts mitigated. | During construction | Perisher |
| **adaptive dust monitoring programs to control air quality** | Low | Low | None proposed. | NA | NA | NA |
| **programming construction activities to avoid impacts; for example, timing construction activities for when migratory species are absent** | Low | Low | None proposed. | NA | NA | NA |

| Measure | Risk before mitigation | Risk after mitigation | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|---|---|
| **from the site, or when particular species known to or likely to use the habitat on the site are not breeding or nesting** | | | | | | |
| **temporary fencing to protect significant environmental features such as riparian zones** | Medium | Low | Prior to construction the development site around the top station, bottom station and towers should be marked with exclusion tape to identify the limit of the development site and proposed works.<br>Exclusion fencing should be erected around the Guthega Skink habitat surrounding the top station to ensure that it is not inadvertently disturbed during construction. | Protection of vegetation and habitats beyond the disturbance footprint. | Prior to and during construction | Perisher |
| **hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas** | Medium | Low | Any machinery or vehicles involved with the proposed works that are not owned by Perisher will be washed down to remove all soil and vegetative matter before entering the site to limit spread of weeds and disease such as *Phytophthora cinnamomic.* | Risk of weed or pathogen spread substantially reduced. | Prior to and during construction | Perisher |
| **staff training and site briefing to communicate environmental features to be protected and measures to be implemented** | Medium | Low | Brief all workers as to limit of the disturbance footprint and other environmental safeguards. | Risk of disturbance beyond proposed disturbance corridor is reduced. | Prior to and during construction as necessary | Perisher |
| **making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site** | Medium | Low | Post construction rehabilitation consistent with standard Perisher rehabilitation strategies | Post construction vegetation within the development footprint with high medium-term recovery potential. | Immediately post construction | Perisher |

### 2.2.6 Serious and Irreversible Impacts (SAII)

The development does not have any Serious and Irreversible Impacts (SAII).

## 2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures (Table 33) have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 34, Table 35 and Table 36 respectively.

**Table 34: Likelihood criteria**

| Likelihood criteria | Description |
|---|---|
| Almost certain<br>(Common) | Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances. |
| Likely<br>(Has occurred in recent history) | There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances. |
| Possible<br>(Could happen, has occurred in the past, but not common) | The event could occur. There is likely to be an event on average every five to twenty years. |
| Unlikely<br>(Not likely or uncommon) | The event could occur but is not expected. A rare occurrence (once per one hundred years). |
| Remote<br>(Rare or practically impossible) | The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as unique. |

**Table 35: Consequence criteria**

| Consequence category | Description |
|---|---|
| Critical<br>(Severe, widespread long-term effect) | Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely. |
| Major<br>(Wider spread, moderate to long term effect) | Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible. |
| Moderate<br>(Localised, short-term to moderate effect) | Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern. |
| Minor<br>(Localised short-term effect) | Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification. |
| Negligible<br>(Minimal impact or no lasting effect) | Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols. |

**Table 36: Risk matrix**

| Consequence | Likelihood | | | | |
|---|---|---|---|---|---|
| | Almost certain | Likely | Possible | Unlikely | Remote |
| Critical | Very High | Very High | High | High | Medium |
| Major | Very High | High | High | Medium | Medium |
| Moderate | High | Medium | Medium | Medium | Low |
| Minor | Medium | Medium | Low | Low | Very Low |
| Negligible | Medium | Low | Low | Very Low | Very Low |

**Table 37: Risk assessment**

| Potential impact | Project phase | Risk (pre-mitigation) | Risk (post mitigation) |
|---|---|---|---|
| Vegetation clearing | Construction | Medium | Low |
| sedimentation and contaminated and/or nutrient rich run-off | Construction | Medium | Low |
| noise, dust or light spill | Construction | Low | Very Low |
| inadvertent impacts on adjacent habitat or vegetation | Construction | Medium | Low |
| transport of weeds and pathogens from the site to adjacent vegetation | Construction | Medium | Low |
| vehicle strike | Construction | Low | Very Low |
| trampling of threatened flora species | Construction | Low | Very Low |
| rubbish dumping | Construction | Low | Very Low |
| wood collection | Construction | Low | Very Low |
| bush rock removal and disturbance | Construction | Low | Very Low |
| increase in predatory species populations | Construction | Low | Very Low |
| increase in pest animal populations | Construction | Low | Very Low |
| increased risk of fire | Construction | Low | Very Low |
| disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds. | Construction | Medium | Low |
| sedimentation and contaminated and/or nutrient rich run-off | Construction | Medium | Very Low |

## 2.4 Adaptive management strategy

This section is required for those impacts that are infrequent, cumulative or difficult to predict. Impacts associated with the proposed development have been considered extensively and addressed in Section 2.2 and further consideration of infrequent, cumulative or difficult to predict impacts is not considered to be necessary.

## 2.5 Impact summary

Following implementation of the BAM and the BAMC, the following impacts have been determined.

### 2.5.1 Serious and Irreversible Impacts (SAII)

The development does not have any Serious and Irreversible Impacts (SAII).

### 2.5.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 38 and shown on Figures 23-26. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 39.

**Table 38: Impacts to native vegetation that require offsets**

| PCT ID | PCT Name | Vegetation Class | Vegetation Formation | Direct impact (ha) |
|---|---|---|---|---|
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Herbfields | 0.07 |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Alpine Complex | Alpine Heaths | 0.18 |
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Alpine Complex | Alpine Bogs and Fens | 0.06 |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Grassy Woodlands | Subalpine Woodlands | 0.05 |

**Table 39: Impacts on threatened species and threatened species habitat that require offsets**

| Species | Common Name | Direct impact habitat (ha) | NSW listing status | EPBC Listing status |
|---|---|---|---|---|
| Guthega Skink | *Liopholis guthega* | 0.3 | Endangered | Endangered |
| Alpine She-oak Skink | *Cyclodomorphus praealtus* | 0.3 | Endangered | Endangered |
| Broad-toothed Rat | *Mastacomys fuscus* | 0.36 | Vulnerable | Vulnerable |
| Anemone Buttercup | *Ranunculus anemoneus* | 0.01 | Vulnerable | Vulnerable |

### 2.5.3 Impacts not requiring offsets

All the impacts of the proposed development on native vegetation require offsets for native vegetation and threatened species.

### 2.5.4 Areas not requiring assessment

The 0.76 ha of the development site that comprises the existing access road or heavily disturbed ski runs dominated by exotic grasses do not require assessment.

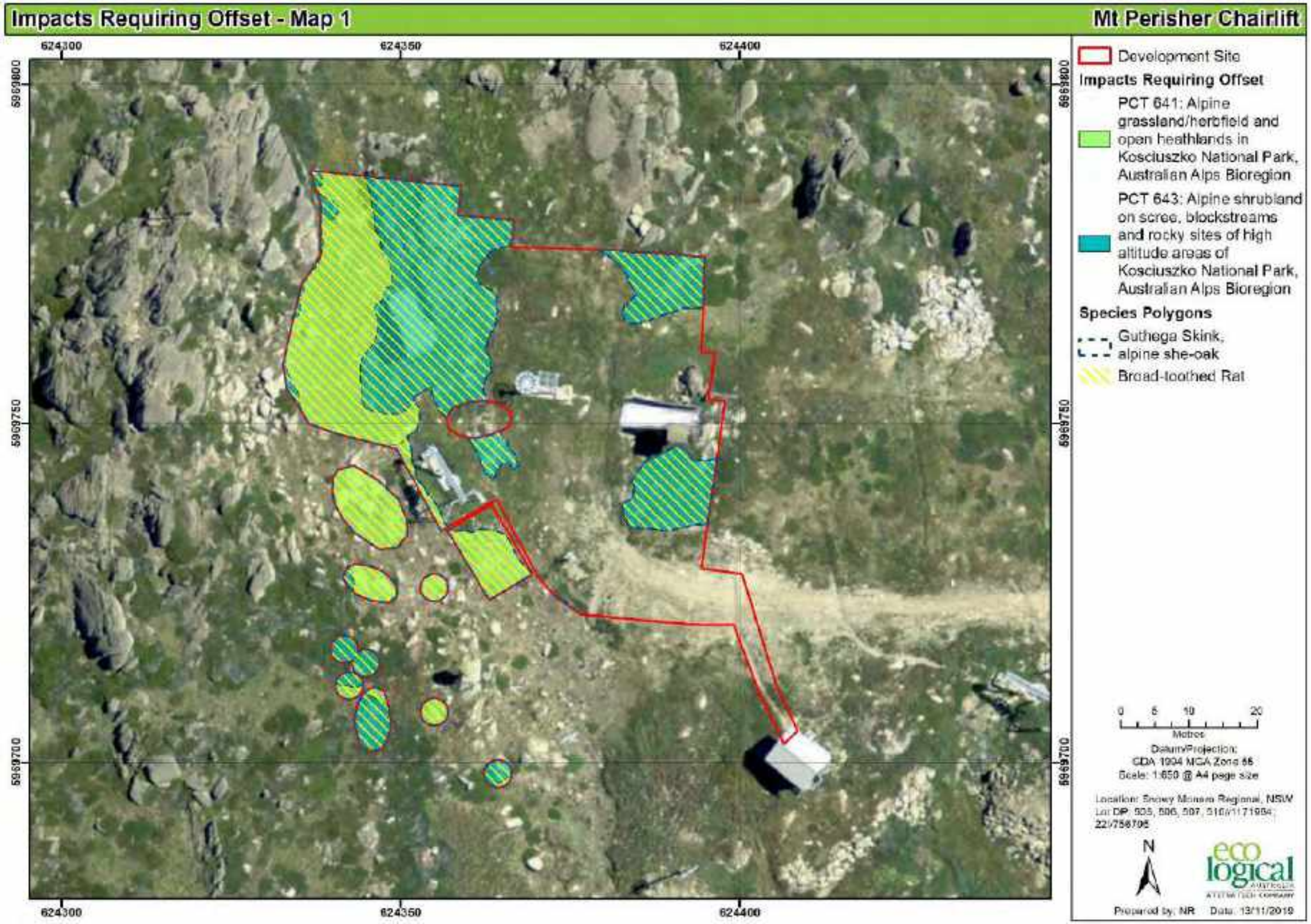


**Figure 23: Impacts requiring offset around the top station.**

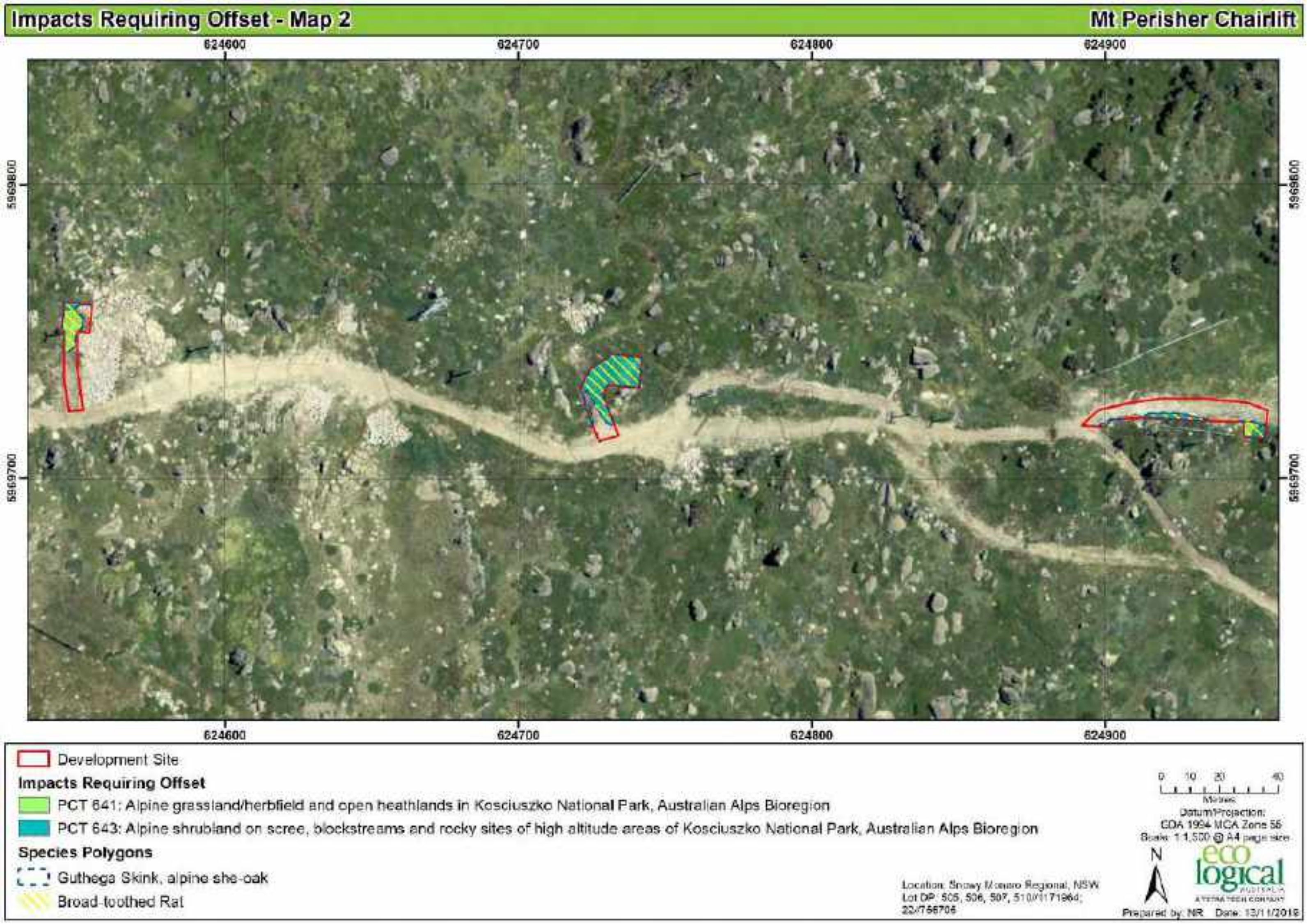


**Figure 24: Impacts requiring offset towers 6-8.**

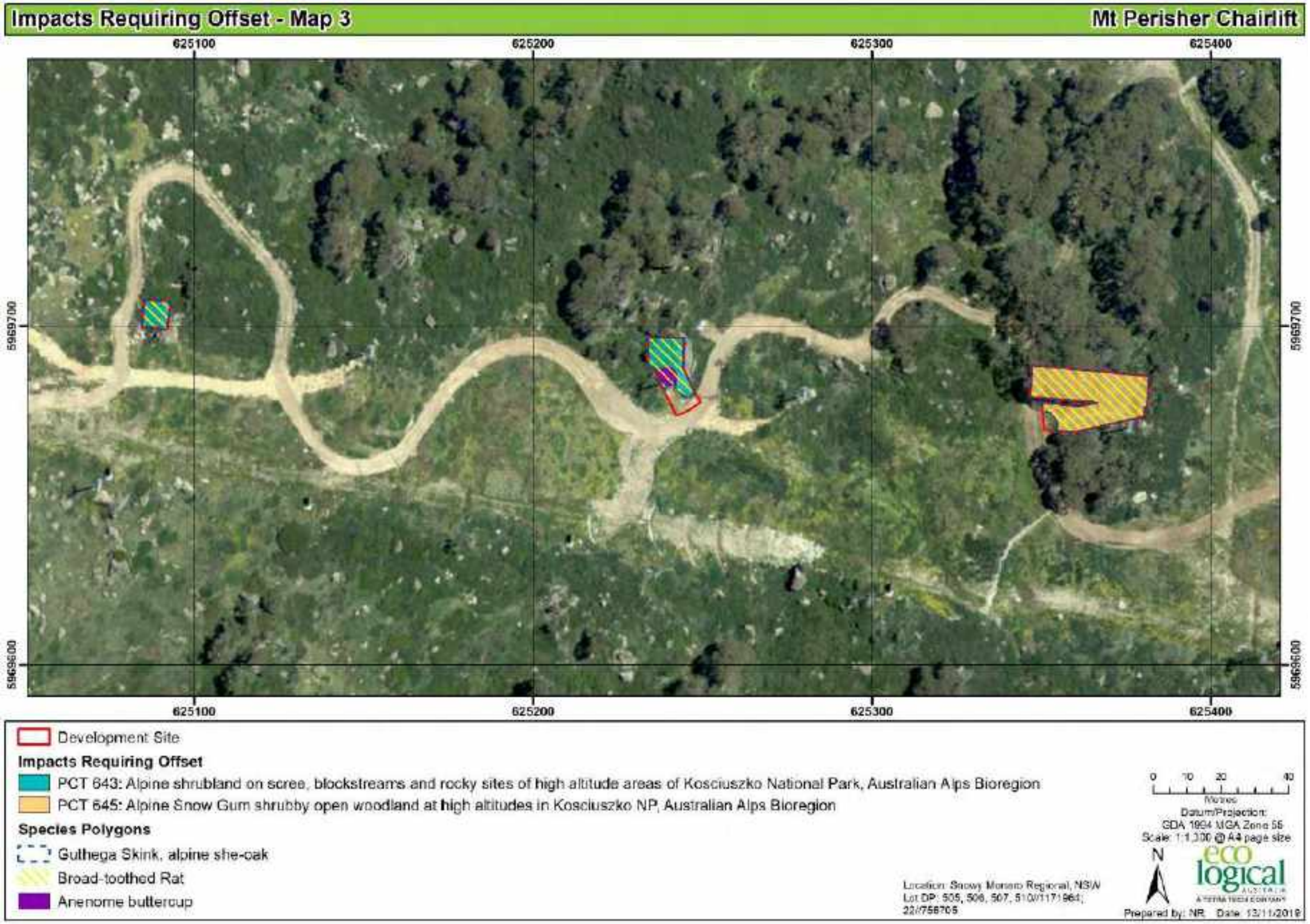


**Figure 25: Impacts requiring offset towers 3-5.**

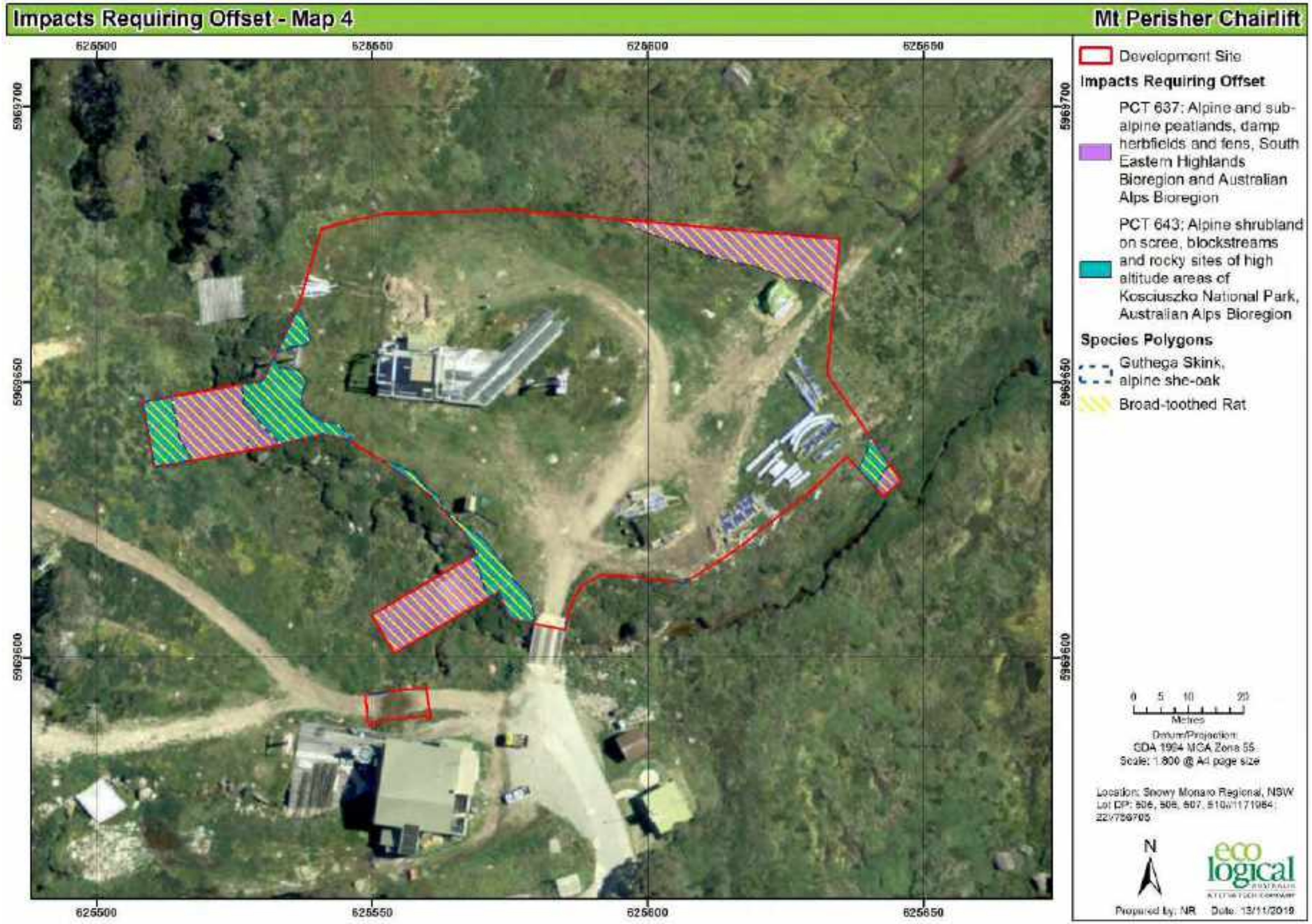


**Figure 26: Impacts requiring offset around the bottom station.**

### 2.5.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 40. The number of species credits required for the development are outlined in Table 41. A biodiversity credit report is included in Appendix D.

**Table 40: Ecosystem credits required**

| PCT ID | PCT Name | Vegetation Formation | Direct impact (ha) | Credits required |
|---|---|---|---|---|
| 641 | Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Alpine Herbfields | 0.07 | 3 |
| 643 | Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Alpine Heaths | 0.18 | 5 |
| 637 | Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Alpine Bogs and Fens | 0.06 | 1 |
| 645 | Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Subalpine Woodlands | 0.05 | 1 |

**Table 41: Species credit summary**

| Species | Common Name | Direct impact habitat (ha) | Credits required |
|---|---|---|---|
| Guthega Skink | *Liopholis guthega* | 0.3 | 7 |
| Alpine She-oak Skink | *Cyclodomorphus praealtus* | 0.3 | 7 |
| Broad-toothed Rat | *Mastacomys fuscus* | 0.36 | 9 |
| Anemone Buttercup | *Ranunculus anemoneus* | 0.01 | 1 |

## 2.6 Consistency with legislation and policy

An impact assessment under the EPBC Act was undertaken on MNES known to occur within the development site or immediate surrounds or with potential to occur there. These MNES were:

- Guthega Skink
- Alpine She-oak Skink
- Broad-toothed Rat
- Anenome Buttercup
- Alpine Sphagnum Bogs and Associated Fens EEC.

The outcome of this assessment was that it is highly unlikely that the development would significantly impact on those MNES assessed (Appendix C).

A referral to the Commonwealth under the EPBC Act is not recommended.

# 3. Recommendations

To further ameliorate the potential impacts of the proposed development and to improve environmental outcomes, the mitigation measures identified in Table 33 should be incorporated into the proposal.

# 4. Conclusion

Eco Logical Australia Pty Ltd was engaged by Perisher Blue Pty Ltd to prepare a Biodiversity Development Assessment Report for the proposed construction of a new chairlift and associated works on Mount Perisher.

This report has been prepared to meet the requirements of the Biodiversity Assessment Method 2016 established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016*.

This BDAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development site during the design, construction and operation of the development. The residual unavoidable impacts of the proposed development were calculated in accordance with the BAM by utilising the Biodiversity Assessment Method Credit Calculator. The BAMC calculated that a total of ten ecosystem credit and 24 species credits are required to offset the unavoidable impacts to the vegetation and habitat present within the development site.

Serious and Irreversible Impacts (SAII) values have been considered as part of this assessment. The proposal will not result in any SAII.

Following consideration of the administrative guidelines for determining significance under the EPBC Act, it is concluded that the proposal is unlikely to have a significant impact on matters of National Environmental Significance or Commonwealth land, and a referral to the Commonwealth Environment Minister is therefore, not recommended.

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**Personal Communications**

Zac Atkins. 2015 and 2019. Zac has a PhD in the ecology of the Guthega Skink from La Trobe University.

# Appendix A: Definitions

| Terminology | Definition |
|---|---|
| **Biodiversity credit report** | The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site. |
| **BioNet Atlas** | The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish. |
| **Broad condition state:** | Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score. |
| **Connectivity** | The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation. |
| **Credit Calculator** | The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site. |
| **Development** | Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act. |
| **Development footprint** | The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials. |
| **Development site** | An area of land that is subject to a proposed development that is under the EP&A Act. |
| **Ecosystem credits** | A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site. |
| **High threat exotic plant cover** | Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species. |
| **Hollow bearing tree** | A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles. |
| **Important wetland** | A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands, |
| **Linear shaped development** | Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length |
| **Local population** | The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately. |
| **Local wetland** | Any wetland that is not identified as an important wetland (refer to definition of Important wetland). |
| **Mitchell landscape** | Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000. |

| Terminology | Definition |
|---|---|
| **Multiple fragmentation impact development** | Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines |
| **Operational Manual** | The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM |
| **Patch size** | An area of intact native vegetation that: a) occurs on the development site or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or stewardship site. |
| **Proponent** | A person who intends to apply for consent to carry out development or for approval for an activity. |
| **Reference sites** | The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources. |
| **Regeneration** | The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm within a vegetation zone. |
| **Remaining impact** | An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values. |
| **Retirement of credits** | The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement. |
| **Riparian buffer** | Riparian buffers applied to water bodies in accordance with the BAM |
| **Sensitive Biodiversity Values Land map** | Development within an area identified on the map requires assessment using the BAM. |
| **Site attributes** | The matters assessed to determine vegetation integrity. They include: native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs. |
| **Site-based development** | a development other than a linear shaped development, or a multiple fragmentation impact development |
| **Species credits** | The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection. |
| **Subject land** | Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement. |
| **Threatened Biodiversity Data Collection** | Part of the BioNet database, published by OEH and accessible from the BioNet website. |
| **Threatened species** | Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable. |

| Terminology | Definition |
|---|---|
| **Vegetation Benchmarks Database** | A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification. |
| **Vegetation zone** | A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state. |
| **Wetland** | An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water |
| **Woody native vegetation** | Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs |

# Appendix B: Vegetation plot data

**Table 42: Flora species matrix**

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Acaena sp.A*** | | | | g | 0.2 | 5 | | | | | | | | | | g | 0.1 | 2 | g | 0.1 | 1 | g | 0.1 | 2 |
| ***Acetosella vulgaris*** | g | 0.1 | 100 | g | 0.5 | 500 | g | 0.1 | 100 | | | | g | 0.1 | 50 | g | 0.5 | 500 | g | 0.3 | 500 | g | 0.1 | 100 |
| ***Achillea millefolium*** | | | | g | 0.1 | 10 | | | | | | | | | | | | | | | | | | |
| ***Aciphylla glacialis*** | g | 0.1 | 5 | | | | | | | | | | | | | | | | g | 0.5 | 100 | | | |
| ***Aciphylla simplicifolia*** | g | 0.1 | 10 | | | | g | 0.1 | 5 | g | 0.1 | 20 | | | | | | | g | 0.1 | 10 | | | |
| ***Acrothamnus montanus.*** | g | 0.2 | 5 | g | 0.1 | 3 | | | | | | | g | 0.1 | 5 | g | 0.1 | 1 | | | | | | |
| ***Agrostis capillaris*** | g | 0.2 | 200 | g | 0.5 | 200 | g | 0.1 | 50 | g | 0.1 | 20 | g | 10 | 1000 | g | 35 | 1000 | g | 0.1 | 100 | | | |
| ***Asperula gunnii*** | g | 0.1 | 20 | g | 0.1 | 5 | g | 0.1 | 20 | | | | | | | | | | | | | g | 0.2 | 50 |
| ***Astelia psychrocharis*** | | | | | | | | | | g | 1 | 100 | | | | | | | | | | | | |
| ***Baeckea gunniana*** | g | 0.2 | 10 | | | | | | | m | 20 | 500 | g | 0.1 | 10 | | | | g | 0.1 | 1 | | | |
| ***Bossiaea foliosa*** | | | | | | | | | | | | | | | | | | | | | | m | 0.2 | 5 |
| ***Brachyscome spathulata*** | g | 0.1 | 20 | | | | | | | | | | | | | | | | | | | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Cardamine astoniae*** | | | | | | | | | | | | | | | | g | 0.1 | 1 | | | | | | |
| ***Carex breviculmis*** | g | 0.2 | 200 | g | 0.1 | 20 | g | 0.1 | 20 | | | | | | | g | 0.1 | 10 | g | 2 | 500 | g | 0.2 | 50 |
| ***Carex echinata*** | | | | | | | | | | g | 2 | 500 | | | | | | | | | | | | |
| ***Carex gaudichaudiana*** | | | | | | | | | | g | 2 | 500 | | | | | | | | | | | | |
| ***Carex hebes*** | | | | g | 0.2 | 100 | | | | | | | g | 0.1 | 100 | | | | g | 2 | 500 | | | |
| ***Carpha nivicola*** | | | | | | | | | | g | 10 | 1000 | | | | | | | | | | | | |
| ***Celmisia costiniana*** | g | 0.3 | 50 | g | 0.1 | 1 | | | | | | | g | 0.1 | 100 | | | | | | | g | 0.1 | 10 |
| ***Celmisia pugioniformis*** | g | 0.5 | 100 | g | 1 | 50 | | | | g | 0.1 | 5 | | | | g | 0.1 | 5 | | | | | | |
| ***Coronidium scorpioides*** | | | | g | 0.1 | 5 | | | | | | | g | 0.5 | 100 | g | 0.3 | 100 | g | 0.1 | 10 | | | |
| ***Cotula alpina*** | | | | | | | | | | g | 0.1 | 1 | | | | | | | | | | | | |
| ***Craspedia aurantia*** | g | 0.2 | 50 | g | 5 | 5000 | | | | | | | | | | | | | | | | | | |
| ***Craspedia maxgrayi*** | g | 0.1 | 10 | | | | | | | | | | | | | | | | | | | | | |
| ***Craspedia* sp.** | | | | | | | | | | g | 0.1 | 10 | g | 0.2 | 100 | g | 0.1 | 50 | g | 0.1 | 10 | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Deyeuxia crassiuscula*** | | | | | | | g | 0.1 | 1 | | | | g | 0.1 | 100 | | | | g | 0.1 | 50 | | | |
| ***Empodisma minus*** | g | 0.1 | 1 | | | | g | 0.1 | 2 | g | 30 | 1000 | | | | | | | g | 0.1 | 1 | | | |
| ***Epacris glacialis*** | | | | | | | | | | g | 20 | 1000 | g | 0.2 | 20 | g | 0.1 | 1 | | | | | | |
| ***Epacris microphylla*** | g | 10 | 50 | g | 0.2 | 1 | | | | | | | | | | | | | | | | | | |
| ***Epacris paludosa*** | | | | | | | | | | g | 1 | 20 | g | 0.1 | 5 | | | | | | | | | |
| ***Epacris petrophila*** | g | 1 | 10 | | | | | | | | | | g | 15 | 100 | | | | | | | | | |
| ***Erigeron nitidus*** | | | | | | | | | | g | 0.1 | 10 | g | 0.1 | 5 | | | | g | 1 | 100 | | | |
| ***Eucalyptus niphophila*** | | | | | | | u | 8 | 8 | | | | | | | | | | | | | u | 40 | 20 |
| ***Euchiton* sp.** | | | | g | 0.5 | 50 | | | | | | | g | 0.1 | 1 | | | | g | 0.1 | 1 | | | |
| ***Euphrasia collina* subsp. *diversicolor*** | | | | g | 0.5 | 200 | | | | | | | | | | | | | | | | | | |
| ***Euphrasia collina* subsp. *glacialis*** | | | | | | | | | | g | 0.5 | 100 | | | | | | | | | | | | |
| ***Ewartia nubigena*** | | | | g | 1 | 100 | | | | | | | g | 0.1 | 20 | | | | g | 0.1 | 2 | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Festuca rubra* subsp. *rubra*** | | | | g | 2 | 1000 | | | | | | | g | 0.5 | 100 | g | 10 | 1000 | | | | | | |
| ***Gentianella mulleriana* subsp. *alpestris*** | | | | g | 0.1 | 1 | | | | | | | | | | | | | | | | | | |
| ***Geranium potentilloides* var. *potentilloides*** | | | | | | | g | 0.1 | 1 | | | | | | | | | | | | | g | 0.1 | 1 |
| ***Gonocarpus montanus*** | | | | g | 0.2 | 30 | | | | | | | | | | | | | | | | | | |
| ***Goodenia hederacea* subsp. *alpestris*** | | | | | | | g | 0.1 | 1 | | | | | | | | | | | | | | | |
| ***Grevillea australis*** | g | 5 | 50 | g | 0.5 | 5 | m | 2 | 20 | | | | g | 0.1 | 2 | g | 20 | 50 | | | | m | 0.2 | 5 |
| ***Hovea montana*** | | | | | | | g | 0.5 | 10 | | | | | | | | | | | | | g | 10 | 100 |
| ***Hypochaeris radicata*** | | | | g | 1 | 500 | g | 0.1 | 2 | g | 0.1 | 5 | g | 0.5 | 500 | g | 2 | 1000 | g | 0.2 | 100 | | | |
| ***Hypochaeris* sp.** | | | | | | | | | | | | | g | 0.1 | 100 | | | | | | | | | |
| ***Kunzea muelleri*** | g | 50 | 100 | | | | g | 1 | 10 | | | | g | 0.2 | 1 | | | | g | 1 | 1 | | | |
| ***Lobelia surrepens*** | | | | | | | | | | g | 0.5 | 500 | | | | | | | | | | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Luzula alpestris*** | | | | | | | | | | | | | | | | | | | g | 0.1 | 10 | | | |
| ***Luzula australasica* subsp. *dura*** | g | 0.1 | 50 | | | | | | | | | | g | 0.1 | 1 | | | | | | | | | |
| ***Luzula modesta*** | | | | | | | | | | g | 0.1 | 10 | | | | | | | | | | | | |
| ***Luzula novae-cambriae*** | g | 0.2 | 100 | g | 1 | 500 | g | 0.1 | 1 | | | | g | 0.1 | 50 | g | 0.1 | 10 | g | 0.1 | 10 | g | 0.1 | 10 |
| ***Lycopodium fastigiatum*** | g | 0.1 | 5 | g | 0.5 | 200 | g | 10 | 100 | | | | g | 0.1 | 10 | | | | g | 3 | 500 | | | |
| ***Melicytus dentatus*** | | | | g | 0.1 | 1 | | | | | | | | | | g | 0.1 | 1 | | | | | | |
| ***Microseris lanceolata*** | g | 0.2 | 200 | g | 2 | 500 | | | | | | | g | 0.1 | 20 | g | 0.5 | 100 | g | 0.1 | 100 | | | |
| ***Nematolepis ovatifolia*** | m | 1 | 5 | | | | m | 60 | 100 | | | | g | 0.1 | 1 | g | 4 | 20 | | | | m | 0.3 | 2 |
| ***Olearia phlogopappa.*** | g | 0.2 | 20 | g | 0.1 | 5 | m | 1 | 20 | | | | | | | g | 0.2 | 20 | | | | m | 10 | 100 |
| ***Oreobolus distichus*** | | | | | | | | | | g | 2 | 1000 | g | 0.1 | 20 | | | | g | 0.1 | 10 | | | |
| ***Oreomyrrhis ciliata*** | | | | | | | | | | g | 0.5 | 500 | | | | | | | | | | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Oreomyrrhis eriopoda*** | g | 0.2 | 50 | g | 2 | 1000 | | | | | | | g | 0.5 | 100 | g | 1 | 500 | g | 1 | 500 | | | |
| ***Orites lancifolius*** | m | 2 | 10 | m | 2 | 10 | m | 20 | 20 | | | | g | 10 | 50 | g | 0.2 | 1 | | | | m | 10 | 20 |
| ***Oschatzia cuneifolia*** | | | | | | | | | | g | 0.1 | 20 | | | | | | | | | | | | |
| ***Oxylobium ellipticum*** | | | | | | | m | 10 | 100 | | | | g | 0.1 | 5 | g | 0.1 | 1 | | | | g | 1 | 20 |
| ***Ozothamnus alpinus*** | | | | | | | m | 2 | 1 | | | | | | | | | | | | | m | 0.3 | 5 |
| ***Ozothamnus cupressoides.*** | | | | g | 0.1 | 1 | | | | g | 2 | 100 | | | | | | | g | 0.1 | 1 | | | |
| ***Ozothamnus secundiflorus*** | | | | | | | m | 0.1 | 2 | | | | | | | | | | | | | m | 1 | 10 |
| ***Pentachondra pumila*** | | | | | | | | | | | | | g | 0.2 | 5 | | | | | | | | | |
| ***Pimelea alpina*** | g | 0.2 | 30 | g | 0.2 | 10 | | | | | | | g | 0.1 | 5 | g | 0.2 | 20 | g | 0.1 | 5 | | | |
| ***Pimelea axiflora* subsp. *alpina*** | | | | | | | g | 3 | 100 | | | | | | | | | | | | | g | 2 | 50 |
| ***Pimelea ligustrina* subsp. *ciliata*** | | | | | | | m | 0.1 | 1 | | | | | | | | | | | | | g | 0.5 | 20 |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Plantago alpestris*** | g | 0.1 | 30 | | | | | | | | | | | | | | | | | | | | | |
| ***Poa costiniana*** | g | 0.5 | 50 | g | 10 | 100 | | | | g | 5 | 500 | g | 0.1 | 20 | | | | g | 30 | 1000 | | | |
| ***Poa ensiformis*** | | | | | | | g | 0.1 | 10 | | | | | | | | | | | | | g | 1 | 200 |
| ***Poa fawcettiae*** | g | 3 | 300 | g | 10 | 100 | g | 1 | 100 | | | | g | 0.5 | 100 | g | 10 | 500 | g | 30 | 1000 | g | 15 | 1000 |
| ***Poa hiemata*** | g | 2 | 200 | g | 10 | 100 | | | | | | | g | 0.1 | 5 | g | 1 | 100 | g | 5 | 500 | | | |
| ***Podocarpus lawrencei*** | | | | | | | | | | | | | g | 0.1 | 1 | | | | | | | | | |
| ***Polystichum proliferum*** | | | | g | 0.1 | 1 | | | | | | | | | | | | | g | 0.1 | 1 | | | |
| ***Prasophyllum* sp.** | g | 0.1 | 20 | g | 0.1 | 1 | | | | | | | g | 0.1 | 10 | | | | g | 0.1 | 2 | | | |
| ***Prostanthera cuneata*** | g | 5 | 30 | m | 2 | 30 | m | 2 | 20 | | | | | | | g | 2 | 20 | | | | m | 40 | 100 |
| ***Ranunculus anemoneus*** | | | | | | | | | | | | | | | | | | | g | 0.1 | 1 | | | |
| ***Ranunculus dissectifolius*** | | | | | | | | | | g | 1 | 100 | | | | | | | | | | | | |
| ***Ranunculus gunnianus*** | | | | | | | | | | g | 0.1 | 20 | | | | | | | | | | | | |
| ***Richea continentis*** | | | | | | | g | 0.1 | 1 | g | 10 | 100 | g | 0.3 | 10 | g | 0.1 | 1 | | | | | | |

| Species | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance | Stratum & Layer | Cover | Abundance |
| ***Rytidosperma alpicola*** | g | 0.1 | 1 | g | 0.1 | 5 | | | | | | | | | | | | | | | | | | |
| ***Rytidosperma nivicolum*** | | | | | | | | | | g | 0.2 | 100 | | | | | | | | | | | | |
| ***Rytidosperma nudiflorum*** | g | 0.5 | 100 | g | 10 | 1000 | | | | | | | g | 0.1 | 100 | g | 0.1 | 100 | g | 20 | 1000 | | | |
| ***Scleranthus singuliflorus*** | g | 0.1 | 5 | g | 0.1 | 5 | | | | | | | g | 0.1 | 20 | | | | g | 0.1 | 10 | | | |
| ***Senecio gunnii*** | g | 0.1 | 10 | g | 0.1 | 2 | g | 0.1 | 1 | | | | | | | g | 0.1 | 1 | g | 0.1 | 1 | | | |
| ***Senecio pinnatifolius* var. *pinnatifolius*** | g | 0.2 | 50 | g | 0.1 | 20 | | | | | | | g | 0.1 | 10 | g | 0.1 | 5 | g | 0.1 | 10 | | | |
| ***Sphagnum cristatum*** | | | | | | | | | | g | 60 | 1000 | | | | | | | | | | | | |
| ***Stylidium graminifolium*** | | | | | | | | | | g | 1 | 1000 | g | 0.1 | 2 | | | | | | | | | |
| ***Tasmannia xerophila* subsp. *xerophila*** | | | | | | | m | 0.2 | 2 | | | | | | | | | | | | | g | 0.1 | 3 |
| ***Trisetum spicatum*** | g | 0.2 | 50 | g | 1 | 200 | | | | g | 0.1 | 1 | | | | | | | | | | | | |
| ***Viola betonicifolia*** | g | 0.1 | 10 | g | 0.2 | 50 | g | 0.1 | 50 | | | | g | 0.1 | 20 | g | 0.1 | 20 | g | 0.5 | 500 | | | |

**Table 43: Plot location data**

| Plot no. | PCT | Condition | Easting | Northing | Bearing |
|---|---|---|---|---|---|
| **1** | 643 | Excellent | 624366 | 5969778 | 330 |
| **2** | 641 | Moderate | 624339 | 5969749 | 0 |
| **3** | 643 | With Trees | 624890 | 5969740 | 30 |
| **4** | 637 | Good | 625634 | 5969686 | 0 |
| **5** | 641 | Disturbed | 624374 | 5969688 | 300 |
| **6** | 643 | Disturbed | 624411 | 5969744 | 90 |
| **7** | 641 | Excellent | 624674 | 5969674 | 180 |
| **8** | 645 | Excellent | 625367 | 5969672 | 0 |

**Table 44: Vegetation integrity data (Composition)**

| | Composition (number of species) | | | | | |
|---|---|---|---|---|---|---|
| **Plot** | Tree | Shrub | Grass | Forb | Fern | Other |
| **1** | 0 | 11 | 10 | 17 | 1 | 0 |
| **2** | 0 | 10 | 9 | 18 | 2 | 0 |
| **3** | 1 | 14 | 6 | 6 | 1 | 0 |
| **4** | 0 | 5 | 9 | 13 | 0 | 0 |
| **5** | 0 | 14 | 9 | 13 | 1 | 0 |
| **6** | 0 | 11 | 5 | 10 | 0 | 0 |
| **7** | 0 | 4 | 11 | 16 | 2 | 0 |
| **8** | 1 | 13 | 4 | 4 | 0 | 0 |

**Table 45: Vegetation integrity data (Structure)**

| Structure (Total cover) | | | | | | |
|---|---|---|---|---|---|---|
| **Plot** | Tree | Shrub | Grass | Forb | Fern | Other |
| **1** | 0.0 | 74.8 | 6.9 | 2.7 | 0.1 | 0.0 |
| **2** | 0.0 | 5.4 | 42.4 | 13.4 | 0.6 | 0.0 |
| **3** | 8.0 | 102.0 | 1.5 | 0.6 | 10.0 | 0.0 |
| **4** | 0.0 | 53.0 | 51.4 | 5.2 | 0.0 | 0.0 |
| **5** | 0.0 | 26.7 | 1.3 | 2.2 | 0.1 | 0.0 |
| **6** | 0.0 | 27.1 | 11.3 | 2.5 | 0.0 | 0.0 |
| **7** | 0.0 | 1.3 | 89.5 | 4.2 | 3.1 | 0.0 |
| **8** | 40.0 | 75.6 | 16.3 | 0.5 | 0.0 | 0.0 |

**Table 46: Vegetation integrity data (Function)**

| **Function** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plot** | Large Trees | Hollow trees | Litter Cover | Length Fallen Logs | Tree Stem 5-9 | Tree Stem 10-1 9 | Tree Stem 20-29 | Tree Stem 30-49 | Tree Stem 50-79 | Tree Regen | High Threat Weed Cover |
| **1** | 0 | 0 | 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 |
| **2** | 0 | 0 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.1 |
| **3** | 0 | 0 | 76 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0.2 |
| **4** | 0 | 0 | 21.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| **5** | 0 | 0 | 10.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.1 |
| **6** | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35.5 |
| **7** | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 |
| **8** | 1 | 0 | 88 | 41 | 1 | 1 | 1 | 1 | 1 | 1 | 0.1 |

# Appendix C: EPBC Act Significant Impact Criteria

The EPBC Act Administrative Guidelines on Significance set out 'Significant Impact Criteria' that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities;
- Listed migratory species;
- Wetlands of International Importance;
- The Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Nuclear actions; and
- Great Barrier Reef.

Specific 'Significant Impact Criteria' are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

The Commonwealth listed species which are known or considered to have the potential to occur within the study area are the Broad-toothed Rat, Guthega Skink, Alpine She-oak Skink, Anenome Buttercup and Alpine Sphagnum Bogs and Associated Fens EEC.

The relevant Significant Impact Criteria have been applied to determine the significance of impacts associated with the proposal.

| Matters to be considered | Impact |
|---|---|
| Any environmental impact on a World Heritage Property or National Heritage Places | No. The proposed action does not impact on a World Heritage Property or a National Heritage Place as addressed in the SEE.<br>(listed natural: Australian Alpine National Parks and Reserves; nominated historic: Snowy Mountains Scheme NSW). |
| any environmental impact on Wetlands of International Importance | No. The proposal will not affect any part of Ramsar wetland. |
| any impact on Commonwealth Listed Critically Endangered or Endangered Species; | Yes. The study area does provide potential and known habitat for the following Commonwealth listed endangered species: Alpine She-oak Skink and Guthega Skink<br>The significant impact criteria for endangered species are discussed below:<br>a. lead to a long-term decrease in the size a population of a species,<br>The impacts associated with the proposed action will affect only a very small area of potential habitat for the Alpine She-oak Skink in the context of that available to the species on Mount Perisher and in the locality. It is considered highly unlikely that the proposed works would result in injury or death of any Alpine She-oak Skinks as the disturbances associated with the proposed works are likely to temporarily deter any individuals from the locations where works are being undertaken. |

| Matters to be considered | Impact |
|---|---|
| | Under these circumstances, it is considered highly unlikely that the proposed action will lead to a long-term decrease in the size of the Alpine She-oak Skink population.<br><br>The Guthega Skink is known from many locations on Mount Perisher, including habitats to the north, west and south of the top station. It is also known to occur in the habitats surrounding several of the proposed tower locations. There are extensive areas of known and potential habitat for the species in the Mount Perisher, Back Perisher and Centre Valley areas and the species is relatively common in suitable habitats through these areas.<br><br>Whilst the proposal will result in temporary disturbances to foraging habitats during the construction phase of the proposal, it will not affect any known burrow systems. Excavations such as those that will be required for the tower, tops station and T-bar bullwheel support footing, and other major disturbances associated with the proposal will be at least 10 m from the nearest known Guthega Skink burrow (near the top station) and generally considerably more i.e. 20-30 m. The burrows are not thought to extend more than a 2-3 m (Atkins pers. comm. 2019). So it is unlikely that the excavation associated with the proposal will encroach upon any of the species burrows.<br><br>Whilst the proposal will involve disturbances in known Guthega Skink habitat, the extensive surveys undertake for this assessment have demonstrated that the proposal is unlikely to involve any direct impacts on the species burrow networks and is expected to only involve temporary impacts on a small area of the species foraging habitat, predominately in associated with the proposed rock reduction and removal for the top station offload, the relocation of the Eyre T-bar bullwheel, and for the Tower 5 footing.<br><br>The species remains locally abundant around the Mount Perisher summit where there has been considerable historic disturbance. It is also regularly observed in other locations on Mount Perisher, in the Centre Valley area and at Charlotte Pass on the margins of places that have been historically heavily disturbed.<br><br>The Guthega Skink on Mount Perisher is relatively abundant including around the top station and elsewhere where there have been extensive historic disturbances. The proposed action is not expected to directly affect any known burrows and will only affect a small amount of foraging habitat and so no significant impacts are expected that would lead to a long-term decline of the Guthega Skink population. Given this, it is considered unlikely that there will be impacts on this species that will lead to a long-term decrease in the size of the Alpine She-oak Skink population.<br><br>b. reduce the area of occupancy of the species<br><br>The proposed action will be limited to the removal or temporary disturbance of only approximately 0.3 ha of known or potential habitat for the Alpine She-oak Skink or Guthega Skink. In the context of the extent of these resources in the locality the proposal is highly unlikely to affect any key habitat resources for the Alpine She-oak Skink or Guthega Skink; nor affect their ability to access habitats within or beyond the development site.<br><br>Under these circumstances, the proposed action is highly unlikely to reduce the area of occupancy of the local populations of the Alpine She-oak Skink or Guthega Skink.<br><br>c. fragment an existing population into two or more populations<br><br>The proposed action will be limited to the removal or disturbance of a small amount of potential habitat for the Guthega Skink and Alpine She-oak Skink in the context of the extent of these resources in the locality and is unlikely to affect their ability to access habitats within or beyond the development site post construction.<br><br>Under these circumstances, the proposed action will not fragment an existing population of the Alpine She-oak Skink or Guthega Skink into two or more populations.<br><br>With respect to the Guthega Skink, the proposed action includes the creation of supplementary rock habitats for the species in a degraded area below the proposed top station. This is expected to supplement the habitat that is available to the species and improve connectivity between habitats to the north and south. |

| Matters to be considered | Impact |
| --- | --- |
| | d. adversely affect habitat critical to the survival of a species<br>No habitat within the development site is considered likely to be critical to the survival of the Alpine She-oak Skink or Guthega Skink. There are thousands of hectares of similar habitats in the alpine and subalpine zones of the Australian alps, including hundreds of hectares of similar habitat elsewhere within the Perisher Resort area.<br>e. disrupt the breeding cycle of a population<br>Little has been published with respect to the breeding ecology of the Guthega Skink however it is thought that the species mates in spring or early summer and young are born in mid to late summer. The generation length, or average age of parents of the current cohort, is thought to be 3-7 years. The proposal will not result in the loss of any key habitats for the species such as known burrow systems. Guthega Skinks are thought to have considerable site fidelity, so are likely to generally remain within 50 m of their burrow system. Given the distance to known burrow systems, the species fidelity with these systems, and the assumed reluctance of individuals to approach areas where machines and people are working during the construction phase, it is considered unlikely that any individuals of the species will be killed during the construction phase. As such, it is considered unlikely that the proposal will disrupt breeding in the colonies which surround parts of the development site.<br>Under these circumstances, it is considered unlikely that the proposed action will disrupt the breeding cycle of the Guthega Skink population which occurs on Mount Perisher.<br>It is considered highly unlikely that the proposal would disrupt the breeding cycle of any population of the Alpine She-oak Skink that may occur in the Mount Perisher area as the proposal will affect only a small area of marginal potential habitat for the species and includes post-construction rehabilitation actions which mitigate against the potential for the disturbed areas to present a barrier to the movement of Alpine She-oak Skink individuals.<br>f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline<br>The proposed action will modify a very small area of potential habitat for the Alpine She-oak Skink or Guthega Skink in the context of the extent of potential habitat surrounding the development site and on Mount Perisher and in the locality.<br>Under these circumstances, it is highly unlikely that the proposed action would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Alpine She-oak Skink or Guthega Skink is likely to decline.<br>g. result in invasive species that are harmful to an endangered species becoming established in the endangered or critically endangered species' habitat<br>The proposed action is unlikely to result in invasive species that are harmful becoming established in potential habitat of the Alpine She-oak Skink or Guthega Skink. Both species continue to occur within the Perisher Resort area and other places within the Australian Alps where a range of invasive species have long been established. The proposed action includes protocols to restrict the potential for introductions of invasive species.<br>h. introduce disease that may cause the species to decline<br>The proposed action is unlikely to introduce disease that may cause the Alpine She-oak Skink or Guthega Skink to decline. There are currently no identified reptile diseases that could be exacerbated byt the proposed actions.<br>i. interfere substantially with the recovery of the species.<br>As the proposed action is not considered to decrease or fragment any existing populations, the recovery of the Alpine She-oak Skink or Guthega Skink is unlikely to be adversely impacted. |
| any impact on Commonwealth Listed vulnerable Species; | Yes. The study area provides known habitat for two Commonwealth listed vulnerable species: the Broad-toothed Rat and the Anenome Buttercup.<br>The significant impact criteria in terms of the vulnerable species are discussed below: |

| Matters to be considered | Impact |
|---|---|
| | a. lead to a long-term decrease in the size of an important population of a species.<br>Whilst the proposed action will affect some known Broad-toothed Rat habitat, it will affect only a very small amount of the potential habitat for the species in a number of discrete areas. As such, the proposed works are unlikely to adversely affect a significant proportion of the home range of one or more Broad-toothed Rat individuals and will not result in habitat fragmentation which could isolate individuals or a population of the Broad-toothed Rat. The noise and vibration associated with the proposed works is likely to temporarily deter any Broad-toothed Rat individuals that may be near the affected areas from entering the work area. As such, it is unlikely that any individuals would be killed during the implementation of the proposed action.<br>Under these circumstances the proposed action will not lead to a long-term decrease in the size of an important population of the Broad-toothed Rat.<br><br>The Anenome Buttercup has recovered well from the brink of extinction since the cessation of grazing in the NSW alpine areas, and is now locally common throughout the main range. The local population of the species is likely to comprise many thousands of plants. The species is common on Mount Perisher and elsewhere throughout the Perisher Resort area.<br><br>Under these circumstances, the loss of one Anenome Buttercup plant in association with the proposed action will not lead to a long-term decrease in the size of an important population of the species.<br>b. reduce the area of occupancy of an important population<br>It is highly likely that the Broad-toothed Rat will continue to occur within the development site after the implementation of the proposed action. The species continues to be locally common in the Perisher Resort Area where there have been many similar and larger developments over many decades. As such, the proposed action is highly unlikely to reduce the area of occupancy of the Broad-toothed Rat.<br>The proposed action will reduce the area of occupancy of the Anenome Buttercup by a very small amount, approximately 0.5 $m^2$.<br>c. fragment an existing important population into two or more populations<br>The proposed action will not fragment an existing important population of either the Broad-toothed Rat or the Anenome Buttercup into two or more populations. Both species populations extend beyond the development site and the Perisher Resort Area.<br>d. adversely affect habitat critical to the survival of a species<br>No habitat within the development site is considered to be critical to the survival of the Broad-toothed Rat or the Anenome Buttercup.<br>e. disrupt the breeding cycle of an important population<br>The proposed action and affected are too small to disrupt the breeding cycle of a population of the Broad-toothed Rat.<br>f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that either species is likely to decline<br>The proposed action will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Broad-toothed Rat or the Anenome Buttercup is likely to decline.<br>g. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat<br>The proposed action will not result in invasive species that are harmful becoming established in habitat for the Broad-toothed Rat or the Anenome Buttercup. Both species continue to occur within the Perisher Resort area and other places within the Australian Alps where a range of |

| Matters to be considered | Impact |
|---|---|
| | invasive species have long been established. The proposed action includes protocols to restrict the potential for introductions of invasive species.<br>h. interferes substantially with the recovery of the species.<br>Whilst there have been documented declines in some Broad-toothed Rat populations within the Snowy Mountains, these declines have been attributed to factors such as major bushfire events and early snow thaws, and not impacts of the nature of those proposed. The local population of the Broad-toothed Rat appears to continue to be relatively large on the basis of the abundance of the species scat throughout the Perisher Resort Area, including within the village, and in areas that have been subject to the sorts of activities proposed. As such, it is considered highly unlikely that proposed action will substantially interfere with the recovery of the Broad-toothed Rat.<br><br>The Anenome Buttercup has recovered well from the brink of extinction since the cessation of grazing in the NSW alpine areas, and is now locally common throughout the main range. The local population of the species is likely to comprise many thousands of plants. The species is common on Mount Perisher and elsewhere throughout the Perisher Resort area. |
| Any impact on a Commonwealth Endangered Ecological Community | Yes: The Alpine Sphagnum Bogs and Associated Fens endangered ecological community occurs within the development site.<br>The significant impact criteria in terms of endangered ecological communities are discussed below:<br>a. reduce the extent of an ecological community<br>The proposal is expected to result in the loss or modification of approximately 600 $m^2$ of Alpine Sphagnum Bogs and Associated Fens EEC where the proposed chair shed and skier bridges will affect two already disturbed sections of the community. The local occurrence of the community is estimated to be at least 100 ha in extent in association with Perisher Creek and Rock Creek.<br>b. fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;<br>The proposal will not fragment the Alpine Sphagnum Bogs and Associated Fens EEC as it will affect a small area on the margins of a very large local occurrence.<br>c. adversely affect habitat critical to the survival of an ecological community<br>The local occurrence of the Alpine Sphagnum Bogs and Associated Fens EEC is estimated to be at least 100 ha in extent in association with Perisher Creek and Rock Creek. In this context, the habitat for the community within the development site is not considered to be critical to its survival.<br>d. modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns<br>The proposal has been designed so as to not modify or destroy the abiotic factors necessary for the survival of the Alpine Sphagnum Bogs and Associated Fens EEC. On the contrary, the proposal has been designed to mitigate against any potential impacts on surface or subsurface hydrology.<br>e. cause a substantial change in the species composition of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.<br>The development site does not support a unique assemblage of characteristic flora species of the Alpine Sphagnum Bogs and Associated Fens EEC that does not occur elsewhere within the local occurrence. Similarly, the fauna assemblage inhabiting the development site is likely to be distributed throughout the local occurrence and contiguous vegetation. Fauna species such as invertebrates, amphibians, reptiles, birds, and mammals utilising foraging substrates within the development site would not be restricted to the areas affected by the action proposed and would be highly likely to continue to utilise habitats in the remainder of the local occurrence. |

| Matters to be considered | Impact |
|---|---|
| | f. cause a substantial reduction in the quality or integrity of an ecological community, including, but not limited to:<br>-assisting invasive species, that area harmful to the listed ecological community, to become established, or<br>-causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants in the ecological community which kill or inhibit the growth of species in the ecological community<br>The proposed action includes appropriate safeguards to limit the potential for invasive plants or pathogens to encroach upon the Alpine Sphagnum Bogs and Associated Fens EEC. It will also include safeguards which limit the potential for any chemicals or pollutants to enter the Alpine Sphagnum Bogs and Associated Fens EEC in association with the action proposed.<br>g. interfere with the recovery of an ecological community<br>The Alpine Sphagnum Bogs and Associated Fens EEC has recovered well since the cessation of grazing in the NSW alps and is one of the most common vegetation communities in alpine and subalpine habitats, and one of the best conserved vegetation communities in Australia. It has also recovered well since the 2003 wildfires.<br>The proposed action will not reduce the extent of the Alpine Sphagnum Bogs and Associated Fens EEC, will not interfere with any wider recovery of the community, which is only potentially threatened by impacts associated with climate change, the re-introduction of grazing, horse and pig impacts or adverse fire regimes. |
| Any environmental impact on Commonwealth Listed Migratory Species; | No. The proposed action will not have any adverse impacts on any listed migratory species. |
| Does any part of the Proposed action involve a Nuclear Action; | No. The project does not include a Nuclear Action. |
| Any environmental impact on a Commonwealth Marine Area; | No. There are no Commonwealth Marine Areas within the study area. |
| In addition, any direct or indirect impact on Commonwealth lands | No. The project does not directly or indirectly affect Commonwealth land. |

# Appendix D: Biodiversity credit report

# BAM Biodiversity Credit Report (Like for like)

## Proposal Details

| Assessment Id | Proposal Name | BAM data last updated * |
|---|---|---|
| 00015431/BAAS17061/19/00015432 | Mount Perisher Chairlift | 26/11/2019 |
| Assessor Name | Assessor Number | BAM Data version * |
| Ryan  Smithers | BAAS17061 | 22 |
| Proponent Names | Report Created | BAM Case Status |
| | 16/12/2019 | Open |
| Assessment Revision | Assessment Type | Date Finalised |
| 0 | Part 4 Developments (General) | To be finalised |

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Potential Serious and Irreversible Impacts

Nil

Nil

## Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

No Changes

## Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

| Name of Plant Community Type/ID | Name of threatened ecological community | Area of impact | Number of credits to be retired |
|---|---|---|---|
| 643-Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion | Not a TEC | 0.2 | 5.00 |
| 641-Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion | Not a TEC | 0.1 | 3.00 |
| 637-Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion | Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions | 0.1 | 1.00 |
| 645-Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion | Not a TEC | 0.1 | 1.00 |

| **637-Alpine and sub-alpine peatlands, damp herbfields and fens, South Eastern Highlands Bioregion and Australian Alps Bioregion** | **Like-for-like credit retirement options** | | | |
|---|---|---|---|---|
| | Name of offset trading group | Trading group | HBT | IBRA region |

| | | | | |
|---|---|---|---|---|
| | Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions<br>This includes PCT's:<br>518, 607, 637, 665, 681, 766, 788, 939, 1188, 1200, 1256, 1270, 1287, 1298, 1743, 1744, 1745 | - | No | Snowy Mountains, Bondo, Monaro, Murrumbateman, Snowy Mountains and South East Coastal Ranges.<br>or<br>Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site. |
| **641-Alpine grassland/herbfield and open heathlands in Kosciuszko National Park, Australian Alps Bioregion** | **Like-for-like credit retirement options** | | | |
| | Class | Trading group | HBT | IBRA region |
| | Alpine Herbfields<br>This includes PCT's:<br>641, 642 | Alpine Herbfields - < 50% cleared group (including Tier 7 or higher). | No | Snowy Mountains, Bondo, Monaro, Murrumbateman, Snowy Mountains and South East Coastal Ranges.<br>or<br>Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site. |

| | | | | |
|---|---|---|---|---|
| **643-Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion** | **Like-for-like credit retirement options** | | | |
| | Class | Trading group | HBT | IBRA region |
| | Alpine Heaths<br>This includes PCT's:<br>643 | Alpine Heaths - < 50% cleared group (including Tier 7 or higher). | No | Snowy Mountains, Bondo, Monaro, Murrumbateman, Snowy Mountains and South East Coastal Ranges.<br>or<br>Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site. |
| **645-Alpine Snow Gum shrubby open woodland at high altitudes in Kosciuszko NP, Australian Alps Bioregion** | **Like-for-like credit retirement options** | | | |
| | Class | Trading group | HBT | IBRA region |
| | Subalpine Woodlands<br>This includes PCT's:<br>644, 645, 650, 677, 679, 952, 1190, 1191, 1196, 1199 | Subalpine Woodlands - < 50% cleared group (including Tier 7 or higher). | Yes | Snowy Mountains, Bondo, Monaro, Murrumbateman, Snowy Mountains and South East Coastal Ranges.<br>or<br>Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site. |

# BAM Biodiversity Credit Report (Like for like)

## Species Credit Summary

| Species | Area | Credits |
|---|---|---|
| **Cyclodomorphus praealtus** / Alpine She-oak Skink | 0.3 | 7.00 |
| **Liopholis guthega** / Guthega Skink | 0.3 | 7.00 |
| **Mastacomys fuscus** / Broad-toothed Rat | 0.4 | 9.00 |
| **Ranunculus anemoneus** / Anemone Buttercup | 0.0 | 1.00 |

| | | | |
|---|---|---|---|
| **Cyclodomorphus praealtus**/ Alpine She-oak Skink | 641_disturbed | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| | 641_excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| | 641_Moderate | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |

| | | | |
|---|---|---|---|
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| | 643_disturbed | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| | 643_Excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| | 643_withtrees | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |

| | | | |
|---|---|---|---|
| | 645_excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Cyclodomorphus praealtus**/Alpine She-oak Skink | Any in NSW |
| **Liopholis guthega**/ Guthega Skink | 641_disturbed | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| | 641_excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| | 641_Moderate | **Like-for-like credit retirement options** | |

| | | | |
|---|---|---|---|
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| | 643_disturbed | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| | 643_Excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| | 643_withtrees | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |

| | | | |
|---|---|---|---|
| | 645_excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Liopholis guthega**/Guthega Skink | Any in NSW |
| **Mastacomys fuscus**/ Broad-toothed Rat | 637_Good | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Mastacomys fuscus**/Broad-toothed Rat | Any in NSW |
| | 641_disturbed | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Mastacomys fuscus**/Broad-toothed Rat | Any in NSW |

<table>
<tr><td rowspan="4">Mastacomys fuscus/<br>Broad-toothed Rat</td><td>641_excellent</td><td>Like-for-like credit retirement options<br>Spp | IBRA region<br>Mastacomys fuscus/Broad-toothed Rat | Any in NSW</td></tr>
<tr><td>641_Moderate</td><td>Like-for-like credit retirement options<br>Spp | IBRA region<br>Mastacomys fuscus/Broad-toothed Rat | Any in NSW</td></tr>
<tr><td>643_disturbed</td><td>Like-for-like credit retirement options<br>Spp | IBRA region<br>Mastacomys fuscus/Broad-toothed Rat | Any in NSW</td></tr>
<tr><td>643_Excellent</td><td>Like-for-like credit retirement options<br>Spp | IBRA region</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | **Mastacomys fuscus**/Broad-toothed Rat | Any in NSW |
| | | | |
| | 643_withtrees | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Mastacomys fuscus**/Broad-toothed Rat | Any in NSW |
| | | | |
| | 645_excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Mastacomys fuscus**/Broad-toothed Rat | Any in NSW |
| | | | |
| **Ranunculus anemoneus**/ Anemone Buttercup | 643_Excellent | **Like-for-like credit retirement options** | |
| | | Spp | IBRA region |
| | | **Ranunculus anemoneus**/Anemone Buttercup | Any in NSW |
| | | | |

| | |
|---|---|
| **Ranunculus anemoneus**/ Anemone Buttercup | 643_Excellent |

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# APPENDIX C

## SITE ENVIRONMENTAL MANAGEMENT PLAN

APPENDIX C

# CONTENTS

# 1. INTRODUCTION

## 1.1 Executive Summary

Dabyne Planning Pty Ltd has been engaged by Perisher Blue Pty Ltd (Perisher Blue) the operator of Perisher Ski Resort to prepare a Site Environmental Management Plan (SEMP) to accompany a Statement of Environmental Effects for the replacement of the current Mount Perisher double chairlift and triple chairlift with a new detachable six seat chairlift plus associated works, within the Perisher Ski Resort.

## 1.2 SEMP Context

This SEMP is to be read in conjunction with:

- Statement of Environmental Effects prepared by Dabyne Planning, November 2019 (which this SEMP forms part of).
- Perisher Blue Ski Resort: Ski Slope Master Plan 2002 (PSSMP) which outlines best practice for development within the Resort.

The following construction practices identified in the PSSMP (Appendix A), are relevant to the proposal, as follows:

- Movement on Tracks (2.1)
- Movement off Tracks (2.2)
- Helicopter Movement (2.3)
- Planning and Design of erosion and sediment control works (4.1)
- Erosion control (4.2)
- Sediment control (4.3)
- Rock removal (5.1)
- Trench construction (5.2)
- Topsoil Management (5.3)
- Stockpile management (5.4)
- Disposal of surplus spoil and rock (5.5)
- Importing of Soil, Rock and Other Fill (5.6)
- Stabilisation of Steep Slopes (5.7)
- Fencing and Protection of sensitive areas (5.8)
- Protection of trees (5.9)
- Disposal of cut timber (5.10)
- Washing of construction equipment (5.11)
- Rehabilitation of well-drained areas (6.2)
- Rehabilitation of wet areas (6.3)
- Permanent road and vehicle tracks (7.2)

- Temporary access (7.3)
- Bridges (8.1)
- Culverts and pipes (8.3)

The guidelines for the above construction practices are to be followed except where there are any inconsistencies with the KNP Rehabilitation Guidelines, which in this case are to prevail.

## 1.3 SEMP Objectives

The objectives of this SEMP are to:

- ensure compliance with the requirements of all relevant environmental legislation;
- identify specific responsibilities for ensuring the safeguards are implemented;
- ensure that works are managed to reduce adverse impacts on the environment;
- ensure environmental safeguards are implemented correctly; and
- provide a basis for the auditing, monitoring and reporting of environmental performance.

# 2. ENVIRONMENTAL ACTIONS

## 2.1 Environmental Actions

The environmental actions required for the proposed works are listed in Table 1 below.

This table includes all the measures proposed to mitigate and manage impacts as outlined in Table 33 of the BDAR, provided in Appendix B.

This table also provides the timeframe and frequency for the actions and subsequent monitoring, as well as the designation of responsibilities.

This provides an all-inclusive checklist for the efficient use by Contractors and relevant staff.

**Table 1 Environmental Actions Checklist**

## Flora & Fauna

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **PRIOR TO CONSTRUCTION** | | |
| All site personnel shall observe the limits of the works area and be made aware of the importance of vegetation of significant value during the site induction. | Site Environmental Manager | Site Induction / Prior to Commencement / During Construction |
| Identify sensitive areas during site induction. | Site Environmental Manager | Site Induction / Prior to Commencement |
| Prior to construction the development site around the top station, bottom station and towers should be marked with exclusion tape to identify the limit of the development site and proposed works. | Site Environmental Manager | Prior to Commencement |
| Exclusion fencing should be erected around the Guthega Skink habitat surrounding the top station to ensure that it is not inadvertently disturbed during construction. | Site Environmental Manager | Prior to Commencement |
| **DURING CONSTRUCTION** | | |
| To reduce the risk of further spread of weeds; machinery and vehicles used on site are to be thoroughly washed before entering Kosciuszko National Park; and footwear and equipment are to be washed prior to being utilised to ensure they area free of weed seeds. | Site Supervisor/ Contractor | Prior to Park Entry |
| Accidental leakages and spillage of concrete, fuel or lubricant from machinery shall be dealt with by taking immediate measures to contain the spill. | Site Supervisor | During Construction |
| Structures should be placed at regular intervals in any trenches or pits that are left open overnight, to enable fauna to exit the trench/pit. Trenches/pits should be inspected in the morning and late afternoon and any animals that have fallen into the trenches/pits removed. Similarly, trenches/pits should be checked for animals immediately prior to back-filling. | Site Supervisor | Each Day |
| Immediately prior to any impacts on rocks, the affected rocks should be tapped or nudged with the excavator to encourage any fauna that may be sheltering beneath or within the rock to move away. | Site Supervisor | During Construction |

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **PRIOR TO CONSTRUCTION** | | |
| Restrict work to daylight hours. | Site Supervisor | During Construction |
| **POST CONSTRUCTION** | | |
| The site is to be progressively stabilised as works are completed. | Site Supervisor | Upon Completion |
| The condition of rehabilitated areas shall be monitored seasonally until permanent vegetation cover is achieved. | Site Environmental Manager | Following Summer |
| Follow up weed control (spot spraying) is to be carried out if deemed necessary. | Site Environmental Manager | Following Summer |
| Areas which have been disturbed are to be rehabilitated immediately following the completion of works. | Site Environmental Manager / Site Supervisor | Upon Completion |

## Erosion and Sedimentation

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **PRIOR TO CONSTRUCTION** | | |
| Where areas are to be disturbed, temporary sediment control structures are to be implemented. | Site Environmental Manager / Site Supervisor | Prior to Commencement |
| **DURING CONSTRUCTION** | | |
| Erosion and sedimentation controls shall be monitored on a daily basis or immediately following a rainfall event. | Site Environmental Manager | Following Rainfall/ Daily |
| Construction activities shall be programmed to minimise the area of disturbed ground that is exposed to erosion at any one time. | Site Supervisor | During Construction |
| **POST CONSTRUCTION** | | |
| All exposed soil areas shall be appropriately stabilised to prevent erosion. | Site Supervisor | During Construction / Prior to Rainfall |

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| All exposed soil areas shall be appropriately revegetated following stabilisation to prevent erosion. | Site Environmental Manager / Site Supervisor | Upon Completion |

## Water Quality

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |
| Spills of any liquids shall not be hosed or flushed away but swept or collected. | Site Supervisor | During Construction |
| Equipment shall be properly maintained to prevent water pollution. All plant and equipment should be inspected daily to avoid leakage of fuel, oil or hydraulic fluid. | Site Supervisor | During Construction |
| No maintenance other than emergency repairs shall be undertaken on site. | Site Supervisor | During Construction |
| Spill kits shall be readily accessible. | Site Supervisor | Prior to Commencement / During Construction |

## Site Working Area

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |
| Water tankers to minimise dust on access roads as required. | Site Supervisor | During Construction |
| Ensure that access to the site is restricted to authorised personnel only and site signage is maintained. | Site Supervisor | During Construction |
| Ensure site and associated plant and equipment is secured when site activities conclude at the end of the day. | Site Supervisor | End of Each Day |

## Air Quality

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |
| Materials transported in open trucks shall be covered to prevent generation of dust. | Site Supervisor | During Construction |
| The tailgates of all vehicles transporting material from the construction site shall be securely fixed prior to loading and immediately after unloading. | Site Supervisor | During Construction |
| Areas no longer required for construction activity shall be progressively stabilised as soon as practicable to assist in controlling dust. | Site Supervisor | Upon Completion |

## Fuel, Chemicals & Hazardous Material (Explosives)

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |
| All flammable and/or explosive materials shall be kept in an approved Workcover area. | Site Supervisor | During Construction |
| An appropriate spill kit is to be made available and used for emergency spills of fuel, oil or other chemicals. | Site Supervisor | Prior to Commencement |
| No fuel will be stored on site. | Site Supervisor | During Construction |
| Any contaminated material (empty drums, rag, contaminated soil etc) shall be removed immediately from the site and disposed of in accordance with the appropriate regulations. | Site Supervisor | End of Each Day |

## Waste Management

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |
| All litter generated on site is to be placed in small garbage bags. At the end of each day, these bags are to be disposed of in appropriate bins. | Site Supervisor | End of Each Day |

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| A daily inspection shall be carried out to ensure the worksite is left in a rubbish free state. | Site Supervisor | End of Each Day |
| All employees shall be informed of the need to maintain a clean worksite. | Site Supervisor | Prior to Commencement / During Construction |
| Any excess spoil is to be removed from the site and deposited at the Smiggin Holes stockpile site. | Site Supervisor | During Construction |
| All loads of rubbish removed shall be securely covered to ensure no spillage. | Site Supervisor | During Construction |
| To the furthest extent possible, efforts shall be made to reduce, reuse and recycle materials used onsite. | Site Supervisor | During Construction |
| **POST CONSTRUCTION** | | |
| The worksite shall be left in a tidy and rubbish free state upon completion of the Project. | Project Manager | Upon Completion |

## European and Aboriginal Heritage

| ACTION CHECKLIST | Who's Responsible | When to be undertaken |
|---|---|---|
| **PRIOR TO CONSTRUCTION** | | |
| All staff and contractors working on the site shall be advised of the need to notify their supervisor and cease work, if either indigenous or non-indigenous heritage items are encountered. | Project Manager | Prior to Commencement |
| **DURING CONSTRUCTION** | | |
| Any evidence of Aboriginal relics discovered during construction shall be reported to NPWS. Work in subject area to cease. | Project Manager | During Construction |

## Noise and Vibration

| ACTION CHECKLIST | WHO'S Responsible | When to be undertaken |
|---|---|---|
| **DURING CONSTRUCTION** | | |

| ACTION CHECKLIST | WHO'S Responsible | When to be undertaken |
|---|---|---|
| All equipment to be used shall be correctly maintained and in good working order. | Site Supervisor | Prior to Commencement |
| All construction activities shall be restricted to the timeframes as stipulated in the development consent issued by the Department of Planning, Industry & Environment. | Project Manager | During Construction |

## 2.2 Demolition

### 2.2.1 Removal of the Triple Chairlift

The removal of the triple chairlift will include removing the top and bottom stations, lift towers and haul rope.

The top and bottom stations can be directly removed from the upgraded access road and surrounding highly disturbed ski slope.

Towers that are not directly accessible from the upgraded access road or disturbed ski slope (i.e. Towers 4,6,7,8,13 & 14) will be removed by helicopter or by an excavator over snow at the end of the preceding winter.

The concrete footings supporting the lift towers will be removed where they protrude above the surface. Where these tower footings are not directly accessible by the upgraded access road or disturbed ski slope, this will be undertaken by hand (i.e. jackhammer). Otherwise the tower footings will be removed by excavator.

The excavations left from removing the footings will be backfilled with top soil and revegetated.

### 2.2.2 Removal of the Double Chairlift

The removal of the double chairlift will include removing the top station structure and bullwheel, the bottom station equipment, lift towers and haul rope.

As the lift towers can be removed in parts, they are proposed to be dissembled in pieces by hand. The lift towers not located within proximity to the access road and/or disturbed ski run will be removed by use of helicopter or be an excavator over snow at the end of the preceding winter.

## 2.3 Soil, Water & Construction Management

A comprehensive best practice manual for soil, water and construction management procedures in relation to all the components of snowmaking infrastructure are provided Appendix A of the PSSMP.

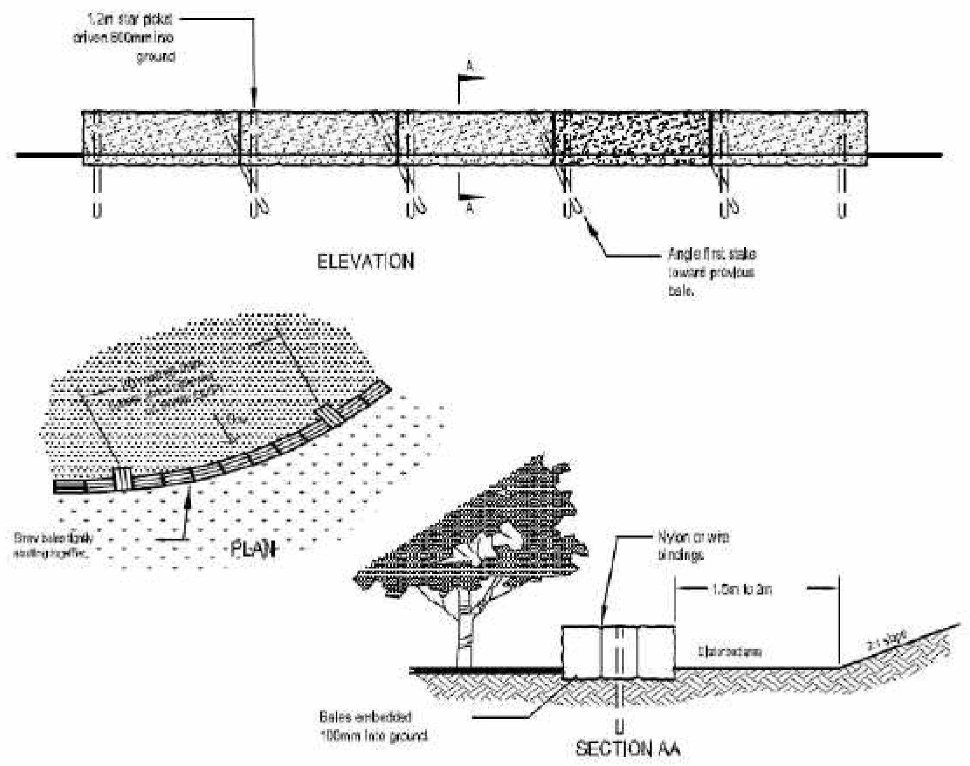
The construction methods prescribed in Appendix A of the PSSMP are to be read in conjunction with the above Environmental Actions Checklist.

For the purposes of clarity and consistency the specific controls required for the development are expanded and discussed below.

### 2.3.1 Erosion and Sedimentation Control

Appropriate environmental management controls may be required to manage soil and surface water during the construction of the development. Temporary controls will include either a straw bale filter, installed as illustrated Diagram A or a sediment fence in accordance with Diagram B below.

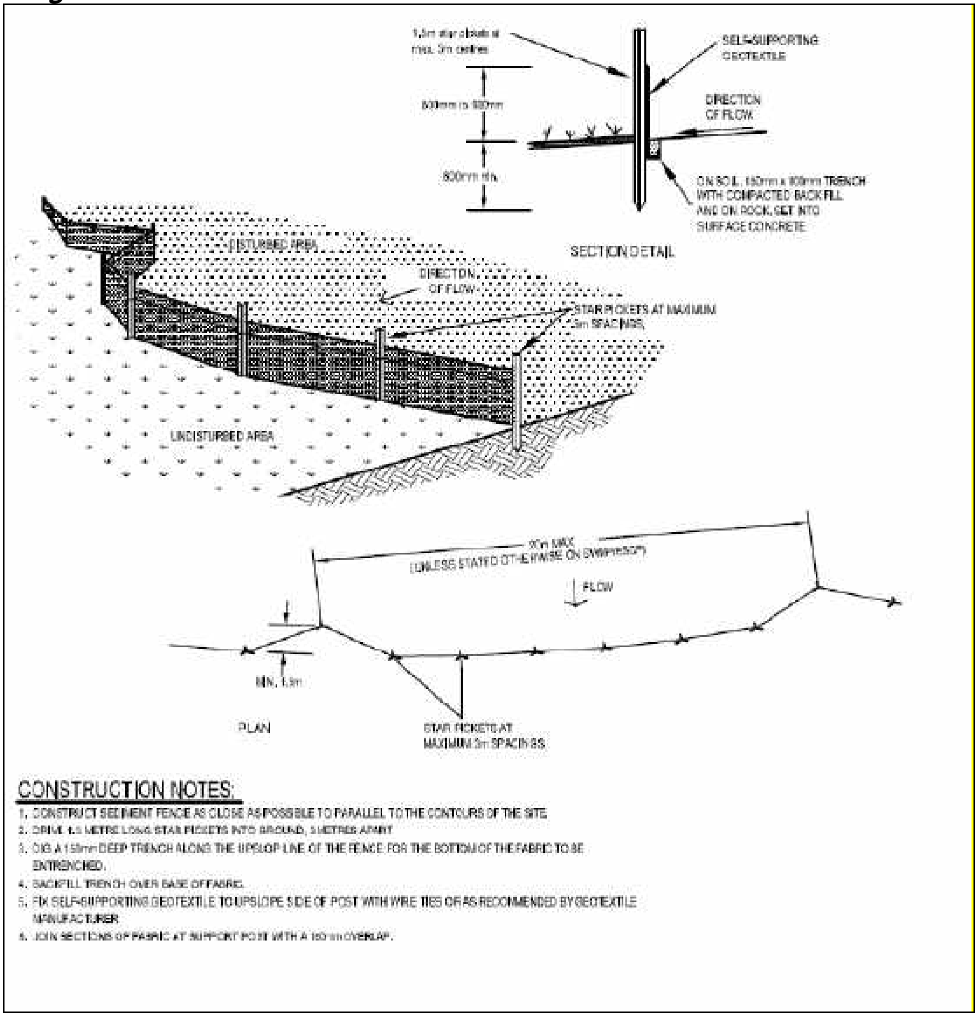
## *Diagram A: Standard Straw Bale Filter Installation*




Construction Notes

1. Construct straw bale filter as close as possible to parallel to the contours of the site or at the toe of a slope
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws to be placed parallel to ground.
3. Maximum height of filter is one bale.
4. On soft materials, embed each bale in the ground 75mm to 100mm and anchor with two 1.2m star pickets. Angle the first stake in each bale towards the previously laid bale. Drive stakes 600mm into the ground and flush with the top of the bales.
5. Where a straw bale filter is constructed downslope from a disturbed batter the bales should be located 1.5 to 2 metres downslope from the toe of the batter

***Diagram B: Standard Sediment Fence Installation***




Due to the size and scale of the project, it is not considered feasible or necessary to specifically locate these controls in plan form (eg by way of an Erosion and Sedimentation Control Management Plan). The controls are however to be installed in accordance with the following suite of criteria:

- Both straw bale and sediment control fencing should be installed on the low side of the work site;
- Both straw bale and sediment control fencing should be installed as close as possible to follow the existing contours of the site;
- A provision for the diversion of water, and stabilisation of channels, around the excavation site should be installed; and
- Areas where soil is to be stockpiled is to be surrounded by sediment control fencing and protected from runoff water.
- Stock piles to be a maximum of 2m in height with a maximum slope of 2:1.

The following additional criteria shall apply to each of the following components of the development:

**Top Station:**

Due to the top station site being relatively dry and level, a straw bale filter downslope of the works is to be installed in accordance with Diagram A above.

**Bottom Station:**

Due to the bottom station comprising both a relatively dry and level area, with wetter areas on its extremities, a combination of straw bay filters and sediment fences located around on the side and downslope of the development footprint is in accordance with Diagrams A & B above.

**Tower Footings:**

All the tower footings are located in relatively dry and level areas, a straw bale filter downslope of the works is to be installed in accordance with Diagram A above.

**Trenching:**

A combined use of straw bale filter fencing in drier areas and sediment fencing in wetter areas is to be used for trenching.

All excavated material is to be placed on the high side of the trench and in areas where native heath predominates; stockpiling should only occur where there are open areas rather than stockpiling continuously along the trench.

The fencing shall be placed at regular intervals across the contour of the slope and should be installed to protect any drainage lines or watercourses downslope.

**Construction Access:**

Areas along the lift corridor where construction access and trenching are proposed through native vegetation and in particular heath areas shall be trimmed (pruned) prior to access so the brushmat generated can be used to help stabilise the site once rehabilitated.

The nominated project Site Environmental Manager will be responsible for ensuring that all the erosion and sedimentation controls are installed in accordance with the above criteria and are regularly maintained and monitored.

**Perisher Creek Culvert:**

Prior to commencement of construction, a sediment barrier (straw bale filter or sediment fence) is to be installed to protect the creek and surrounding vegetation from sedimentation during construction.

At the intersection of the channel and the track, the sediment barrier would be a straw bale fence or similar that can easily removed in the event of a flood.

A sediment barrier is to be placed along the downstream side of the approach road. A barrier is also recommended to be installed between the culvert footings and the creek to prevent sediment entering the creek.

The barriers should be regularly inspected and maintained throughout the works period until the site is stablised. In the event of significant wet weather which may result in flooding the site, the sedimentation fence at the intersection of the existing access track and the downsteam creek channel should be removed and the site stablised.

Prior to the commencement of construction, a temporary water diversion pipe, of sufficient capacity to manage water flow at the time of contruction, would be installed to carry water through the construction site. The would be located in a position that would not impede machinary movements and would be moved as required.

Excavation works are to be limited to that which is necessary. Disturbance to the creek banks and bed between the culvert footings should be minimised.

Exacavations works should occur in dry ground above the water level in the creek crossing.

No materials, equipment or excavation spoil should be deposited on the native vegetation adjacent or in the creek.

Special care is required to control dust, concrete wash and spills from entering the Perisher Creek.

### 2.3.2 Construction Staging Area

The primary construction staging area has been identified at the Perisher car park.
Two secondary construction staging areas have been identified at the top and bottom stations of the proposed lift, with the bottom station predominantly used.

Both lifts will be removed from the site and temporarily stored in the Perisher car park before being relocated to the storage area at The Station at Jindabyne.

### 2.3.3 Tree Cutting Protocol

Where the identified trees are to be pruned or cut down to ground level (retaining the stump), the following measures are to be undertaken to reduce the potential impacts to tree dwelling fauna species:

- Pre-clearing check for tree-dwelling fauna, nests and hollows;
- Trees should be felled by a Perisher staff member using chainsaw;
- Trees should be felled in such a way as to avoid impacts on intact native vegetation;
- Trees with hollows should be felled so that the hollow is uppermost when the tree is lying on the ground;
- Cleared vegetation should not be pushed into surrounding vegetation but carefully placed amongst surrounding vegetation or in hollows where relevant.

### 2.3.4 Rock Reduction/Removal Works

The methodology has been revised over the last couple of projects whereby Perisher have found that some rocks are more easily removed in full, when they are not embedded. In this circumstance the impacts from removing a rock in full are reduced as no drilling or blasting is required and the rock can be more easily transported along the snow.

When this occurs, it is proposed to place the rock in a natural depression on the leeward side of other rocks or trees or remove the rock completely.

Where a hole is left as a result of removing the rock in full, Perisher proposes to either cart in fragmented rock (i.e. football size) from the Smiggins stockpile site or used rock fragments won from the project.

Otherwise, where a rock cannot be removed, Perisher will employ its long standing practice of utilising the snow to cover the rock blast as a mat, which both reduces and controls blast fragments. Rock fragments will be strategically placed in hollows on the leeward side of trees and rocks or utilised for a future fauna crossing.

During summer, Perisher staff will come back through the site and remove small excess fragments that were buried in the snow so as not to damage adjoining heath.

As a result, they end up providing additional faunal habitat and previous projects have demonstrated that the heath will quickly grow around the rock fragment areas.

The proposed rock removal/reduction works are scheduled to be undertaken in spring between mid to late September when the ski run can be closed whilst there is sufficient snow to provide access to the rocks and be utilised during blasting.

## 2.4 Toilet Facilities

Toilet facilities are currently provided at the South Perisher workshop, at the base of the Mount Perisher double chairlift.

## 2.5 Indigenous Heritage

Should any material suspected of being an Aboriginal object become unearthed in the course of works associated with the proposed works, all work at that location shall cease immediately as per Section 90 of the *National Parks and Wildlife Act 1974*, and the NPWS shall be contacted immediately to arrange for representatives to inspect the site.

# 4 Responsibility and Requirements

## 3.1 On-site Structure and Responsibility

**Table 2: Allocation and Responsibility**

| **Environmental Responsibilities** | | |
|---|---|---|
| **Title** | **Name and Contact No.** | **Responsibility** |
| Perisher Operations Director | Michael Fearnside – 6459 4408 / 0428 484 273 | Project Manager:<br>• Oversee the project and manage contractors.<br>• Liaise with Perisher staff and Contractors.<br>• Respond to complaints & inquiries of environmental matters.<br>• Liaise with DPIE and NPWS. |
| Mountain Manager, Perisher | Andrew Kennedy – 6459 4408 | Site Supervisor:<br>• Day to day supervision of the project.<br>• Ensure conditions of consent are complied with.<br>• Implementation and maintenance of environmental controls as detailed in the SEMP. |
| Environmental Manager, Perisher | Tanya Bishop – 6459 4504 / 0424 946 365 (or delegate) | Site Environmental Manager:<br>• Site induction.<br>• Oversee environmental management of the project.<br>• Audit implementation and maintenance of environmental controls as detailed in the SEMP.<br>• Manage rehabilitation and offsets program.<br>• Monitor the site. |

## 3.2 Legislative Requirements

The following legislation applies to the proposed development:

### 3.2.1 Relevant Legislation

**Environmental Planning Legislation**
*Environmental Planning and Assessment Act, 1979* (NSW)

**Conservation and Heritage Legislation**
*National Parks and Wildlife Act, 1974* (NSW)
*Biodiversity Conservation Act, 2016 (NSW)*
*Environment Protection and Biodiversity Conservation Act, 1999* (Cwlth)

**Pollution and Waste Management Legislation**

*Protection of the Environment Operations Act, 1997* (NSW)

# 4. Implementation

## 4.1 Emergency Response Contacts

The following key environmental emergency response contacts are provided as follows:

**Key Environmental Emergency Response Contacts**

| Organisation | Emergency Phone | Non Emergency Phone |
|---|---|---|
| NSW Police | 000 | Jindabyne: 6456 2244 |
| NSW Fire Brigade | 000 | Perisher: 6457 5037<br>Jindabyne: 6456 2476 |
| NSW Ambulance | 000 | Perisher: 131 233 |
| Medical Centres | Jindabyne: 6457 1221 | |
| National Parks and Wildlife Service (NPWS) | 1800 629 104 | Perisher: 6457 5214<br>Jindabyne 6450 5555 |
| RMS | Traffic incidents & road conditions: 131 700<br>Road closures and special events: 132 701 | |
| Environment Protection Authority Environment Line | 131 555 | |
| NRMA Road Service | Jindabyne: 6456 2170 | |

## 4.2 Environmental Training

All the contractors and staff involved with the works are to be made aware of the relevant requirements of this SEMP. Site induction is to be undertaken prior to the commencement of works by the nominated project environmental officer.

It is the responsibility of the nominated project environmental officer to ensure that all staff and subcontractors working on the site are provided with environmental training to achieve a level of awareness and competence appropriate to their assigned activities. Persons, including subcontractors' personnel, without appropriate environmental training should not be permitted to work on the site.

The nominated project environmental officer should establish and maintain a register of environmental training carried out including dates, names of persons trained and trainer details.

Site induction is to include:

a) Environmental awareness, the principal of due diligence, and other relevant codes of practice.

b) Specific environmental issues including:

- *This SEMP*
- *Relevant legislation (as identified in this Report)*
- *Emergency preparedness/procedures*
- *Incident reporting*
- *Community consultation*

- *Site environmental procedures*

## 4.3 Communication

### 4.3.1 Liaison with EPA

The Project Manager must notify the EPA Regional Manager of pollution incidents on or around the site (or the EPA Pollution Line on telephone 131 555 should the incident occur outside normal EPA business hours), which have occurred in the course of the activities (to comply with the PEOA), in the following circumstances:

- if the actual or potential harm to the health or safety of human beings or ecosystems is not trivial,
- if actual or potential loss or property damage (including clean-up costs) associated with a pollution incident exceeds $10,000.

The Project Manager should notify NPWS verbally within 2 hours and in writing within 24 hours of any pollution incidents that involve the EPA.

### 4.3.2 Complaints Register

Any complaints made by the community & other stakeholders shall be recorded on a complaints register managed by the Project Manager.

All complaints should be responded to within 24 hours of receipt.

## 4.4 Working Hours

As per the DPIE standard condition of consent, the proposed working hours for the project will be between 7am and 6pm on Mondays to Saturdays with no work be carried out on Sundays or public holidays.

Should these hours need to be varied, the Project Manager will request a variation from the DPIE in accordance with the conditions of consent.

## 4.5 Auditing

The Contractor and Site Supervisor in consultation with the Site Environmental Manager will undertake audits of the works to ensure the environmental safeguards and controls are being implemented effectively.

# APPENDIX D

## ABORIGINAL HERITAGE DUE DILLIGENCE ASSESSMENT

PastTraces Heritage Consultants

# Aboriginal Cultural Heritage Due Diligence Assessment

## Mt Perisher Chairlift Redevelopment Perisher Ski Resort

Report Prepared for Perisher Ski Resort

8 November 2019

www.pasttraces.com.au

email: office@pasttraces.com.au

NSW GOVERNMENT | Planning, Industry & Environment

*Issued under the Environmental Planning and Assessment Act 1979*

Approved Application No DA 10115

Granted on the 9 September 2021

Signed MB

Sheet No 3 of 63

# Document Control

| Revision | Date | Author | Reviewed |
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| D1 | 24/4/2019 | LOB | Ivan Pasalich |
| F1 | 6/5/2019 | LOB | |
| F2 | 8/11/2019 | LOB | |

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# Restricted Information

Information contained within this report is culturally sensitive and should not be made publically available. The information that is restricted includes (but is not limited to):

- Maps, Mapping Grid Reference Co-ordinates or images for Aboriginal heritage sites, places and objects.
- Location or detailed information regarding places of Aboriginal cultural significance, as expressed or directed by Representative Aboriginal Organisations, Aboriginal elders, or members of the wider Aboriginal community.
- Other culturally appropriate restricted information as advised by Aboriginal representatives and traditional knowledge holders.

Information in the report covered by the above categories should be redacted before being made available to the general public. This information should only be made available to those persons with a genuine and reasonable need for access.

# CONTENTS

# EXECUTIVE SUMMARY

This report provides Aboriginal heritage due diligence advice for the proposed replacement of the Mt Perisher double and triple chairlifts with a new detachable chairlift and associated upgrade works. The proposed alignment will generally follow the existing triple chair alignment with a chair shed integrated into the new bottom station. A new top station is proposed to be located above the current double chairlift top station to provide increased connectivity options.

The area of the proposed works has been highly impacted by the construction of the current chairlifts, associated infrastructure, access roads and ongoing use of the mountain. The study area is shown on Figure 1 in a regional context with details of the proposed works in Figure 2 and Appendix A.

This Due Diligence Aboriginal heritage assessment has been undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010a).

The proposal would involve the following impacts:

- Removal of existing chairlift and towers
- Construction of new towers and installation of chairlift
- Connection to infrastructure, such as electricity
- Relocation of infrastructure, such as snowmaking and Eyre T-bar top station bullwheel
- Upgrading of access roads
- Construction of skier bridges at bottom station
- Construction of new bottom and top stations
- Construction of a culvert over Perisher Creek in existing roadway.
- Inclusion of an additional tower, adjoining previous Tower 9, making it a combined tower 9 & 10
- Extension of the chair shed 5m up-hill into the disturbed slope
- Removal of existing underground fuel tank at the base of the current triple chair bottom station.

No Aboriginal heritage sites or areas of Potential Archaeological Deposit (PAD) were identified within the project area based on a review of previous reports and field survey of the project area.

Field survey was undertaken across the project area in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b). The field survey covered areas of access road, building envelopes (top and bottom stations), tower footings and skier bridges. Ground visibility was moderate to low at the time of field survey, with no heritage sites being identified. Based on degree of slope and prior levels of disturbance no areas of high or moderate potential for unrecorded sites were identified within the project area.

As a result of the field survey and background research completed for the project, the following recommendations have been developed:

- The development proposal should be able to proceed with no additional archaeological investigations. No areas of potential archaeological deposits or heritage sites have been identified within the development area and the potential for Aboriginal heritage objects within the development area has been assessed as low.
- All Aboriginal objects are protected under the *NSW National Parks and Wildlife Act 1974*. It is an offence to disturb an Aboriginal site without a consent permit issued by the NSW Department of Planning, Industry and Environment (DPIE). Should any Aboriginal objects be encountered during works then works must cease and the find should not be moved until assessed by a qualified archaeologist.
- In the unlikely event that human remains are discovered during the construction, all work must cease. DPIE, the local police and the appropriate LALC should be notified. Further assessment would be required to determine if the remains are Aboriginal or non-Aboriginal.
- Further archaeological assessment would be required if the proposal activity extends beyond the area of the current investigation.

# 1 INTRODUCTION

This report provides Aboriginal heritage due diligence advice for the proposed replacement of the Mt Perisher double and triple chairlifts with a new detachable chairlift and associated upgrade works. The proposed alignment will generally follow the existing triple chair alignment with a chair shed integrated into the new bottom station. A new top station is proposed to be located above the current double chairlift top station to provide increased connectivity options.

The area of the proposed works has been highly impacted by the construction of the current chairlifts, associated infrastructure, access roads and ongoing use of the mountain. The study area is shown on Figure 1 in a regional context with an overview of the proposed works in Figure 2. Detailed plans for the project are attached at Appendix A.

This Due Diligence Aboriginal heritage assessment has been undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010a).

The proposal would involve the following impacts:

- Removal of existing chairlift and towers
- Construction of new towers and installation of chairlift
- Connection to infrastructure, such as electricity
- Relocation of infrastructure, such as snowmaking and Eyre T-bar top station bullwheel
- Upgrading of access roads
- Construction of skier bridges at bottom station
- Construction of new bottom and top stations
- Construction of a culvert over Perisher Creek in existing roadway.
- Inclusion of an additional tower, adjoining previous Tower 9, making it a combined tower 9 & 10
- Extension of the chair shed 5m up-hill into the disturbed slope
- Removal of existing underground fuel tank at the base of the current triple chair bottom station.

These works are high impact and would have a negative impact on any Aboriginal heritage located within the project boundary. Aboriginal heritage sites may be located on the surface or subsurface in areas of high potential for the preservation of archaeological remains of past usage by Aboriginal groups.

To assess the potential impacts of the proposed works on Aboriginal heritage this Due Diligence Heritage Assessment has been undertaken.

This report, field survey and associated research has been conducted in accordance to the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010a).

## 1.1 PROJECT OBJECTIVES

The due diligence assessment is being undertaken to complete the following objectives:

1. Review of the NSW Department of Planning, Industry and Environment (DPIE), Aboriginal Heritage Information Management System (AHIMS), to identify any recorded heritage sites within the project area.
2. Review of previous reports in area to develop predictive model of site location
3. Assess landforms present in project area against predictive model to determine potential for heritage sties and determine level of disturbance
4. Complete site visit to visually inspect impact areas or areas assessed as holding potential based on predictive model. The site visit will also document levels of disturbance within project area.
5. Complete due diligence report with management recommendations to avoid or minimise impacts within the project area.

## 1.2 ABORIGINAL CONSULTATION

Consultation with the Aboriginal community is not a requirement of the Due Diligence Code and this Due Diligence assessment has been undertaken without consultation with the local Aboriginal community or the Local Aboriginal Land Council (LALC). If impacts to Aboriginal heritage are found to occur as a result of the development then consultation will be undertaken with the LALC and the wider Aboriginal community as required by NSW Dept of Planning, Industry and Environment (DECCW 2010c).

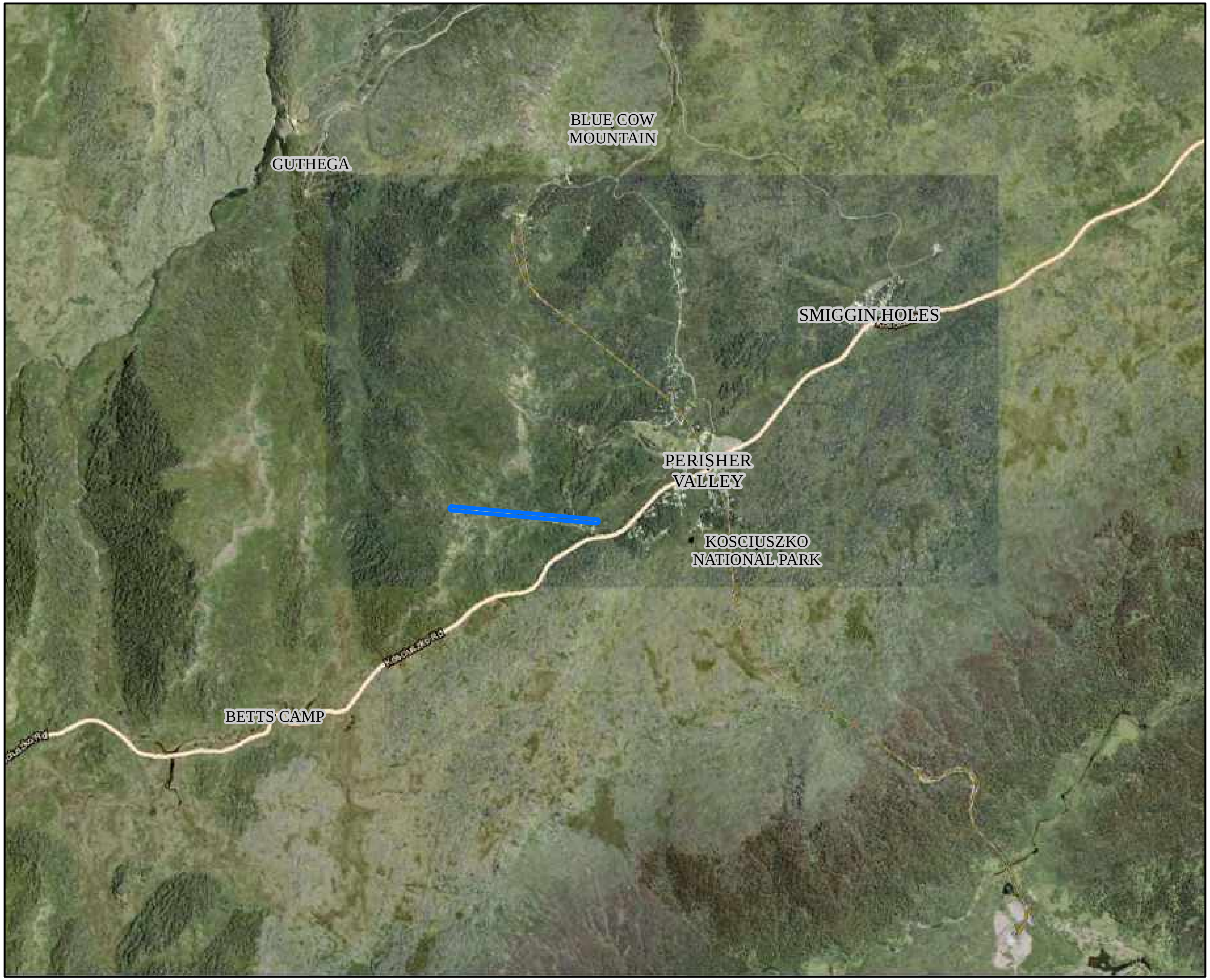


**Figure 1: Regional Context**

**Legend**

Study Area

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1:50,000

0 0.5 1 2

Kilometers

Coordinate System: GDA 1994 MGA Zone 55

Imagery: © Nearmap

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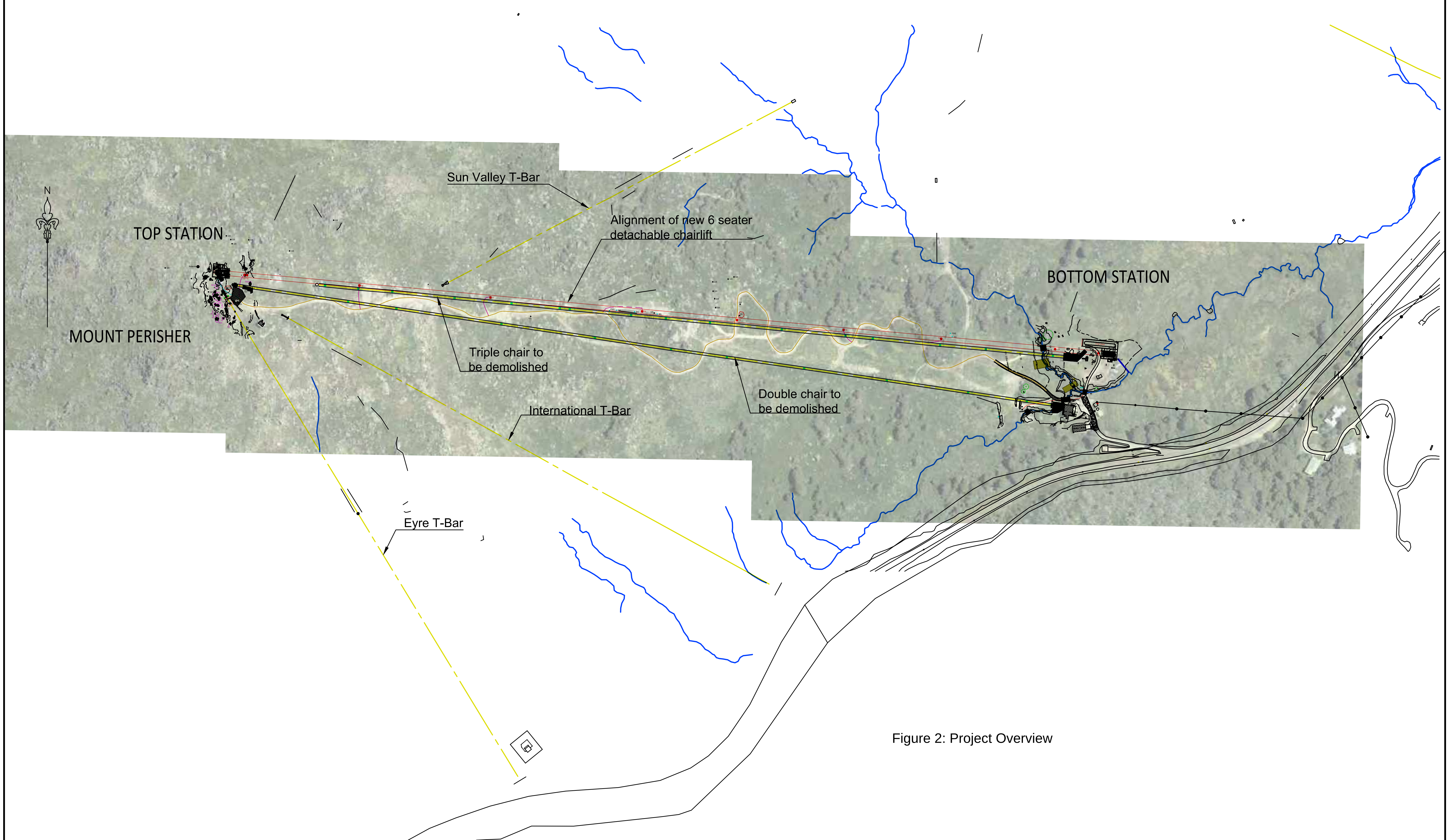



Figure 2: Project Overview


CLM CiViL

CLM CiViL Engineering
40 Zanthus Drive
BROULEE NSW 2537
PH: 0427 886 623

dabyneplanning

perisher


| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Location Plan | T-106 | 1 of 11 |

# 2 DESKTOP ASSESSMENT RESULTS

## 2.1 AHIMS SEARCH

A search of the DPIE AHIMS database was undertaken on the 9th April 2019 covering the 1km surrounding area centred on the project area. The extensive search revealed no previously recorded heritage sites within the project area with 12 sites within the wider search area. Five areas of Potential Archaeological Deposit (PAD) have been recorded within the extended search area, but none within the project area.

The sites located in the wider search area (PADS) conform to the wider site predictive model for the Perisher Ranges developed by Navin Officer Heritage Consultants (NOHC) in 2000. This model predicts a site location model of small sites located on level or low gradient slopes in sheltered positions in well drained contexts. Sites are usually in scattered woodland environments rather than heath vegetation. This predictive model is discussed in more detail in Section 2.4. The location of previously recorded sites and areas of PAD are provided in Table 1 and shown on Figure 3 in relation to the project area.

Table 1. AHIMS Site Details

| Site ID | Site name | Datum | Zone | Easting | Northing | Site features | Report |
|---|---|---|---|---|---|---|---|
| 61-3-0112 | Perisher View PAD 1 | GDA | 55 | 626687 | 5969952 | PAD | NSW Archaeology 2005 |
| 61-3-0008 | Perisher Gap; | AGD | 55 | 624800 | 5968700 | Artefact : - | Jo Flood 1971 |
| 61-3-0101 | Perisher Blue 4 | AGD | 55 | 625140 | 5970350 | Artefact : 10 | NOHC 2000 |
| 61-3-0100 | Perisher Blue 3 | AGD | 55 | 625300 | 5970320 | Artefact : 3 | NOHC 2000 |
| 62-1-0227 | Perisher Blue 2 | AGD | 55 | 625490 | 5970110 | Artefact : 12 | NOHC 2000 |
| 61-3-0098 | PRTL10 Perisher South, Rock Creek | AGD | 55 | 626296 | 5969463 | PAD | NOHC 2000 |
| 61-3-0113 | Porcupine Walking Track | AGD | 55 | 626330 | 5969150 | Artefact : - | Mr.Edward Clarke |
| 61-3-0099 | PRTL11 Perisher South | AGD | 55 | 626444 | 5969537 | PAD | NOHC 2000 |
| 61-3-0094 | PRTL3 Mount Pier South Spurline | AGD | 55 | 626574 | 5970444 | PAD | NOHC 2000 |
| 61-3-0074 | The Perisher Range Test Location No.3 | AGD | 55 | 626700 | 5970500 | Artefact : 6 | NOHC 2000 |
| 61-3-0107 | PRTL3 | AGD | 55 | 626750 | 5970600 | Artefact : 11 | Southern Cross Heritage 2003 |

| Site ID | Site name | Datum | Zone | Easting | Northing | Site features | Report |
|---|---|---|---|---|---|---|---|
| 61-3-0093 | PRTL2 Pipers Gap Slope | AGD | 55 | 626926 | 5970796 | PAD | NOHC 2000 |

## 2.2 ABORIGINAL GROUPS WITHIN THE PROJECT AREAS

Three main Aboriginal language groups have been recorded within the Snowy Mountain ranges consisting of the Wolgal, Djilamatung and Ngarigo (Tindale 1974). Ethno historical records from the 19th century record these groups as having close social and cultural links and annual inter-tribal gatherings within the Highlands (Howitt 1904:512, 565). Groups from further afield and from the western areas also participated in some of these ceremonies (Flood 1980:72) including the annual Bogong Moth gatherings which focused on the high peaks and were accessed along broad ridgelines and spurlines.

## 2.3 PREVIOUS HERITAGE STUDIES

A number of heritage assessments have been undertaken for the Perisher Snowfields and Range. These studies have been commissioned due to the infrastructure required for the Perisher Snowfields and the surrounding villages. The studies most relevant for the current project are briefly summarised below to provide a context for the site predictive model and landform assessment for the project.

Jo Flood (1971, 1980) undertook for her PhD thesis the most comprehensive study of the NSW Alpine areas. Flood concentrated on the annual Bogong Moth gatherings, when Aboriginal people visited the peaks in numbers. She identified a number of small artefact scatters within the Perisher Valley which she interpreted as a trail of sites leading from Jindabyne to the Rams head range (198:192). Flood concluded that Aboriginal people only inhabited the upper Alps during the summer months with larger sites at lower elevations such as the Snowy River Valley (1980:194).

Flood developed the following site locational model:

- Sites were located within one kilometre and most within 100m of a water source
- Sites will be located on well drained ground with generally easterly or northerly aspects for shelter
- Sites must be close to food resources, which was probably a major factor in campsite selection (1980:158)

Gerring (1982) completed surveys for the Skitube development along the banks of Perisher Creek and the Mt Piper spurline. No sites were identified though thick vegetation and low visibility were noted. The area was considered to hold low potential for unrecorded sites.

Following from this, Paton and Hughes (1984) completed a survey of areas classified as holding potential based on predictive modelling (following Flood ) that were to be disturbed by the development of the Mt Blue Cow Resort. The areas considered to hold potential were in high altitude locations, around granodiorite tors and possible Bogong Moth sites. No sites were found but low visibility was noted.

NOHC (1989) surveyed the ski slope development on the southern spurline of Mount Perisher. Low visibility with the heath vegetation was noted and no sites or areas of potential were located.

Kinhill (1997) completed a report for the Perisher Village Master Plan, which surveyed a wide range of landforms within a large area of 622ha. Only a small proportion of this area was ground truthed by foot survey. Low visibility was again noted and no sites or areas of potential were recorded.

Grinsbergs (1997) undertook a survey for the Perisher Valley Sewerage Treatment Plant augmentation works. No sites were located and it was considered that due to high levels of previous disturbance no areas of potential were present within the project area.

NOHC 2000 were engaged to develop a model of Aboriginal site location for the Perisher Ranges for the NSW National Parks and Wildlife Service. NOHC focuses on development of a predictive model based on the results from a program of subsurface testing across different landform variables. NOHC found that most sites were low density, that they were present in scattered woodland contexts in sheltered positions from prevailing winds, on relatively level ground and in well drained contexts. Quartz was the predominant material for stone artefacts.

Southern Cross Heritage Surveys (2003) completed an assessment for the Ski School and Workshop area at Perisher Blue following surface surveys in 2002. No surface sites were identified but an area of potential was investigated with subsurface testing along the crest line. The spurline of Mt Piper was classified as holding high potential. Barber concluded that the testing confirmed the model developed by NOHC in 2000 for the Perisher region.

NSW Archaeology (2005) undertook an assessment of the Perisher View lodge relocation at Perisher Valley. The proposed site was located on a broad spurline within areas of high vegetation coverage affording nil visibility for surface survey which identified no sites. The spurline is a landform which according to NOHC 2000 holds moderate potential. NSW Archaeology followed this model and recommended a program of sub surface testing to determine presence of cultural deposits.

NOHC (2007) undertook an assessment of the installation of snow making facilities at Perisher Valley. Stage 3 of this assessment covered the current study area and resulted in the installation of the current snowmaking facilities throughout the project area. This 2007 study completed desktop review, predictive modelling (based on NOHC 2000) and field survey. The assessment found that the area of Mt Perisher was low in potential and severe past impacts had occurred throughout the project area.

These previous assessments for the region have returned consistent results and confirmed the importance of level or low gradient slopes, spur lines and ridge crests for site location. The sites located in these areas contain low density sites, as opposed to low elevation valley locations that hold higher density sites. As a result areas of saddles, level spurline crests or sheltered ridgelines are considered to hold moderate potential (dependant of degree of disturbance) but sites should be small and consist of common materials.

## 2.4 PREDICTIVE MODEL

NOHC (2000: 4) concluded the following in regards to impacts of potential developments:

- Developments within treeless valley floor and basal slope contexts (cold air drainage areas) are unlikely to impact Aboriginal archaeological sites.
- Development within poorly drained and/or moderate to steeply graded slopes is unlikely to impact Aboriginal archaeological sites.
- Development within closed heath vegetation communities are unlikely to impact on Aboriginal archaeological sites

- Disturbance to locally sheltered, relatively level and well drained ground, within elevated grasslands or grassy woodland is likely to impact Aboriginal archaeological sites.

The predictive model that they developed can be summarised as follows:

- Sites will be low density and dispersed
- Sites will be located within areas of scattered woodland rather than heath vegetation
- Sites will be located outside of areas of cold air drainage, avoiding treeless contexts
- Sites will be located in sheltered positions from prevailing cold westerly winds and cold air drainage
- Sites will be located on level or low gradient slopes in well drained contexts.

The following predictive model has been developed for the project area (Table 2). The project area is limited in size and confined to pre-existing areas of disturbance resulting from the past construction, installation, maintenance and ongoing use of the current double and triple chairlifts.

This site prediction model is based on:

- Gradient of slope
- Known site distribution in relation to landscape features within the project area
- Consideration of site type and densities likely to be present within the project area
- Potential Aboriginal use of natural resources present or once present within the project area
- Degree of previous disturbance of the landscape

**Table 2 Site Prediction Model**

| Probability | Site Type | Definition | Landform |
|---|---|---|---|
| **Low** | Isolated finds and surface scatters of stone artefacts | Stone artefacts ranging from single artefact to high numbers | Creek lines and spur crests. Features are present within the study area, but with high disturbance |
| **Low** | Potential Archaeological Deposits (PADS) | Area considered on landform to hold higher potential for unidentified subsurface deposits | Located on low gradient or level slopes in sheltered positions |
| **Low** | Culturally Modified Trees (CMTs) | Trees which have been modified by scarring, marking or branch twining | Wherever old remnant trees remain |
| **Nil** | Rock Engravings | Images engraved on flat rock surfaces | Escarpments, rock platforms or rock shelters |

| Probability | Site Type | Definition | Landform |
|---|---|---|---|
| **Nil** | Stone arrangements | Arrangements of stones by human intention, including circles lines or patterns. | Crest lines or large ceremonial areas on creekflats, but may occur on any landform |
| **Nil** | Stone quarries/Ochre sources | Quarry sites where resources have been mined. | Any landform. |
| **Nil** | Axe grinding grooves | Grooves in stone caused by the grinding of stone axes | Usually in creek lines, as water is used as abrasive with sand |
| **Nil** | Burials | Burials of Aboriginal persons | Usually requiring deep sandy soils on eastern facing slopes |
| **Nil** | Aboriginal places | A place that hold spiritual, traditional or historical significance to Aboriginal people | Any landform, identified through consultation with RAPs and historical sources |

## 2.5 LANDFORM AND DISTURBANCE LEVEL ASSESSMENT

The following assessment of the heritage potential and previous disturbance of the project area has been undertaken by review of topographic maps and aerial photographs.

Mount Perisher forms the highest summit at 2050m. The slopes are moderate to high gradient with small areas of lower slope gradient, to which the current infrastructure impacts have been focused with footings for current chair lifts, snow making towers and buildings at top and bottom stations. Apart from these areas where impacts are classified as high, the entire slope has been trenched with snowmaking infrastructure and power lines. An access road winds up the slope from the base to the current top station. This road has also abraded and has suffered erosion with soil and sediment displacement across level areas and on turns.

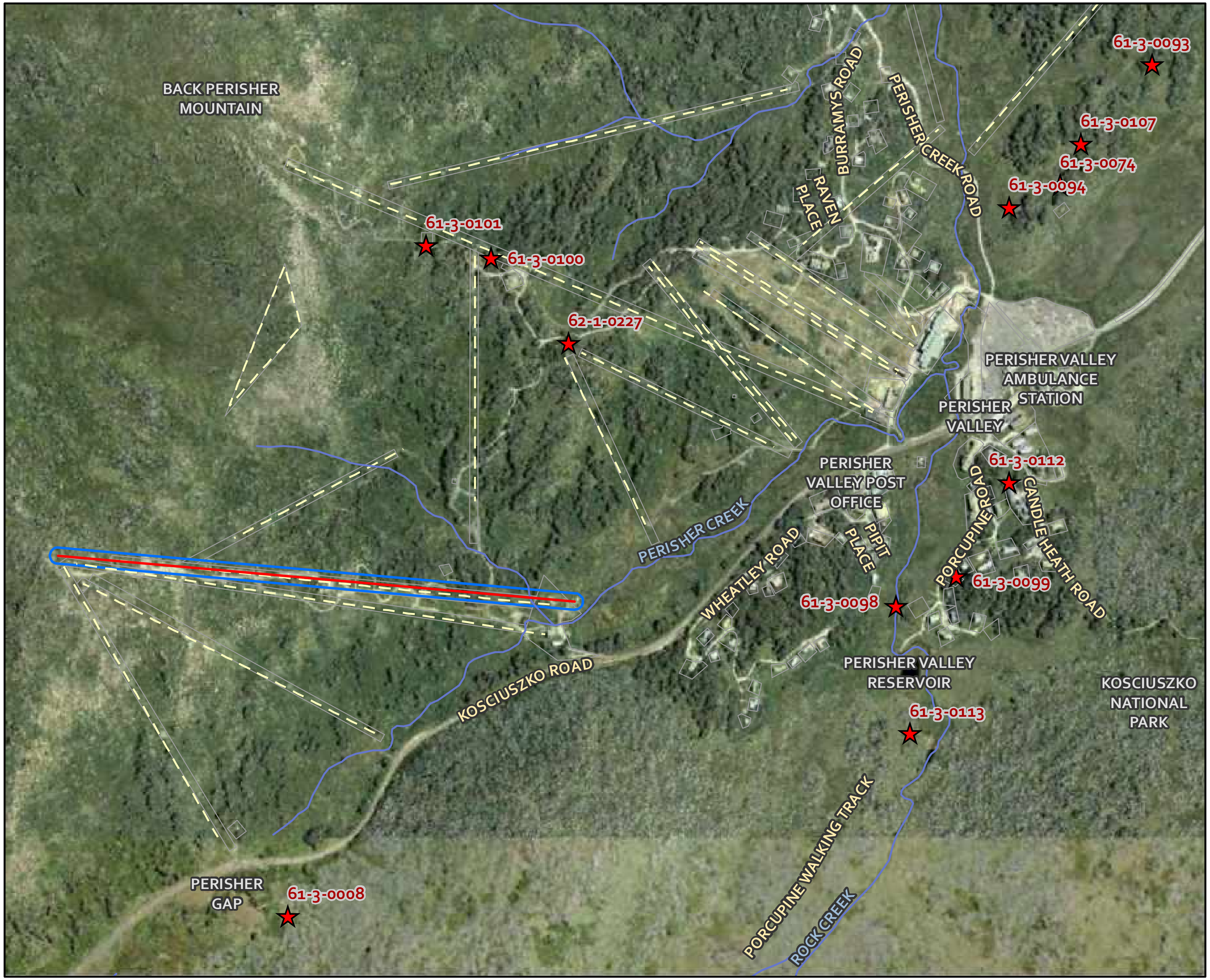
The current vegetation of the project area is dominated by heath and grassy understorey. Remnant or clusters of snow gum woodland are present in one or two locations within the project area. The bottom station location appears to consist of a treeless frost hollow dominated by heathland with grasses.

A comparison of the project area against the results of previous assessments and the predictive model do not show areas of moderate or high potential as present due to the following factors:

- The bottom station locations are placed within a treeless frost hollow environment
- The top station location is amongst moderate gradient slopes. The small areas of low grade to level areas appear to have been highly impacted by placement of current infrastructure.
- The proposed new chairlift tower footings are placed within the impacted area of the current chairlift and are mainly located on areas of moderate to high gradient

- The area is dominated by heath communities, not conducive to Aboriginal site location
- The area is distant to any water sources and not in proximity to any known resources.
- The area has been highly impacted by road, power lines, current infrastructure and buildings.

As a result of the desktop assessment no areas of potential have been identified within the project area. An aim of the field survey will be to determine the validity of this findings. The field survey will be undertaken to assess the extent of the previous disturbance and degree of slope present throughout the project area in order to confirm the assessment of disturbance and low potential.




# Figure 3: AHIMS

**Legend**

- AHIMS Sites
- Proposed Chairlift
- Watercourse
- Existing Chairlift
- Study Area
- Cadastre

N

1:14,000

0 175 350 700

Meters

Coordinate System: GDA 1994 MGA Zone 55

Imagery: © Nearmap

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# 3 FIELD SURVEY RESULTS

A site visit and field survey of the project area was undertaken on the 8th April 2019 to verify the findings of the desktop review of landforms and disturbance. The aim of the investigation was to identify heritage objects or places of potential archaeological Deposit (PAD). Based upon the background research, known Aboriginal site patterning, and current aerial photography, the entire area of the project area was inspected.

All surveyed areas and items of interest were recorded on a topographic map of the study area (using a GPS and GDA 94 coordinates), along with levels of visibility, erosion, soil conditions, and evidence of land disturbance.

Ground surface visibility (GSV) is the percentage of ground surface that is visible during the field inspection. GSV increases in areas of exposures such as stock impact trails, roads, gates and along areas of erosion such as creek banks and dam walls. As a result surveys undertaken in areas with high exposure rates result in a more effective survey coverage.

The site visit resulted in the following findings.

## 3.1 GROUND SURFACE VISIBILITY

Ground surface visibility (GSV) is the percentage of ground surface that is visible during the field inspection. GSV increases in areas of exposures such as vehicle impact trails, roads, buildings, previous impacts and areas of erosion or vegetation clearance. As a result surveys undertaken in areas with high exposure rates result in a more effective survey coverage.

GSV over most of the study area was low due to heath/grass coverage across the slopes and basal valley contexts. Bare earth was visible only in exposures along the vehicle trail and areas of erosion. Across the project area the average GSV was estimated at 20%. Exposures were common at moderate frequency within the low gradient areas at bottom and top stations near the buildings and chairlifts with their large areas of disturbance.

Soils appeared thin with areas of bedrock and surface outcrops. The conditions at the time of the field survey are shown in plates 1 to 6.

**Plate 1: current infrastructure top location**

**Plate 2. Looking along alignment**

Plate 3: Footing location in areas of lower gradient, note thinness of soils

Plate 4: Footing location, rock outcrops present on mid slopes

Plate 5: Bottom location showing slope of alignment

Plate 6: valley context at bottom station showing previous impacts

## 3.2 DISTURBANCE

The degree of disturbance across the study area was high in the top and bottom station locations where previous infrastructure and buildings had been constructed. The landforms in these locations had also been disturbed with soil displacements from the time of construction evident. Disturbance across the remainder of the project area is moderate, present in the form of prior vegetation and tree removal, vehicle access road, infrastructure construction and power line trenching.

## 3.3 RESULTS – FIELD SURVEY

### 3.3.1 Aboriginal Heritage Sites

No areas of Aboriginal heritage were identified during the field survey despite moderate rate of exposures. No known heritage sites will be affected by the proposed development.

### 3.3.2 Results - Areas of Potential Archaeological Deposit (PAD)

Areas of PAD are defined as landforms that hold higher potential than their surrounds to contain subsurface deposits of past Aboriginal occupation. Based on a review of previous studies completed for the region, none of the landforms within the project area have been assessed as holding high potential for subsurface deposits and in addition impacts have been high to moderate over the majority of the project area. As a result, no areas of PAD have been identified within the project area.

Small areas of landforms (level saddles) holding moderate potential were present along the alignment. These areas however had suffered previous disturbance or were the locations for boggy water prone areas. As a result, none are considered to represent areas of PAD.

### 3.3.3 Summary

As a result of the site visit, field survey of alignments and background research, it is considered that the project has low potential to impact on unrecorded Aboriginal heritage sites or areas of PAD. No Aboriginal heritage sites or areas of PAD were recorded or identified as a result of the assessment and no areas of high or moderate sensitivity are present in the development area based on previous research and modelling.

# 4 IMPACT ASSESSMENT

The proposed chairlift alignment will generally follow the existing triple chair alignment with a chair shed integrated into the new bottom station. A new top station is proposed to be located above the current double chairlift top station to provide increased connectivity options.

The area of the proposed works has been highly impacted by the construction of the current chairlifts, associated infrastructure, access roads and ongoing use of the mountain.

The proposal would involve the following impacts:

- Removal of existing chairlift and towers
- Construction of new towers and installation of chairlift
- Connection to infrastructure, such as electricity
- Relocation of infrastructure, such as snowmaking and Eyre T-bar top station bullwheel
- Upgrading of access roads
- Construction of skier bridges at bottom station
- Construction of new bottom and top stations
- Construction of a culvert over Perisher Creek in existing roadway.
- Inclusion of an additional tower, adjoining previous Tower 9, making it a combined tower 9 & 10
- Extension of the chair shed 5m up-hill into the disturbed slope
- Removal of existing underground fuel tank at the base of the current triple chair bottom station.

These areas of impact have been assessed and a field survey undertaken. No heritage sites were identified. The moderate to steep gradients along most of the route are considered to hold low potential for unrecorded heritage sites or subsurface deposits.

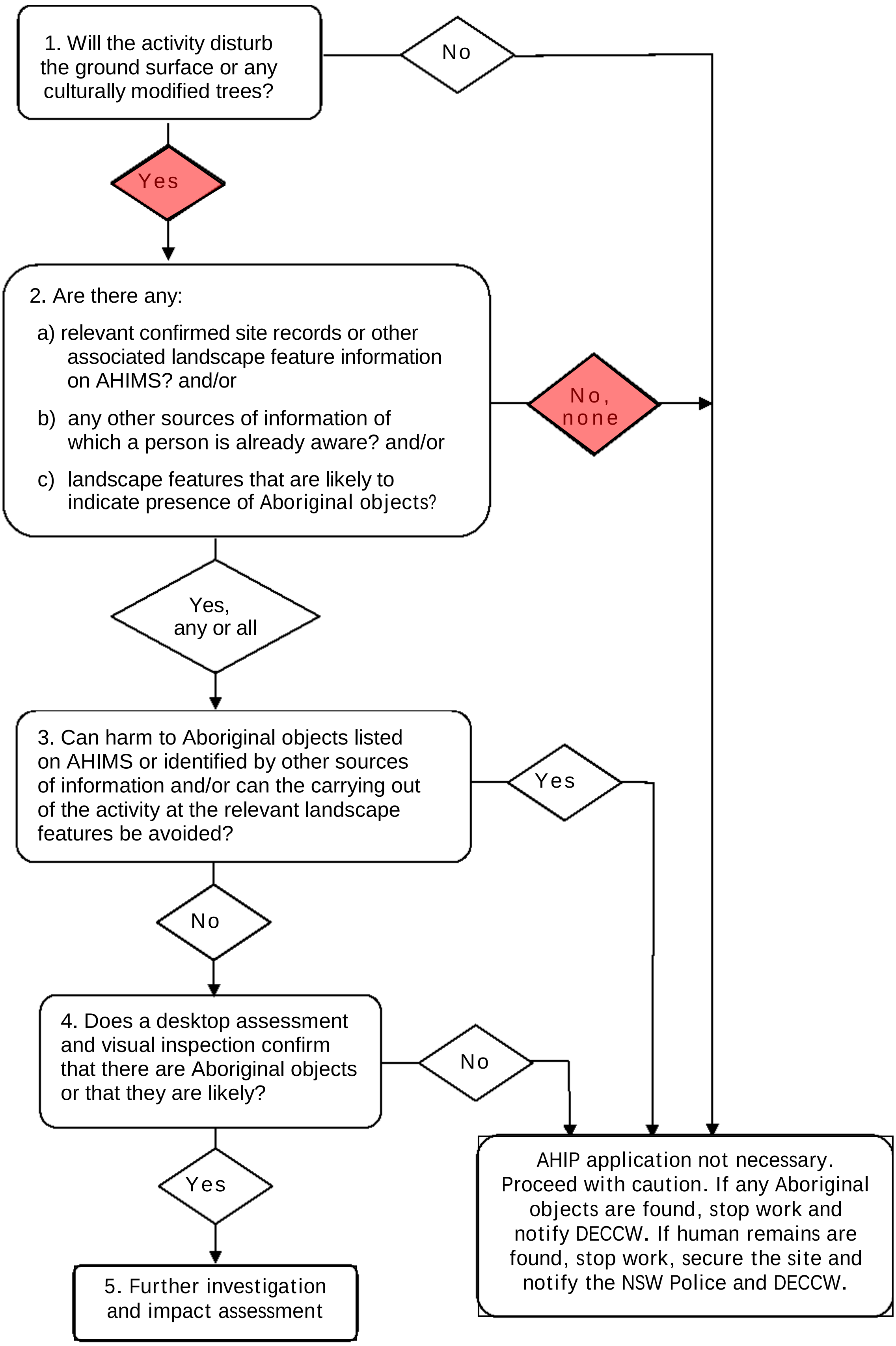
Within areas of lower gradient that might have held potential, the project area has a high to moderate degree of disturbance and soils appear to be thin with rock outcrops. These areas appear to be exposed to winds and to contain an original heath environment.

Based on the assessment the impacts from the project are as follows:

- No known Aboriginal objects or places will be impacted by the proposed works.
- No known Aboriginal objects or places are present in the project area.
- No areas of high potential to contain unrecorded Aboriginal objects of places are present in the project area.

The Code provides a flowchart of six questions to identify the presence of and potential harm to Aboriginal heritage. These questions and their applicability to the project are shown in Figure 4. The responses to these questions determine if further heritage investigations are required.

Figure 4. Due Diligence Flow Diagram



## 4.1 RECOMMENDATIONS

Based on this due diligence assessment the following actions are recommended for the project.

**Recommendation 1: Works to proceed without further heritage assessment with caution.**

The proposed works can proceed without further assessment as no Aboriginal heritage sites (objects or places) are present within the project area. The potential of impacting unrecorded sites within these areas during the proposed works is assessed as extremely low, based on landform analysis and field survey.

**Recommendation 2: Discovery of Unanticipated Aboriginal cultural material.**

All Aboriginal places and objects are protected under the *NPW Act 1977*. This protection extends to Aboriginal material that has not been previously identified, but might be unearthed during construction activities. In the event that Aboriginal material is discovered during construction the following steps should be undertaken:

- Works must cease in the vicinity of the find and a fenced buffer zone of 10m around the find be erected.
- The office of DPIE must be notified of the find.
- A qualified heritage consultant should be engaged to assess and record the find in accordance with the legislative requirements and DPIE guidelines. If the find is Aboriginal in nature, consult with DPIE in regards to appropriate steps and management. This would usually involve consultation with the Aboriginal community and may require application for an Aboriginal Heritage Impact Permit.

**Recommendation 3: Discovery of Human Remains**

In the unlikely event that human remains are discovered during the construction, all work must cease. DPIE, the local police and the appropriate LALC should be notified. Further assessment would be required to determine if the remains are Aboriginal or non-Aboriginal.

**Recommendation 4: Alteration of impact footprint**

Further archaeological assessment would be required if the proposal activity extends beyond the area of the current investigation.

Implementation of the above management recommendations will result in low potential for the project to impact on Aboriginal heritage values or result in damage to heritage sites

# 5 REFERENCES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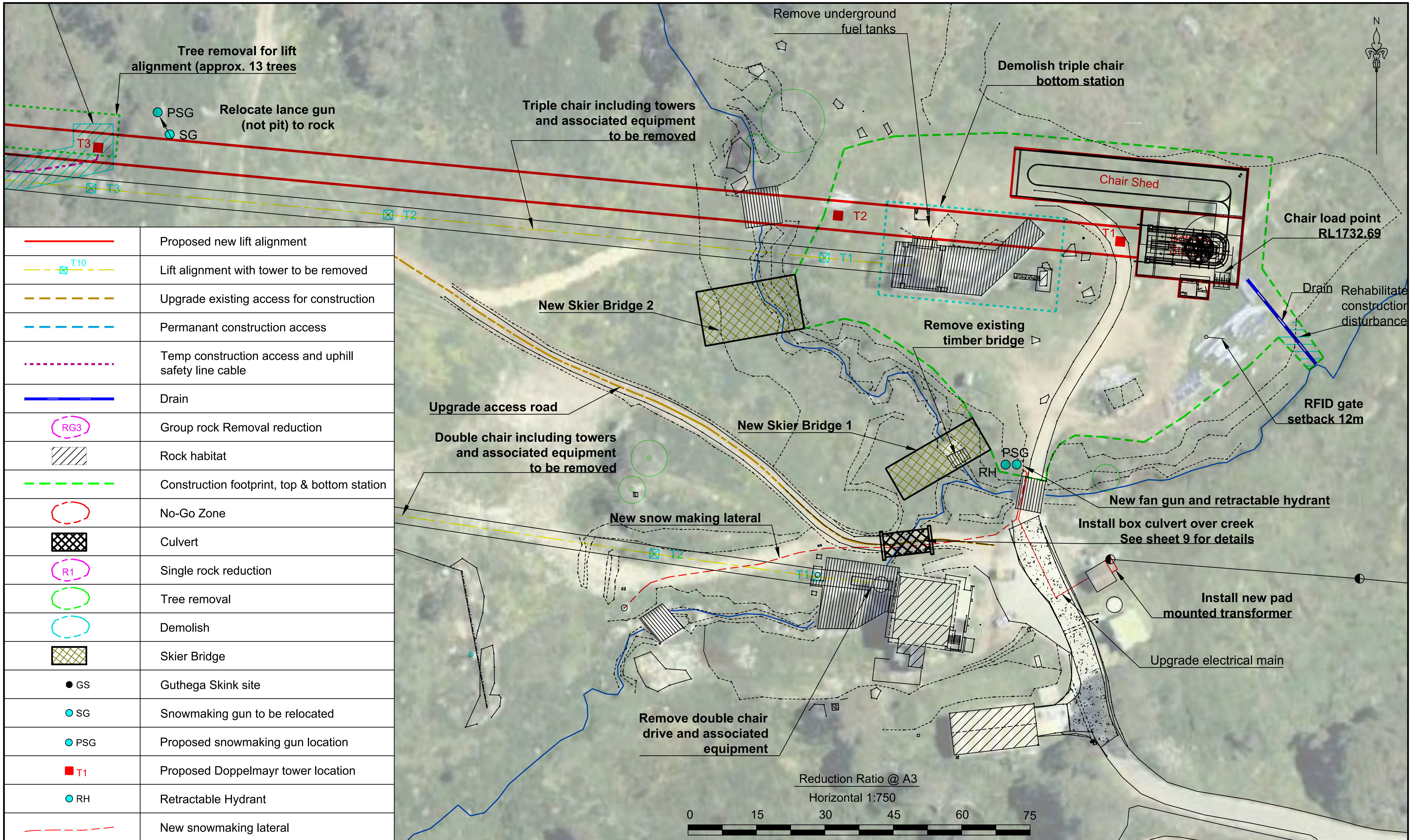
## *Appendix A. Detailed Design Plans*




| | |
|---|---|
| | Proposed new lift alignment |
| T10 | Lift alignment with tower to be removed |
| | Upgrade existing access for construction |
| | Permanant construction access |
| | Temp construction access and uphill safety line cable |
| | Drain |
| RG3 | Group rock Removal reduction |
| | Rock habitat |
| | Construction footprint, top & bottom station |
| | No-Go Zone |
| | Culvert |
| R1 | Single rock reduction |
| | Tree removal |
| | Demolish |
| | Skier Bridge |
| GS | Guthega Skink site |
| SG | Snowmaking gun to be relocated |
| PSG | Proposed snowmaking gun location |
| T1 | Proposed Doppelmayr tower location |
| RH | Retractable Hydrant |
| | New snowmaking lateral |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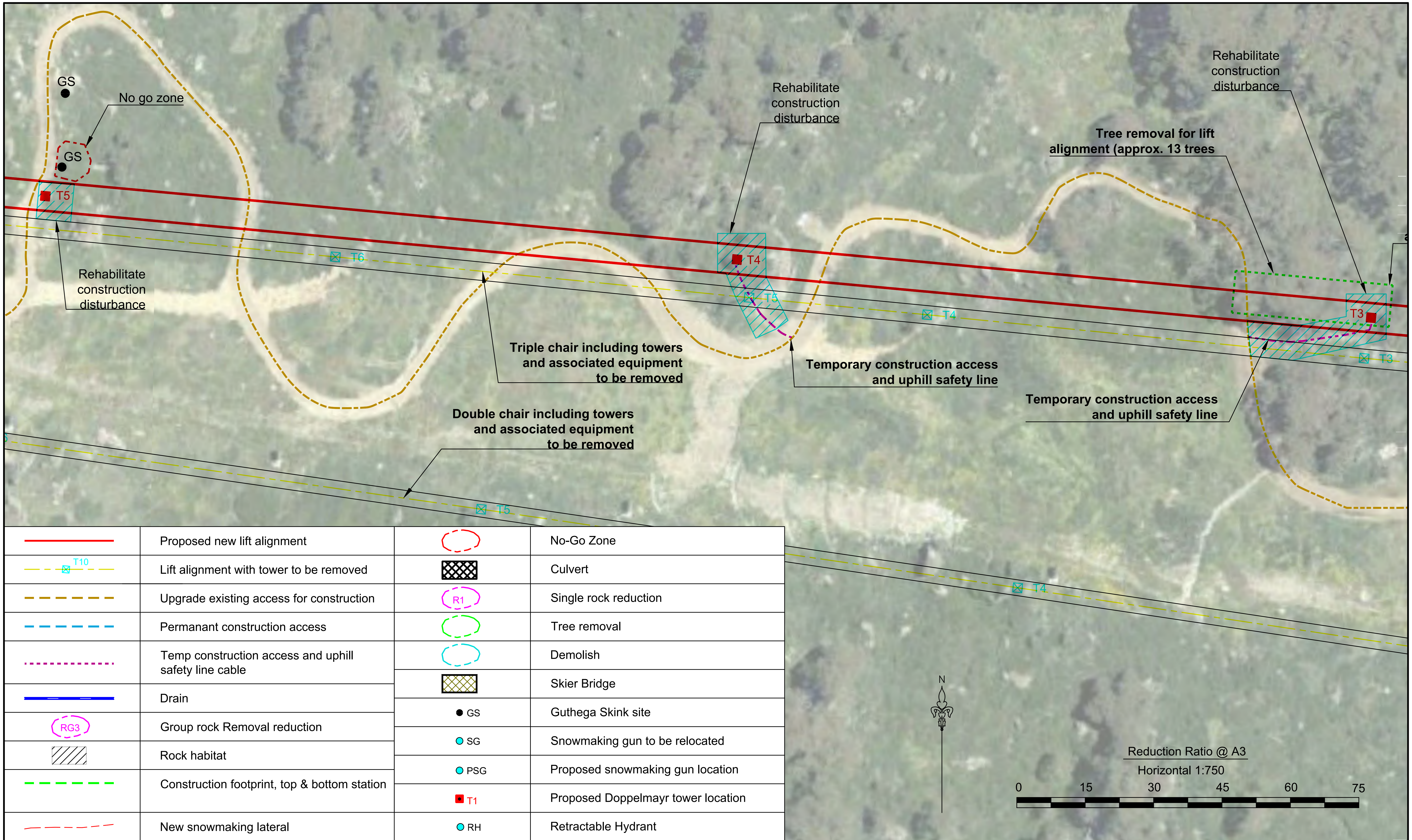
perisher

| | |
|---|---|
| JOB NAME: | Mount Perisher Chairlift Project |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 |
| DESCRIPTION: | New 6 seater detachable chairlift |
| DRAWING: | DA Plans - Bottom Station |

| | |
|---|---|
| ISSUE: | DA |
| DATE: 30/10/2019 | |
| JOB NUMBER | SHEET |
| T-106 | 2 of 11 |




| | | | |
|---|---|---|---|
| | Proposed new lift alignment | | No-Go Zone |
| T10 | Lift alignment with tower to be removed | | Culvert |
| | Upgrade existing access for construction | R1 | Single rock reduction |
| | Permanant construction access | | Tree removal |
| | Temp construction access and uphill safety line cable | | Demolish |
| | Drain | | Skier Bridge |
| RG3 | Group rock Removal reduction | ● GS | Guthega Skink site |
| | Rock habitat | SG | Snowmaking gun to be relocated |
| | Construction footprint, top & bottom station | PSG | Proposed snowmaking gun location |
| | | T1 | Proposed Doppelmayr tower location |
| | New snowmaking lateral | RH | Retractable Hydrant |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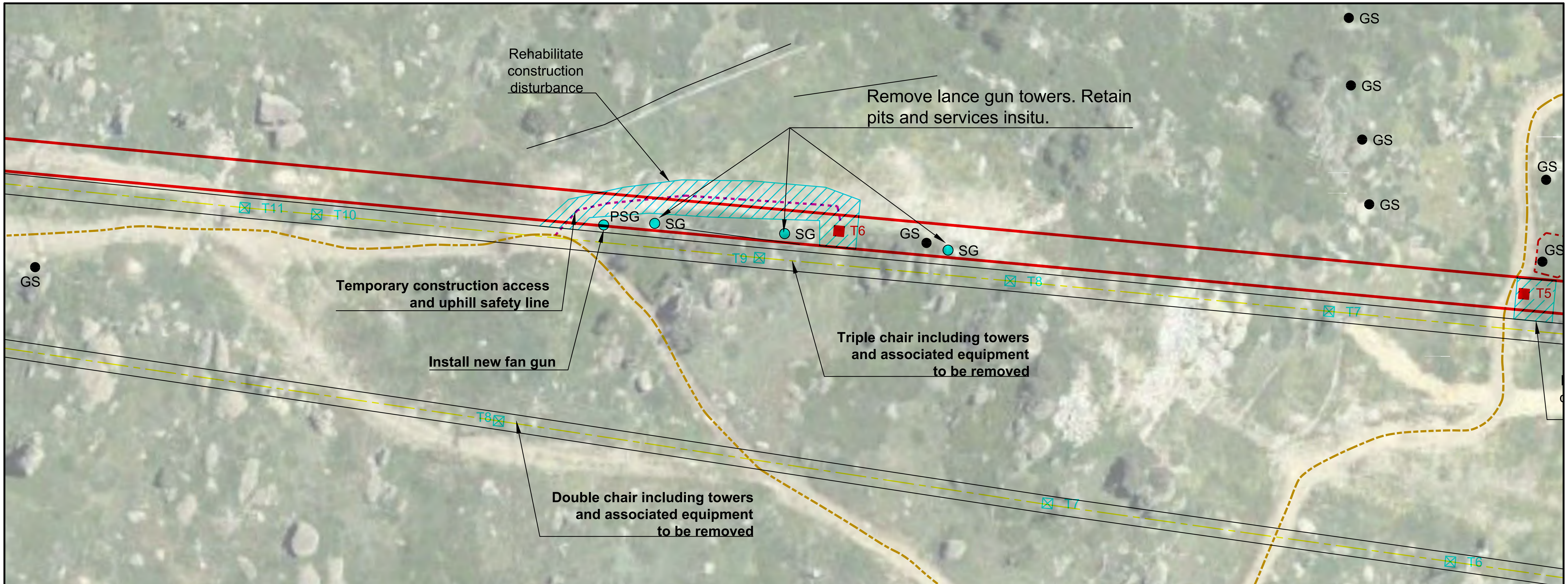
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Lower Lift | T-106 | 3 of 11 |




| | | | |
|---|---|---|---|
| | Proposed new lift alignment | | No-Go Zone |
| T10 | Lift alignment with tower to be removed | | Culvert |
| | Upgrade existing access for construction | R1 | Single rock reduction |
| | Permanant construction access | | Tree removal |
| | Temp construction access and uphill safety line cable | | Demolish |
| | Drain | | Skier Bridge |
| RG3 | Group rock Removal reduction | GS | Guthega Skink site |
| | Rock habitat | SG | Snowmaking gun to be relocated |
| | Construction footprint, top & bottom station | PSG | Proposed snowmaking gun location |
| | | T1 | Proposed Doppelmayr tower location |
| | New snowmaking lateral | RH | Retractable Hydrant |

Reduction Ratio @ A3
Horizontal 1:750
0 15 30 45 60 75

N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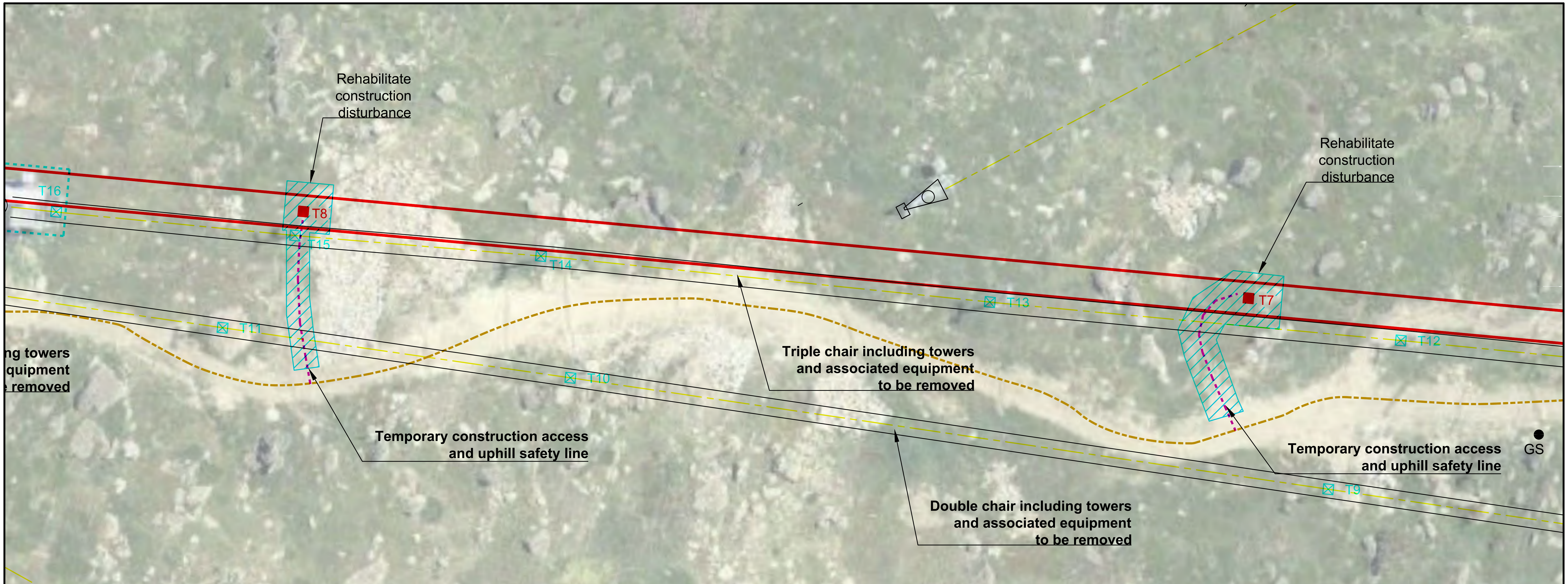
perisher

| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Mid Lift | T-106 | 4 of 11 |




| | | | |
|---|---|---|---|
| Red solid line | Proposed new lift alignment | Red dashed ellipse | No-Go Zone |
| T10 | Lift alignment with tower to be removed | Cross-hatched box | Culvert |
| Brown dashed line | Upgrade existing access for construction | R1 | Single rock reduction |
| Blue dashed line | Permanant construction access | Green dashed ellipse | Tree removal |
| Magenta dotted line | Temp construction access and uphill safety line cable | Cyan dashed ellipse | Demolish |
| Blue solid line | Drain | Cross-hatched box | Skier Bridge |
| RG3 | Group rock Removal reduction | GS | Guthega Skink site |
| Hatched box | Rock habitat | SG | Snowmaking gun to be relocated |
| Green dashed line | Construction footprint, top & bottom station | PSG | Proposed snowmaking gun location |
| | | T1 | Proposed Doppelmayr tower location |
| Red dash line | New snowmaking lateral | RH | Retractable Hydrant |

N

Reduction Ratio @ A3

Horizontal 1:750

0 15 30 45 60 75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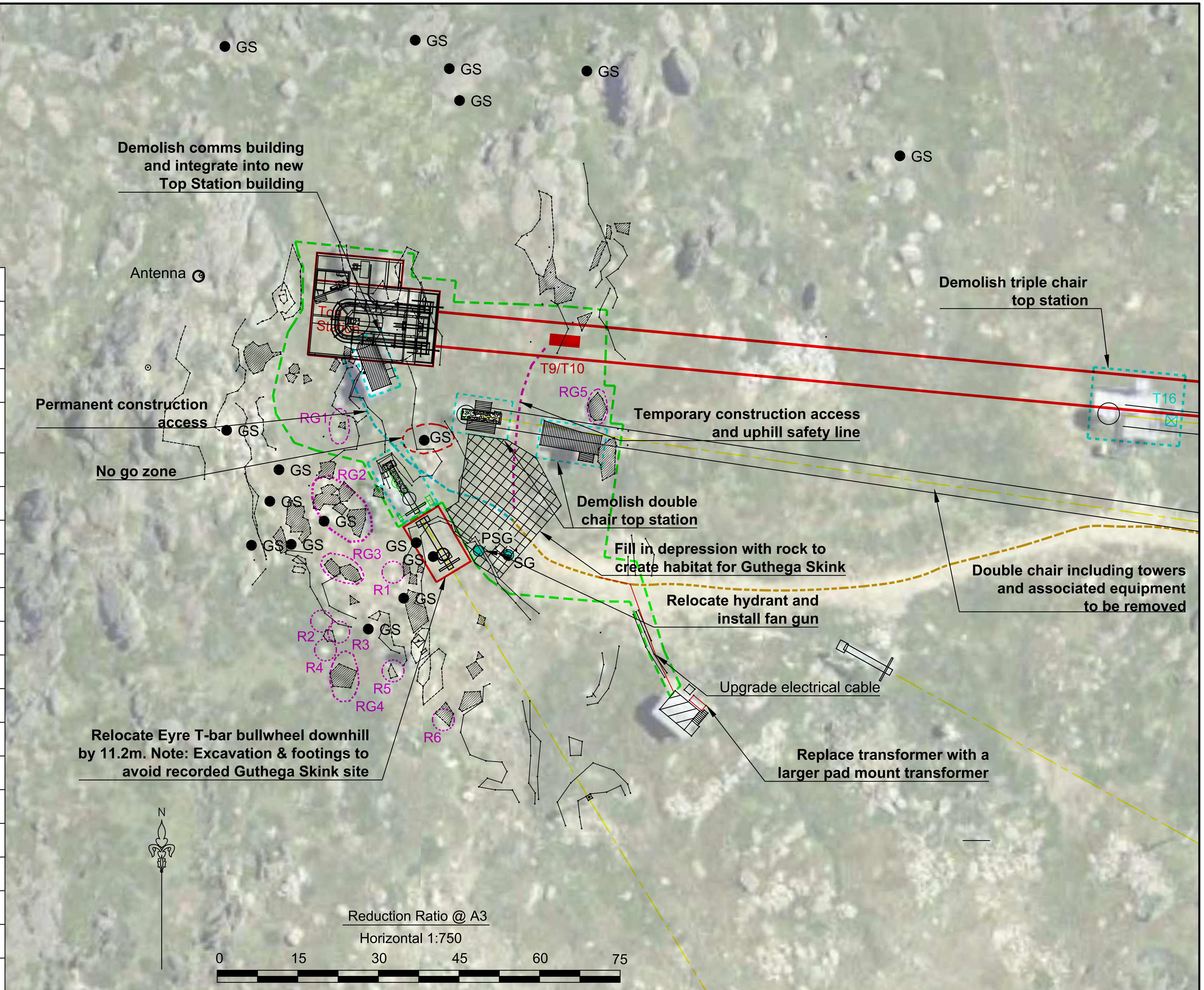
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Upper Lift | T-106 | 5 of 11 |




| | |
|---|---|
| (solid red line) | Proposed new lift alignment |
| T10 (yellow dashed line) | Lift alignment with tower to be removed |
| (brown dashed line) | Upgrade existing access for construction |
| (blue dashed line) | Permanant construction access |
| (magenta dotted line) | Temp construction access and uphill safety line cable |
| (blue line) | Drain |
| RG3 | Group rock Removal reduction |
| (hatching) | Rock habitat |
| (green dashed line) | Construction footprint, top & bottom station |
| (red dashed circle) | No-Go Zone |
| (cross-hatching) | Culvert |
| R1 | Single rock reduction |
| (green dashed circle) | Tree removal |
| (cyan dashed circle) | Demolish |
| (cross-hatched box) | Skier Bridge |
| GS | Guthega Skink site |
| SG | Snowmaking gun to be relocated |
| PSG | Proposed snowmaking gun location |
| T1 | Proposed Doppelmayr tower location |
| RH | Retractable Hydrant |
| (red dash line) | New snowmaking lateral |

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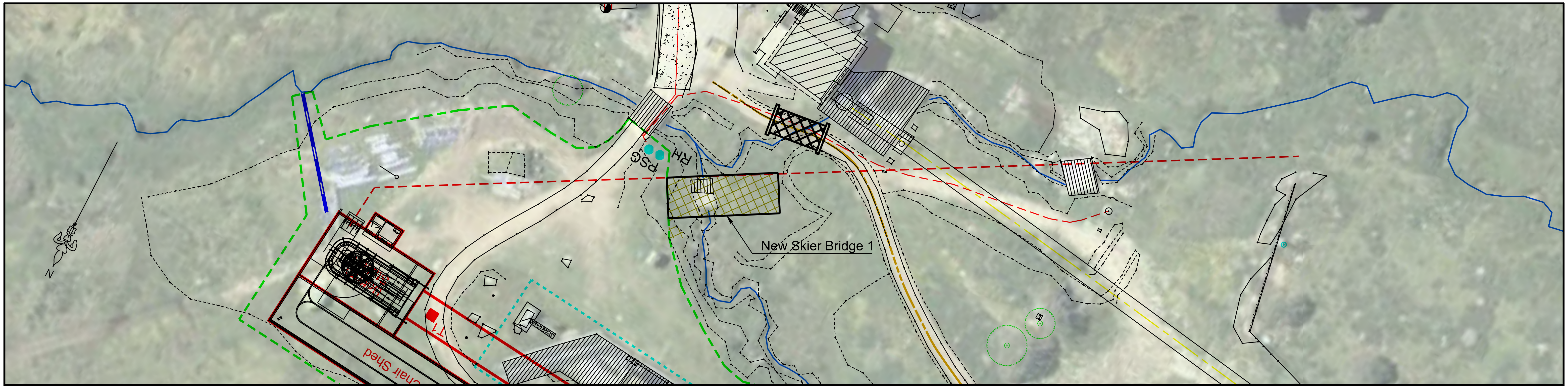
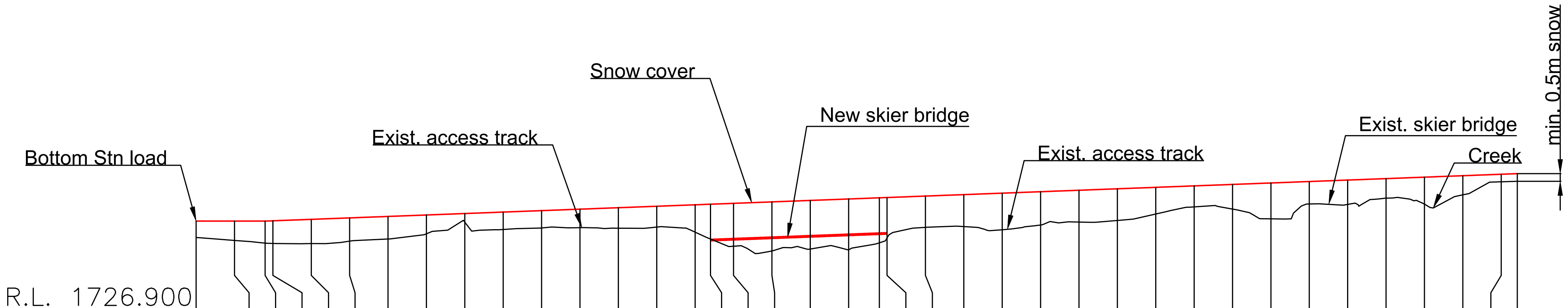
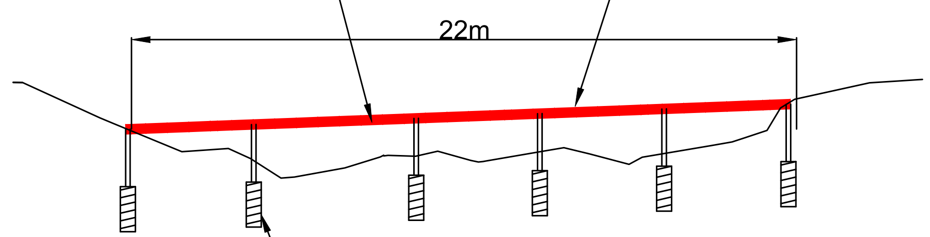
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Top Station | T-106 | 6 of 11 |




| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Levels | 1732.690 | 1732.690 | 1732.690 | 1732.709 | 1732.804 | 1732.899 | 1732.994 | 1733.088 | 1733.183 | 1733.278 | 1733.373 | 1733.468 | 1733.562 | 1733.657 | 1733.752 | 1733.790 | 1733.847 | 1733.942 | 1734.036 | 1734.131 | 1734.207 | 1734.226 | 1734.321 | 1734.416 | 1734.510 | 1734.605 | 1734.700 | 1734.795 | 1734.889 | 1734.984 | 1735.079 | 1735.174 | 1735.268 | 1735.363 | 1735.458 | 1735.553 | 1735.647 | 1735.742 | 1735.782 |
| Existing Levels | 1731.621 | 1731.430 | 1731.253 | 1731.234 | 1731.226 | 1731.384 | 1731.524 | 1731.861 | 1732.621 | 1732.145 | 1732.242 | 1732.263 | 1732.227 | 1732.302 | 1731.970 | 1731.523 | 1731.052 | 1730.742 | 1730.871 | 1730.821 | 1731.274 | 1731.591 | 1732.284 | 1732.333 | 1732.125 | 1732.433 | 1732.627 | 1732.733 | 1733.150 | 1733.616 | 1733.473 | 1732.838 | 1733.807 | 1733.778 | 1734.186 | 1733.799 | 1734.402 | 1735.251 | 1735.282 |
| Chainage | 0.000 | 5.000 | 8.985 | 10.000 | 15.000 | 20.000 | 25.000 | 30.000 | 35.000 | 40.000 | 45.000 | 50.000 | 55.000 | 60.000 | 65.000 | 67.000 | 70.000 | 75.000 | 80.000 | 85.000 | 89.000 | 90.000 | 95.000 | 100.000 | 105.000 | 110.000 | 115.000 | 120.000 | 125.000 | 130.000 | 135.000 | 140.000 | 145.000 | 150.000 | 155.000 | 160.000 | 165.000 | 170.000 | 172.099 |




## SKIER BRIDGE ONE DETAIL

Note: Construction to commence on northern side with bridge launched to minimise construction footprint

Reduction Ratio @ A3

Horizontal 1:750 Vertical Exaggeration = 2

0 15 30 45 60 75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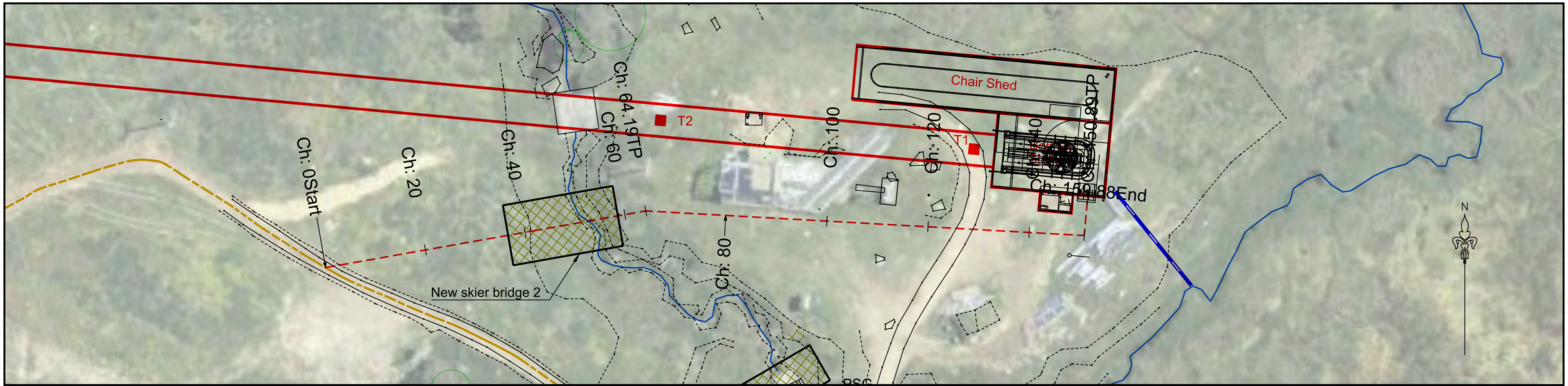
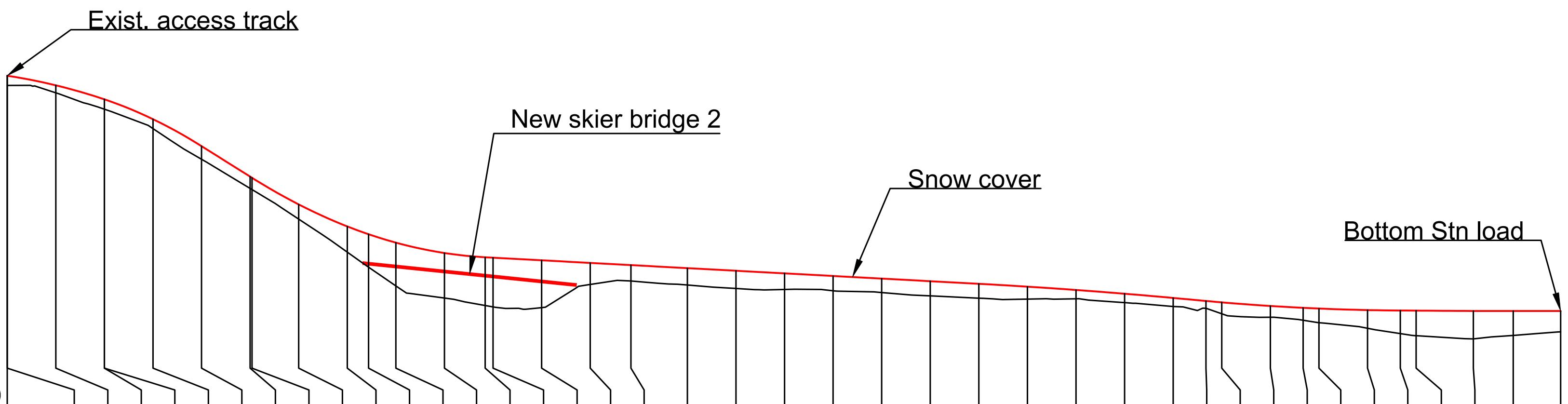
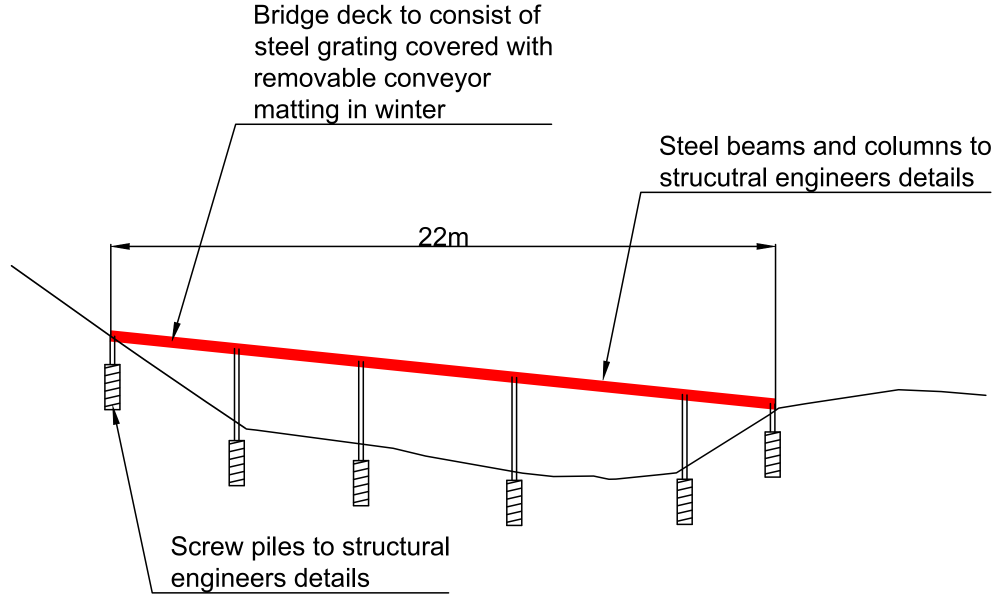
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Skier Cat Run 1 | T-106 | 7 of 11 |




R.L. 1727.500

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Levels | 1744.794 | 1744.793 | 1744.301 | 1743.579 | 1743.579 | 1742.559 | 1741.173 | 1739.604 | 1739.543 | 1738.173 | 1737.040 | 1736.638 | 1736.207 | 1735.672 | 1735.455 | 1735.433 | 1735.299 | 1735.164 | 1735.051 | 1734.895 | 1734.761 | 1734.626 | 1734.492 | 1734.357 | 1734.223 | 1734.089 | 1733.942 | 1733.772 | 1733.579 | 1733.361 | 1733.207 | 1733.135 | 1732.950 | 1732.854 | 1732.817 | 1732.738 | 1732.715 | 1732.710 | 1732.690 | 1732.690 | 1732.690 |
| Existing Levels | 1744.294 | 1744.294 | 1743.916 | 1743.075 | 1743.075 | 1742.075 | 1740.497 | 1738.996 | 1738.938 | 1737.419 | 1735.717 | 1734.944 | 1733.982 | 1733.357 | 1732.974 | 1732.903 | 1732.862 | 1734.057 | 1734.236 | 1734.026 | 1733.848 | 1733.797 | 1733.729 | 1733.640 | 1733.469 | 1733.350 | 1733.303 | 1733.320 | 1733.121 | 1732.922 | 1732.828 | 1732.547 | 1732.368 | 1732.215 | 1732.088 | 1731.802 | 1731.528 | 1731.420 | 1731.253 | 1731.435 | 1731.621 |
| Chainage | 0.000 | 0.001 | 5.000 | 9.999 | 10.000 | 15.000 | 20.000 | 25.000 | 25.192 | 30.000 | 35.000 | 37.191 | 40.000 | 45.000 | 49.191 | 50.000 | 55.000 | 60.000 | 64.192 | 70.000 | 75.000 | 80.000 | 85.000 | 90.000 | 95.000 | 100.000 | 105.000 | 110.000 | 115.000 | 120.000 | 123.374 | 125.000 | 130.000 | 133.374 | 135.000 | 140.000 | 143.374 | 145.000 | 150.894 | 155.000 | 159.879 |




## SKIER BRIDGE TWO DETAIL

Note: Construction to commence on eastern side with bridge launched to minimise construction footprint

Reduction Ratio @ A3

Horizontal 1:750 Vertical Exaggeration = 2

0 15 30 45 60 75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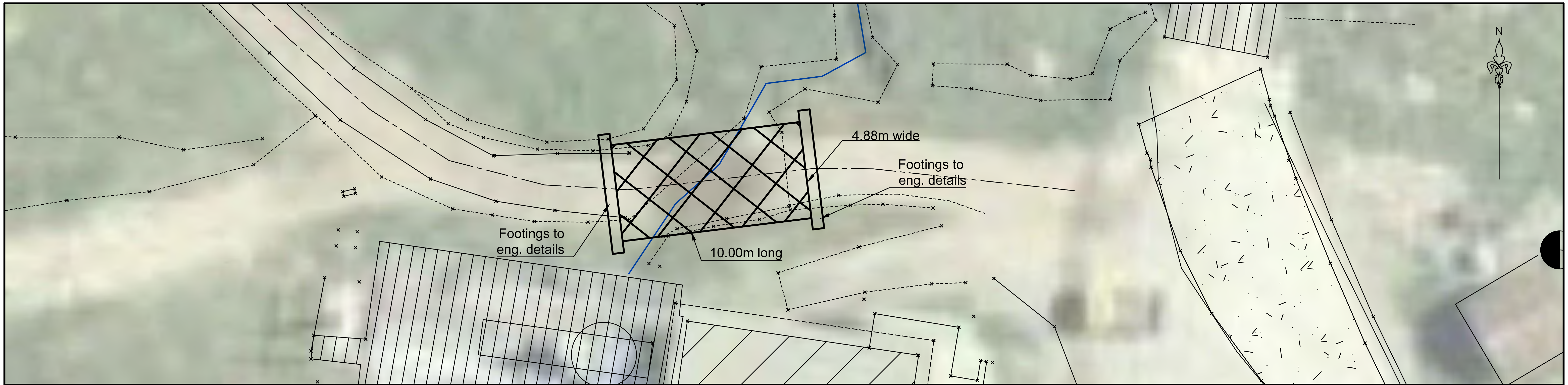
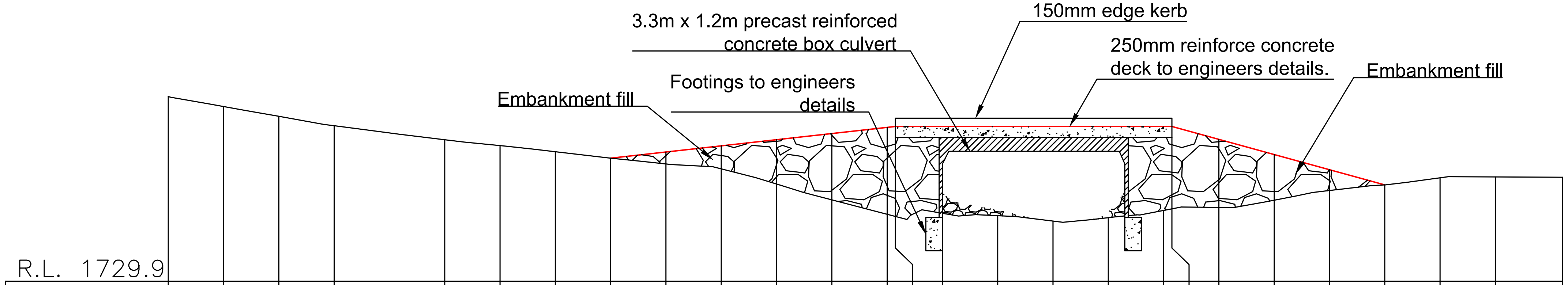
perisher

| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | DA Plans - Skier Cat Run 2 | T-106 | 8 of 11 |



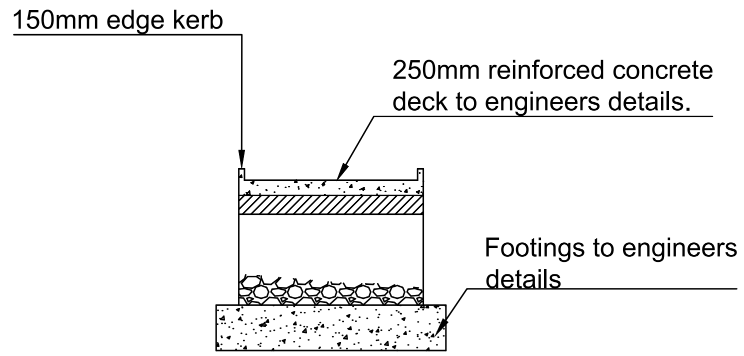




| Chainage | Existing Levels | Design Levels |
|---|---|---|
| 0.000 | 1733.241 | |
| 2.000 | 1733.061 | |
| 4.000 | 1732.884 | |
| 6.000 | 1732.713 | |
| 10.000 | 1732.460 | |
| 12.000 | 1732.353 | |
| 14.000 | 1732.243 | |
| 16.000 | 1732.127 | 1732.127 |
| 18.000 | 1732.021 | 1732.238 |
| 20.000 | 1731.933 | 1732.350 |
| 22.000 | 1731.658 | 1732.461 |
| 24.000 | 1731.371 | 1732.572 |
| 26.000 | 1731.110 | 1732.683 |
| 26.300 | 1731.071 | 1732.700 |
| 28.000 | 1731.128 | |
| 30.000 | 1731.085 | |
| 32.000 | 1730.987 | |
| 34.000 | 1731.049 | |
| 36.000 | 1731.180 | |
| 36.300 | 1731.209 | 1732.700 |
| 38.000 | 1731.234 | 1732.466 |
| 40.000 | 1731.365 | 1732.192 |
| 42.000 | 1731.541 | 1731.917 |
| 44.000 | 1731.642 | 1731.642 |
| 46.000 | 1731.771 | |
| 48.000 | 1731.786 | |
| 50.434 | 1731.780 | |

0 4 8 12 16 20

Horizontal 1:200 Vertical Exaggeration = 2

Access Track Longitudinal Section




Section A-A

Similar culvert 800m downstream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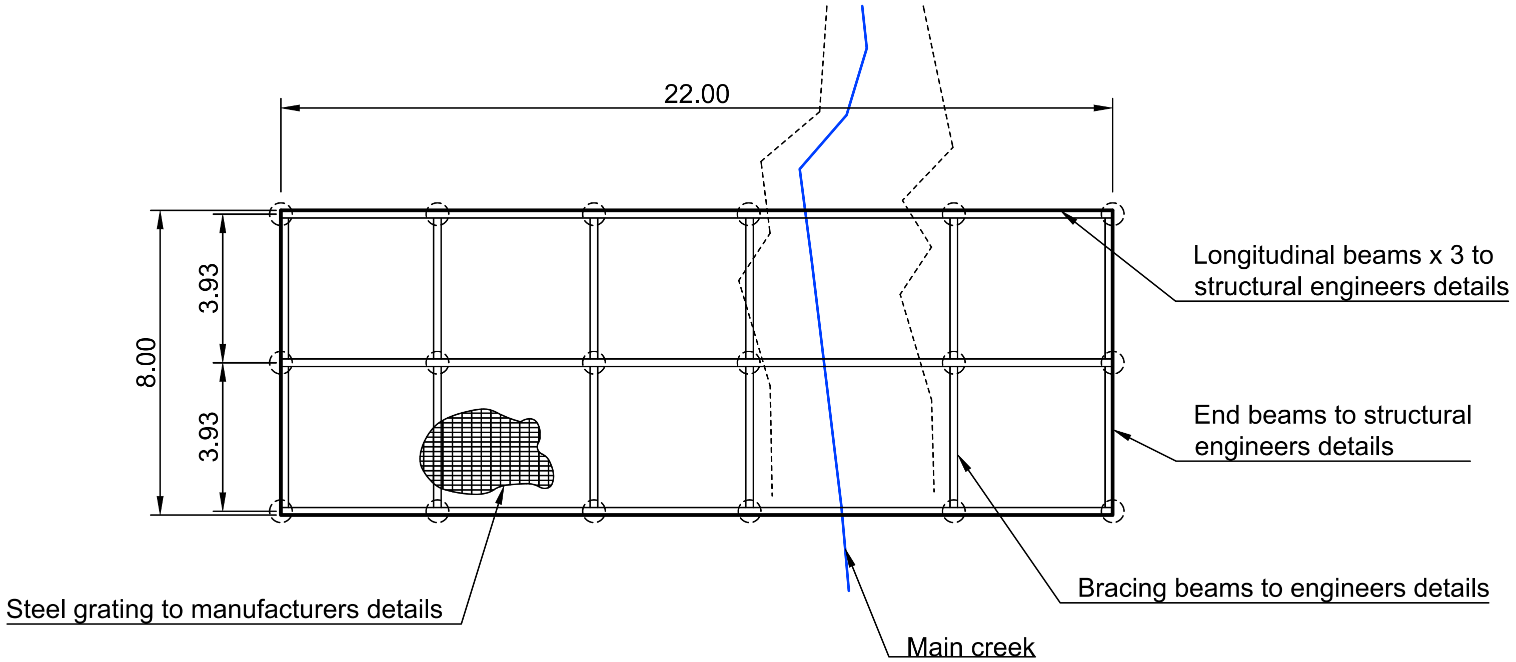
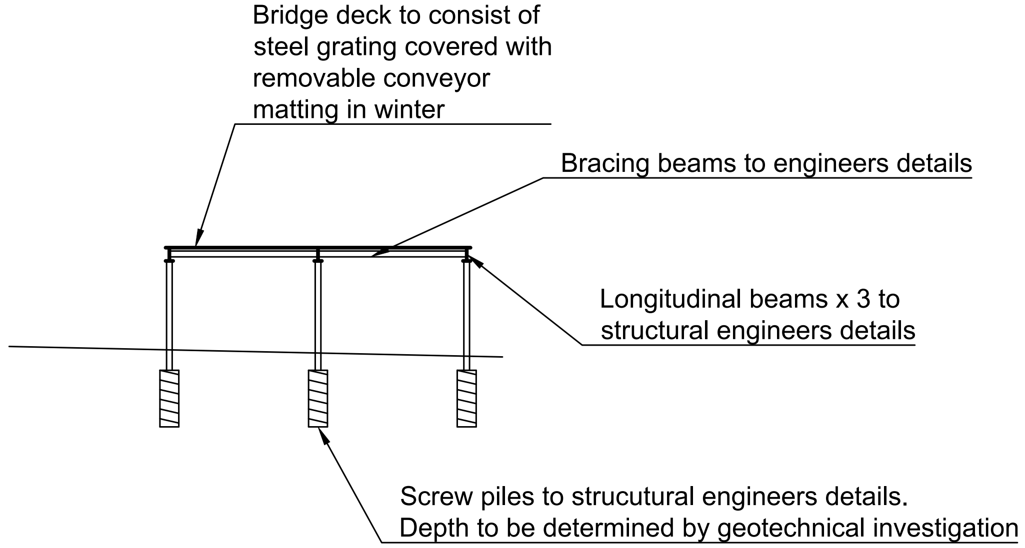
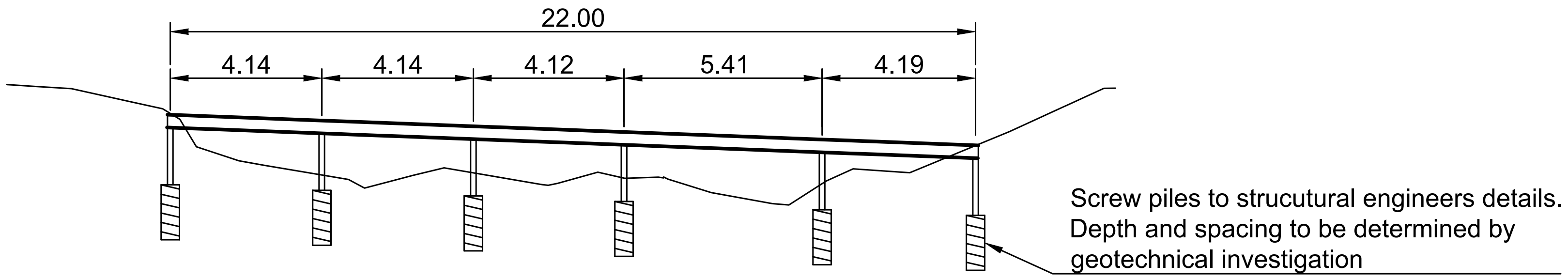
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | Culvert Details (Powder Inn) | T-106 | 9 of 11 |




Plan View




Cross Section




Long Section

Notes:
1.Construction to commence on northern side with bridge launched to minimise construction footprint
2.Strucutral design to allow for the following imposed actions (Q);
- 4 metre deep snow load
- 12.5 tonne grooming machine
- 13 tonne excavator for construciton

0 4 8 12 16 20

Horizontal 1:200

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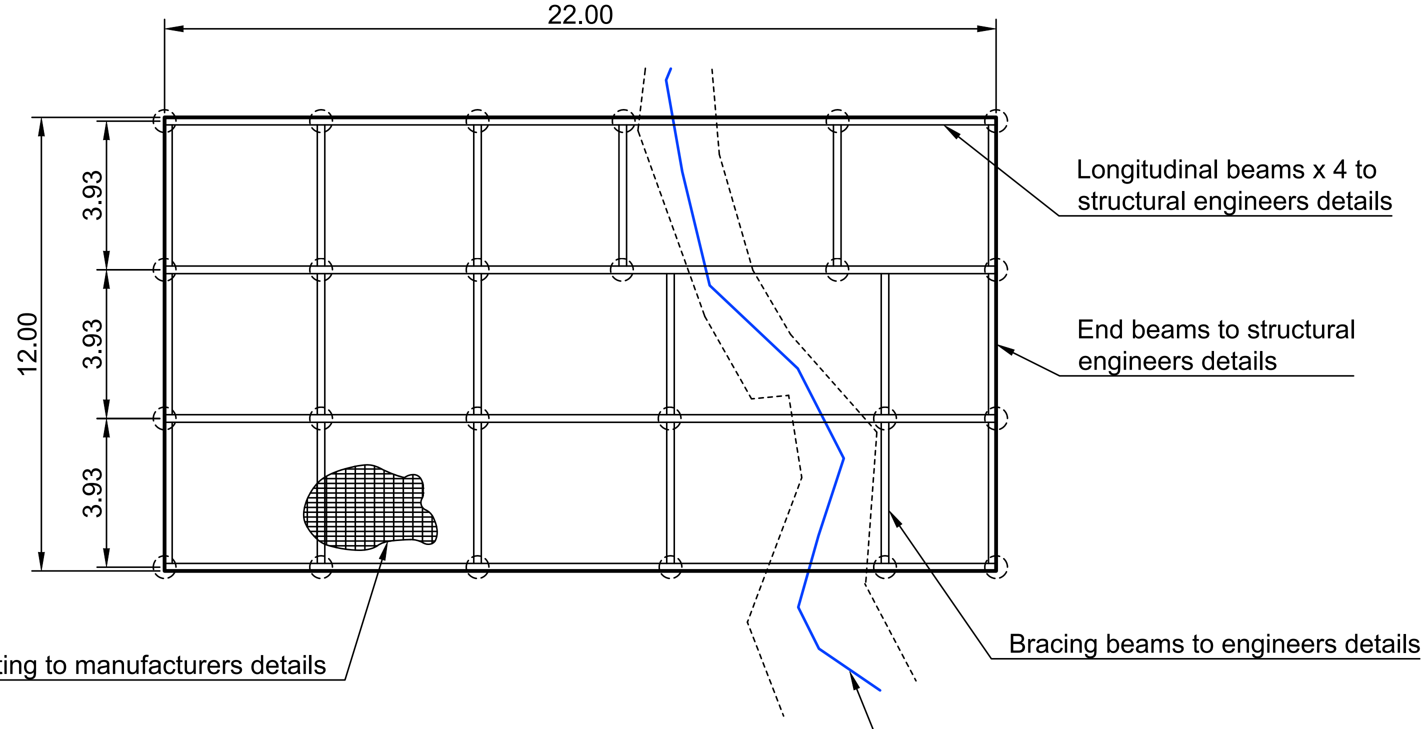
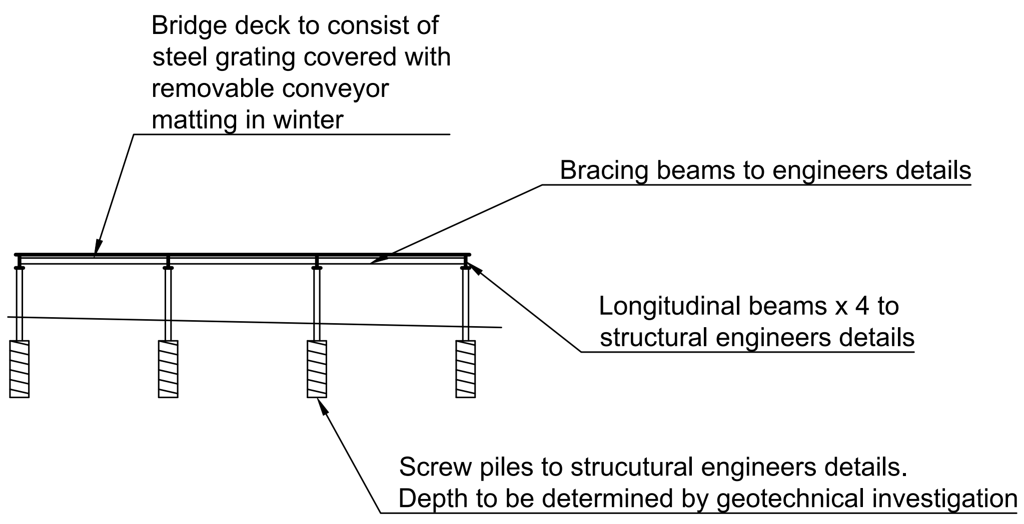
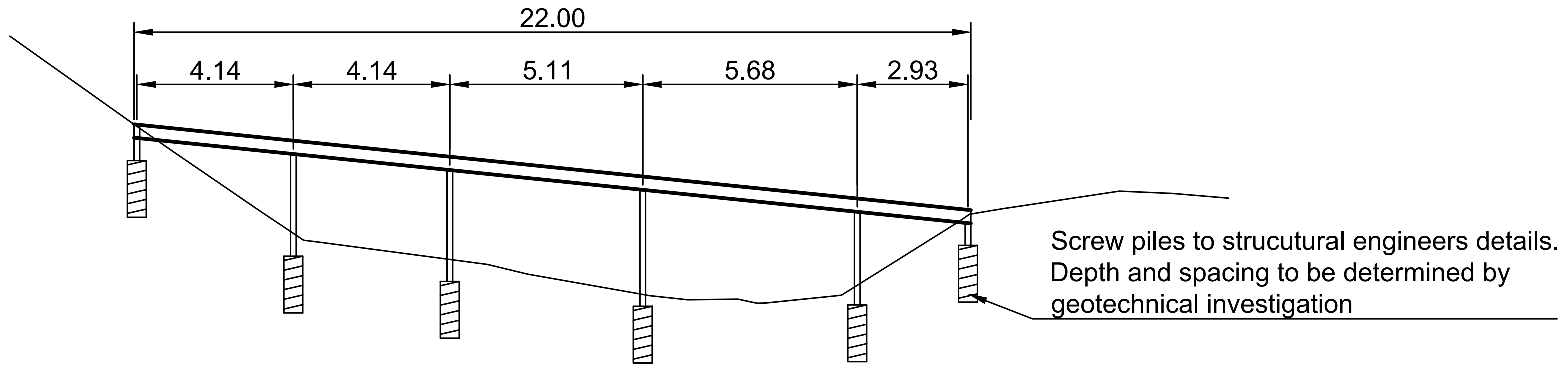
| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | Skier Bridge 1 Details | T-106 | 10 of 11 |




Plan View

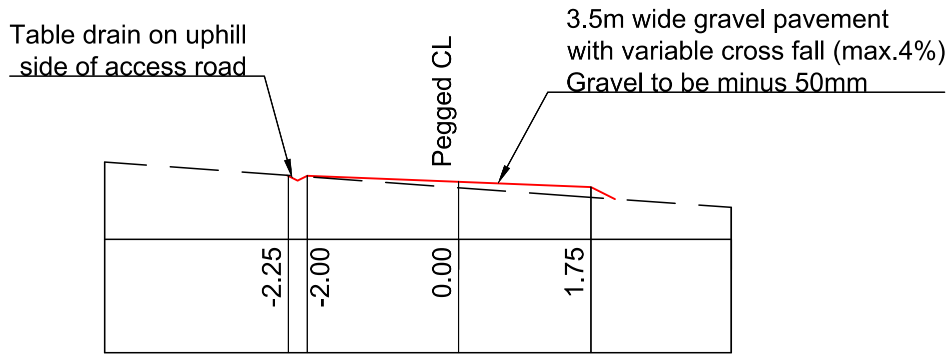



Cross Section




Long Section

Photo of Typical Access Road Cross Section




Typical Access Road Cross Section

Notes:

1. Construction to commence on eastern side with bridge launched to minimise construction footprint
2. Structral design to allow for the following imposed actions (Q);
   - 4 metre deep snow load
   - 12.5 tonne grooming machine
   - 13 tonne excavator for construciton


Horizontal 1:200

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| | | | |
|---|---|---|---|
| JOB NAME: | Mount Perisher Chairlift Project | ISSUE: | DA |
| LOCATION: | Mount Perisher, Kosciuszko Road Perisher Valley NSW 2624 | DATE: 30/10/2019 | |
| DESCRIPTION: | New 6 seater detachable chairlift | JOB NUMBER | SHEET |
| DRAWING: | Skier Bridge 2 Details | T-106 | 11 of 11 |

# APPENDIX E

## WATER RESOURCES ASSESSMENT

APPENDIX E

# Mount Perisher Chairlift – Water Resources Assessment

## Perisher Blue Pty Ltd

Planning, Industry & Environment

*Issued under the Environmental Planning and Assessment Act 1979*

Approved Application No DA 10115

Granted on the 9 September 2021

Signed MB

Sheet No 5 of 63

A TETRA TECH COMPANY

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## DOCUMENT TRACKING

| | |
|---|---|
| **Project Name** | Mount Perisher Chairlift – Water Resources Assessment |
| **Project Number** | 18HNG_9801 |
| **Project Manager** | Ryan Smithers |
| **Prepared by** | Ryan Smithers |
| **Reviewed by** | David Coombes |
| **Approved by** | Ryan Smithers |
| **Status** | **Final** |
| **Version Number** | **V1** |
| **Last saved on** | **16 December 2019** |

This report should be cited as 'Eco Logical Australia 2019. *Mount Perisher Chairlift – Water Resources Assessment*. Prepared for Perisher Blue Pty Ltd.'

### ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Dabyne Planning

# Contents



# List of Figures

# 1. Introduction

## 1.1 Background

Liaison with the NSW Natural Resources Access Regulator (NRAR) and its predecessor, the NSW Office of Water (NoW), in relation to other developments in the NSW Ski Resorts has identified three key issues and assessment requirements in relation to water resources:

- Watercourses and riparian land
- Wetlands
- Groundwater and groundwater dependent ecosystems (GDEs).

This report provides an assessment of the proposal in relation to the key outcomes for each issue.

## 1.2 The proposal

The proposal is described in detail in the accompanying statement of environmental effects (SEE) (Dabyne Planning 2019) and Biodiversity Development Assessment Report (BDAR) (Eco Logical Australia 2019).

The impacts on water resources associated with the proposal will be minor, and will be restricted primarily to temporary disturbances associated with:

- the proposed culvert where the existing access road crosses Perisher Creek (see Figure 1 and Photo 1)
- the proposed chair shed where it encroaches on the bog associated with Perisher Creek (see Figure 2 and Photo 2)
- the footings for the skier bridges where they encroach on bog associated with a tributary of Perisher Creek (see Figure 2 and Photo 3).

Impacts on water resources will be limited to minor temporary changes in sub-surface and surface flows during the construction phase of the proposal. The watercourses and associated bog that will be affected are already modified in association with existing disturbances.

Water resources beyond the proposed disturbance footprint are considered highly unlikely to be affected by the proposal. The proposal will include appropriate measures to avoid fuel or chemical spills or substantial sediment input into watercourses during the construction period.

The proposal is not anticipated to result in any changes in surface or subsurface hydrology which may lead to the adverse modification of any watercourses or other water resources. The minor excavation, filling, vegetation removal and other works associated with the proposal will be small scale, and will incorporate appropriate sediment and drainage control measures, and post construction rehabilitation, and thus are unlikely to substantially modify the hydrology of any water resources.

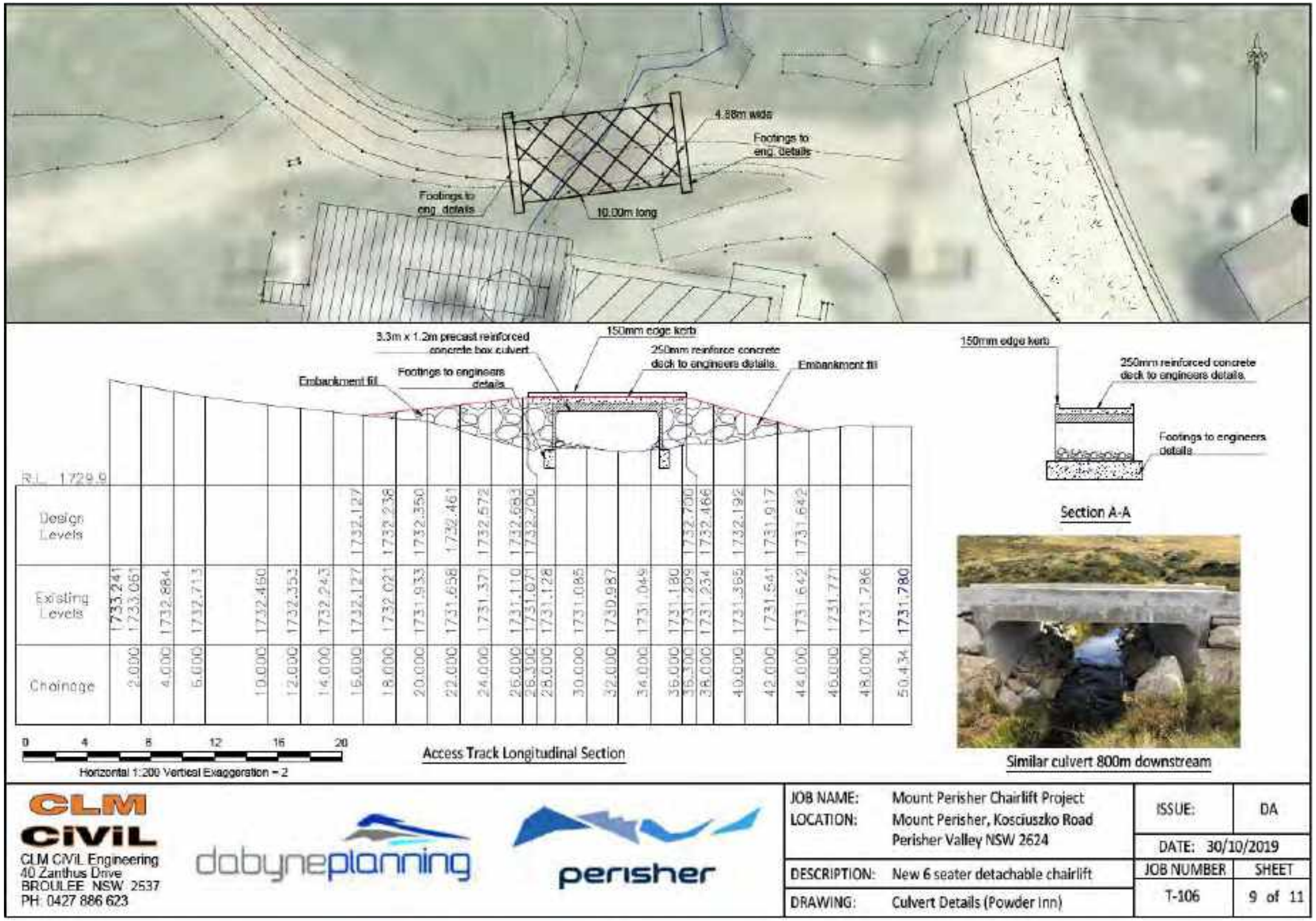


**Figure 1: The proposed culvert where the existing access road crosses Perisher Creek.**

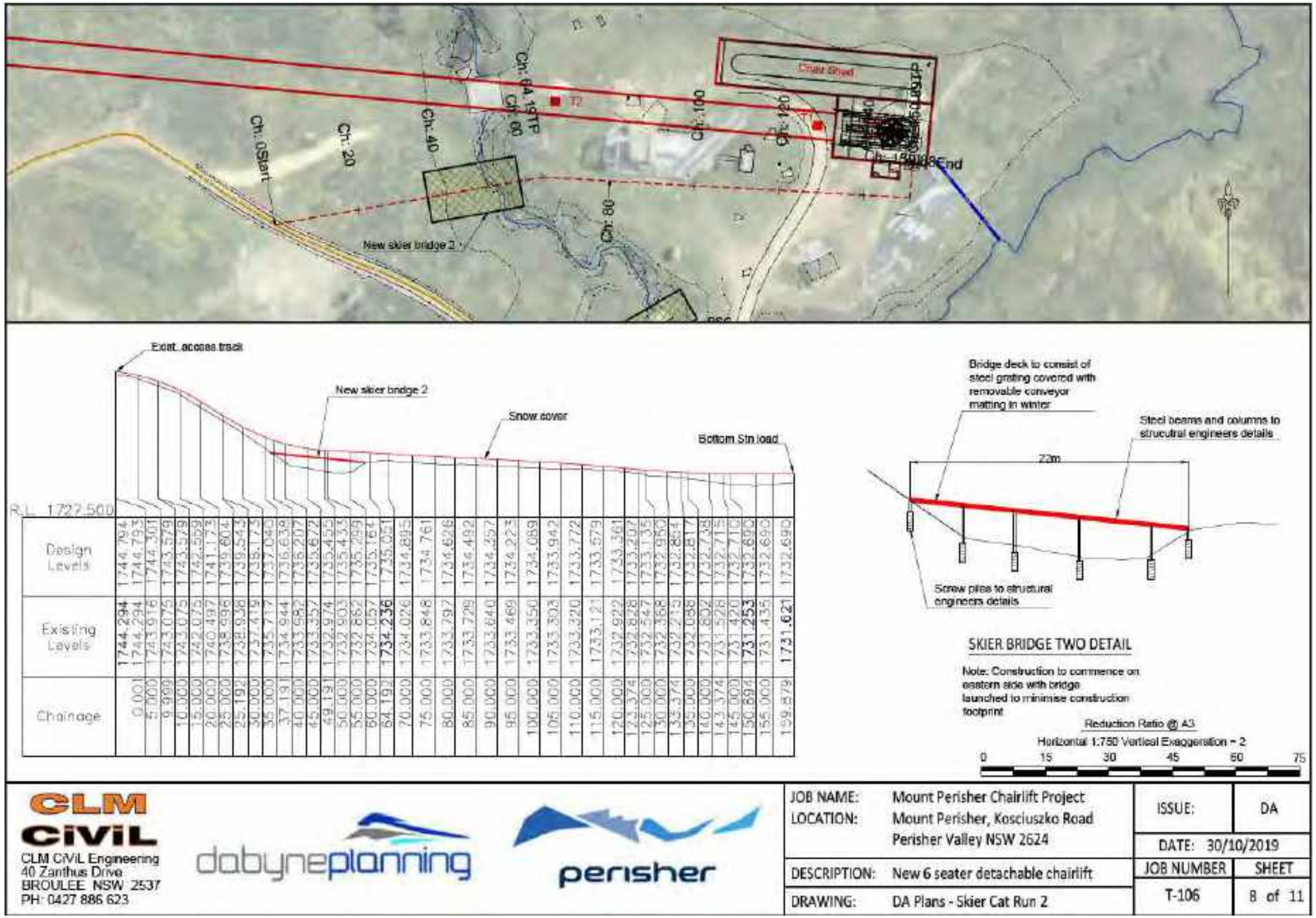


**Figure 2: Skier bridge design and location of chair shed.**

**Photo 1: The crossing of Perisher Creek will be upgraded to improve construction access and reduce water quality impacts that would otherwise be associated with construction access. The upgrade will be similar to existing crossings further downstream i.e. near the Quad Express Chairlift.**

**Photo 2: The chair shed and associated pad will encroach slightly into the disturbed margins of the extensive bog associated with Perisher Creek.**

**Photo 3: The proposed skier bridges will affect remnant bog and heath that has been subject to historic disturbances and is already weedy in places. The location of skier bridge 2 is shown above.**

# 2. Water resources assessment

## 2.1 Watercourse and riparian land

The proposal will affect two watercourses that appear on the Perisher Valley 1:25,000 topographical map, Perisher Creek (2nd order watercourse using NRAR guidelines), and an unnamed minor tributary of Perisher Creek which is a 1st order watercourse using NRAR guidelines. Using the NRAR guidelines for riparian corridors on waterfront land, Perisher Creek requires a Vegetated Riparian Zone (VRZ) of 20 m on either side of the creek and the unnamed tributary requires a 10 m VRZ. As such, the proposal will encroach upon the required VRZs where the culvert is proposed on Perisher Creek and where the skier bridges traverse the unnamed tributary.

The impacts on both watercourses will be negligible and will not result in any impacts apart from some minor water quality impacts during the construction phase. The longer-term impacts on water quality will be positive as the culvert and associated bridge will remove the water quality impacts associated with vehicle movements during the construction phase and post construction. The minor encroachment of the proposal on the VRZs are more than compensated for by the extensive vegetation within the VRZ and beyond up and downstream of the proposed development.

## 2.2 Wetlands

The proposal will affect approximately 600 $m^2$ of bog surrounding the proposed bottom station in association with the proposed chair shed and skier bridges. Approximately 200 $m^2$ of this impact will comprise partial shading in association with the skier bridge decking. The impact on the bog in association with the chair shed will comprise filling for the pad upon which the chair shed will be constructed.

Ecology Australia (2002) estimate that there is approximately 625 ha of bog in the Perisher Resort area. In fact, bog communities are amongst the most widespread vegetation communities in the ACT, NSW and Victorian Alps (McDougall and Walsh 2007) and amongst the best conserved vegetation communities in the country. Given the very small area of bog to be affected by the proposal, and given the very large area of bog in association with Perisher Creek (more than 100 ha), the effects of the proposal on wetlands are considered to be relatively minor.

Under these circumstances, it is considered that the proposal will not have any adverse impacts on wetlands.

## 2.3 Groundwater and groundwater dependent ecosystems

The bogs within and in proximity to the proposed disturbance footprint comprise groundwater dependent ecosystems (GDEs), as they are dependent upon impeded subsurface drainage.

The excavation and filling associated with the proposal are minor in the context of the extent of the bog in association with Perisher Creek. Given that the excavations and filling will be minor and will not result in any major diversion or impeding of flows, negligible impacts on surface or subsurface hydrology are anticipated beyond the proposal footprint. Many similar developments have been undertaken within the Perisher Resort area without any noticeable adverse impacts on GDEs beyond the disturbance footprint, including the bottom stations for the Freedom Chairlift and Leichhardt Chairlift, both of which are located in areas of bog.

The proposal does not involve any groundwater extraction, beyond limited extraction during the construction phase to drain the excavated footprint as necessary i.e. for pouring of concrete footings or draining of trenches. The extracted water will be discharged immediately downstream of the affected area. The discharge of the extracted water is highly unlikely to have any adverse impacts on the receiving areas, given that the bogs naturally tolerate much more substantial fluctuations in watertable levels in association with natural climate variability.

The operation of the proposed chairlift will not result in any other discharges of water that may infiltrate groundwater sources. The potential for pollutants such as oils or chemicals to enter the groundwater in association with the proposal will be mitigated by appropriate controls during the construction and operation phases.

The small scale of the proposal relative to the extent of the GDEs associated with Perisher Creek and the nature of the design are such that the proposal is considered highly unlikely to have any impact on recharge to the groundwater surrounding the proposed development footprint.

Under these circumstances, it is considered that the impacts of the proposal on GDEs will be minor and acceptable and will be appropriately offset by the proposed biodiversity credit retirement and rehabilitation actions.

# 3. Conclusion

Given the relatively minor impacts on water resources associated with the proposal and the proposed mitigating measures, it is considered that the proposal meets the objectives for water resources identified in the NRAR guidelines.

Ryan Smithers

**Senior Ecologist**

# 4. References

Dabyne Planning. 2019. *Statement of Environmental Effects: Proposed Mount Perisher Chairlift*.

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McDougall, K.L. & Walsh, N.G. 2007. Treeless vegetation of the Australian Alps. *Cunninghamia 10, 1-57*.

NSW Natural Resources Access Regulator (NRAR), 2018. *Guidelines for Controlled Activities on Waterfront Land*.

# APPENDIX F

## GEOTECHNICAL ENGINEERING ASSESSMENT & CERTIFICATION

APPENDIX F

Perisher Blue Pty Ltd

# Proposed Mt Perisher Ski Lift
# Mt Perisher, NSW

## Geotechnical Assessment

Our ref: 5498-G1-Rev2
22 November 2019

## DOCUMENT AUTHORISATION

**Proposed Mt Perisher Ski Lift**
**Mt Perisher, NSW**
**Geotechnical Assessment**

Prepared for Perisher Blue Pty Ltd

Our ref: 5498-G1-Rev2
22 November 2019

For and on behalf of
**Asset Geotechnical Engineering Pty Ltd**

MGreen

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## Contents

# 1. INTRODUCTION

## 1.1 General

This report presents the results of a geotechnical investigation for a new ski lift for the above project. The investigation was commissioned on 4 April 2019 by Mr Michael Fearnside of Perisher Blue Pty Ltd, Purchase Order 89408/MF. The work was carried out in accordance with the email proposal by Asset Geotechnical Engineering Pty Ltd (AssetGeo) dated 2 April 2019, reference 5498-P1.

Documents supplied to us for this investigation comprised:

- Email from Ivan Pasalich of Dabyne Planning, dated 27 March 2019, Request for Proposal, including a comprehensive briefing document dated 2 November 2018 that incorporates a Concept Plan from Doppelmayr Australia with further concept plans from Dabyne Planning.
- DA Drawing set Mount Perisher Chairlift Project; CLM Civil Job T-106, dwg Nos 1-11, dated 30/10/2019
- DA Drawing set Bottom Station; djrd Architects, Job 19_43, dwg Nos A0.0, A0.5, A1.0, A1.1, A2.0, A2.5, dated 23/9/19
- DA Drawing set Top Station: djrd Architects, Job 19_430, dwg Nos A0.0, A0.5, A1.0, A1.1, A2.0, A2.5, dated 23/9/19

Based on the supplied documents, we understand that Perisher Ski Resort seek to replace two existing chairlifts (Triple and Double) with a new larger capacity (six-person) chairlift. As part of this the top station for the Eyre T-Bar lift will need moving downhill slightly.

## 1.2 Scope of Work

The main objectives of the investigation were to assess the surface and subsurface conditions and to provide comments and recommendations relating to:

- Slope instability risk assessment as per AGS 2007.
- Site Classification to AS2870-2011.
- Excavation requirements and batter slopes.
- Subgrade preparation.
- Suitable footing systems and geotechnical design parameters for the footing systems.
- Groundwater conditions and control measures as required.

The following scope of work was carried out to achieve the project objectives:

- A review of existing regional maps and reports relevant to the site held within our files.
- Visual observations of surface features.
- Clearance of underground services at proposed test locations.
- Subsurface investigation at site selected locations to sample and assess the nature and consistency of subsurface conditions at accessible areas of the site.
- Engineering assessment and reporting.

This report must be read in conjunction with the attached "Important Information about your Geotechnical Report" in Appendix A. Attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein. Slope instability considerations presented in this report must be read in conjunction with the attached GeoGuides for Slope Management and Maintenance.

## 2. REGIONAL TOPOGRAPHY & GEOLOGY

The regional topography comprises moderately to steeply sloping terrain flanking the north-easterly then northerly flowing Perisher Creek, with ground slopes over the land flanking the river generally ranging from 10º to 30º and some locally steeper sections especially up Mt Perisher, and more gentle slopes over the river shoulders. Numerous drainage depressions and watercourses flow towards the river, with some of the persistent watercourses to the north of the river carved several metres into the underlying granite bedrock.

The site lies within the G-line as defined in DIPNR's "Geotechnical Policy – Kosciuszko Alpine Resorts", November 2003.

The 1:250,000 Tallangatta Geological Map indicates the site is underlain by Lower Devonian aged intrusive granites, microdiorites and tonalites.

## 3. FIELDWORK

The fieldwork was undertaken on 9 April 2019 by a Principal Geotechnical Engineer from AssetGeo and included invasive investigation at four locations and observations of site conditions at nine key inspection points (IPs) by walkover traverse of the route.

The IPs and invasive investigation locations are shown in the attached Figure 2 and were set out by our Principal Engineer by pacing measurements relative to existing site features. Each proposed pylon had been previously set out with a timber peg by Perisher Blue surveyors prior to the inspection. Ground levels have been estimated from the Dabyne Planning concept plan contours

Buried metallic services and utilities in the vicinity of the invasive test locations were cleared by Perisher Blue personnel.

The invasive investigation included excavation of two test pits by a tracked excavator to target top of weathered rock in the area of the Bottom Station (TP1 and TP2) and Pylons 1 and 2. Dynamic Cone Penetrometer (DCP) soundings were carried out at or near to the test pit location TP2 (shallow obstructions prevented probing elsewhere). At two of the proposed pylon locations (Pylon #3 and #8) hand auger boreholes were attempted but refused at shallow depth on top of weathered rock. Shallow obstructions and rock outcrops prevented hand augering or DCPs elsewhere.

The subsurface conditions encountered were logged during excavation and testing. On completion of logging and sampling, the test pits were backfilled with the excavation spoil.

Engineering logs are provided in Appendix B together with their explanatory notes.

## 4. SITE OBSERVATIONS

A summary of the observations made by Asset Geo are provided in the following sections. These should be read in conjunction with the attached figures and photograph portfolio.

## 4.1 General Observations

The proposed chairlift follows a similar alignment as the existing triple chairlift on Mt Perisher. The proposed six-person chairlift alignment descends over the steeply sloping (typically 30°) east facing mountainside to a moderately sloping north-east facing hillside down to the bottom station, the area of which is relatively flat.

At the time of the walkover inspection, the existing chairlift comprised metal and concrete top and bottom stations and thirteen intermediate pylons. The existing structures generally appeared to be in modest condition. Beyond the top station, the proposed new top station will replace an existing comms building that will be incorporated into the new structure.

Close by, to the south of the Triple Top Station, is the top station for the T-Bar lift. This is understood to be required to be relocated slightly downhill. The ground in the vicinity of the T-Bar station and comms building are gentler than the main mountain slopes at around 10-15 degrees.

Slightly weathered and fresh granite of at least high strength frequently outcropped across the hillside, particularly over the upper reaches, including at, or adjacent to, many of the proposed pylon locations.

We did not observe any signs of deep-seated hillside slope instability during the walkover inspection. The rough access track for quad bike and tracked plant is locally heavily eroded by the plant movement.

We note that at the time of the walkover inspections, the ground surface was ‘moist’ to ‘damp’ under foot, with localised shallow streams running clear water. Localised peat/moss deposits up to 200mm were observed. Generally, the drainage conditions across the hillside were considered good.

The geotechnical walk-over inspection was carried out from the top station progressing downhill. Investigation points (IPs) were numbered from top to bottom (See Figure 2).

## 4.2 Bottom Station and Pylons 1 and 2 Locations

The proposed bottom station and the adjacent pylons 1 and 2 are to be located around the footprint of the existing Bottom Station, over an area currently occupied by a gently sloping, undulating area covered with grass, as indicated in Plate 1. Proposed pylon 2 is close to existing pylon #1. Proposed pylon 1 and the new bottom station are located just to the south of the existing bottom station.

The Perisher Creek is located on the western edge of the platform and forms a meander around the site. Two creek crossings via steel bridges supported off screw piles are proposed. Sufficient provisional sums should be in place to cover any abortive installation of screw piles and subsequent repositioning or bridging over buried boulder obstructions.

The geotechnical investigation in this area (IP9) revealed an alluvial platform probably formed by flood over-flow consisting of a silty clayey sand with variable quantities of granite cobbles and boulders. Extremely weathered (soil-like) granite was positively located in TP2 at a depth of 0.45m below ground level (bgl), becoming highly weathered below 2.6m bgl. Groundwater was observed at 2.5m bgl just above the highly weathered rock. TP1 encountered alluvium until refusal on coarse boulders at a depth of 1.15m bgl. It is anticipated that extremely weathered granite would be a short depth below.

There was no sign of slope instability issues at this location.

**Plate 1**

**Plate 2 (Pylon #2)**

**Plate 3 (Pylon #1 and TP2)**

## 4.3 Proposed Pylon 3

The proposed Tower 3 location is situated towards the lower reaches of the hillside, on a relatively flat platform. It is close to existing pylon #3. There was dense heather cover, dead trees, and sparse alpine vegetation on the ground surface, with scattered granite corestones nearby, as shown in Plates 4 and 5. On the down slope side there was a distinct drop down to the trackway. Close to the proposed pylon position, a hand augered borehole was attempted though was challenging due to the dense vegetation (at IP8). The Topsoil was shown to be 500mm thick before the weathered granite was encountered. There are numerous granite boulders and floaters forming the platform.

There was no sign of slope instability issues at this location.

**Plate 4 (Pylon #3)**

**Plate 5 (Pylon #3 – downslope – large corestones)**

## 4.4 Proposed Pylon 4

The proposed Pylon 4 location is situated at a mound of granite corestones (torr) with scant topsoils or soils trapped between boulders. It is close to existing pylon #5. A group of small trees are set further back from the pylon base. The remainder of the slope (at approx. 15 degrees) is covered. A number of snow canons are close by. The torr is 5m to 10m high on the downhill face. The granite is only slightly weathered and very strong (IP7). There is a distinct sub-parallel near vertical joint close to the downhill face that could be at risk of ice wedging or tree root wedging. It is recommended this front sliver of rock is removed as part of the proposed works (see Plate 7).

**Plate 6 (Pylon #4)**

**Plate 7 (Pylon #4)**

## 4.5 Proposed Pylon 5

The proposed Pylon 5 location is situated over a small torr which graded down to the south at approximately 20 to 30 degrees. A gravel access track was located just to the north of the proposed pylon location, which was elevated approximately 1.5m below the tracks. This proposed pylon is located approximately between existing pylons #6 and #7. Granite bedrock outcropped and corestones were present all around. Small pockets of topsoil and dense alpine vegetation were present over the surface of the weathered granite bedrock at the proposed tower location (IP6). The adjacent trackway exposed completely weathered granite and showed some sign of erosion from overland stormwater flow.

There was no sign of slope instability issues at this location.

**Plate 8 (Pylon #5)**

## 4.6 Proposed Pylon 6

The proposed pylon 6 situated close to existing pylon #8, and a snow lance. It is at the uphill end of another small torr with outcropping granite bedrock and boulders as shown in Plates 9, 10 and 11. The ground surface is covered with alpine vegetation. The ground generally slopes to the south at around 5° to 10°.

A cover of topsoil could be made out in the open grassed area between a number of rocky outcrops. There could be some fill or disturbed ground from the adjacent existing pylon construction

There was no sign of slope instability issues at this location.

**Plate 9 (Pylon #6)**

**Plate 10 (Pylon #6, snow lance base downhill of proposed location showing construction against granite outcrop. )**

**Plate 11 (Pylon #6, torr below the proposed position)**

## 4.7 Proposed Pylon 7

The proposed Tower 7 location is situated close to existing pylon #12. Close by (downhill) is a spring line and stream with clear water running over the bedrock with peat/moss deposits up to 200mm thick either side as shown in Plate 12. In between the granite boulder slopes, the ground slope modestly at approximately 5 to 10°. Granite outcrops are to be observed all around (IP4).

There was no sign of slope instability issues at this location.

**Plate 12 (Pylon #7)**

## 4.8 Proposed Pylon 8

The proposed pylon #8 location is situated close to existing pylon #15, as shown in Plate 13. There were several granite corestones and many granite bedrock outcrops present nearby. A thin layer of topsoil and alpine vegetation were present over the surface of granite bedrock at the proposed Tower location (IP3). The ground slopes modestly at around 10°.

There was no sign of slope instability issues at this location.

**Plate 13 (Pylon #8)**

## 4.9 Proposed Top Station and Pylon 9/10

The proposed Top Station, and the nearby pylon #9/10 location, are close to the summit of Mt Perisher. Pylon #9/10 ("top pylon") is located a short distance downhill of the Top Station, where similar ground conditions are anticipated.

The new top station is to be over the footprint of the existing comms building (see Plate 14). The existing triple and double tops stations will be demolished. There was a light cover of alpine vegetation and grass on the ground surface, with scattered granite boulders and extensive bedrock outcrops nearby (IP2). The general ground slopes modestly at around 5 to 10°. Plate 15 shows a panorama view of the area of the proposed Top Station and the nearby Pylon #9/10.

There was no sign of slope instability issues at this location.

**Plate 14 (Top Station – existing comms building)**

**Plate 15 (Top Station Panorama)**

## 4.10 Proposed Relocated T-Bar Bull-Wheel

The location of the proposed new T-Bar bull-wheel is approximately 11.2m downhill of its present position. is located towards the crest of a south-east facing hillside. The hillside, just below the summit of Mt Perisher, slopes down at approximately 10-15°. Granite bedrock outcropped and corestones were prevalent throughout this area and along the crest (IP1), as shown in Plate 16. The ground surface has a thin cover of grass and low alpine shrubs. At this elevation (close to 2,000m) there are no trees.

There was no sign of slope instability issues at this location.

**Plate 16 (Relocated T-Bar Top Bull-Wheel)**

# 5. SUBSURFACE CONDITIONS

A generalised geotechnical model for the site has been developed is shown in Table 1. For a detailed description of the subsurface conditions, refer the attached engineering logs and explanatory notes. For specific design input, reference should be made to the logs and/or the specific test results, in place of the following summary. For the majority of pylons and the top station area, granite bedrock rock was exposed.

**Table 1 - Generalised Site Geotechnical Model**

| Unit | Origin | Description | Depth to Top of Unit [1] (m) | Unit Thickness [1] (m) |
|---|---|---|---|---|
| **Bottom Station** (TP1, TP2, DCP1, DCP2) | | | | |
| **1** | Topsoil | Silty Clayey Sand with roots, root content reducing with depth | Ground surface | 0.40 – 0.45 |
| **3a** | Alluvium | Variable, silty clayey SAND, sands are medium to coarse grained, compact, Variable granite cobble and boulder content. High boulder content at the base of TP1 | 0.40 – 0.45 | 0.75 – 2.15 |
| **4** | Bedrock | GRANITE, completely to highly weathered, extremely low to low strength, assessed very dense. | 2.5 (TP2) | Not proven |
| **Pylons & Top Station** | | | | |
| **1** | Topsoil | Silty Clayey Sand with roots | Ground surface | 0.2 – 0.5 |
| **2** | Inferred Bedrock | GRANITE cobbles within a fine to medium grained Silty SAND matrix, assessed very dense. | 0.2 – 0.5 | Unknown |

Notes:

1. The depths and unit thicknesses are based on the information from the test locations only and do not necessarily represent the maximum and minimum values across the site.

***Special Note for DCP testing***

*Caution must be used when inferring subsurface conditions from DCP results. Refusal can be encountered on obstructions such as gravel, cemented materials, rock floaters, or other inclusions within a soil mass. DCP testing on soils with a gravel component or cementation can indicate a higher density than actual. Also, the DCP results in clay soils are significantly affected by the in-situ moisture content. It is therefore strongly recommended that an experienced Geotechnical Engineer is engaged to confirm the inferred subsurface conditions during construction and to provide advice where subsurface conditions are significantly different.*

Groundwater was only observed in TP2 at a depth of 2.5m bgl. Close to Pylon 5, spring water was observed rising from the bedrock.

It is noted that the groundwater observation may have been made before water levels had stabilised. No long-term groundwater monitoring was carried out.

# 6. DISCUSSIONS & RECOMMENDATIONS

## 6.1 Key Geotechnical Site Constraints

Key geotechnical constraints to the development include potential slope instability, excavation conditions, groundwater control (during construction and long-term), temporary shoring (of deeper excavations), permanent retaining including embankment filling, and potentially variable foundation conditions. Recommendations for design and construction of the development are provided in the following sections.

## 6.2 Slope Instability Risk

A limited, preliminary level, risk assessment has been carried out for this site with regard to slope instability, using the methods of the AGS publication *"Landslide Risk Management",* (Reference 2).

The basis of the preliminary assessment undertaken for this site and important factors relating to slope conditions and the impacts of the development that commonly influence the risks of slope instability are discussed in the attached "Important Information about your Slope Instability Risk Assessment", and the attached GeoGuides.

The preliminary assessment has been carried out by:

- Consideration of the likely slope failure mechanisms and the likely initiating circumstances that could affect the elements at the site. The type and mode of landslide failure has also been classified.
- **Risk to Property.** For each case, the likely consequences with respect to future development have been considered. The current assessed probability of occurrence of each event has been estimated on a qualitative basis. The consequences and probability of occurrence have been combined for each case to provide the risk assessment.
- **Risk to Life**. For each case, the risk for the person most at risk is assessed based on multiplying the indicative annual probability of the occurrence of the hazard, the probability of spatial impact, the temporal probability, the vulnerability, and the probability of not evacuating. The risk is then compared with acceptable and tolerable risk criteria.

The following general potential hazards/events are identified for this site and relate to slope instability:

A. Shallow earth slide.
B. Deep-seated earth slide.
C. Translational earth slide (slow creep movement).
D. Rock topple (whole or partial) of detached granite boulders.
E. Instability of permanent cut/fill slopes.

This risk assessment considers the hazards / events identified as they affect the proposed Stations, Towers, and cables in-between. Tables A, C, and E provide our preliminary risk assessment with respect to risk to property, and Tables B, D, and F provide our preliminary risk assessment with respect to risk to life.

Provided the development is carried out in accordance with the recommendations in this report, a **Low Risk** is assessed with respect to property (during and post-construction) and the risk to life is assessed to be **Acceptable** (during and post-construction)**.** These risk levels are considered to be acceptable for the development.

The development should be carried out in accordance with good engineering practice that is described in the attached GeoGuides, and in accordance with the general recommendations in the following sections.

## 6.3 Footings

### *6.3.1 Bottom Station*

The testing carried out in the vicinity of the Bottom Station indicates that inferred bedrock is present at about 2 m to 3 m depth.

Filling overlying topsoil/remnant grass was encountered in the test pits, with the natural soils commencing at about 1.2 m depth at the two locations. The fill is not considered to be a suitable founding stratum as it does not appear to have been well-compacted and was placed over ground that does not appear to have been adequately prepared.

The Bottom Station could be founded on the underlying natural soils or on bedrock.

If founding on the underlying natural soils, a maximum allowable bearing pressure of 200 kPa could be adopted for very stiff or better clay soils or medium dense or better sandy soils, with the footing invert level at least 1.5 m (preferably 2 m) below existing ground level to ensure that adequate penetration into suitable quality soils is achieved and to enhance bearing capacity of the footing, as well as mitigation of the risk of creeping soils.

If founding on the bedrock, pile foundations may be more appropriate given the anticipated variation in rock depths which would make it impractical to carry out bulk excavation. A relatively conservative allowable bearing pressure of 800 kPa may be adopted for footings on moderately weathered, medium strength or better granite bedrock.

In accordance with AS2159-2009 "Piling–Design and Installation", for limit state design, the ultimate geotechnical pile capacity shall be multiplied by a geotechnical reduction factor (Φg). This factor is derived from an Average Risk Rating (ARR) which considers geotechnical uncertainties, redundancy of the foundation system, construction supervision, and the quantity and type of pile testing (if any). Where testing is undertaken, or more comprehensive ground investigation is carried out, it may be possible to adopt a larger Φg value that results in a more economical pile design. Further geotechnical advice will be required in consultation with the pile designer and piling contractor, to develop an appropriate Φg value.

Options for piles, if required, include:

> **Bored Piles.** It assessed that the construction of bored piles would require the use of a heavy track-mounted drilling rig. It is also assessed that the bored pile holes would probably require liners to support the overburden soils (particularly the fill). Also, groundwater may be expected within bored pile holes and dewatering by a down-hole pump may or pouring of concrete using tremie methods may be required.
>
> **Continuous Flight Auger (CFA) Piles.** CFA piles are constructed by drilling a hollow-stemmed continuous flight auger to the required founding depth. Concrete is then injected under pressure through the auger stem as the auger is extracted from the soil. The reinforcing cage is then inserted upon completion of the concreting process. Pile diameters vary from 300mm to 1200mm. Drilled spoil is produced during CFA piling, and must subsequently be removed from the site. CFA piles are considered non-displacement piles as defined in AS2159. This pile type might not be practical for this site depending on availability and cost of suitable equipment.

**Steel Screw Piles.** Hollow-stemmed steel piles fitted with a single or double helix at the tip are installed using specially modified hydraulic excavators. Shaft diameters typically vary from 90mm to 220mm and helix diameters vary from 350mm to 600mm. Single pile capacities range from 2 to 65 tonnes. The piles can be filled with concrete or grout post-installation to improve durability.

Groundwater control will also need to be considered particularly for deeper footing excavations and piles where the risk of encountering groundwater is likely to be significant. This will require temporary dewatering during footing excavation and pouring of concrete, and permanent groundwater control to reduce the risk of long-term groundwater softening of the foundation soils.

An experienced Geotechnical Engineer should review footing designs to check that the recommendations of the geotechnical report have been included and should assess footing excavations to confirm the design assumptions, particularly if piles to rock are adopted.

### 6.3.2 Bottom Station Surrounding Works

For the works surrounding the Bottom Station including concrete paving, a site classification of Class P (Problem site) is assessed as per AS2870-2011 'Residential Slabs and Footings'. This is due to the presence of variable natural soils beneath. This will require that footings be designed from first principles rather than standard designs.

Where subgrade preparation works as described in Section 6.4.2 are adopted, a maximum allowable bearing pressure of 100 kPa may be adopted for pavement that is formed on the prepared surface. To address the risk of differential movement, a site classification of Class H1 (Highly reactive) is suggested for design purposes, and structural jointing of slab panels should be incorporated.

### 6.3.3 Top Station and Pylons

For the works surrounding the Top Station and pylons including concrete paving, a site classification of Class A is assessed as per AS2870-2011 'Residential Slabs and Footings' as long as all footings are taken down to the granite bedrock.

Bedrock is anticipated to be exposed or at very shallow depth for the Top Station and many of the Towers, and therefore, footings on bedrock are appropriate. A maximum allowable bearing pressure of 600kPa may be adopted for such footings, assuming that the bedrock at footing subgrade level is relatively weathered. Higher bearing pressures may be available subject to further inspection at each footing. We understand that the footing design includes allowance for overturning forces and therefore tends to be relatively large footprint and relatively deep and designing for higher bearing pressures does not result in further optimisation of footing sizes.

Where bedrock is not exposed at footing subgrade levels at depths of at least 1.5m below ground level, and the exposed subgrade comprises medium dense or better weathered granite then footings on this material may be adopted and designed for a maximum allowable bearing pressure of 200kPa. Proving during construction should be carried out, comprising inspection by a Geotechnical Engineer, and / or testing by Dynamic Cone Penetrometer to at least 3m below the footing subgrade level.

Where suitable material is not encountered at footing subgrade level (e.g. loose sands or soft clays), options for footings include over-excavation to a suitable founding stratum and backfilling with mass concrete, or pile foundations as per Section 6.3.1.

## 6.4 Earthworks

### *6.4.1 Excavation*

The excavation for the proposed development is anticipated to be partially within soils, partially within cobbles/boulders, and possibly some excavation within granite bedrock. Excavation within the soils should be achievable using conventional earthmoving equipment (i.e. hydraulic excavator bucket).

Excavation within the cobble/boulders and granite bedrock may require low-energy explosive charges in drill holes filled with water or another suitable low-energy methodology.

### *6.4.2 Subgrade Preparation*

The following general recommendations are provided for subgrade preparation for earthworks, pavements, slab-on-ground construction, and structures including reinforced earth:

- Strip existing fill and topsoil. Remove unsuitable materials from the site (e.g. material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate residual soils (and rock if required) to design subgrade level, stockpiling for re-use as engineered fill or remove to spoil.
- Where rock is exposed at footing invert level, it should be free of loose, “drummy" and softened material before concrete is poured.
- Where soil is exposed at bulk excavation level, compact the upper 150mm depth to a dry density ratio (AS1289.5.4.1–2007) not less than 100% Standard.
- Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a dry density ratio not less than 100%.

For the paving and general landscaping around the Bottom Station where variable natural soils exist, an alternative subgrade preparation could be considered which would involve placing a ‘bridging’ layer of stronger material over the poorer ground. This would reduce (but not eliminate) the risk of excessive differential settlement. This preparation could comprise:

- Strip existing topsoil and organic matter. Remove unsuitable materials from the site (e.g. material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate to design subgrade level, stockpiling suitable soils for re-use as engineered fill or remove to spoil.
- Inspect subgrade by a Geotechnical Engineer and carry out further excavation if required (e.g. where loose/soft or worse soils are exposed).
- Place suitable geofabric (e.g. Bidim A34 or equivalent) with minimum 1m overlaps over subgrade.
- Place nominal 50mm thick predominantly sandy soils over the geofabric and then 300mm thick (loose) layer of predominantly coarse granular material with a maximum particle size of 100mm to 150mm. Track-roll this material using suitable construction equipment until no further surface subsidence occurs.
- Where the predominantly coarse granular layer is not well-graded, place geofabric over the surface to provide material separation from the overlying fill.
- Place further engineered fill as per Section 6.4.3 to achieve design subgrade level. Suitable fill should be free of contamination and organic matter or other deleterious material and should preferably be well-graded and non-reactive (to changes in moisture content).

Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate disposal to an appropriately licensed landfill facility. Further advice should be sought from a specialist environmental consultant if required.

### 6.4.3 *Filling*

Where filing is required, place in horizontal layers over prepared subgrade and compact as per Table 2.

**Table 2 – Compaction Specifications**

| Parameter | Cohesive Fill | Non Cohesive Fill |
|---|---|---|
| Fill layer thickness (loose measurement):<br>• Within 1.5m of the rear of retaining walls<br>• Elsewhere | <br>0.2m<br>0.3m | <br>0.2m<br>0.3m |
| Density:<br>• Beneath Pavements<br>• Beneath Structures<br>• Upper 150mm of subgrade | <br>≥ 95% Std<br>≥ 98% Std<br>≥ 100% Std | <br>≥ 70% ID<br>≥ 80% ID<br>≥ 80% ID |
| Moisture content during compaction | ± 2% of optimum | Moist but not wet |

Filling within 1.5m of the rear of any retaining walls should be compacted using lightweight equipment (e.g. hand-operated plate compactor or ride-on compactor not more than 3 tonnes static weight) to limit compaction-induced lateral pressures.

Fill batters should be constructed by over-filling beyond the design batter surface then trimming back after compaction. Fill placed as part of reinforced earth wall construction should be in accordance with the design and specification for that work.

Any soils to be imported onto the site for back-filling and reinstatement of excavated areas should be free of contamination and deleterious material and should include appropriate validation documentation in accordance with current regulatory authority requirements which confirms its suitability for the proposed land use. Further advice should be sought from a specialist environmental consultant if required.

### 6.4.4 *Batter Slopes*

Recommended maximum slopes for permanent and temporary batters are presented in Table 3.

**Table 3 – Recommended Maximum Dry Batter Slopes**

| Unit | Maximum Batter Slope (H : V) | |
|---|---|---|
| | **Permanent** | **Temporary** |
| **Residual Soils** | 2 : 1 | 1 : 1 |
| **Granite Cobbles/Boulders** | 1 : 1 | 0.75 : 1 |
| **MW, Medium strength, or better Granite** | 0.5 : 1 * | 0.25 : 1 * |

* subject to inspection by a Geotechnical Engineer and carrying out remedial works as recommended (e.g. shotcrete, rock bolting).

## 7. RECOMMENDATIONS

The following recommendations are provided:

### 7.1 Establishment of Design Parameters

The development of the Mt Perisher Ski Lift shall be carried out in accordance with the requirements and recommendations of this report.

### 7.2 Detailed Design for the Construction Certificate

Structural design relating to the geotechnical aspects of the proposed development shall be checked and certified by a suitably qualified and experienced Geotechnical Engineer as being in accordance with the geotechnical recommendations.

### 7.3 Construction

Geotechnical inspection (be it physically on site or by verifiable proxy or remote methods) shall be carried out during construction at the following stages, to ensure that the requirements of the geotechnical report are followed:

a) Footing excavations shall be inspected prior to pouring concrete.

b) All cut batters shall be inspected immediately after cutting and remedial works carried out, as directed by the Geotechnical Engineer.

c) Filling shall be tested for compaction and material quality suitability in accordance with the earthworks methodology to be developed for the Construction Certificate.

### 7.4 Ongoing Management of the Site/Structure

No specific maintenance measures are required with respect to geotechnical conditions.

## 8. LIMITATIONS

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited investigations. To confirm the assessed soil and rock properties in this report, further investigation would be required such as coring and strength testing of rock and should be carried out if the scale of the development warrants, or if any of the properties are critical to the design, construction, or performance of the development.

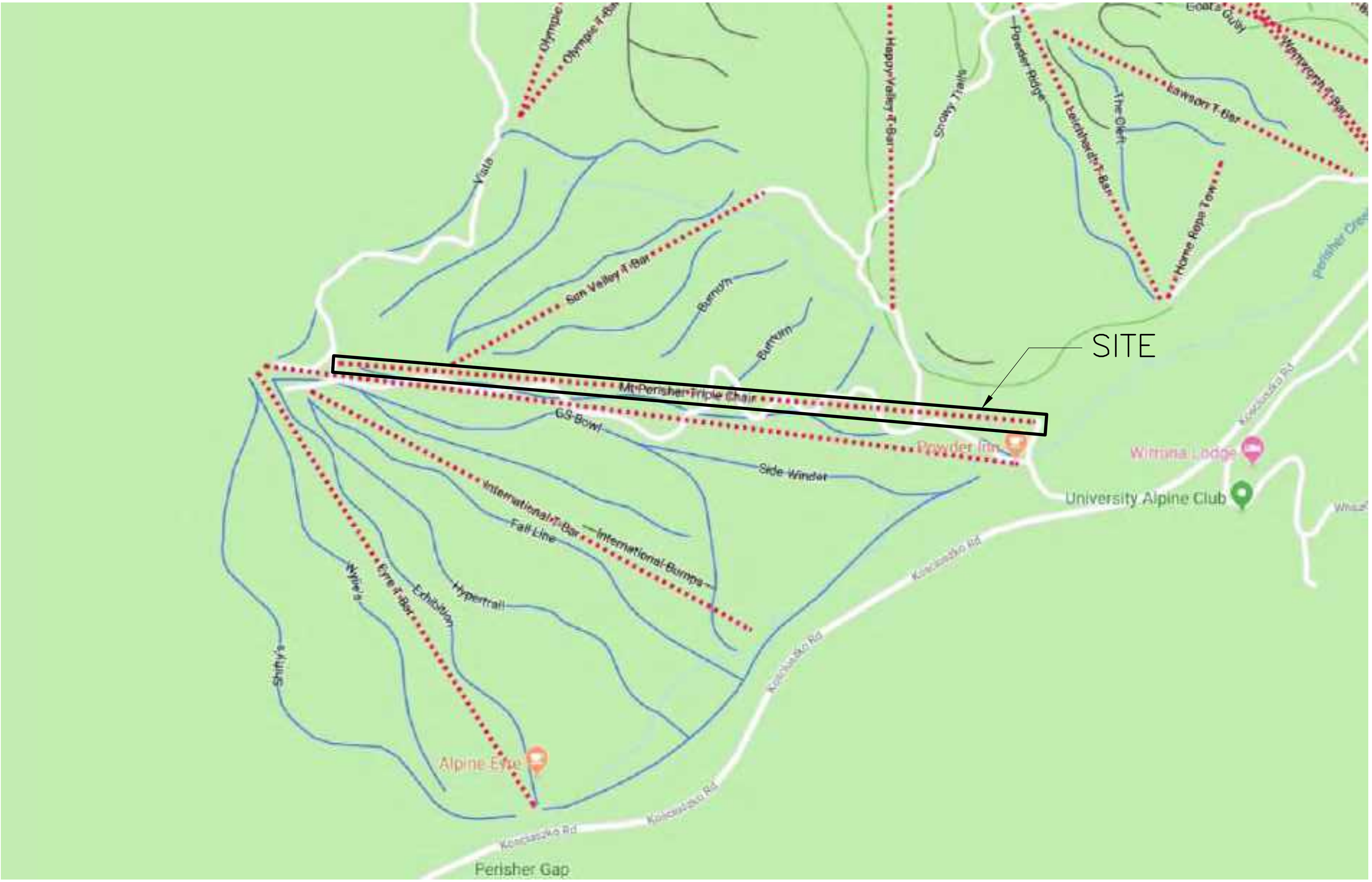
It is recommended that a qualified and experienced Geotechnical Engineer be engaged to provide further input and review during the design development; including site visits during construction to verify the site conditions and provide advice where conditions vary from those assumed in this report. Development of an appropriate inspection and testing plan should be carried out in consultation with the Geotechnical Engineer.

This report may have included geotechnical recommendations for design and construction of temporary works (e.g. temporary batter slopes or temporary shoring of excavations). Such temporary works are expected to perform adequately for a relatively short period only, which could range from a few days (for temporary batter slopes) up to six months (for temporary shoring). This period depends on a range of factors including but not limited to: site geology; groundwater conditions; weather conditions; design criteria; and level of care taken during construction. If there are factors which prevent temporary works from being completed and/or which require temporary works to function for periods longer than originally designed, further advice must be sought from the Geotechnical Engineer and Structural Engineer.

This report and details for the proposed development should be submitted to relevant regulatory authorities that have an interest in the property or are responsible for services that may be within or adjacent to the site, for their review.

Asset accepts no liability where our recommendations are not followed or are only partially followed. The document "Important Information about your Geotechnical Report" in Appendix A provides additional information about the uses and limitations of this report.

# FIGURES

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| issue | date | description |
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| A | 18.6.19 | INITIAL ISSUE |


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PROPOSED SKI CHAIRLIFT
PERISHER SKI RESORT,
KOSCIUSZKO NATIONAL PARK NSW
for
PERISHER BLUE

SITE LOCALITY

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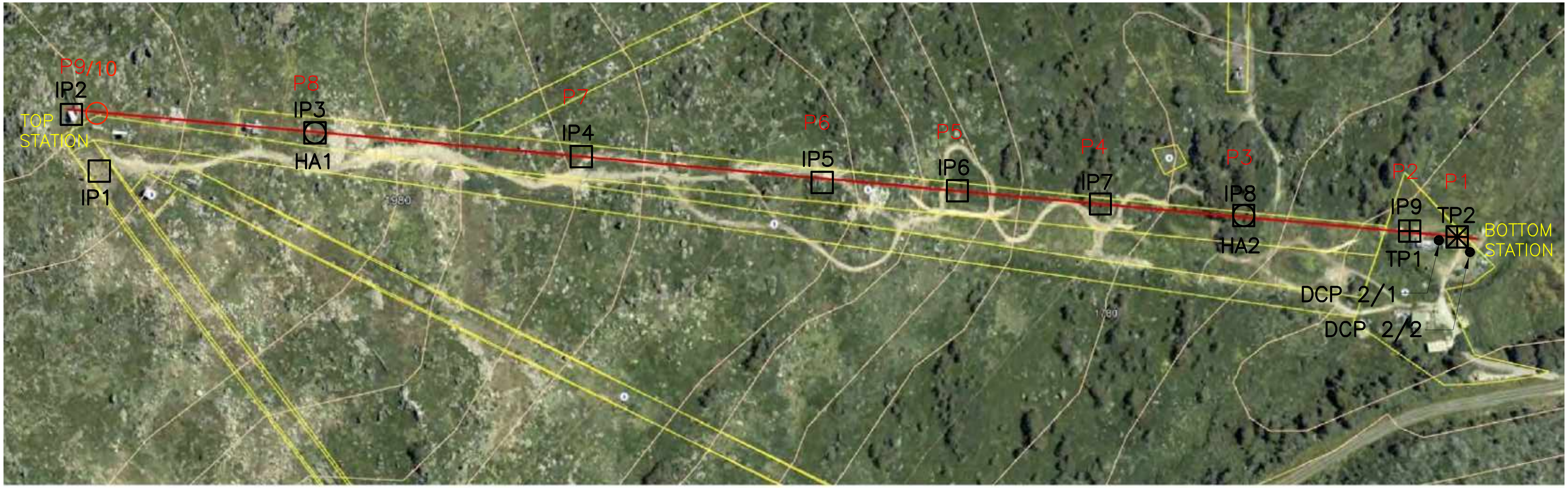
**fig:** 1
**issue:** A




KEY

☐ IP = INSPECTION POINT

HA = HAND AUGER

☒ DCP = DYNAMIC CONE PENETROMETER

⊞ TP = TEST PIT

P# = PROPOSED PYLON

N

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SOURCE: CONCEPT PLAN (PREPARED BY: DABYNE PLANNING)

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for
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INVESTIGATION LOCATION PLAN

| | | | |
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## APPENDIX A

Important Information about your Geotechnical Report
Important Information about your Slope Instability Risk Assessment
GeoGuides (pp1-17)

# Important Information about your Geotechnical Report

## SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Asset Geotechnical Engineering Pty Ltd ("Asset"), for the specific site investigated. The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

The report should not be used if there have been changes to the project, without first consulting with Asset to assess if the report's recommendations are still valid. Asset does not accept responsibility for problems that occur due to project changes if they are not consulted.

## RELIANCE ON DATA

Asset has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, Asset will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Asset.

## GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

## LIMITATIONS OF SITE INVESTIGATION

The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behavior with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether or not changes should be considered as the project proceeds.

## SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

## VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

## REPRODUCTION OF REPORTS

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

## REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

## DATA MUST NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the site assessment, and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

## PARTIAL USE OF REPORT

Where the recommendations of the report are only partially followed, there may be significant implications for the project and could lead to problems. Consult Asset if you are not intending to follow all of the report recommendations, to assess what the implications could be. Asset does not accept responsibility for problems that develop where the report recommendations have only been partially followed if they have not been consulted.

## OTHER LIMITATIONS

Asset will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

# Important Information about your Slope Risk Assessment

## BASIS OF THE ASSESSMENT

Our assessment of the stability of the land is presented in the framework of Landslide Risk Management (Australian Geomechanics Society, Vol 42, No 1, March 2007). The attached GeoGuides provide further information on landslide risk management and maintenance.

This assessment is based on a visual inspection of the property and also the immediate adjoining land. Limited subsurface investigation may also have been undertaken as part of this appraisal. Slope monitoring has not been carried out within or adjacent to the property for the purpose of this appraisal. The opinions ex- pressed in this report also take into account our relevant local experience.

The property is within an area where landslip and/or subsidence have occurred, or where there is a risk that slope instability may occur. Important factors relating to slope conditions and the impact of development which commonly influence the risks of slope instability are discussed herein.

An owner's decision to acquire, develop or build on land within an area such as this involves the understanding and acceptance of a level of risk. It is important to recognise that soil and rock movements are an ongoing geological process, which may be affected by development and land management within the site or on ad- joining land. Soil and rock movements may cause visible damage to structures even where the risk of slope failure is considered low. This report is intended only to assess the risk of slope failure, apparent at the time of inspection.

Our opinion is provided on the present risk of slope instability for the land specifically referenced in the title to this report. Foundations suitable for future building development are discussed in relation to slope stability considerations. Limited foundation advice may be provided. If so, advice is intended to guide the footing design for the proposed development. However, this report is not intended as, is not suitable for, and must not be used in lieu of a detailed foundation investigation for final design and costing of foundations, retaining walls or associated structures.

## LIMITATIONS OF THE ASSESSMENT PROCEDURE

The assessment procedures carried out for this appraisal are in accordance with the recommendations in Landslide Risk Management (Australian Geomechanics Society, Vol 42, No 1, March 2007), and with accepted local practice.

The following limitations must be acknowledged:

- the assessment of the stability of natural slopes requires a great degree of judgment and personal experience, even for experienced practitioners with good local knowledge;
- the assessment must be based on development of a sound geological model; slope processes and process rates influencing land sliding or landslide potential will vary according to geomorphologic influences;
- the likelihood that land sliding may occur on a given slope is generally hard to predict and is associated with significant uncertainties;
- different practitioners may produce different assessments of risk;
- actual risk of land sliding cannot be determined; risk changes with time;
- consequences of land sliding need to be considered in a rational framework of risk acceptance;
- acceptable risk in relation to damage to property from landslide activity is subjective; it remains the responsibility of the owner and/or local authority to decide whether the risk is acceptable; the geotechnical practitioner can assist with this judgment;
- the extent and methods of investigation for assessment of landslide risk will be governed by experience, by the perceived risk level, and by the degree to which the risk or consequences of land sliding are accepted for a specific project;
- the assessment may be required at a number of stages of the project or development; frequently (due to time or budget constraints imposed by the client) there will be no opportunity for long-term monitoring of the slope behaviour or groundwater conditions, or for on-going opportunity for the slope processes and performance of structures to be reviewed during and after development; such limitations should be recognised as relevant to the assessment.

## DEVELOPMENT ON SLOPES

Some risk of slope instability is always attached to the development of land on slopes.

Guidelines for hillside construction and examples of good practices for hillside developments are described in the attached GeoGuides.

# THE AUSTRALIAN GEOGUIDES
# FOR SLOPE MANAGEMENT AND MAINTENANCE

**AGS Landslide Taskforce, Slope Management and Maintenance Working Group**

The Australian Geomechanics Society (AGS) presents on the following pages a guideline on slope management and maintenance, as part of the landslide risk management guidelines developed under the National Disaster Funding Program (NDMP). This Guideline is aimed at home owners, developers and local councils, but also has applicability to a larger audience which includes builders and contractors, consultants, insurers, lawyers, government departments and in fact any person, or organisation, with a responsibility for the management or maintenance of a slope. The objective is to inform those with little or no knowledge of geotechnical engineering about landslides.

Each GeoGuide is a stand-alone document, which is formatted so that it can be printed on two sides of a single A4 sheet. It is expected that the set of GeoGuides will increase with time to cover a range of topics. As things stand:

- **GeoGuide LR1** is an introductory sheet that should be read by all users, since it explains what the LR (landslide risk) series is about and defines terms.
- **GeoGuides LR2, 3 and 4** explain why landslides occur and provide information on different types of landslide.
- **GeoGuide LR5** discusses the critical part that water often plays in relation to landslide occurrence and discusses measures that can be adopted to limit its effect.
- **GeoGuide LR6** refers to retaining walls and their maintenance.
- **GeoGuide LR7** puts the concept of landslide risk into an everyday context, so users can relate a particular landslide risk to other risks that they know they are prepared to take, sometimes on a daily basis.
- **GeoGuide LR8** retains the ideas of good and poor hillside construction practice originally provided by an AGS sub-committee in 1985.
- **GeoGuide LR9** concentrates specifically on effluent and surface water disposal, which is an important topic in some development areas.
- **GeoGuide LR10** is specifically aimed at those who have property on the coast and could be susceptible to coastal erosion processes.
- **GeoGuide LR11** provides information about the benefits of keeping records on inspection and maintenance activities and provides a proforma record sheet for users.

It is recognised that the GeoGuides are likely to be upgraded from time to time. Feedback on use and suggested changes should be sent to the National Chair of the Australian Geomechanics Society. The latest versions of the GeoGuides will be downloadable from the AGS website www.australiangemechanics.org

Through the NDMP, Australian governments (at Commonwealth, State and Local Government levels) are also funding the development of a Landslide Zoning Guideline (AGS 2007a), and a Practice Note Guideline (AGS 2007c) to which interested readers seeking in-depth information should refer.

## ACKNOWLEDGEMENTS

These guidelines have been prepared by The Australian Geomechanics Society with funding from the National Disaster Mitigation Program, the Sydney Coastal Councils Group, and The Australian Geomechanics Society.

The Australian Geomechanics Society established a Working Group within a Landslide Taskforce to develop the guidelines. The development of the guidelines was managed by a Steering Committee. Membership of the Working Group, Taskforce and Steering Committee is listed in the Appendix.

Drafts of these GeoGuides have been subject to review by members of the AGS Landslide Taskforce, members of the geotechnical profession and local government.

## REFERENCES

AGS (2007a) Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Management. Australian Geomechanics Society, *Australian Geomechanics*, Vol 42, No1.

AGS (2007c). Practice Note Guidelines for Landslide Risk Management. Australian Geomechanics Society. *Australian Geomechanics*, Vol 42, No1,

AGS (2007e). The Australian GeoGuides for slope management and maintenance –. Australian Geomechanics Society. *Australian Geomechanics*, Vol 42, No 1, - this paper.

# AUSTRALIAN GEOGUIDE LR1 (INTRODUCTION)

## INTRODUCTION TO LANDSLIDE RISK

Photographs courtesy of Greg Kotze and Tony Phillips

### AUSTRALIAN GEOGUIDES

The **Australian GeoGuides (LR series)** are a set of information sheets on the subject of landslide risk management and maintenance, published by the Australian Geomechanics Society (AGS). They provide background information intended to help people without specialist technical knowledge understand the basic issues involved. Topics covered include:

| | | |
|---|---|---|
| LR1 - Introduction | LR2 - Landslides | LR3 - Landslides in Soil |
| LR4 - Landslides in Rock | LR5 - Water & Drainage | LR6 - Retaining Walls |
| LR7 - Landslide Risk | LR8 - Hillside Construction | LR9 - Effluent & Surface Water Disposal |
| LR10 - Coastal Landslides | LR11 - Record Keeping | |

The GeoGuides explain why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local authority approval (if required) to remove, or reduce, the risk they represent.

Preparation of the GeoGuides has been funded by Australian governments through the National Disaster Mitigation Program (NDMP). This is a national program aimed at identifying and addressing natural disaster risk priorities across Australia. Technical input has been provided by experienced geotechnical engineers, engineering geologists and local government and government agency representatives from around Australia.

### BACKGROUND

A number of landslides and cliff collapses occurred in Australia in the 1980's and 1990's in which lives were lost. Of these the Thredbo landslide probably received the most publicity, but there were several others. During this period the AGS issued a number of advisory notes to practitioners in relation to the assessment of landslide risk and its reduction. Building on these notes, and responding to changes in technology, a technical paper known as AGS2000 was prepared. It was followed in 2002 by an intensive nation-wide educational campaign attended by a large number of interested professionals from government departments and private industry. This resulted in an increased awareness of the risks associated with unstable slopes and a changed approach in many government departments responsible for regional planning, domestic development, roads, railways and the maintenance of natural features such as cliffs.

### STATUS OF THE GEOGUIDES

The GeoGuides reflect the essence of good practice as perceived by a large number of geotechnical engineers, engineering geologists and other practitioners such as local government planners. **The GeoGuides are generic and do not, and cannot, constitute advice in relation to a specific situation. This must be sought from a geotechnical practitioner with first hand knowledge of the site.** It is expected that some local councils will refer to the GeoGuides and their companion publications in planning and building legislation. Check with your local council to see how it regards these documents. Companion publications to the GeoGuides are:

- AGS (2007a) Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Management Australian Geomechanics Society, *Australian Geomechanics*, Vol 42, No1 and its associated commentary (AGS 2007b).
- AGS (2007c). Practice Note Guidelines for Landslide Risk Management. Australian Geomechanics Society. *Australian Geomechanics*, Vol 42, No1 2007, and its associated "Commentary" (AGS 2007d).

Copies of the above documents are available on the AGS website www.australiangeomechanics.org

# AUSTRALIAN GEOGUIDE LR1 (INTRODUCTION)

**TERMINOLOGY**

Terminology tends to change with time and place and with the context in which it is used. The terms listed below have the following meanings in the GeoGuides:

| | |
|---|---|
| Consequence | the outcome, or potential outcome, arising from the occurrence of a landslide expressed quantitatively, or qualitatively, in terms of loss, disadvantage, damage, injury, or loss of life. |
| Discontinuity | in relation to the ground is a crack, a bedding plane (a boundary between strata) or fault (a plane along which the ground has sheared) which forms a plane of weakness and reduces the overall strength of the ground. |
| Equilibrium | the condition when the forces on a mass of soil or rock in the ground, or on a retaining structure, are equal and opposite. |
| Factor of safety (FOS) | theoretically the forces available to prevent a part of the ground, or a retaining structure, from moving divided by those trying to move it. A FOS of one or less indicates that failure is likely to occur, but not how likely it is. To allow for unknowns and to limit movements engineers always aim to achieve a FOS significantly larger than one. |
| Failure | when part of the ground experiences movement as a result of the out of balance forces on it. Failure of a retaining structure means it is no longer able to fulfil its intended function. |
| Geotechnical practitioner | when referred to in the Australian GeoGuides (LR series), is a professional geotechnical engineer, or engineering geologist, with chartered status in a recognised national professional institution and relevant training, experience and core competencies in landslide risk assessment and management. In some government departments, technical officers are specifically trained to undertake some of the functions of a geotechnical practitioner. |
| Hazard | a condition with the potential for causing an undesirable consequence. In relation to landslides this includes the location, size, speed, distance of travel and the likelihood of its occurrence within a given period of time. |
| Landslide | the movement, or the potential movement, of a mass of rock, debris, or earth down a slope. |
| Likelihood | a qualitative description of probability, or frequency, of occurrence. |
| Partial saturation | the condition in the ground above the water table where both air and water are present as well as soil, or rock. |
| Perched water table | a water table above the true water table supported by a low permeability stratum. |
| Permeability | a measure of the ability of the ground to allow water to flow through it. |
| Risk | a measure of the probability and severity of an adverse effect to life, health, property or the environment. |
| Slip failure | landslide. |
| Stable | the condition when failure will not occur. Over geological time no part of the ground can be considered stable. Over short periods (eg the life of a structure) stability implies a very low likelihood of failure. |
| Retaining structure | anything built by humans which is intended to support the ground and inhibit failure. |
| Structure | in relation to rock, or soil, means the spacing, extent, orientation and type of discontinuities found in the ground at a particular location. |
| Tension crack | a distinct open crack that normally develops in the ground around a landslide and indicates actual, or imminent , failure. |
| Water table | the level in the ground below which it is saturated and the voids are filled with water. |

# AUSTRALIAN GEOGUIDE LR2 (LANDSLIDES)

## LANDSLIDES

**What is a Landslide?**

Any movement of a mass of rock, debris, or earth, down a slope, constitutes a “landslide”. Landslides take many forms, some of which are illustrated. More information can be obtained from Geoscience Australia, or by visiting its Australian Landslide Database at www.ga.gov.au/urban/factsheets/landslide.jsp. Aspects of the impact of landslides on buildings are dealt with in the book "Guideline Document Landslide Hazards" published by the Australian Building Codes Board and referenced in the Building Code of Australia. This document can be purchased over the internet at the Australian Building Codes Board's website www.abcb.gov.au .

Landslides vary in size. They can be small and localised or very large, sometimes extending for kilometres and involving millions of tonnes of soil or rock. It is important to realise that even a 1 cubic metre boulder of soil, or rock, weighs at least 2 tonnes. If it falls, or slides, it is large enough to kill a person, crush a car, or cause serious structural damage to a house. The material in a landslide may travel downhill well beyond the point where the failure first occurred, leaving destruction in its wake. It may also leave an unstable slope in the ground behind it, which has the potential to fail again, causing the landslide to extend (regress) uphill, or expand sideways. For all these reasons, both "potential" and "actual" landslides must be taken very seriously. They present a real threat to life and property and require proper management.

Identification of landslide risk is a complex task and must be undertaken by a geotechnical practitioner (GeoGuide LR1) with specialist experience in slope stability assessment and slope stabilisation.

**What Causes a Landslide?**

Landslides occur as a result of local geological and groundwater conditions, but can be exacerbated by inappropriate development (GeoGuide LR8), exceptional weather, earthquakes and other factors. Some slopes and cliffs never seem to change, but are actually on the verge of failing. Others, often moderate slopes (Table 1), move continuously, but so slowly that it is not apparent to a casual observer. In both cases, small changes in conditions can trigger a landslide with serious consequences. Wetting up of the ground (which may involve a rise in ground water table) is the single most important cause of landslides (GeoGuide LR5). This is why they often occur during, or soon after, heavy rain. Inappropriate development often results in small scale landslides which are very expensive in human terms because of the proximity of housing and people.

**Does a Landslide Affect You?**

Any slope, cliff, cutting, or fill embankment may be a hazard which has the potential to impact on people, property, roads and services. Some tell-tale signs that might indicate that a landslide is occurring are listed below:

- open cracks, or steps, along contours
- ground water seepage, or springs
- bulging in the lower part of the slope
- hummocky ground
- trees leaning down slope, or with exposed roots
- debris/fallen rocks at the foot of a cliff
- tilted power poles, or fences
- cracked or distorted structures

These indications of instability may be seen on almost any slope and are not necessarily confined to the steeper ones (Table 1). Advice should be sought from a geotechnical practitioner if any of them are observed. Landslides do not respect property boundaries. As mentioned above they can "run-out" from above, "regress" from below, or expand sideways, so a landslide hazard affecting your property may actually exist on someone else's land.

Local councils are usually aware of slope instability problems within their jurisdiction and often have specific development and maintenance requirements. **Your local council is the first place to make enquiries if you are responsible for any sort of development or own or occupy property on or near sloping land or a cliff.**

**TABLE 1 - Slope Descriptions**

| Appearance | Slope Angle | Maximum Gradient | Slope Characteristics |
|---|---|---|---|
| Gentle | 0° - 10° | 1 on 6 | Easy walking. |
| Moderate | 10° - 18° | 1 on 3 | Walkable. Can drive and m anoeuvre a car on driveway |
| Steep | 18° - 27° | 1 on 2 | Walkable with effort. Possible to drive straight up or down roughened concrete driveway, but cannot practically manoeuvre a car. |
| Very Steep | 27° - 45° | 1 on 1 | Can only climb slope by cl utching at vegetation, rocks etc. |
| Extreme | 45° - 64° | 1 on 0.5 | Need rope access to climb slope |
| Cliff | 64° - 84° | 1 on 0.1 | Appears vertical. Can absei l down. |
| Vertical or Overhang | 84° - 90±° | Infinite | Appears to o verhang. Abseiler likely to lose contact with the face. |

Some typical landslides which could affect residential housing are illustrated below:

# AUSTRALIAN GEOGUIDE LR2 (LANDSLIDES)

**Rotational or circular slip failures (Figure 1) -** can occur on moderate to very steep soil and weathered rock slopes (Table 1). The sliding surface of the moving mass tends to be deep seated. Tension cracks may open at the top of the slope and bulging may occur at the toe. The ground may move in discrete "steps" separated by long periods without movement. More rapid movement may occur after heavy rain.

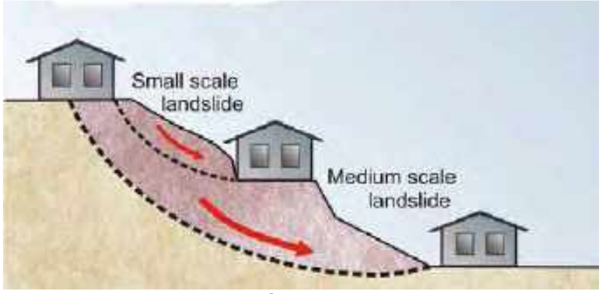


Figure 1

**Translational slip failures (Figure 2) -** tend to occur on moderate to very steep slopes (Table 1) where soil, or weak rock, overlies stronger strata. The sliding mass is often relatively shallow. It can move, or deform slowly (creep) over long periods of time. Extensive linear cracks and hummocks sometimes form along the contours. The sliding mass may accelerate after heavy rain.

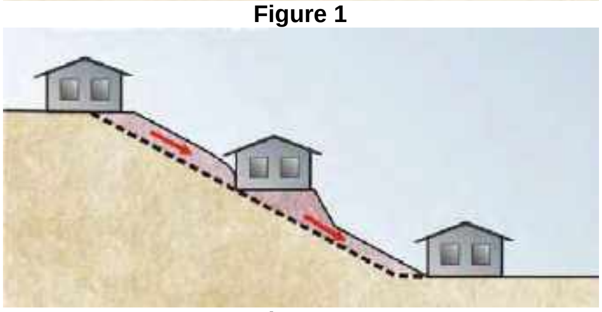

Figure 2

**Wedge failures (Figure 3) -** normally only occur on extreme slopes, or cliffs (Table 1), where discontinuities in the rock are inclined steeply downwards out of the face.

**Rock falls (Figure 3) -** tend to occur from cliffs and overhangs (Table 1).

Cliffs may remain apparently unchanged for hundreds of years. Collections of boulders at the foot of a cliff may indicate that rock falls are ongoing. Wedge failures and rock falls do not "creep". Familiarity with a particular local situation can instil a false sense of security since failure, when it occurs, is usually sudden and catastrophic.

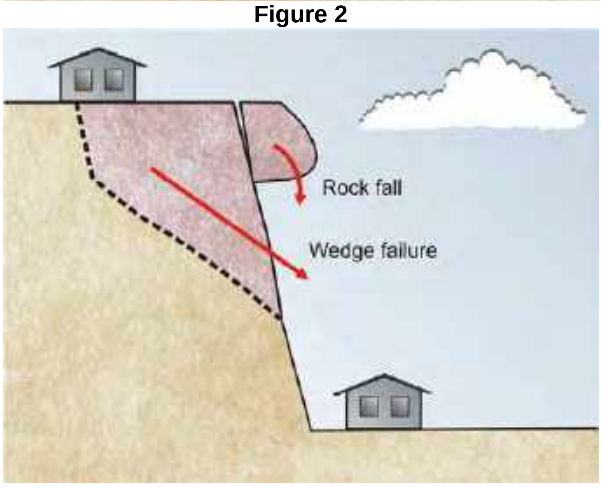


Figure 3

**Debris flows and mud slides (Figure 4)** - may occur in the foothills of ranges, where erosion has formed valleys which slope down to the plains below. The valley bottoms are often lined with loose eroded material (debris) which can "flow" if it becomes saturated during and after heavy rain. Debris flows are likely to occur with little warning; they travel a long way and often involve large volumes of soil. The consequences can be devastating.

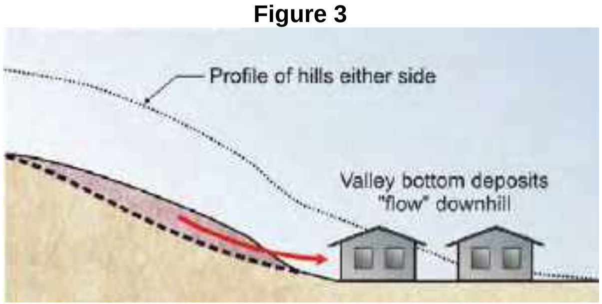


Figure 4

**More information relevant to your particular situation may be found in other Australian GeoGuides:**

- GeoGuide LR1 - Introduction
- GeoGuide LR3 - Soil Slopes
- GeoGuide LR4 - Rock Slopes
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

# AUSTRALIAN GEOGUIDE LR3 (LANDSLIDES IN SOIL)

## LANDSLIDES IN SOIL

Landslides occur on soil slopes and the consequences can include damage to property and loss of life. Soil slopes exist in all parts of Australia and can even occur in places where rock outcrops can be seen on the surface. If you live on, or below, a soil slope it is important to understand why a landslide might occur and what you can do to reduce the risk it presents.

It is always worth asking the question *"why is this slope here?"*, because the answer often leads to an understanding of what might happen in the future. Slopes are usually formed by weathering (breakdown) and erosion (physical movement) of the natural ground - the "parent material". Many factors are involved including rain, wind, chemical change, temperature variation, plant growth, animal activity and our own human enthusiasm for development. The general process is outlined in Figure 1.

The upper levels of the parent material progressively weather over thousands, or millions, of years, losing strength. This can result in a surface layer which looks similar to the parent material (although its colour has probably changed) but has the strength of a soil - this is called "residual soil". At some stage the weathered surface layer is exposed to the elements and fragments are transported down the slope. In this context a fragment could be a single sand grain, a boulder, or a landslide. The time scale could be anything from a few seconds to many thousands of years. The transported fragments often collect on the lower slopes and form a new soil layer that blankets the original slope - "colluvium". If material reaches a river or the sea it is deposited as "alluvium" or as a "marine deposit". With appropriate changes in river and sea level this material can again find itself on the surface to commence another cycle of weathering and erosion. In places often, but not only, near the coast, this can include sand sized fragments which form beaches and are sometimes blown back onto the land to form dunes.

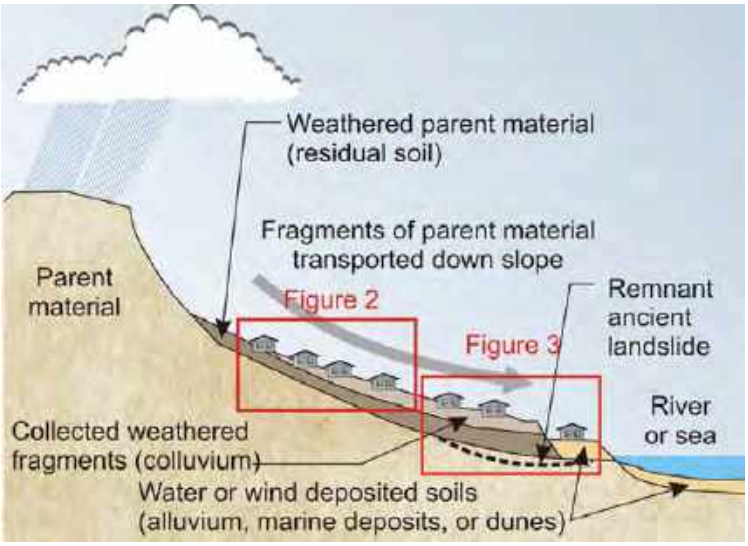


**Figure 1**

Landslides can occur almost anywhere on a soil slope. Slides can be rotational, translational, or debris flows (see GeoGuide LR2) and may have a number of causes.

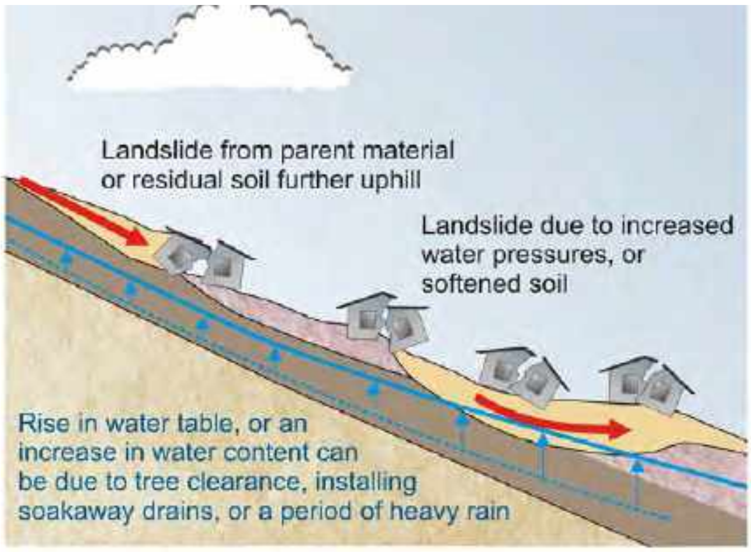


**Figure 2**

# AUSTRALIAN GEOGUIDE LR3 (LANDSLIDES IN SOIL)

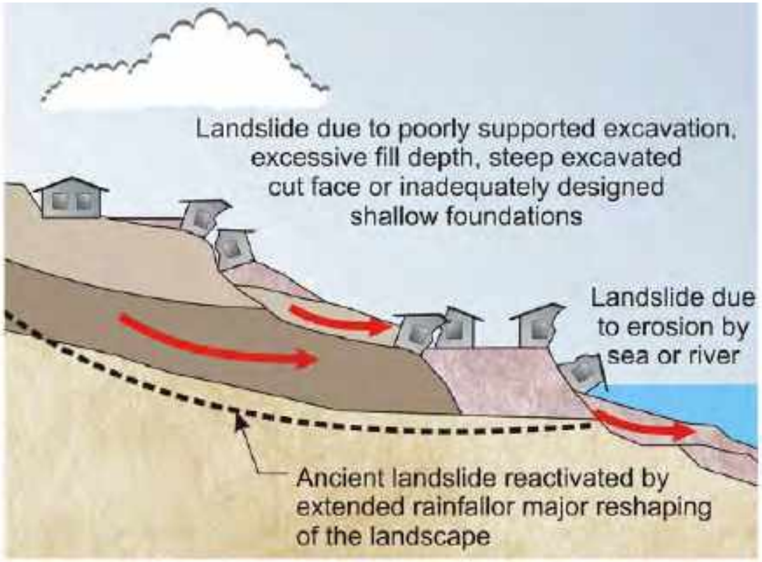


**Figure 3**

Some of the more common causes of landslides in soil are:

1) Falls of the parent material or residual soil from above, due to natural weathering processes (Figure 2).
2) Increased moisture content and consequent softening of the soil, or a rise in the water table. These can be due to excessive tree clearance, ill-considered soak-away drainage or septic systems, or heavy rainfall (Figure 2).
3) Excavation without adequate support, increased surface load from fill placement, or inadequately designed shallow foundations (Figure 3).
4) Natural erosion at the toe of the slope due to scour by a river or the sea (Figure 3).
5) Re-activation of an ancient landslide (Figure 3).

Most soil slopes appear stable, but they all achieved their present shape through a process of weathering and erosion and are often sensitive to minor changes in the factors that affect their stability. As a general rule, human activities only improve the situation if they have been designed to do so. Once this idea is understood, it is probably easy to see why the following basic rules are so important and should not be ignored without seeking site specific advice from a geotechnical practitioner:

- Do not clear trees unnecessarily.
- Do not cut into a slope without supporting the excavated face with an engineer designed structure.
- Do not add weight to a slope by placing earth fill or constructing buildings with inadequately designed shallow foundations (Note: in certain circumstances weight is added to the toe of a slope to inhibit landslide movement, but this must be carried out in accordance with a proper engineering design).
- Do not allow water from storm water drains, or from septic waste or effluent disposal systems to soak into the ground where it could trigger a landslide.

More information in relation to good and poor hillside construction practice is given in GeoGuide LR8. With appropriate engineering input it is often possible to reduce the likelihood, or consequences, of a landslide and so reduce the risk to property and to life. Such measures can include the construction of properly designed storm water and sub-soil drains, surface protection (GeoGuide LR5) and retaining walls (GeoGuide LR6). **Design should be undertaken by a geotechnical practitioner and will normally require local council approval.**

**More information relevant to your particular situation may be found in other Australian GeoGuides:**

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
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# AUSTRALIAN GEOGUIDE LR4 (LANDSLIDES IN ROCK)

## LANDSLIDES IN ROCK

Rocks have been formed by many different geological processes and may have been subjected to intense pressure, large scale distortion, extreme temperature and chemical change. As a result there are many different rock types and their condition varies enormously. Rock strength varies and is often significantly reduced by the presence of discontinuities (GeoGuide LR1). You may think that rock lasts forever, but in reality it weathers under the combined effects of water, wind, chemical change, temperature variation, plant growth and animal activity and erodes with time. Rock is often the parent material that ends up forming soil slopes (GeoGuide LR3). Inevitably different rocks have different physical and chemical characteristics and they weather and erode to form different types of soil.

Weathering can lead to landslides (GeoGuide LR2) on rock slopes. The type of landslide depends on the nature of rock, the way it has weathered and the presence or absence of discontinuities. It is hard to generalise, though normally a specific combination of discontinuities and material types will be the determining factor and these are often underground and out of sight. Typical examples are provided in the figures 1 to 4. A geotechnical practitioner can assess the landslide risk and propose appropriate maintenance measures. This often entails making geological observations over an area significantly larger than the site and a review of available background information, including records of known landslides and aerial photographs. Depending on the amount of information available, geotechnical investigation may or may not be needed. Every site is different and every site has to be assessed individually.

**It is impossible to predict exactly when a landslide will occur on a rock slope, but failure is normally sudden and the consequences can be catastrophic.**

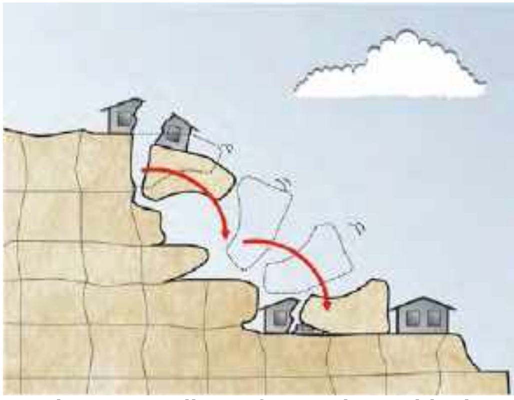

**Figure 1 - Failure of an undercut block**

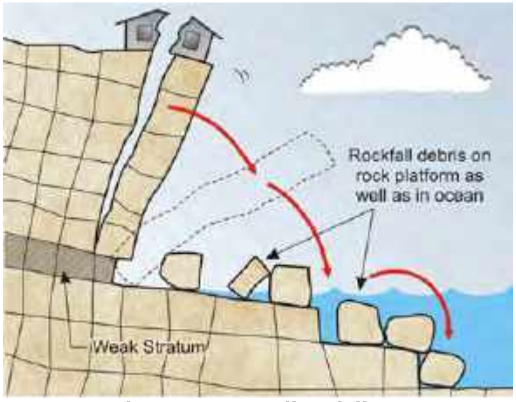


**Figure 2 - Toppling failure**

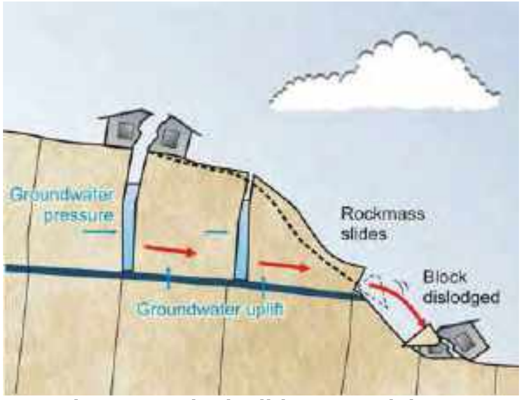


**Figure 3 - Block slide on weak layer**

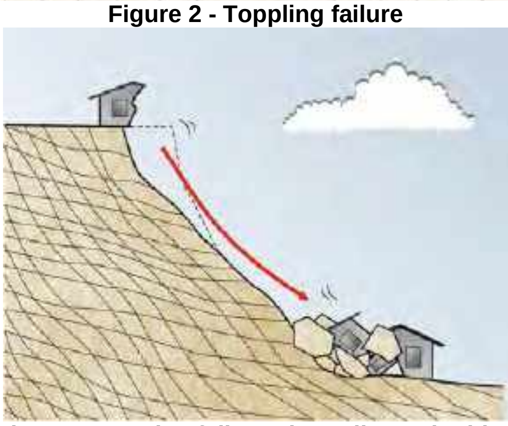

**Figure 4 - Wedge failure along discontinuities**

If the landslide risk is assessed as being anything other that Low, or Very Low, (GeoGuide LR7) it may be possible to carry out work aimed at reducing the level of risk.

The most common options are:

1) Trimming the slope to remove hazardous blocks of rock.
2) Bolting, or anchoring, to fix hazardous blocks in position and prevent movement.
3) Installation of catch fences and other rockfall protection measures to limit the impact of rockfalls.
4) Deep drainage designed to limit changes in the ground water table (GeoGuide LR5).

Although such measures can be effective, they need inspection and on-going maintenance (GeoGuide LR11) if they are to be effective for periods equivalent to the life of a house. **Design should be undertaken by a geotechnical practitioner and will normally require local council approval.** It should be appreciated that it may not be viable to carry out remedial works in all circumstances: for example where the landslide is on someone else's property, where the cost is out of proportion to the value of the property, or where the risk inherent in carrying out the work is actually greater than the risk of leaving things as they are. In situations such as these, development may be considered inappropriate.

# AUSTRALIAN GEOGUIDE LR4 (LANDSLIDES IN ROCK)

## ROCK SLOPE HAZARD REDUCTION MEASURES

**Removal of loose blocks** - may be effective but, depending on rock type, ongoing erosion can result in more blocks becoming unstable within a matter of years. Routine inspection, every 5 or so years, may be required to detect this.

**Rock bolts and rock anchors** (Figure 5) - can be installed in the ground to improve its strength and prevent individual blocks from falling. Rock bolts are usually tightened using a torque wrench, whilst rock anchors carry higher loads and require jacking. Both can be designed to be "permanent" using stainless steel, or sheathing, to inhibit corrosion, but the cost can be up to 10 times that of the "temporary" alternative. You should inspect rock bolts and rock anchors for signs of water seepage, rusting and deterioration around the heads at least once every 5 years. If you notice any of these warning signs, have them checked by a geotechnical practitioner. It is recommended that you keep copies of design drawings and maintenance records (GeoGuide LR11) for the anchors on your site and pass them on to the new owner should you sell.

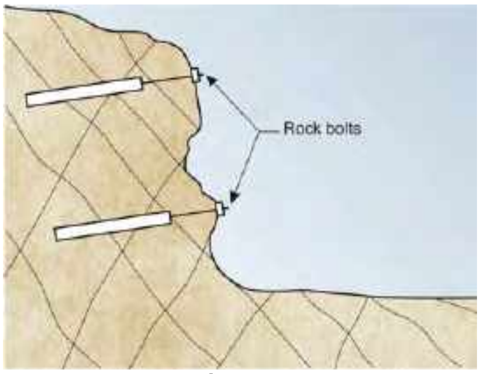


**Figure 5**

**Rock fall netting, catch fences and catch pits** (Figure 6) - are designed to catch or control falling rocks and prevent them from damaging nearby property. You should inspect them at least once every 5 years, and after major falls, and arrange for fallen and trapped rocks to be removed if they appear to be filling up. Check for signs of corrosion and replace steel elements and fixings before they lose significant strength.

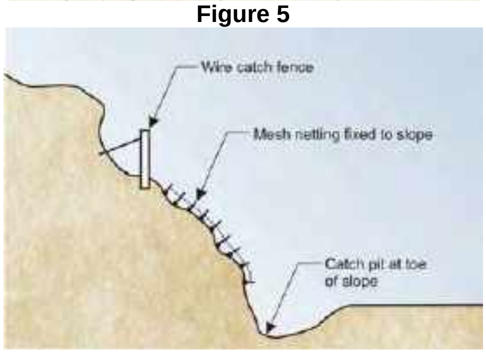


**Figure 6**

**Cut-off drains** (Figure 7) - can be used to intercept surface water run-off and reduce flows down the cliff face. Suitable drains are often excavated into the rock, or constructed from mounds of concrete, or stabilised soil, depending on conditions. Drains must be laid to a fall of at least 1% so they drain adequately. Frequent inspection is needed to ensure they are not blocked and continue to function as intended.

**Clear trees and large bushes** (Figure 7) - from slopes since roots can prize boulders from the face increasing the landslide hazard.

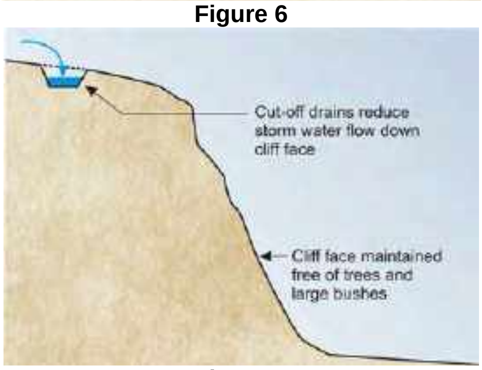


**Figure 7**

**Natural cliffs and bluffs** - often present the greatest hazard and yet are easily overlooked, because they have "been there forever". They can exist above a building, road, or beach, presenting the risk of a rock falling onto whatever is below. They also sometimes support buildings with a fine view to the horizon. Cliffs should be observed frequently to ensure that they are not deteriorating. You may find it convenient to use binoculars to look for signs of exposed "fresh" rock on the face, where a recent fall has occurred, or to go to the foot of the cliff from time to time to see if debris is collecting. A thorough inspection of a cliff face is often a major task requiring the use of rope access methods and should only be undertaken by an appropriately qualified professional. If tension cracks are observed in the ground at the top of a cliff take immediate action, since they could indicate imminent failure. **If you have any concerns at all about the possibility of a rock fall seek advice from a geotechnical practitioner.**

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## WATER, DRAINAGE & SURFACE PROTECTION

One way or another, water usually plays a critical part in initiating a landslide (GeoGuide LR2). For this reason, it is a key factor to be controlled on sites with more than a low landslide risk (GeoGuide LR7).

### Groundwater and Groundwater Flow

The ground is permeable and water flows through it as illustrated in Figure 1. When rain falls on the ground, some of it runs along the surface ("surface water run-off") and some soaks in, becoming groundwater. Groundwater seeps downwards along any path it can find until it meets the water table: the local level below which the ground is saturated. If it reaches the water table, groundwater either comes to a halt in what is effectively underground storage, or it continues to flow downwards, often towards a spring where it can seep out and become surface water again. Above the water table the ground is said to be "partially saturated", because it contains both water and air. Suctions can develop in the partially saturated zone which have the effect of holding the ground together and reducing the risk of a landslide. Vegetation and trees in particular draw large quantities of water out of the ground on a daily basis from the partially saturated zone. This lowers the water table and increases suctions, both of which reduce the likelihood of a landslide occurring.

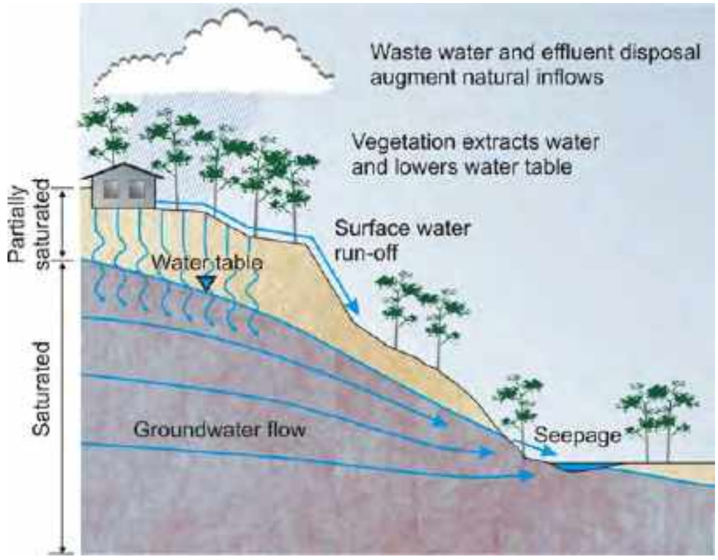


**Figure 1 - Groundwater flow**

### Groundwater Flow and Landslides

The landslide risk in a hillside can be affected by increase in soak-away drainage or the construction of retaining walls which inhibit groundwater flow. The groundwater is likely to rise after heavy rain, but it can also rise when human interference upsets the delicate natural balance. Activities such as felling trees and earthworks can lead to:

- a reduction in the beneficial suctions in the partially saturated zone above the water table.
- increased static water pressures below the water table,
- increased hydraulic pressures due to groundwater flow,
- loss of strength, or softening, of clay rich strata,
- loss of natural cementing in some strata,
- transportation of soil particles.

Any of these effects, or a combination of them, can lead to landslides like those illustrated in GeoGuides LR2, LR3 and LR4.

### Limiting the Effect of Water

Site clearance and construction must be carefully considered if changes in groundwater conditions are to be limited. GeoGuide LR8 considers good and poor development practices. Not surprisingly much of the advice relates to sensible treatment of water and is not repeated here. Adoption of appropriate techniques should make it possible to either maintain the current ground water table, or even cause it to drop, by limiting inflow to the ground.

If drainage measures and surface protection are relied on to keep the risk of a landslide to a tolerable level, it is important that they are inspected routinely and maintained (GeoGuide LR11).

The following techniques may be considered to limit the destabilising effects of rising groundwater due to development and are illustrated in Figure 2.

# AUSTRALIAN GEOGUIDE LR5 (WATER & DRAINAGE)

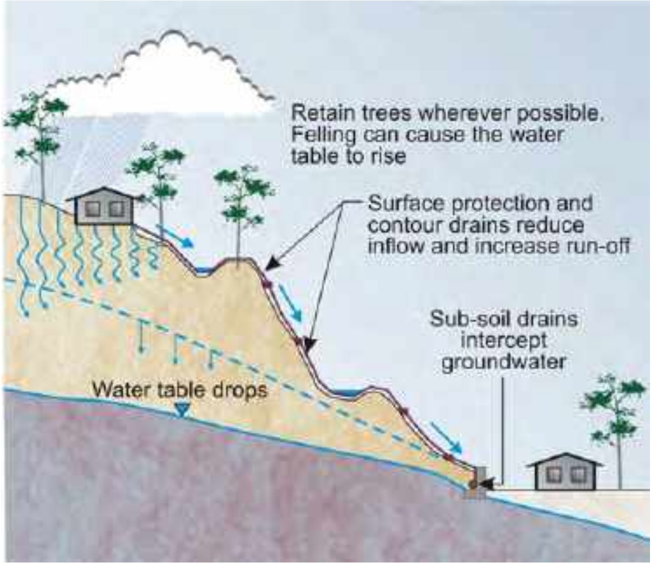


**Figure 2 - Techniques used to control groundwater flow**

**Surface water drains** (dish drains, or table drains) - are often used to prevent scour and limit inflow to a slope. Other than in rock, they are relatively ineffective unless they have an impermeable lining. You should clear them regularly, and as required, and not less than once a year. If you live in an area with seasonal rainfall, it is best to do this near the end of the dry season. If you notice that soil or rock debris is falling from the slope above, determine the source and take appropriate action. This may mean you have to seek advice from a geotechnical practitioner.

**Surface protection** - is sometimes used in addition to surface water drainage to prevent scour and minimise water inflow to a slope. You should inspect concrete, shotcrete or stone pitching for cracking and other signs of deterioration at least once a year. Make sure that weepholes are free of obstructions and able to drain. If the protection is deteriorating, you should seek advice from a geotechnical practitioner.

**Sub-soil drains** - are often constructed behind retaining walls and on hillsides to intercept groundwater. Their function is to remove water from the ground through an appropriate outlet. It is important that subsoil drains are designed to complement other measures being used. They should be laid in a sand, or gravel, bed and protected with a graded stone or geotextile filter to reduce the chance of clogging. Sub-soil drains should always be laid to a fall of at least 1 vertical on 100 horizontal. Ideally the high end should be brought to the surface, so it can be flushed with water from time to time as part of routine maintenance procedures.

**Deep, underground drains** - are usually only used in extreme circumstances, where the landslide risk is assessed as not being tolerable and other stabilisation measures are considered to be impractical. They work by permanently lowering the water table in a slope. They are not often used in domestic scale developments, but if you have any on your site be aware that professional maintenance is essential. If they are not maintained and stop working, the water table will rise and a landslide may even occur during normal weather conditions. Both an increase or a reduction in the normal flow from deep drains could indicate a problem if it appears to be unrelated to recent rainfall. If changes of this sort are observed, you should have the drains and your site checked by a geotechnical practitioner.

**Documentation** - design drawings and specifications for geotechnical measures intended to minimise landslide risk can be of great assistance to a geotechnical specialist, or structural engineer, called in to inspect and report on them. Copies of available documentation should be retained and passed to the new owner when the property is sold (GeoGuide LR11). You should also request details of an appropriate maintenance program for drainage works from the designer and keep that information with other relevant documentation and maintenance records.

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## RETAINING WALLS

Retaining walls are used to support cuts and fills. Some are built in the open and backfill is placed behind them (gravity walls). Others are inserted into the ground (cast *in situ* or driven piles) and the ground is subsequently excavated on one side. Retaining walls, like all man-made structures, have a finite life. Properly engineered walls should last 50 years, or more, without needing significant repairs. However, not all walls fit this category. Some, particularly those built by inexperienced tradesmen without engineering input, can deflect and even fail because they are unable to withstand the pressures that develop in the ground around them or because the materials from which they are built deteriorate with time. **Design of retaining walls more than 900mm high should be undertaken by a geotechnical practitioner or structural engineer and normally require local council approval.**

Retaining walls have to withstand the weight of the ground on the high side, any water pressure forces that develop, any additional load (surcharge) on the ground surface and sometimes swelling pressures from expansive clays. These forces are resisted by the wall itself and the ground on the low side. Engineers calculate the forces that the retained ground, the water, and the surcharge impose on a wall (the disturbing force) as well as the maximum force that the wall and ground on the low side can provide to resist them (the restoring force). The ratio of the restoring force to the disturbing force is called the "factor of safety" (GeoGuide LR1). Permanent retaining walls designed in accordance with accepted engineering standards will normally have a factor of safety in the range 1.5 to 2.

**Never** add surcharge to the high side of a wall (e.g. place fill, erect a structure, stockpile bulk materials, or park vehicles) unless you know the wall has been designed with that purpose in mind.

**Never** more than lightly water plants on the high side of a retaining wall.

**Never** excavate at the toe of a retaining wall.

Any of these actions will reduce the factor of safety of the wall and could lead to failure. If in doubt about any aspect of an existing retaining wall, or changes you would like to make near one, seek advice from a geotechnical practitioner, or a structural engineer. This GeoGuide sets out basic inspection requirements for retaining walls and identifies some common signs that might indicate all is not well. GeoGuide LR11 provides information about records that should be kept.

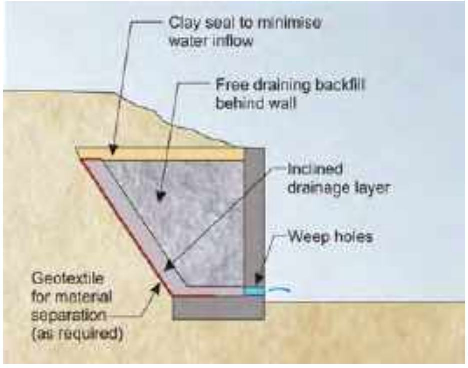


**Figure 1- Typical formed concrete wall**

### GRAVITY WALLS

Gravity walls are so called because they rely on their own weight (the force of gravity) to hold the ground behind in place.

**Formed concrete and reinforced blockwork walls** (Figure 1) **-** should be built so the backfill can drain. They should be inspected at least once a year. Look for signs of tilting, bulging, cracking, or a drop in ground level on the high side, as any of these may indicate that the wall has started to fail. Look for rust staining, which may indicate that the steel reinforcement is deteriorating and the wall is losing structural strength ("concrete cancer"). Ensure that weep holes are clear and that water is able to drain at all times, as high water pressures behind the wall can lead to sudden and catastrophic failure.

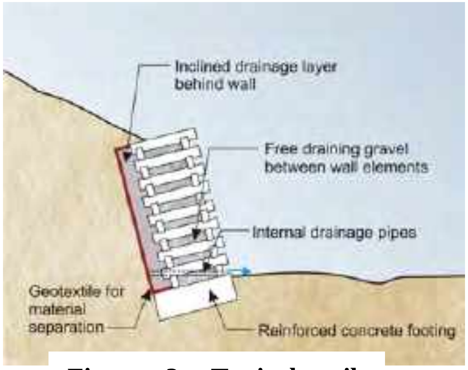


**Figure 2 -Typical crib**

**Concrete "crib" walls** (Figure 2) **-** should be filled with clean gravel, or "blue metal" with a nominated grading. Sometimes soil is used to reduce cost, but this is undesirable, from an engineering perspective, unless internal drainage is incorporated in the wall's construction. Without backfill drainage, a soil filled crib wall is likely to have a lower factor of safety than is required. Crib walls should be inspected as for formed concrete walls. In addition, you should check that material is not being lost through the structure of the wall, which has large gaps through it.

**Timber "crib" walls -** should be checked as for concrete crib walls. In addition, check the condition of the timber. Once individual elements show signs of rotting, it is necessary to have the wall replaced. If you are uncertain seek advice from a geotechnical practitioner, or a structural engineer.

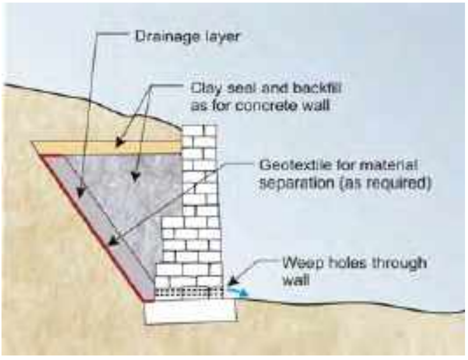


**Figure 3 -Typical masonry wall**

**Masonry walls: natural stone, brick, or interlocking blocks** (Figure 3) - more than about 1m high, should be wider at the bottom than at the top and include specific measures to permit drainage of the backfill. They should be checked as for formed concrete walls. Natural stone walls should be inspected for signs of deterioration of the individual blocks: strength loss, corners becoming rounded, cracks appearing, or debris from the blocks collecting at the foot of the wall.

# AUSTRALIAN GEOGUIDE LR6 (RETAINING WALLS)

**Old Masonry walls** (Figure 4) - Many old masonry retaining walls have not been built in accordance with modern design standards and often have a low "factor of safety" (GeoGuide LR1). They may therefore be close to failure and a minor change in their condition, or loading, could initiate collapse. You need to take particular care with such structures and seek professional advice sooner rather than later. Although masonry walls sometimes deflect significantly over long periods of time collapse, when it occurs, is usually sudden and can be catastrophic. Familiarity with a particular situation can instil a false sense of confidence.

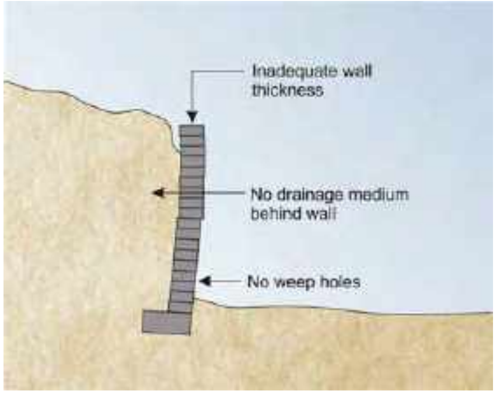


**Figure 4 - Poorly built masonry wall**

**Reinforced soil walls** (Figure 5) **-** are made of compacted select fill in which layers of reinforcement are buried to form a "reinforced soil zone". The reinforcement is all important, because it holds the soil "wall" together. Reinforcement may be steel strip, or mesh, or a variety of geosynthetic ("plastic") products. The facing panels are there to protect the soil "wall" from erosion and give it a finished appearance.

Most reinforced soil walls are proprietary products. Construction should be carried out strictly in accordance with the manufacturer's instructions. Inspection and maintenance should be the same as for formed concrete and concrete block walls. If unusual materials such as timber, or used tyres, are used as a facing it should be checked to see that it is not rotting, or perishing.

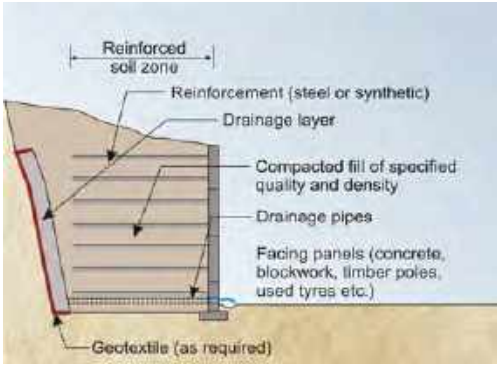


**Figure 5 - Typical reinforced soil wall**

### OTHER WALLS

**Cantilevered and anchored walls** (Figure 6) **-** rely on earth pressure on the low side, rather than self-weight, to provided the restoring force and an adequate factor of safety. These walls may comprise:

- a line of touching bored piers (contiguous bored pile wall) or
- sprayed concrete panels between bored piers (shotcrete wall) or
- horizontal timber or concrete planks spanning between upright timber or steel soldier piles or
- steel sheet piles.

Depending on the form of construction and ground conditions, walls in excess of 3 m height normally require at least one row of permanent ground anchors.

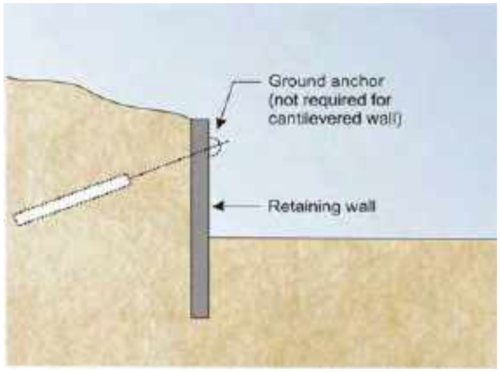


**Figure 6 - Typical cantilevered or anchored wall**

### INSPECTION

All walls should be inspected at least once a year, looking for tilting and other signs of deterioration. Concrete walls should be inspected for cracking and rust stains as for formed concrete gravity walls. Contiguous bored pile walls can have gaps between the piles - look for loss of soil from behind which can become a major difficulty if it is not corrected. Timber walls should be inspected for rot, as for timber crib walls. Steel sheet piles should be inspected for signs of rusting. In addition, you should make sure that ground anchors are maintained as described in GeoGuide LR4 under the heading "Rock bolts and rock anchors".

One of the most important issues for walls is that their internal drainage systems are operational. Frequently verify that internal drainage pipes and surface interception drains around the wall are not blocked nor have become inoperative.

**More information relevant to your particular situation may be found in other Australian GeoGuides:**

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR7 - Landslide Risk
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## LANDSLIDE RISK

### Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

### Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

**Landslide risk assessment must be undertaken by a geotechnical practitioner**. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

### Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

**TABLE 2: LIKELIHOOD**

| Likelihood | Annual Probability |
|---|---|
| Almost Certain | 1:10 |
| Likely | 1:100 |
| Possible | 1:1,000 |
| Unlikely | 1:10,000 |
| Rare | 1:100,000 |
| Barely credible | 1:1,000,000 |

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

**TABLE 1: RISK TO PROPERTY**

| Qualitative Risk | | Significance - Geotechnical engineering requirements |
|---|---|---|
| Very high | VH | **Unacceptable** without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low. May be too expensive and not practical. Work likely to cost more than the value of the property. |
| High | H | **Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property. |
| Moderate | M | **May be tolerated** in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as possible. |
| Low | L | **Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required. |
| Very Low | VL | **Acceptable**. Manage by normal slope maintenance procedures. |

# AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

**Risk to Life**

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

**TABLE 3: RISK TO LIFE**

| **Risk** (deaths per participant per year) | **Activity/Event Leading to Death** (NSW data unless noted) |
|---|---|
| 1:1,000 | Deep sea fishing (UK) |
| 1:1,000 to 1:10,000 | Motor cycling, horse riding , ultra-light flying (Canada) |
| 1:23,000 | Motor vehicle use |
| 1:30,000 | Fall |
| 1:70,000 | Drowning |
| 1:180,000 | Fire/burn |
| 1:660,000 | Choking on food |
| 1:1,000,000 | Scheduled airlines (Canada) |
| 1:2,300,000 | Train travel |
| 1:32,000,000 | Lightning strike |

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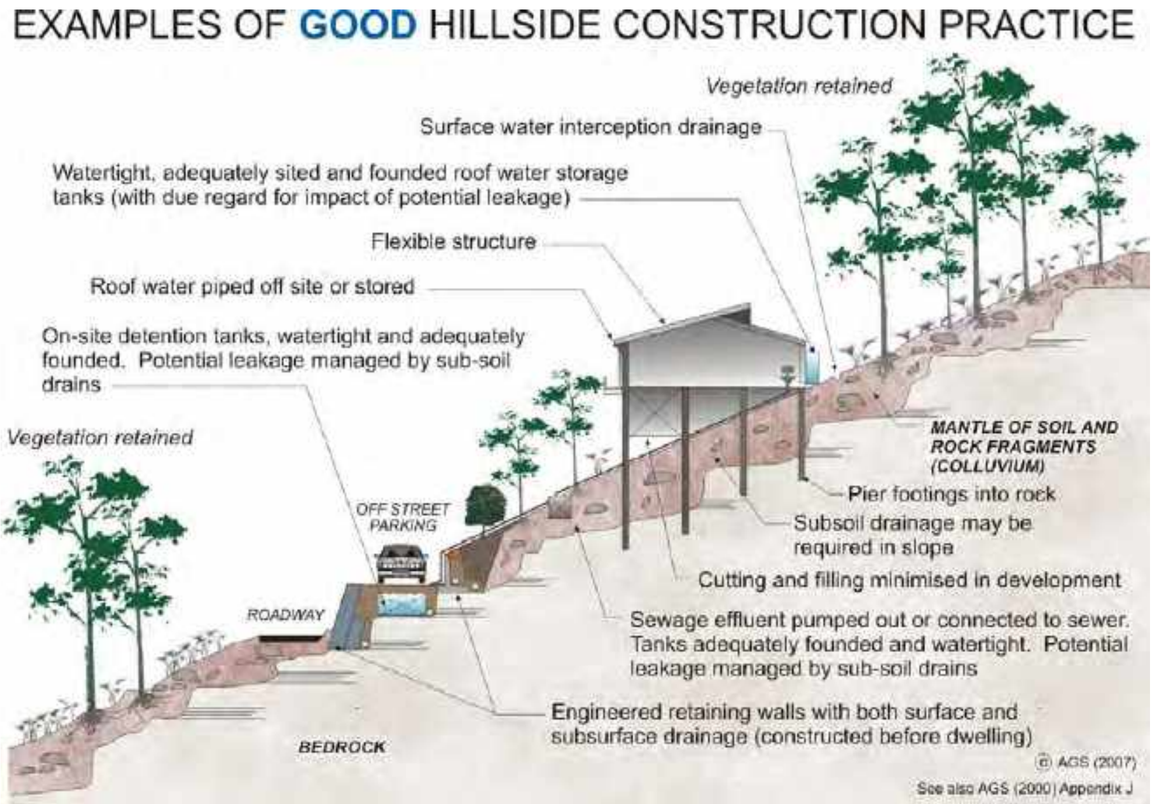
# AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

## HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.




### WHY ARE THESE PRACTICES GOOD?

**Roadways and parking areas -** are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

**Cuttings -** are supported by retaining walls (GeoGuide LR6).

**Retaining walls -** are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

**Sewage -** whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

**Surface water -** from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

**Surface loads** - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

**Flexible structures -** have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

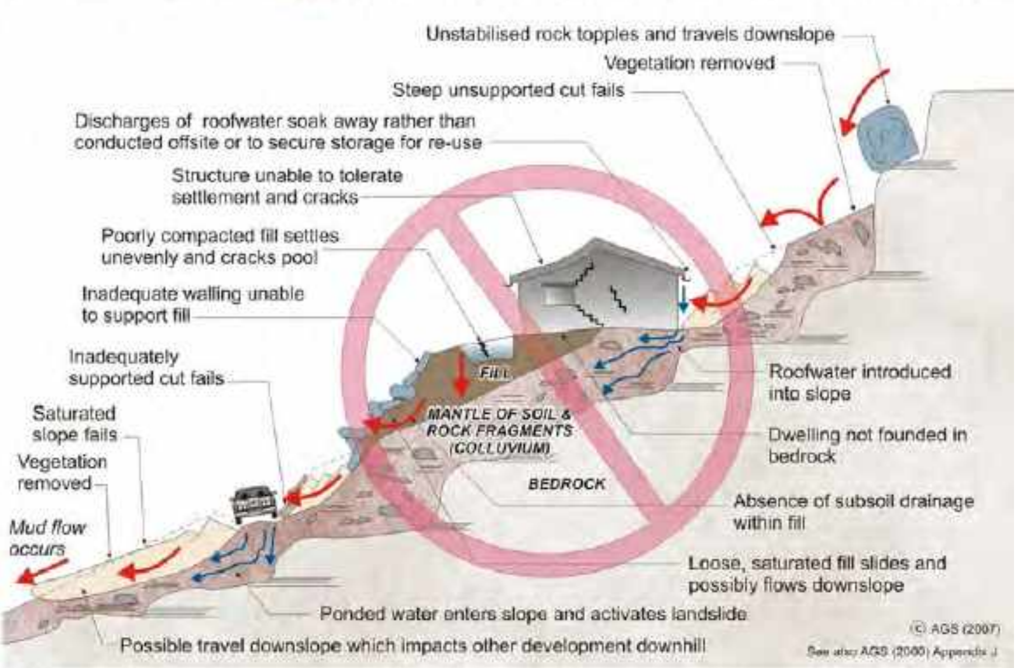
**Vegetation clearance -** on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

**ADOPT GOOD PRACTICE ON HILLSIDE SITES**

# AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

## EXAMPLES OF POOR HILLSIDE CONSTRUCTION PRACTICE




### WHY ARE THESE PRACTICES POOR?

**Roadways and parking areas -** are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

**Cut and fill -** has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

**Retaining walls -** have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

**A heavy, rigid, house** - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

**Soak-away drainage -** has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

**Rock debris** - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

**Vegetation** - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

**DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER**

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# EFFLUENT AND SURFACE WATER DISPOSAL

## EFFLUENT AND WASTEWATER

All households generate effluent and wastewater. The disposal of these products and their impact on the environment are key considerations in the planning of safe and sustainable communities. Cities and townships generally have reticulated water, sewer and stormwater systems, which are designed to deliver water and dispose of effluent and wastewater with minimal impact on the environment. However, many smaller communities and metropolitan fringe suburbs throughout Australia are un-sewered. Some of these are located in hillside or coastal settings where landslides present a hazard.

### Processes by which wastewater can affect slope stability

As explained in GeoGuides LR3 and LR5, groundwater variations have a significant impact on slope stability. Inappropriate disposal of effluent and wastewater may result in the ground becoming saturated. The result is equivalent to a localised rise of the groundwater table and may have the potential to cause a landslide (GeoGuides LR2, LR5 and LR8).

### On-site effluent disposal

In un-sewered areas disposal of effluent must be achieved through suitable methods. These methods usually involve containment within the boundaries of the site ("on-site disposal"). State environment protection agencies and local government authorities can usually provide advice on suitable disposal systems for your area. Such systems may include:

- *Septic systems,* which involve a storage/digestion tank for solids, with disposal of the liquid effluent via absorption trenches and beds, leach drains, or soak wells. Such systems are best suited to areas not prone to landslides.
- *Aerobic treatment units* which incorporate an individual household treatment plant to aid breakdown of the waste into a higher quality effluent. Such effluent is further treated and disposed of by surface or sub-surface irrigation, sub-soil dripper, or shallow leach drain system.
- *Nutrient retentive leaching systems* which utilise septic tanks to process the solid and liquid wastes in conjunction with discharge of the effluent through sand filters, media filters, mound systems and nutrient retentive leaching systems, which strip the effluent of nutrients.

Toilet (and sometimes kitchen) waste is known as *black water.* Other, less contaminated, wastewater streams from showers, baths and laundries are known as *grey water*. *Grey water re-use systems* allow a household to conserve water from bathrooms, kitchens and laundries, for re-use on gardens and lawns.

### Recommendations for effluent disposal

In areas prone to landslide hazard, it is recommended that whatever effluent disposal system is employed, it should be designed by a qualified professional, familiar with how such a system can impact on the local environment. Local council, and in some instances state environment protection agency, approval is usually required as well. Many local authorities require a site assessment report, which covers all relevant issues. If approved, the report's recommendations must be incorporated in the system design. Reduction in the volume of effluent is beneficial so composting toilets and highly rated (i.e. low consumption) water appliances are recommended. It should be noted that in some state and local government jurisdictions there are restrictions on the alternative measures that can be applied. Consideration should be given to applying treated wastewater to land at low rates and over as large an area as possible. Further guidance can be found in Australian Standard AS/NZS 1547:2000 On-site domestic wastewater management.

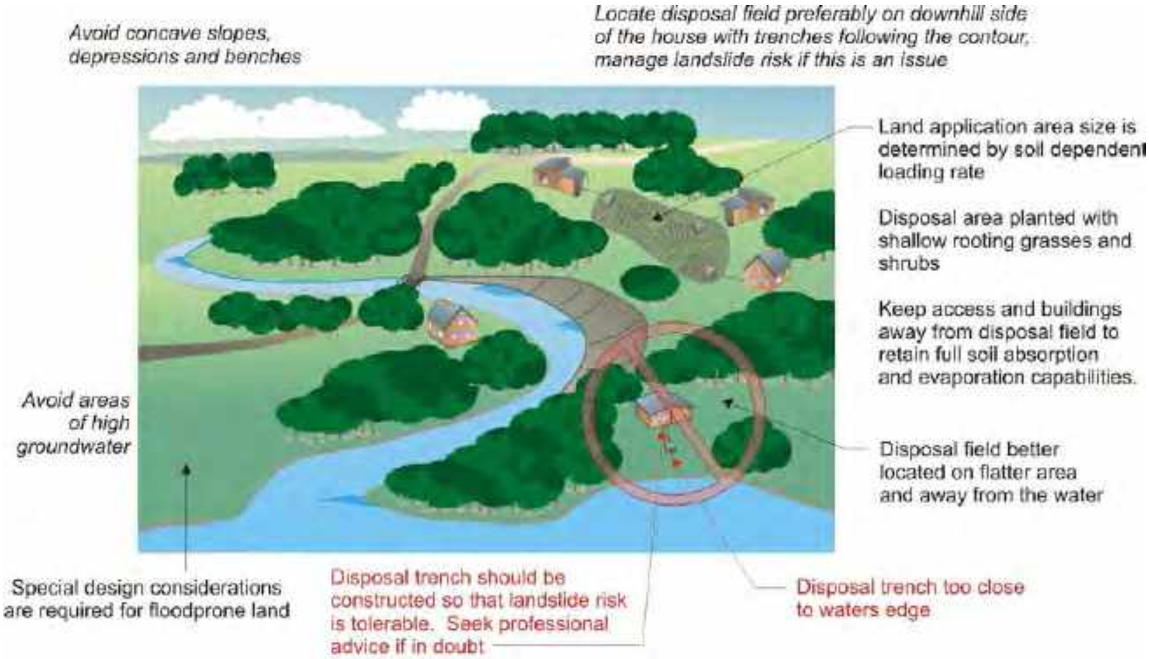
Effluent disposal fields should be sited with due consideration to the overall landscape and the individual characteristics of the property. Some guidance is provided. In particular, effluent fields should be located downslope of the building, away from stormwater, or *grey water*, discharge areas and where there is minimal potential for downstream pollution. Set backs and buffer distances vary from state to state and local requirements should be adhered to. All systems require regular maintenance and inspection. Efficient operation of the system must be a priority for property owners/occupiers to ensure safe and sustainable communities. Responsibility for maintenance rests with owners.

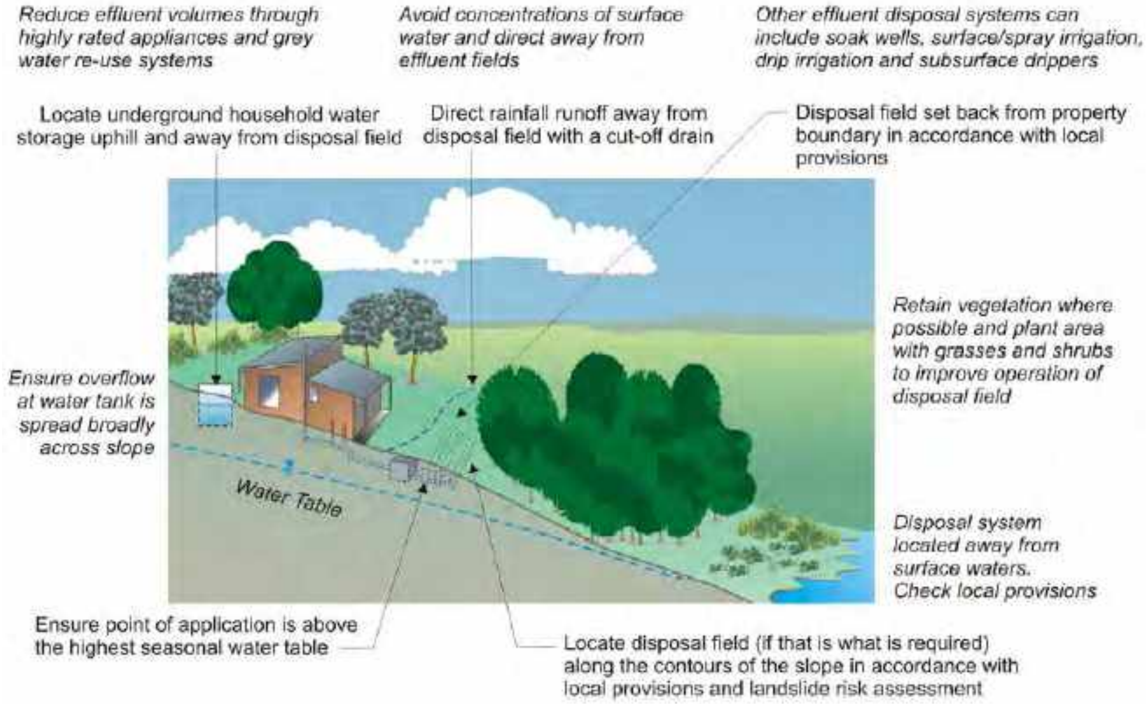
## SURFACE WATER DRAINAGE

Attention to on-site surface water management is also important. Runoff from developments, including buildings, decks, access tracks and hardstand areas should be collected and discharged away from the development and other effluent disposal fields. Particular care must be given to the design of overflows on water tanks, as this is often overlooked. Discharge from any development should be spread out as much as possible, unless it can be directed to an existing natural water course. Ponding of water on hillsides and the concentration of water flows on slopes must be avoided.

It is recommended that a specific drainage plan and strategy should be developed in conjunction with the effluent disposal system for sites with a high potential for slope instability. Maintenance of the surface water drainage system is as important as maintenance of the effluent disposal system and again the responsibility rests with owners.

# AUSTRALIAN GEOGUIDE LR9 (EFFLUENT DISPOSAL)




*Note: Adapted from EPA Vic. Publication 451 (March 1990) "Code of Practice - Septic Tanks", which was sourced from Vic. Department of Planning and Loddon-Campaspe Regional Planning Authority.*

**More information relevant to your particular situation may be found in other Australian GeoGuides:**

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
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- GeoGuide LR8 - Hillside Construction
- GeoGuide LR10 - Coastal Landslides
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The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

# AUSTRALIAN GEOGUIDE LR10 (COASTAL LANDSLIDES)

## LANDSLIDES IN THE COASTAL ENVIRONMENT

**Coastal Instability**

The coast presents a particularly dynamic environment where change is often the norm. Hazards exist in relation to both cliffs and sand dunes. The coast is also the most heavily populated part of Australia and always regarded as "prime" real estate, because of the views and access to waterways and beaches.

Photo courtesy Greg Kotze

Waves, wind and salt spray play a significant part, causing dunes to move and cliff-faces to erode well above sea level. Our response is often to try to neutralise these effects by doing such things as dumping rock in the sea, building groynes, dredging, or carrying out dune stabilisation. Such works can be very effective, but ongoing maintenance is usually needed and total reconstruction may be necessary after a relatively short working life.

Of particular significance are extreme events that cause destruction on a scale that ignores our efforts at coastal protection. Records show that cliffs have collapsed, taking with them backyards which had been relied upon as a buffer between a house and the ocean. Sand dunes have also been washed away resulting in the dramatic loss of homes and infrastructure. As with most landslide issues, even though such events may be infrequent, they could happen tomorrow. It is easy to be lulled into a false sense of security on a calm day.

In coastal areas, typical landslide hazards (GeoGuides LR1 to LR4) are compounded by coastal erosion which, over time, undercuts cliffs and eventually results in failure. In the case of sand dunes, dune erosion and dune slumping have equally dramatic effects. Coastal locations are subject to particular processes relating to fluctuating water tables, inundation under storm tides and direct wave attack. Large sections of our more sandy coastline are receding under present sea conditions. The hazards are progressive and likely to be exacerbated through climate change.

**Coastal Development**

If you own, or are responsible for, a coastal property it is important that you understand that, where the shore line is receding, there is a greater landslide risk than would be the case on a similar site inland. The view may make the risk worthwhile, but does not reduce it.

**Coastal Landslides**

Coastal landslides are little different from other landslides in that the signs of failure (GeoGuides LR2) and the causes (LR3, LR4 & LR5) are largely the same. The main difference relates to the overriding influence of wave impact, tidal movement, salt spray and high winds.

*Cliff failures*

In addition to the processes that produce cliff instability on inland cliffs, coastal cliffs are also subjected to repeated cycles of wetting and drying which can be accompanied by the expansive effect of salt crystal growth in gaps in the rocks. These processes accelerate the deterioration of coastal cliffs. At the base of cliffs, direct wave attack and the impact of boulders moved by wave action causes undercutting and hence instability of the overall face. Figure 2 of GeoGuide LR4 provides an example. Whilst the processes leading to coastal cliff collapse may take years, failure tends to be catastrophic and with little warning. In many cases, waves produced by large oceanic storms are the trigger assisted by rainfall to produce collapse. These are also the conditions in which you are more likely to be inside your home and oblivious to unusual noises or movements associated with imminent failure.

*Sand dune escarpment and slope failures*

An understanding of coastal processes is essential when determining beach erosion potential. Waves produced by large oceanic storms can erode beaches and cut escarpments into dunes. These may be of relatively short duration, when beach re-building happens after the storm, but can be a permanent feature where long term beach recession is taking place. In many locations, houses and infrastructure are sited on or immediately behind coastal dunes. After an escarpment has eroded, those assets may be lost or damaged by subsequent slumping of the dune. It is important that, on erodible coastal soils, the potential for landward incursion of an erosion escarpment is determined. Having done this, the likelihood of slope instability can be established as part of the landslide risk management process. Injury, death and structural damage have occurred around the Australian coast from collapsing sand escarpments.

Photo courtesy DNR NSW

# AUSTRALIAN GEOGUIDE LR10 (COASTAL LANDSLIDES)

The large scale and potentially high speed of coastal erosion processes means that major civil engineering work and large cost is normally involved in their control. The installation of rock bolts (LR4), drainage (LR5), or retaining walls (LR6) on a single house site may be necessary to provide local stability, but are unlikely to withstand the attack of a large storm on a beach or cliff-line.

## BUILDING NEAR CLIFFS AND HEADLANDS

Coastal cliffs and headlands exist because the rock that they are made from is able to resist erosion. Even so, cliff-faces are not immune and will continue to collapse (Figure 1) by one or other of the mechanisms shown on GeoGuide LR4. If you live on a coastal cliff, you should undertake inspection and maintenance as recommended in LR4 and the other GeoGuides, as appropriate. The top of the cliff, its face, and its base should be inspected frequently for signs of recent rock falls, opening of cracks, and heavy seepage which might indicate imminent failure. Since the sea can remove fallen rocks rapidly, inspections should be made shortly after every major storm as a matter of course. **<u>If collapses are occurring seek advice from an appropriately experienced geotechnical practitioner. Advise you local council if you believe erosion is rapid or accelerating.</u>**


**Figure 1**

### Building on Coastal Dunes

Any excavation in a natural dune slope is inherently unstable and must be supported and maintained (GeoGuide LR6). Dunes are particularly susceptible to ongoing erosion by wind and wave action and extreme changes can occur in a single storm. Whilst vegetation can help to stabilise dunes in the right circumstances, unfortunately a single storm has the potential to cut well into dunes and, in some cases, remove an entire low lying dune system or shift the mouth of a river. **<u>As for cliffs, it is appropriate to observe the effects of major storms on the coastline. If erosion is causing the coastline to recede at an appreciable rate, seek advice from suitably experienced geotechnical and coastal engineering practitioners and bring it to the attention of the local council.</u>**

Photo courtesy DNR NSW

## CLIMATE CHANGE

The coastal zone will experience the most direct physical impacts of climate change. A number of reviews of global data indicate a general trend of sea level rise over the last century of 0.1 - 0.2 metres. Current rates of global average sea level rise, measured from satellite altimeter data over the last decade, exceed 3 mm/year and are accelerating. The most authoritative and recent (at the time of writing) report on climate change (IPCC, 2007) predicts a global average sea level rise of between 0.2 and 0.8 metres by 2100, compared with the 1980 - 1999 levels (the higher value includes the maximum allowance of 0.2 m to account for uncertainty associated with ice sheet dynamics).

In addition to sea level rise, climate change is also likely to result in changes in wave heights and direction, coastal wind strengths and rainfall intensity, all of which have the capacity to impact adversely on coastal dunes and cliff-faces. A Guideline for responding to the effects of climate change in coastal areas was published by Engineers Australia in 2004.

### References


Engineers Australia 2004 'Guidelines for responding to the effects of climate change in coastal and ocean engineering." The National Committee on Coastal and Ocean Engineering , Engineers Australia , updated 2004.

IPCC (2007) *Climate Change 2007: The Physical Science Basis.* Summary for Policy Makers. Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Nielsen, A.F., Lord D.B. and Poulos, H.G. (1992). 'Dune Stability Considerations for Building Foundations', *Aust. Civil Eng. Transactions* CE No.2, 167-174.


More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

# AUSTRALIAN GEOGUIDE LR11 (RECORD KEEPING)

## RECORD KEEPING

It is strongly recommended that records be kept of all construction, inspection and maintenance activities in relation to developments on sloping blocks. In some local authority jurisdictions, maintenance requirements form part of the building consent conditions, in which case they are mandatory.

### CONSTRUCTION RECORDS

If at all possible, you should keep copies of drawings, specifications and construction (i.e. "as built") records, particularly if these differ from the design drawings. The importance of these documents cannot be over-emphasised. If a geotechnical practitioner comes to a site to carry out a landslide risk assessment and is only able to see the face of a retaining wall, the heads of some ground anchors, or the outlets of a number of sub-soil drains, it may be necessary to determine how these have been built and how they are meant to work before completing the assessment. This could involve drilling through the wall to determine how thick it is, or probing the length of the drains, or even ignoring the anchors altogether, because it is uncertain how long they are. Such "investigation" of something that may only have been built a few years before is, at best, a waste of time and money and, at worst, capable of coming up with a misleading answer which could affect the outcome of the assessment. Documentary information of this sort often proves to be invaluable later on, so treat it with as much importance as the title deeds to your property.

### INSPECTION AND MAINTENANCE RECORDS

If you follow the recommendations of the Australian GeoGuides it is likely that you will either carry out periodic inspections yourself, or you will engage a geotechnical practitioner to do them for you. The collected records of these inspections will provide a detailed history of changes that might be occurring and will indicate, better than your own memory, whether things are deteriorating and, if so, at what rate. Unfortunately, without some form of written record, all information is usually lost each time a property is sold. It is recommended that a prospective purchaser should have a pre-purchase landslide risk assessment carried out on a hillside site, in much the same way that they would commission a structural assessment, or a pest inspection, of the building. If the vendor has kept good records, then the assessment is likely to be quicker and cheaper, and the outcome more reliable, than if none are available. Each site is different, but noting the following would normally constitute a reasonable record of an inspection/maintenance undertaken:

- date of inspection/maintenance and the name and professional status of the person carrying it out
- description of the specific feature (eg. cliff face, temporary rock bolt, cast *in situ* retaining wall, shallow leach drain system)
- sketch plans, sketches and photographs to indicate location and condition
- activity undertaken (eg. visual inspection; cleared vegetation from drain; removed fallen rock about 500 mm diameter)
- condition of the feature and any matters of concern (e.g. weep holes damp and flowing freely; rust on anchor heads getting worse; shotcrete uncracked and no sign of rust stains; ground saturated around leach field)
- specific outcomes (eg. no action necessary; geotechnical practitioner called in to advise on the state of the anchors; cliff face to be trimmed following the most recent rock fall; leach field to be rebuilt at new location)

A proforma record is provided overleaf for convenience. Photographs and sketches of specific observations can prove to be very useful and should be included whenever possible. Geotechnical practitioners may devise their own site specific inspection/maintenance records.

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The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

**AUSTRALIAN GEOGUIDE LR11 (RECORD KEEPING)**

## INSPECTION/MAINTENANCE RECORD

(Tick boxes as appropriate and add information as required) Date...........................................

**Site location** (street address / lot & DP numbers / map reference / latitude and longitude)

...........................................................................................................................................................

| FEATURE | Inspected | Maintained | Tested | By Owner | By Professional |
|---|---|---|---|---|---|
| **Slopes & surface protection:** | | | | | |
| ☐ Natural slope/cliff ☐ Cut/fill slope | | | | | |
| ☐ Surface water drains | | | | | |
| ☐ Shotcrete ☐ Stone pitching ☐ Other | | | | | |
| **Retaining walls:** | | | | | |
| ☐ Cast in situ concrete ☐ Concrete block | | | | | |
| ☐ Masonry (natural stone) ☐ Masonry (brick, block) | | | | | |
| ☐ Cribwall (concrete) ☐ Cribwall (timber) | | | | | |
| ☐ Anchored wall ☐ Reinforced soil wall | | | | | |
| ☐ Sub-soil drains ☐ Weep holes | | | | | |
| **Ground improvement:** | | | | | |
| ☐ Rock bolts | | | | | |
| ☐ Ground anchors ☐ Soil nails | | | | | |
| ☐ Deep subsoil drains | | | | | |
| **Effluent and storm water disposal systems:** | | | | | |
| ☐ Effluent treatment system | | | | | |
| ☐ Effluent disposal field | | | | | |
| ☐ Storm water disposal field | | | | | |
| **Other:** | | | | | |
| ☐ Netting ☐ Catch fence ☐ Catch pit | | | | | |
| ☐ ------------------------------------------------ | | | | | |
| ☐ ------------------------------------------------ | | | | | |
| ☐ ------------------------------------------------ | | | | | |

Observations/Notes (Add pages/details as appropriate)

...........................................................................................................................................................

...........................................................................................................................................................

...........................................................................................................................................................

Attachments: ☐ Sketch(es) ☐ Photograph(s) ☐ Other (eg measurements, test results)

Record prepared by ............................................... (name): .......................................(signature)

Contact details: Phone:....................................... E-mail:..........................................................

Professional Status (in relation to landslide risk assessment):......................................................

# APPENDIX

## AUSTRALIAN GEOMECHANICS SOCIETY

**STEERING COMMITTEE**

Andrew Leventhal, GHD Geotechnics, Sydney, Chair
Robin Fell, School of Civil and Environmental Engineering, UNSW, Sydney, Convenor Guidelines on Landslide Susceptibility, Hazard and Risk Working Group
Tony Phillips, Consultant, Sydney, Convenor Slope Management and Maintenance Working Group
Bruce Walker, Jeffery and Katauskas, Sydney, Convenor Practice Note Working Group
Geoff Withycombe, Sydney Coastal Councils Group, Sydney

**WORKING GROUP -** Guidelines on Slope Management and Maintenance
Tony Phillips, Tony Phillips Consulting, Sydney, Convenor
Henk Buys, NSW Roads and traffic Authority, Parramatta
John Braybrooke, Douglas Partners, Sydney
Tony Miner, A.G. Miner Geotechnical, Geelong

**LANDSLIDE TASKFORCE**
Laurie de Ambrosis, GHD Geotechnics, Sydney
Mark Eggers, Pells Sullivan Meynink, Sydney
Max Ervin, Golder Associates, Melbourne
Angus Gordon, retired, Sydney
Greg Kotze, GHD, Sydney
Arthur Love, Coffey Geotechnics, Newcastle
Alex Litwinowicz, GHD Geotechnics, Brisbane
Tony Miner, A.G. Miner Geotechnical, Geelong
Fiona MacGregor, Douglas Partners, Sydney
Garry Mostyn, Pells Sullivan Meynink, Sydney
Grant Murray, Sinclair Knight Merz, Auckland
Garth Powell, Coffey Geotechnics, Brisbane
Ralph Rallings, Pitt and Sherry, Hobart
Ian Stewart, NSW Roads and Traffic Authority, Sydney
Peter Tobin, Wollongong City Council, Wollongong
Graham Whitt, Shire of Yarra Ranges, Lillydale

# APPENDIX B

Soil & Rock Explanation Sheets
Test Pit Logs
Hand Auger & DCP Logs

# Soil and Rock Explanation Sheets (1 of 2)

assetgeo

## LOG ABBREVIATIONS AND NOTES

**METHOD**

| **borehole logs** | | **excavation logs** | |
|---|---|---|---|
| AS | auger screw * | NE | natural excavation |
| AD | auger drill * | HE | hand excavation |
| RR | roller / tricone | BH | backhoe bucket |
| W | washbore | EX | excavator bucket |
| CT | cable tool | DZ | dozer blade |
| HA | hand auger | R | ripper tooth |
| D | diatube | | |
| B | blade / blank bit | | |
| V | V-bit | | |
| T | TC-bit | | |

* bit shown by suffix e.g. ADV

***coring***
NMLC, NQ, PQ, HQ

**SUPPORT**

| ***borehole logs*** | | ***excavation logs*** | |
|---|---|---|---|
| N | nil | N | nil |
| M | mud | S | shoring |
| C | casing | B | benched |
| NQ | NQ rods | | |

**CORE—LIFT**

casing installed

barrel withdrawn

**NOTES, SAMPLES, TESTS**

| | |
|---|---|
| D | disturbed |
| B | bulk disturbed |
| U50 | thin-walled sample, 50mm diameter |
| HP | hand penetrometer (kPa) |
| SV | shear vane test (kPa) |
| DCP | dynamic cone penetrometer (blows per 100mm penetration) |
| SPT | standard penetration test |
| N* | SPT value (blows per 300mm)<br>* denotes sample taken |
| Nc | SPT with solid cone |
| R | refusal of DCP or SPT |

**USCS SYMBOLS**

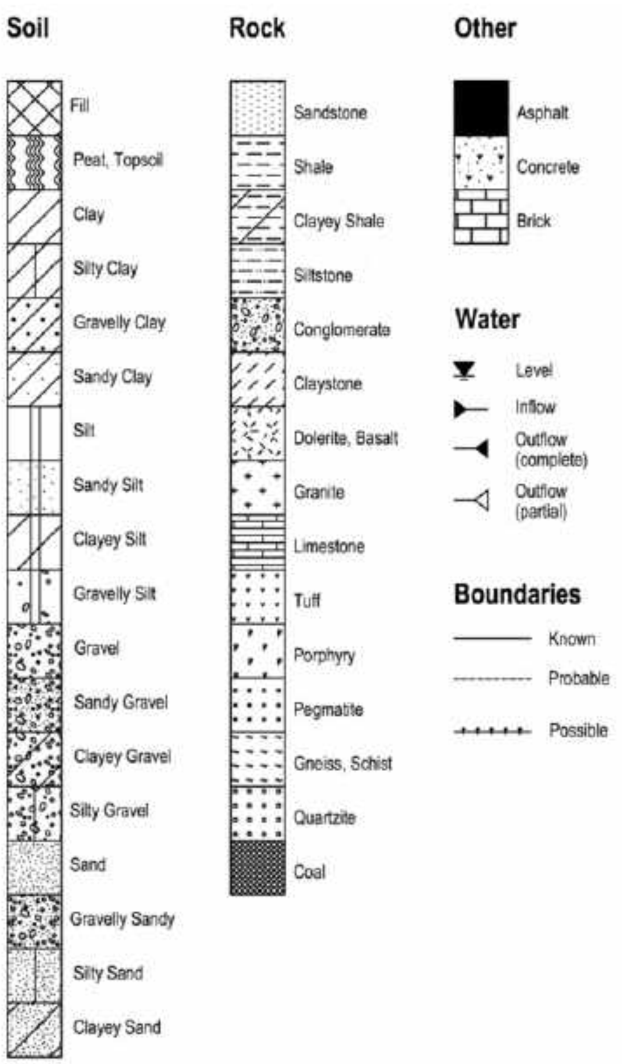
| | |
|---|---|
| GW | Gravel and gravel-sand mixtures, little or no fines. |
| GP | Gravel and gravel-sand mixtures, little or no fines, uniform gravels |
| GM | Gravel-silt mixtures and gravel-sand-silt mixtures. |
| GC | Gravel-clay mixtures and gravel-sand-clay mixtures. |
| SW | Sand and gravel-sand mixtures, little or no fines. |
| SP | Sand and gravel sand mixtures, little or no fines. |
| SM | Sand-silt mixtures. |
| SC | Sand-clay mixtures. |
| ML | Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity. |
| CL, CI | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays. |
| OL | Organic silts |
| MH | Inorganic silts |
| CH | Inorganic clays of high plasticity. |
| OH | Organic clays of medium to high plasticity, organic silt |
| PT | Peat, highly organic soils. |

**MOISTURE CONDITION**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| Wl | liquid limit |

| **CONSISTENCY** | | **DENSITY INDEX** | |
|---|---|---|---|
| VS | very soft | VL | very loose |
| S | soft | L | loose |
| F | firm | MD | medium dense |
| St | stiff | D | dense |
| VSt | very stiff | VD | very dense |
| H | hard | | |
| Fb | friable | | |

## GRAPHIC LOG




| **WEATHERING** | | **STRENGTH** | |
|---|---|---|---|
| XW | extremely weathered | VL | very low |
| HW | highly weathered | L | low |
| MW | moderately weathered | M | medium |
| SW | slightly weathered | H | high |
| FR | fresh | VH | very high |
| | | EH | extremely high |

**RQD (%)**

$$= \frac{\text{sum of intact core pieces > 2 x diameter}}{\text{total length of core run drilled}} \times 100$$

**DEFECTS:**

| ***type*** | | ***coating*** | |
|---|---|---|---|
| JT | joint | cl | clean |
| PT | parting | st | stained |
| SZ | shear zone | ve | veneer |
| SM | seam | co | coating |

| ***shape*** | | ***roughness*** | |
|---|---|---|---|
| pl | planar | po | polished |
| cu | curved | sl | slickensided |
| un | undulating | sm | smooth |
| st | stepped | ro | rough |
| ir | irregular | vr | very rough |

***inclination***
measured above axis and perpendicular to core

# Soil and Rock Explanation Sheets (2 of 2)

## AS1726-2017

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-2017.

## SOIL

### MOISTURE CONDITION

| Term | Description |
|---|---|
| Dry | Looks and feels dry. Fine grained and cemented soils are hard, friable or powdery. Uncemented coarse grained soils run freely through hand. |
| Moist | Soil feels cool and darkened in colour. Fine grained soils can be moulded. Coarse soils tend to cohere. |
| Wet | As for moist, but with free water forming on hand. |

Moisture content of cohesive soils may also be described in relation to plastic limit ($W_P$) or liquid limit ($W_L$) [>> much greater than, > greater than, < less than, << much less than].

### CONSISTENCY OF FINE GRAINED SOILS

| Term | Su (kPa) | Term | Su (kPa) |
|---|---|---|---|
| Very soft | < 12 | Very Stiff | >100 – ≤200 |
| Soft | >12 – ≤25 | Hard | > 200 |
| Firm | >25 – ≤50 | Friable | – |
| Stiff | >50 – ≤100 | | |

### RELATIVE DENSITY OF COURSE GRAINED SOILS

| Term | Density Index (%) | Term | Density Index (%) |
|---|---|---|---|
| Very Loose | < 15 | Dense | 65 – 85 |
| Loose | 15 – 35 | Very Dense | >85 |
| Medium Dense | 35 – 65 | | |

### PARTICLE SIZE

| Name | Subdivision | Size (mm) |
|---|---|---|
| Boulders | | > 200 |
| Cobbles | | 63 – 200 |
| Gravel | coarse | 19 – 63 |
| | medium | 6.7 – 19 |
| | fine | 2.36 – 6.7 |
| Sand | coarse | 0.6 – 2.36 |
| | medium | 0.21 – 0.6 |
| | fine | 0.075 – 0.21 |
| Silt & Clay | | < 0.075 |

### MINOR COMPONENTS

| Term | Proportion by Mass: *coarse grained* | *fine grained* |
|---|---|---|
| Trace | ≤ 15% | ≤ 5% |
| With | >15% – ≤30% | >5% – ≤12% |

### SOIL ZONING

| | |
|---|---|
| Layers | Continuous across exposures or sample. |
| Lenses | Discontinuous, lenticular shaped zones. |
| Pockets | Irregular shape zones of different material. |

### SOIL CEMENTING

| | |
|---|---|
| Weakly | Easily broken up by hand pressure in water or air. |
| Moderately | Effort is required to break up by hand in water or in air. |

### USCS SYMBOLS

| Symbol | Description |
|---|---|
| GW | Gravel and gravel-sand mixtures, little or no fines. |
| GP | Gravel and gravel-sand mixtures, little or no fines, uniform gravels. |
| GM | Gravel-silt mixtures and gravel-sand-silt mixtures. |
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| OL | Organic silts |
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| OH | Organic clays of medium to high plasticity, organic silt |
| PT | Peat, highly organic soils. |

## ROCK

### SEDIMENTARY ROCK TYPE DEFINITIONS

| Rock Type | Definition (more than 50% of rock consists of .....) |
|---|---|
| Conglomerate | ... gravel sized (>2mm) fragments. |
| Sandstone | ... sand sized (0.06 to 2mm) grains. |
| Siltstone | ... silt sized (<0.06mm) particles, rock is not laminated. |
| Claystone | ... clay, rock is not laminated. |
| Shale | ... silt or clay sized particles, rock is laminated. |

### LAYERING

| Term | Description |
|---|---|
| Massive | No layering apparent. |
| Poorly Developed | Layering just visible. Little effect on properties. |
| Well Developed | Layering distinct. Rock breaks more easily parallel to layering. |

### STRUCTURE

| Term | Spacing (mm) | Term | Spacing |
|---|---|---|---|
| Thinly laminated | <6 | Medium bedded | 200 – 600 |
| Laminated | 6 – 20 | Thickly bedded | 600 – 2,000 |
| Very thinly bedded | 20 – 60 | Very thickly bedded | > 2,000 |
| Thinly bedded | 60 – 200 | | |

### STRENGTH (NOTE: Is50 = Point Load Strength Index)

| Term | Is50 (MPa) | Term | Is50 (MPa) |
|---|---|---|---|
| Extremely Low | <0.03 | High | 1.0 – 3.0 |
| Very low | 0.03 – 0.1 | Very High | 3.0 – 10.0 |
| Low | 0.1 – 0.3 | Extremely High | >10.0 |
| Medium | 0.3 – 1.0 | | |

### WEATHERING

| Term | Description |
|---|---|
| Residual Soil | Material is weathered to an extent that it has soil properties. Rock structures are no longer visible, but the soil has not been significantly transported. |
| Extremely ..... | Material is weathered to the extent that it has soil properties. Mass structures, material texture & fabric of original rock is still visible. |
| Highly ..... | Rock strength is significantly changed by weathering; rock is discolored, usually by iron staining or bleaching. Some primary minerals have weathered to clay minerals. |
| Moderately ..... | Rock strength shows little or no change of strength from fresh rock; rock may be discolored. |
| Slightly ..... | Rock is partially discolored but shows little or no change of strength from fresh rock. |
| Fresh | Rock shows no signs of decomposition or staining. |

### DEFECT DESCRIPTION

| Type | |
|---|---|
| Joint | A surface or crack across which the rock has little or no tensile strength. May be open or closed. |
| Parting | A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/bedding. May be open or closed. |
| Sheared Zone | Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. |
| Seam | Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed). |

| Shape | |
|---|---|
| Planar | Consistent orientation. |
| Curved | Gradual change in orientation. |
| Undulating | Wavy surface. |
| Stepped | One or more well defined steps. |
| Irregular | Many sharp changes in orientation. |

| Roughness | |
|---|---|
| Polished | Shiny smooth surface. |
| Slickensided | Grooved or striated surface, usually polished. |
| Smooth | Smooth to touch. Few or no surface irregularities. |
| Rough | Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper. |
| Very Rough | Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper. |

| Coating | |
|---|---|
| Clean | No visible coating or discolouring. |
| Stained | No visible coating but surfaces are discolored. |
| Veneer | A visible coating of soil or mineral, too thin to measure; may be patchy |
| Coating | Visible coating =1mm thick. Thicker soil material described as seam. |

# Excavation Log

| | |
|---|---|
| EX no: | TP1 |
| sheet: | 1 of 1 |
| job no.: | 5498 |

| | | | |
|---|---|---|---|
| client: | Perisher Blue | started: | 9.4.2019 |
| principal: | | finished: | 9.4.2019 |
| project: | Proposed Ski Chairlift | logged: | MAG |
| location: | Perisher Ski Resort, Kosciuszko National Park NSW | checked: | MAB |
| equipment: | Tracked Excavator | RL surface: | 1736 m |
| dimensions: | 0.6 x 1.5 E: N: | datum: | AHD |

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EX | N | None Observed | | | 0 | | SC-SM | TOPSOIL, dark brown, Silty Clayey SAND with roots. | M | L | | Topsoil |
| | | | | | .15 | | SC-SM | SUBSOIL, dark brown, Silty Clayey SAND, gravelly, rare roots. | M | C | | Topsoil |
| | | | | | .4 | | GP | Sandy GRAVEL with cobbles and occational bolders(> 600mm). | M | C | | Alluvium (flood wash-out) |
| | | | | 1735.5 | 0.5 | | | | | | | |
| | | | | 1735.0 | 1.0 | | | | | | | |
| | | | | | 1.15 | | | EX refusal on coarse cobbles and boulders, assumed close to top of weathered Granite. Excavation No: TP1 terminated at 1.15m | | | | Sides of pit were stable |
| | | | | 1734.5 | 1.5 | | | | | | | |
| | | | | 1734.0 | 2.0 | | | | | | | |
| | | | | 1733.5 | 2.5 | | | | | | | |
| | | | | 1733.0 | 3.0 | | | | | | | |

Refer to Information Sheets for Terms and Symbols

Excavation Log - Revision 9

# Excavation Log

| | |
|---|---|
| EX no: | TP2 |
| sheet: | 1 of 1 |
| job no.: | 5498 |

| | | | |
|---|---|---|---|
| **client:** | Perisher Blue | **started:** | 9.4.2019 |
| **principal:** | | **finished:** | 9.4.2019 |
| **project:** | Proposed Ski Chairlift | **logged:** | MAG |
| **location:** | Perisher Ski Resort, Kosciuszko National Park NSW | **checked:** | MAB |
| **equipment:** | Tracked Excavator | **RL surface:** | 1733 m |
| **dimensions:** | 0.6 x 2.5 E: N: | **datum:** | AHD |

**excavation information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetrometer kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EX | N | | | | 0.0 | | SC-SM | TOPSOIL, dark brown, Silty Clayey SAND with roots. | M | L | | Topsoil |
| | | | | | .2 | | SC-SM | SUBSOIL, dark brown, Silty Clayey SAND, gravelly with rare roots, occasional cobbles. | M | C | | Topsoil |
| | | | | 1732.5 | .45 (0.5) | | SC-SM | Light brown, Silty Clayey SAND with occasional granite gravel and boulder, completely decomposed granite, completely weathered, extremely low strength. | M | C | | Completely Decomposed Granite |
| | | | | 1732.0 | 1.0 | | | | | | | |
| | | | | 1731.5 | 1.5 | | | | | | | |
| | | | | 1731.0 | 2.0 | | | | | | | |
| | | | | 1730.5 | 2.5 | | | | | | | |
| | | ► | | | 2.6 | | GP | Highly weathered, low strength sandy GRAVEL, highly decomposed granite. | W | C | | Highly Decomposed Granite |
| | | | | | 2.8 | | | EX refusal on moderately decomposed granite. Excavation No: TP2 terminated at 2.8m | | | | Sides of pit were stable |
| | | | | 1730.0 | 3.0 | | | | | | | |

Refer to Information Sheets for Terms and Symbols

Excavation Log - Revision 9

# Borehole Log

| | |
|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 1 of 1 |
| **job no.:** | 5498 |

| | | | |
|---|---|---|---|
| **client:** | Perisher Blue | **started:** | 9.4.2019 |
| **principal:** | | **finished:** | 9.4.2019 |
| **project:** | Proposed Ski Chairlift | **logged:** | MAG |
| **location:** | Perisher Ski Resort, Kosciuszko National Park NSW | **checked:** | MAB |
| **equipment:** | HA | **RL surface:** | 1996 m approx. |
| **diameter:** | 75mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description<br>soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | hand penetrometer kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | N | None Observed | | | | | SC-SM | TOPSOIL, dark brown, Silty Clayey SAND with roots. | M | | | Topsoil |
| | | | | | .35 | | | HA refusal on assumed completely decomposed granite.<br>Borehole No: BH1 terminated at .35m | | | | Granite |
| | | | | 1995.5 | 0.5 | | | | | | | |
| | | | | 1995.0 | 1.0 | | | | | | | |

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Borehole Log - Revision 10

# Borehole Log

| | |
|---|---|
| BH no: | BH2 |
| sheet: | 1 of 1 |
| job no.: | 5498 |

| | | | |
|---|---|---|---|
| client: | Perisher Blue | started: | 9.4.2019 |
| principal: | | finished: | 9.4.2019 |
| project: | Proposed Ski Chairlift | logged: | MAG |
| location: | Perisher Ski Resort, Kosciuszko National Park NSW | checked: | MAB |
| equipment: | HA | RL surface: | 1773 m approx. |
| diameter: | 75mm inclination: -90° bearing: --- E: N: | datum: | AHD |

| drilling information | | | | | | material information | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description<br>soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | hand penetrometer kPa 100 200 300 400 | structure and additional observations |
| HA | N | None Observed | | 1772.5 | 0.5 | | SC-SM | TOPSOIL, dark brown, Silty Clayey SAND with roots. | M | | | Toposoil |
| | | | | 1772.0 | .5<br>1.0 | | | HA refusal on assumed completely decomposed granite.<br>Borehole No: BH2 terminated at .5m | | | | Granite |

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Borehole Log - Revision 10

# Dynamic Cone Penetrometer

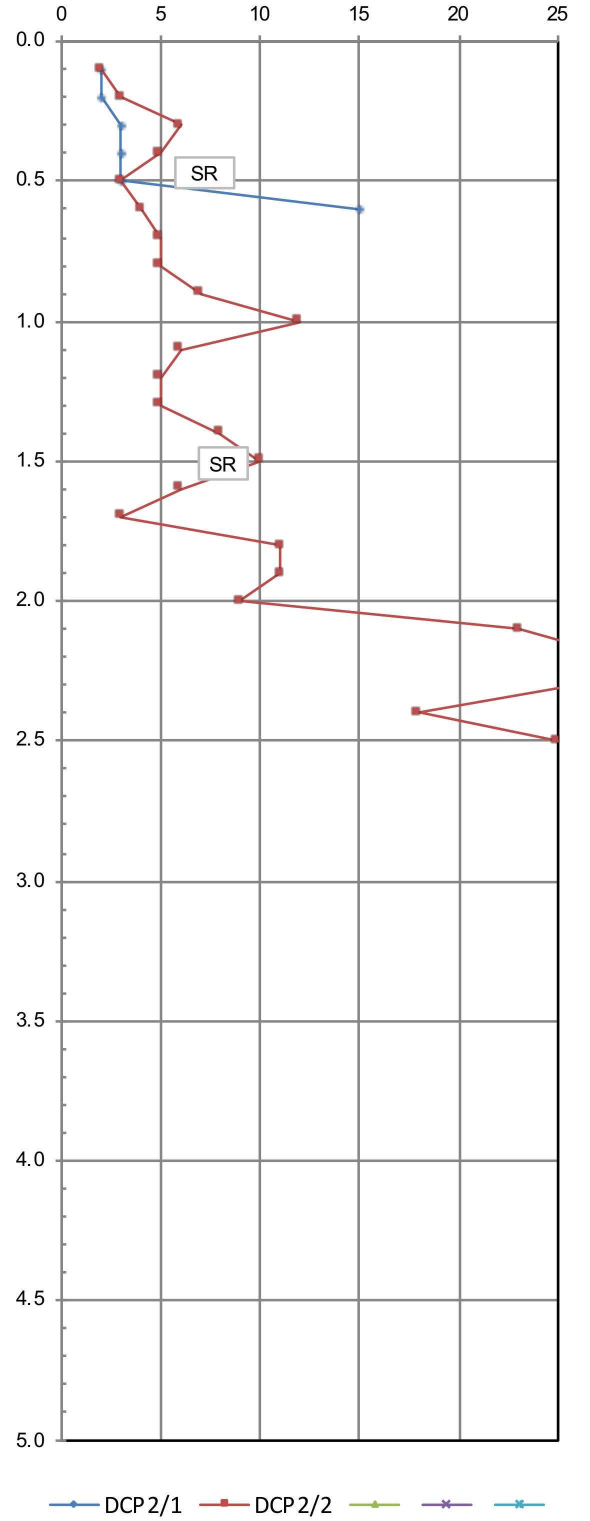
| | |
|---|---|
| Sheet: | 1 of 1 |
| Job No: | 5498 |

| | | | |
|---|---|---|---|
| **client:** | Perisher Blue | **started:** | 9/4/19 |
| **principal:** | | **finished:** | 9/4/19 |
| **project:** | Mt Perisher Ski Lift | **logged:** | MAG |
| **location:** | Mt Perisher NSW | **checked:** | MAB |
| **equipment:** | 9kg hammer, 510mm drop, cone tip | | |
| **standard:** | AS1289.6.3.2-1997 | | |

| Depth (m) | Test Results (blows / 100mm) | | | | |
|---|---|---|---|---|---|
| | DCP2/1 | DCP2/2 | | | |
| | 1733m AHD | 1733mAHD | | | |
| 0.00 – 0.10 | 2 | 2 | | | |
| 0.10 – 0.20 | 2 | 3 | | | |
| 0.20 – 0.30 | 3 | 6 | | | |
| 0.30 – 0.40 | 3 | 5 | | | |
| 0.40 – 0.50 | 3 | 3 | | | |
| 0.50 – 0.60 | 15 | 4 | | | |
| 0.60 – 0.70 | 50mm penetration | 5 | | | |
| 0.70 – 0.80 | | 5 | | | |
| 0.80 – 0.90 | SR | 7 | | | |
| 0.90 – 1.00 | | 12 | | | |
| 1.00 – 1.10 | | 6 | | | |
| 1.10 – 1.20 | | 5 | | | |
| 1.20 – 1.30 | | 5 | | | |
| 1.30 – 1.40 | | 8 | | | |
| 1.40 – 1.50 | | 10 | | | |
| 1.50 – 1.60 | | 6 | | | |
| 1.60 – 1.70 | | 3 | | | |
| 1.70 – 1.80 | | 11 | | | |
| 1.80 – 1.90 | | 11 | | | |
| 1.90 – 2.00 | | 9 | | | |
| 2.00 – 2.10 | | 23 | | | |
| 2.10 – 2.20 | | 28 | | | |
| 2.20 – 2.30 | | 26 | | | |
| 2.30 – 2.40 | | 18 | | | |
| 2.40 – 2.50 | | 25 | | | |
| 2.50 – 2.60 | | 90mm penetration | | | |
| 2.60 – 2.70 | | | | | |
| 2.70 – 2.80 | | SR | | | |
| 2.80 – 2.90 | | | | | |
| 2.90 – 3.00 | | | | | |
| 3.00 – 3.10 | | | | | |
| 3.10 – 3.20 | | | | | |
| 3.20 – 3.30 | | | | | |
| 3.30 – 3.40 | | | | | |
| 3.40 – 3.50 | | | | | |
| 3.50 – 3.60 | | | | | |
| 3.60 – 3.70 | | | | | |
| 3.70 – 3.80 | | | | | |
| 3.80 – 3.90 | | | | | |
| 3.90 – 4.00 | | | | | |
| 4.00 – 4.10 | | | | | |
| 4.10 – 4.20 | | | | | |
| 4.20 – 4.30 | | | | | |
| 4.30 – 4.40 | | | | | |
| 4.40 – 4.50 | | | | | |
| 4.50 – 4.60 | | | | | |
| 4.60 – 4.70 | | | | | |
| 4.70 – 4.80 | | | | | |
| 4.80 – 4.90 | | | | | |
| 4.90 – 5.00 | | | | | |

two further atempts made at location of TP2 but refused at suface on coarse floaters

**Plot (blows / 100mm vs depth)**




Notes:
RL = ground surface level (m) AHD
TD = target depth, PR = practical refusal (15+ blows per 100mm), SR = "solid" refusal (no further penetration and "solid" ringing sound from slide hammer)

# APPENDIX C

Preliminary Landslide Risk Assessment Tables

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# Table A - Preliminary Landslide Risk Assessment (Risk to Property)
## Mt Perisher Ski Lift - Bottom Station

| Possible Hazard | Use of Affected Structure & Persons at Risk | Likelihood | Indicative Annual Probability P (H) | Probability of Spatial Impact P (S:H) | Temporal Probability P (T:S) | Vulner-ability V (D:T) | Probability of becoming Trapped | Risk for Person Most at Risk [Risk Evaluation] | Risk Outcome: A = Acceptable T = Tolerable NT = Not Tolerable |
|---|---|---|---|---|---|---|---|---|---|
| A - Shallow earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.05 | 1.38E-07 | A |
| B - Deep-seated earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.25 | 6.88E-07 | A |
| C - Translational earth slide (slow creep). | Chair - passengers | Likely | 1.0E-02 | 1.00 | 0.11 | 0.01 | 0.01 | 1.10E-07 | A |
| D - Rock topple of detached granite boulders. | Chair - passengers | Unlikely | 1.0E-04 | 0.01 | 0.11 | 0.20 | 0.10 | 2.20E-09 | A |
| E - Instability of permanent cut/fill slopes | Chair - passengers | Rare (engineered works) | 1.0E-05 | 1.00 | 0.11 | 0.10 | 0.50 | 5.50E-08 | A |

Notes:

1. The appraisal of the assessed risk relative to acceptable and tolerable risks is based on Table 1 of AGS (2007) – Reference 1, for a new development.
2. Risk mitigation will be required to ensure that the assessed risk outcome during and after the proposed development is acceptable. Referred to report for further details.
3. This table must be read in conunction with Table A.
4. Risk Outcome:
   A = Acceptable $\leq 10^{-6}$
   T = Tolerable $\leq 10^{-5}$
   NT = Not Tolerable - treatment options to be assessed and implemented
5. Temporal Probability based on per-person average 8 hours per day for four months of the year in ski season, and 100% occupancy of chairlift = 0.11.

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## Table A - Preliminary Landslide Risk Assessment (Risk to Property)
## Mt Perisher Ski Lift - Intermediate Pylons

| Possible Hazards | | Consequences (Note 2) | Assessed Likelihood | Risk (Note 1) | Risk Treatment and Comments |
|---|---|---|---|---|---|
| **Failure Envisaged** | **Failure Mode** | | | | |
| A - Shallow earth slide. | Slide | Minor | Unlikely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019. **Stability analysis to be carried out for detailed design of any filling as part of the cut-and-fill earthworks for project.** |
| B - Deep-seated earth slide. | Slide | Minor | Unlikely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019. **Stability analysis to be carried out for detailed design of any filling as part of the cut-and-fill earthworks for project.** |
| C - Translational earth slide (slow creep). | Slide | Insignificant | Likely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019. |
| D - Rock topple of detached granite boulders. | Topple | Medium | Unlikely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019, including identifying and remediating any boulders at risk of dislodging. |
| E - Instability of permanent cut/fill slopes | Slide | Medium | Rare (engineered works) | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019 |

Notes:

1. The risk assessment addresses only the consequences to property from potential landslide events considered relevant to the subject site. Injury to persons or potential for fatality from land sliding is not assessed in this table (refer Table D). The risk assessment is based on a preliminary appraisal only, carried out by inspection. Further assessment or quantification of the assessed geotechnical risks for the subject property would require additional data and/or investigation.
2. The consequences are for a development that is designed to accomodate the potential landslide risk or has demonstrated adequate performance over many years.
3. Refer to report and associated figures for illustration of possible hazards / slope failure mechanisms.
4. Refer to attachments for definitions and explanations of terms used in the risk assessment.

## Table A - Preliminary Landslide Risk Assessment (Risk to Property)
## Mt Perisher Ski Lift - Intermediate Pylons

| Possible Hazard | Use of Affected Structure & Persons at Risk | Likelihood | Indicative Annual Probability P (H) | Probability of Spatial Impact P (S:H) | Temporal Probability P (T:S) | Vulnerability V (D:T) | Probability of becoming Trapped | Risk for Person Most at Risk [Risk Evaluation] | Risk Outcome: A = Acceptable T = Tolerable NT = Not Tolerable |
|---|---|---|---|---|---|---|---|---|---|
| A - Shallow earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.05 | 1.38E-07 | A |
| B - Deep-seated earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.25 | 6.88E-07 | A |
| C - Translational earth slide (slow creep). | Chair - passengers | Likely | 1.0E-02 | 1.00 | 0.11 | 0.01 | 0.01 | 1.10E-07 | A |
| D - Rock topple of detached granite boulders. | Chair - passengers | Unlikely | 1.0E-04 | 0.20 | 0.11 | 1.00 | 0.10 | 2.20E-07 | A |
| E - Instability of permanent cut/fill slopes | Chair - passengers | Rare (engineered works) | 1.0E-05 | 1.00 | 0.11 | 1.00 | 0.25 | 2.75E-07 | A |

Notes:

1. The appraisal of the assessed risk relative to acceptable and tolerable risks is based on Table 1 of AGS (2007) – Reference 1, for a new development.
2. Risk mitigation will be required to ensure that the assessed risk outcome during and after the proposed development is acceptable. Referred to report for further details.
3. This table must be read in conunction with Table C.
4. Risk Outcome:
   A = Acceptable $\leq 10^{-6}$
   T = Tolerable $\leq 10^{-5}$
   NT = Not Tolerable - treatment options to be assessed and implemented
5. Temporal Probability based on per-person average 8 hours per day for four months of the year in ski season, and 100% occupancy of chairlift = 0.11.

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## Table A - Preliminary Landslide Risk Assessment (Risk to Property)
## Mt Perisher Ski Lift - Top Station

| Possible Hazards | | Consequences (Note 2) | Assessed Likelihood | Risk (Note 1) | Risk Treatment and Comments |
|---|---|---|---|---|---|
| **Failure Envisaged** | **Failure Mode** | | | | |
| A - Shallow earth slide. | Slide | Minor | Unlikely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019. |
| B - Deep-seated earth slide. | Slide | Minor | Unlikely | Low | |
| C - Translational earth slide (slow creep). | Slide | Insignificant | Likely | Low | |
| D - Rock topple of detached granite boulders. | Topple | Medium | Unlikely | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019, including identifying and remediating any boulders at risk of dislodging. |
| E - Instability of permanent cut/fill slopes | Slide | Medium | Rare (engineered works) | Low | Design and construction of the development to be in accordance with recommendations in Geotechnical Report 5498-G1 dated 23 June 2019. |

Notes:

1. The risk assessment addresses only the consequences to property from potential landslide events considered relevant to the subject site. Injury to persons or potential for fatality from land sliding is not assessed in this table (refer Table F). The risk assessment is based on a preliminary appraisal only, carried out by inspection. Further assessment or quantification of the assessed geotechnical risks for the subject property would require additional data and/or investigation.
2. The consequences are for a development that is designed to accomodate the potential landslide risk or has demonstrated adequate performance over many years.
3. Refer to report and associated figures for illustration of possible hazards / slope failure mechanisms.
4. Refer to attachments for definitions and explanations of terms used in the risk assessment.

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## Table A - Preliminary Landslide Risk Assessment (Risk to Property)
## Mt Perisher Ski Lift - Top Station

| Possible Hazard | Use of Affected Structure & Persons at Risk | Likelihood | Indicative Annual Probability P (H) | Probability of Spatial Impact P (S:H) | Temporal Probability P (T:S) | Vulner-ability V (D:T) | Probability of becoming Trapped | Risk for Person Most at Risk [Risk Evaluation] | Risk Outcome: A = Acceptable T = Tolerable NT = Not Tolerable |
|---|---|---|---|---|---|---|---|---|---|
| A - Shallow earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.05 | 1.38E-07 | A |
| B - Deep-seated earth slide. | Chair - passengers | Unlikely | 1.0E-04 | 0.25 | 0.11 | 1.00 | 0.25 | 6.88E-07 | A |
| C - Translational earth slide (slow creep). | Chair - passengers | Likely | 1.0E-02 | 1.00 | 0.11 | 0.01 | 0.01 | 1.10E-07 | A |
| D - Rock topple of detached granite boulders. | Chair - passengers | Unlikely | 1.0E-04 | 0.20 | 0.11 | 1.00 | 0.25 | 5.50E-07 | A |
| E - Instability of permanent cut/fill slopes | Chair - passengers | Rare (engineered works) | 1.0E-05 | 1.00 | 0.11 | 1.00 | 0.25 | 2.75E-07 | A |

Notes:

1. The appraisal of the assessed risk relative to acceptable and tolerable risks is based on Table 1 of AGS (2007) – Reference 1, for a new development.
2. Risk mitigation will be required to ensure that the assessed risk outcome during and after the proposed development is acceptable. Referred to report for further details.
3. This table must be read in conunction with Table E.
4. Risk Outcome:
   A = Acceptable $\leq 10^{-6}$
   T = Tolerable $\leq 10^{-5}$
   NT = Not Tolerable - treatment options to be assessed and implemented
5. Temporal Probability based on per-person average 8 hours per day for four months of the year in ski season, and 100% occupancy of chairlift = 0.11.

# APPENDIX D

Form 1

# Form 1 – Declaration and certification made by geotechnical engineer or engineering geologist in a geotechnical report.

DA Number: ____________________

To be submitted with a development application

You can use Form 1 to verify that the author of a geotechnical report is a geotechnical engineer or engineering geologist as defined by the Department of Planning & Environment (DP&E) Geotechnical Policy. Alternatively, where a geotechnical report has been prepared by a professional person not recognised by DP&E Geotechnical Policy, then Form 1 may be used as technical verification of the geotechnical report if signed by a geotechnical engineer or engineering geologist as defined by the DP&E Geotechnical Policy.

**Please contact the Alpine Resorts Team in Jindabyne for further information - phone 02 6456 1733.**

To complete this form, please place a cross in the appropriate boxes ☐ and complete all sections.

## 1. Declaration made by geotechnical engineer or engineering geologist as part of a geotechnical report

I,

Mr ☑ Ms ☐ Mrs ☐ Dr ☐ Other ☐

First Name: MARK
Family Name: GREEN

OF

Company/organisation: ASSET GEOTECHNICAL ENGINEERING PTY LTD

on this the 22 day of NOVEMBER 2019

certify that I am a geotechnical engineer or engineering geologist as defined by the "Policy" and I (tick appropriate box)

☑ prepared the geotechnical report referenced below in accordance with the AGS 2000 and DP&E Geotechnical Policy – Kosciuszko Alpine Resorts.

☐ am willing to technically verify that the Geotechnical Report referenced below has been prepared in accordance the AGS 2000 and DP&E Geotechnical Policy – Kosciuszko Alpine Resorts.

## 2. Geotechnical Report Details

Report Title: MT PERISHER GEOTECHNICAL ASSESSMENT

Author: MARK GREEN

Dated: 22 NOVEMBER 2019

DA Site Address: MT PERISHER, NSW

DA Applicant: PERISHER BLUE PTY LTD

I am aware that the Geotechnical Report I have either prepared or am technically verifying, (referenced above) is to be submitted in support of a development application for the proposed development site (referenced above), and it's findings will be relied upon by the Consent Authority in determining the development application.

## 3. Checklist of essential requirements to be contained in a geotechnical risk assessment report to be submitted with a development application

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Report. This checklist is to accompany the report.

Please tick appropriate box

- ☑ Risk assessment of all identifiable geotechnical hazards in accordance with AGS 2000, as per 6.1 (a) of the policy.
- ☑ Site plans with key hazards identified and other information as per 6.1 (b)
- ☑ Details of site investigation and inspections as per 6.1 (c)
- ☑ Photographs and/or drawings of the site as per 6.1 (d)
- ☑ Presentation of geotechnical model as per 6.1 (e)
- ☑ A specific conclusion as to whether the site is suitable for the development proposed on the above site, if applicable, subject to the following conditions;
    - ☐ Conditions to be provided to establish design parameters,
    - ☐ Conditions to be incorporated into the detailed design to be submitted for the construction certificate,
    - ☐ Conditions applying to the construction phase,
    - ☐ Conditions relating to ongoing management of the site/structure.

## 4. Signatures

Signature

MGreen

Chartered professional status

BSc(Hons) CPEng (membership number 4104405) MIEAus
NER IntPE (Aus) CGeol FGS

Name

MARK GREEN

Date

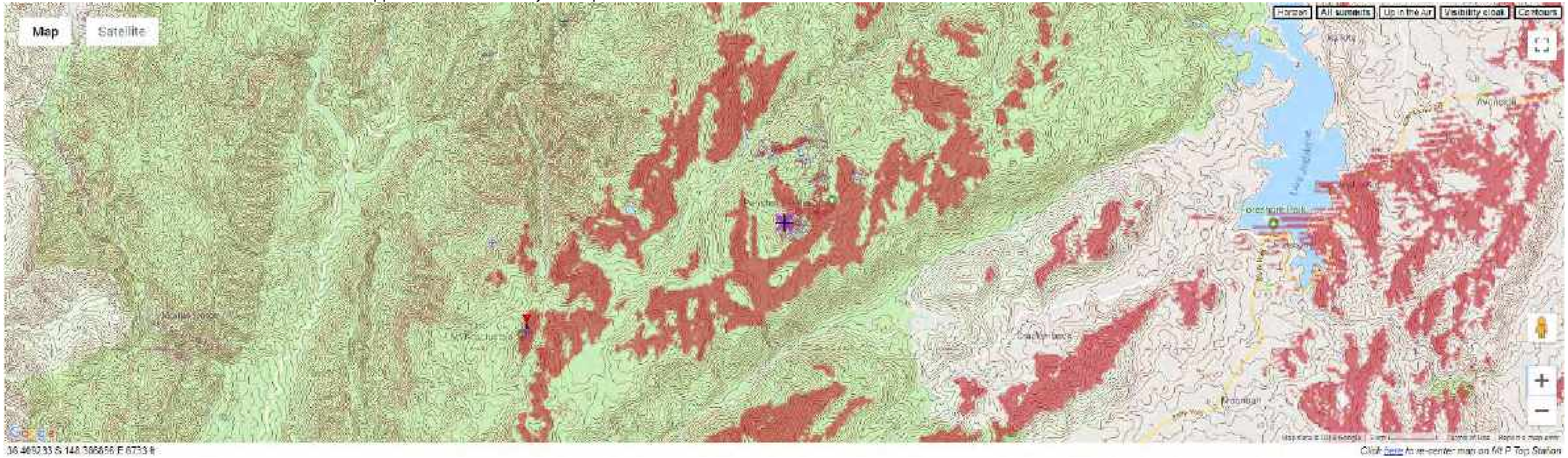
22 NOVEMBER 2019

## 5. Contact details

Department of Planning & Environment
Alpine Resorts Team
Shop 5A, 19 Snowy River Avenue
PO Box 36, JINDABYNE 2627
Telephone: 02 6456 1733
Facsimile: 02 6456 1736
Email: alpineresorts@planning.nsw.gov.au

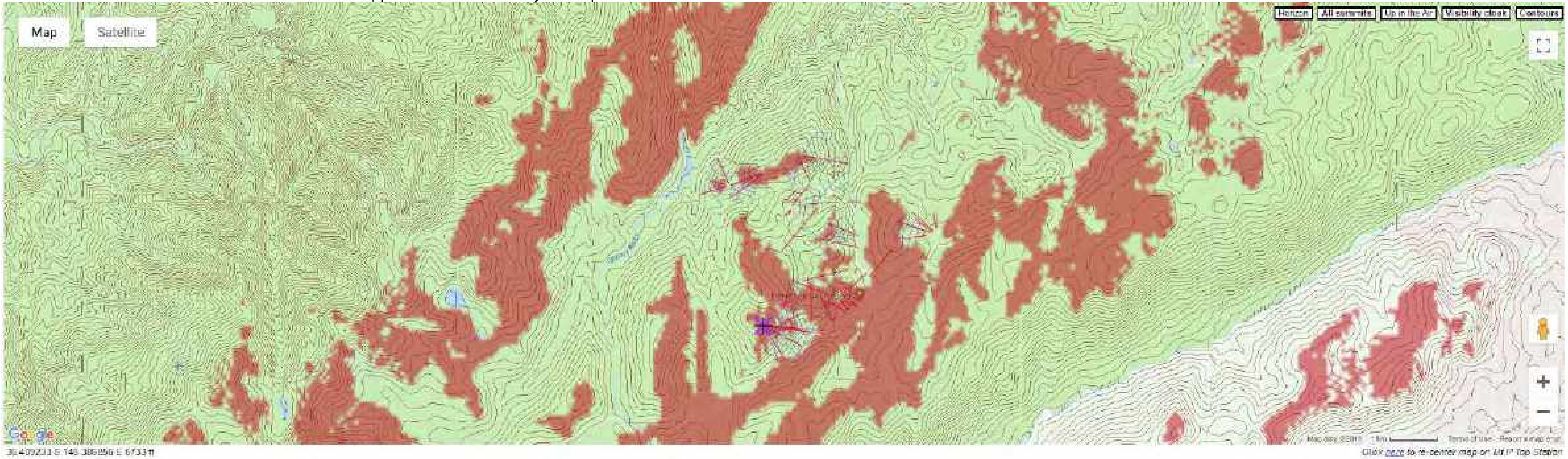
# APPENDIX G

## VISUAL ANALYSIS MAPS



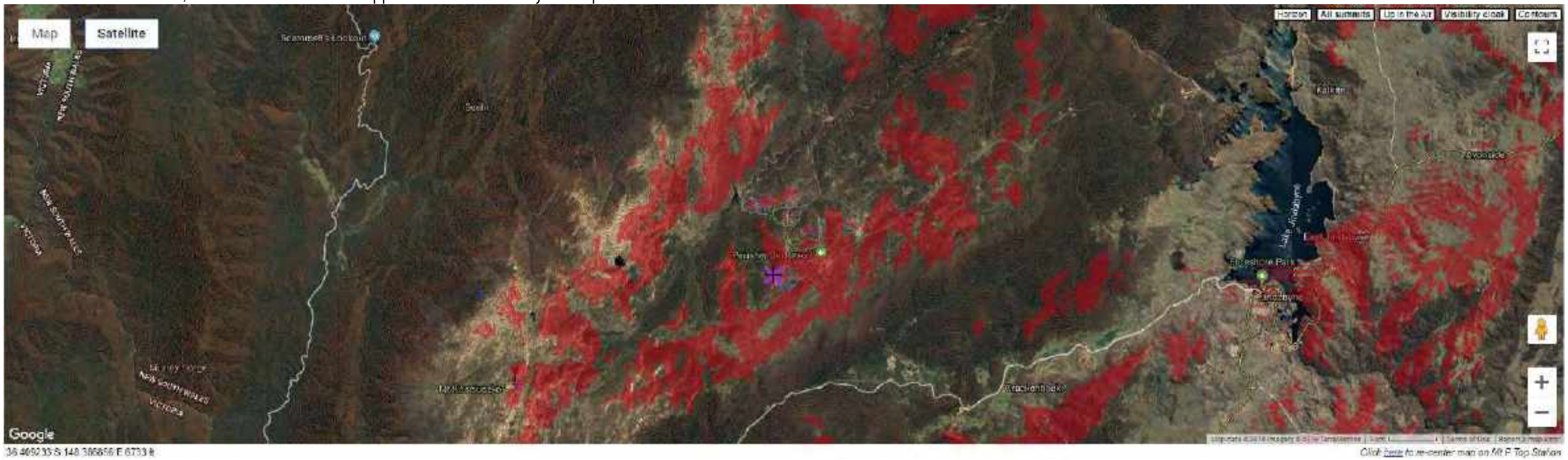

+ = Denotes the proposed location of the Top Station

= Denotes the visibility cloak – areas where the highest point of the top station can be potentially seen from, measured at RL2052m
(nb: does not take into account vegetation, localised land forms (i.e. rocky outcrops) or existing structures that would otherwise screen the structure)




\+ = Denotes the proposed location of the Top Station

= Denotes the visibility cloak – areas where the highest point of the top station can be potentially seen from, measured at RL2052m
(nb: does not take into account vegetation, localised land forms (i.e. rocky outcrops) or existing structures that would otherwise screen the structure)




\+ = Denotes the proposed location of the Top Station

= Denotes the visibility cloak – areas where the highest point of the top station can be potentially seen from, measured at RL2052m
(nb: does not take into account vegetation, localised land forms (i.e. rocky outcrops) or existing structures that would otherwise screen the structure)


+ = Denotes the proposed location of the Top Station

= Denotes the visibility cloak – areas where the highest point of the top station can be potentially seen from, measured at RL2052m
(nb: does not take into account vegetation, localised land forms (i.e. rocky outcrops) or existing structures that would otherwise screen the structure)

# APPENDIX H

## 3D RENDERED IMAGES

APPENDIX H