

Remarkables Ski Area Upgrade and Doolans Expansion

Noise and vibration effects

Prepared for NZSki Limited

May 2026

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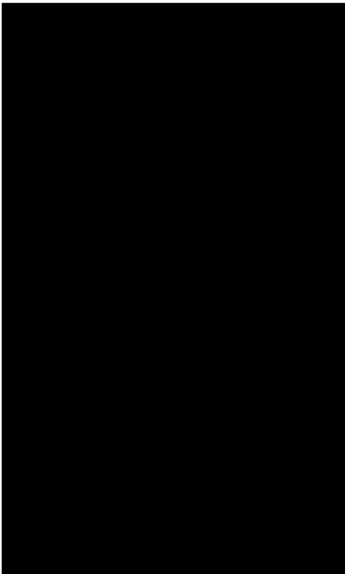
Noise and vibration effects

NZSki Limited

E260229 RP1

May 2026

Version	Date	Prepared by	Reviewed by	Comments
1	12/5/2026			Final



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Executive Summary

ES1 Assessment

This noise and vibration effect assessment (NVEA) supports the Assessment of Environmental Effects (AEE) application for the Remarkables Ski Field Expansion Project (the Project), under the *Fast Track Approvals Act 2024*. The Project is located approximately 24 kilometres from downtown Queenstown.

The NVEA addresses all environmental noise and vibration assessment requirements relevant to the Project in accordance with the relevant district plans, standards (New Zealand and international standards) and guidelines.

Noise and vibration criteria and/or noise limits for all surrounding receivers were established based on noise rules provided in the Operative Queenstown Lakes District Plan (OQLDP) (2005), Proposed Queenstown Lakes District Plan (PQLDP) (2026) and Central Otago District Plan (CODP) (2026).

Noise from the Project construction and operation were predicted using ISO 9613-2:1996 algorithms within the DGMR iNoise noise modelling software (the model). The model calculates total noise levels at assessment locations from concurrent operation of multiple noise sources and considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions.

Potential effects from construction vibration and road traffic noise (during construction and operation) were qualitatively assessed in accordance with the relevant district plans, standards and guidelines.

ES2 Construction noise

ES2.1 General construction

Noise modelling was undertaken for scenarios corresponding to worst-case construction activities over the proposed four-year schedule. Modelling considered plant and equipment sound power levels, operating times and their locations in relation to sensitive receivers. Noise predictions were assessed against the recommended upper noise limits provided in NZS 6803:1999 for long-term construction.

Construction noise levels from works proposed within the existing Remarkables Ski Area and the proposed Doolans Basin expansion areas are predicted to satisfy the relevant L_{Aeq} noise limits.

Construction noise (L_{Aeq}) levels from the lower carpark (Carpark A) upgrades and construction of the proposed lower carparks (Carpark B and Boneyard carpark) (outside the main ski area and closest to receivers), are predicted to exceed the noise limits at up to eight residential receivers, during the more sensitive times of the day. Activities associated with these works will be restricted to the hours between 7:30 am and 8:00 pm on weekdays and 7:30 am and 6:00 pm on Saturdays.

Maximum noise (L_{Amax}) levels from any of the proposed construction works are predicted to satisfy the relevant noise limits at all residential receivers, including those applicable during the more sensitive night period.

ES2.2 Helicopter noise during construction

Noise from the use of helicopters during construction was assessed in accordance with the noise limits provided in the relevant district plans and methodology outlined in NZS 6807:1994. It was found that helicopter noise during construction works is predicted to be below the relevant limits and therefore unlikely to cause effects at all residential receivers.

ES3 Operational noise

Noise modelling of Project operation was completed to determine potential effects at surrounding receivers. It was found that noise levels associated with the daily operation and maintenance of the Project are predicted to satisfy the L_{Aeq} limits and sleep disturbance L_{Amax} limit at all receivers in accordance with the district plans.

ES4 Recreational users

During proposed construction works, potential noise and vibration effects on the relatively small number of recreational users are likely to be temporary and transient.

During operation, in the Summer months, negligible effects are anticipated due to the relatively low use of the area currently. In the Winter months, new recreational opportunities in the Doolans Basin will be created as a result of lift-accessed activities.

To mitigate potential effects to recreational users during construction and operation, a communication strategy is recommended to be implemented to inform recreational users of potential noise and vibration effects from proposed construction and operational activities. This will ensure a relatively high and safe user experience.

ES5 Road traffic noise

Road traffic movements on the public road network (e.g. State Highway 6) during Project construction and operation (during the peak of the ski season) are anticipated to negligibly (<2 dB) increase average road traffic noise at receivers along the transport routes. An increase of 2 dB is considered imperceptible, therefore, road traffic noise effects would be negligible.

ES6 Construction vibration and blasting

The assessment of potential vibration effects from the Project construction showed that, given the distances between the work areas and the nearest buildings, vibration emissions are unlikely to be perceptible at the nearest residence and will be significantly below the levels likely to cause building damage.

There is a high level of uncertainty in the prediction of blasting emissions; vibration and airblast overpressure. Notwithstanding, given the significant separation distance between the likely blast locations and the nearest sensitive receivers, as well as the small-scale nature of the proposed blasts, the effects of blasting activity associated with the Project is expected to be minimal.

ES7 Noise and vibration mitigation and management

Project-specific and general noise and vibration mitigation and consultation measures have been recommended for consideration in this assessment.

During construction, potential noise exceedances are predicted at up to three residential receivers during the proposed lower carpark upgrades and new lower carpark construction if activities occur during the more sensitive times outside of the normal working hours. The contractor will consider site-specific noise and vibration mitigation and management measures during construction works and hence potential effects from noise and vibration at nearby sensitive receivers would be minimised.

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1 Introduction

1.1 Overview

The Remarkables Ski Area Upgrade and Doolans Expansion (the Project) will involve upgrades to the existing Remarkables Ski Area and expansion into the Doolans Basin. The Remarkables Ski Area is located approximately 24 kilometres (km) from downtown Queenstown and is a popular destination for New Zealanders and international visitors alike.

The primary objective of the Project is to provide a world class multi-valley ski area that will attract local and international visitors and cater to both the existing and future visitor demands for ski tourism in the district and region. To achieve this objective, NZSki Limited (NZSki) seek to upgrade the existing infrastructure within the Remarkables Ski Area (Rastus Burn) and expand the skiable terrain available through an expansion into the adjacent Doolans Basin. The Doolans Basin will be accessed via newly proposed gondola and ski trails.

The Remarkables Ski Area is currently designed to accommodate approximately 3,500 skiers per day. At the completion of the Project, the expanded ski field will accommodate up to 6,000 skiers per day.

NZSki have engaged EMM Consulting Pty Limited (EMM) to prepare a noise and vibration effect assessment (NVEA) to support the Assessment of Environmental Effects (AEE) submission for the Project, under the provisions of the *Fast Track Approvals Act 2024* (FTAA or the Act).

Acoustics terms relevant to this assessment are described in the Glossary of this report.

1.2 Code of conduct

The authors of this report are Teanuanua Villierme and Katie Teyhan.

Teanuanua Villierme is a professional acoustics consultant with over 15 years' consulting experience. Teanuanua has worked in the field of environmental noise and vibration across sectors including construction, transport, extractive, waste and remediation and renewables. His project experience includes the preparation of noise and vibration effect assessments as well as noise monitoring and sound power testing for mines, quarries, construction sites and other industrial sites. Teanuanua is a current member of the Australian Acoustical Society.

Katie Teyhan is EMM's national Acoustics Team Manager, a Director of the Association of Australasian Acoustical Consultants (AAAC, www.aaac.org.au) and a current member of the Australian Acoustical Society. Katie has over 20 years' consulting experience in environmental acoustics for mining, industry, road and railway transportation systems. She is a practitioner in the measurement, prediction and assessment of noise and vibration associated with developments, as well as land use planning near infrastructure and industrial sites. Katie's experience has provided many opportunities to demonstrate effective communication with regulators, community members and clients. She has been endorsed by the NSW Department of Planning and Environment (Australia) to conduct peer reviews, prepare management plans and act as Acoustics Advisor on major infrastructure projects. She has undertaken audits and prepared expert evidence in relation to noise and vibration assessment, methodology and compliance. Katie has demonstrated experience in delivering expert noise and vibration advice and has contributed to innovative solutions regarding the measurement and assessment of noise emissions from industrial and transport developments.

We confirm that we have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This report has been prepared in compliance with that Code, as if it was expert evidence presented in proceedings before the Environment Court. Unless we state otherwise, this report is within our area of expertise, and we have not omitted to consider material facts known to either of us that might alter or detract from the opinions expressed in this report.

2 Project description

2.1 Project summary

The Project is located within the Rastus Burn and Doolans Basin, within the wider Remarkables Ranges. The Project broadly falls into three distinct areas:

1. **The existing Remarkables Ski Area:** This area includes the existing ski area in the Rastus Burn and the associated Remarkables Ski Area site access road.
2. **The Doolans Basin Ski Expansion Area:** This area is a new expansion of the existing ski area into the adjacent Doolans Basin.
3. **Lower Carpark Area:** This area includes the existing lower carpark adjacent to State Highway 6 and the proposed new areas of car parking located at the foot of the Remarkables, near the Remarkables Ski Field Access Road.

The proposed overall Project site plan is shown in Figure 2.1 and Project key elements for the existing Remarkables Ski Area and Doolans Basin Ski Expansion Area are shown in Figure 2.2.

It should be noted that the activities described in the following sections represent a 'greatest extent' or 'worst-case' scenario, including the maximum disturbance footprints for the Project. It is noted that NZSki is seeking to refine and reduce the footprint of the Project during the preliminary design phase of the Project, where practicable, as detailed design is complete.

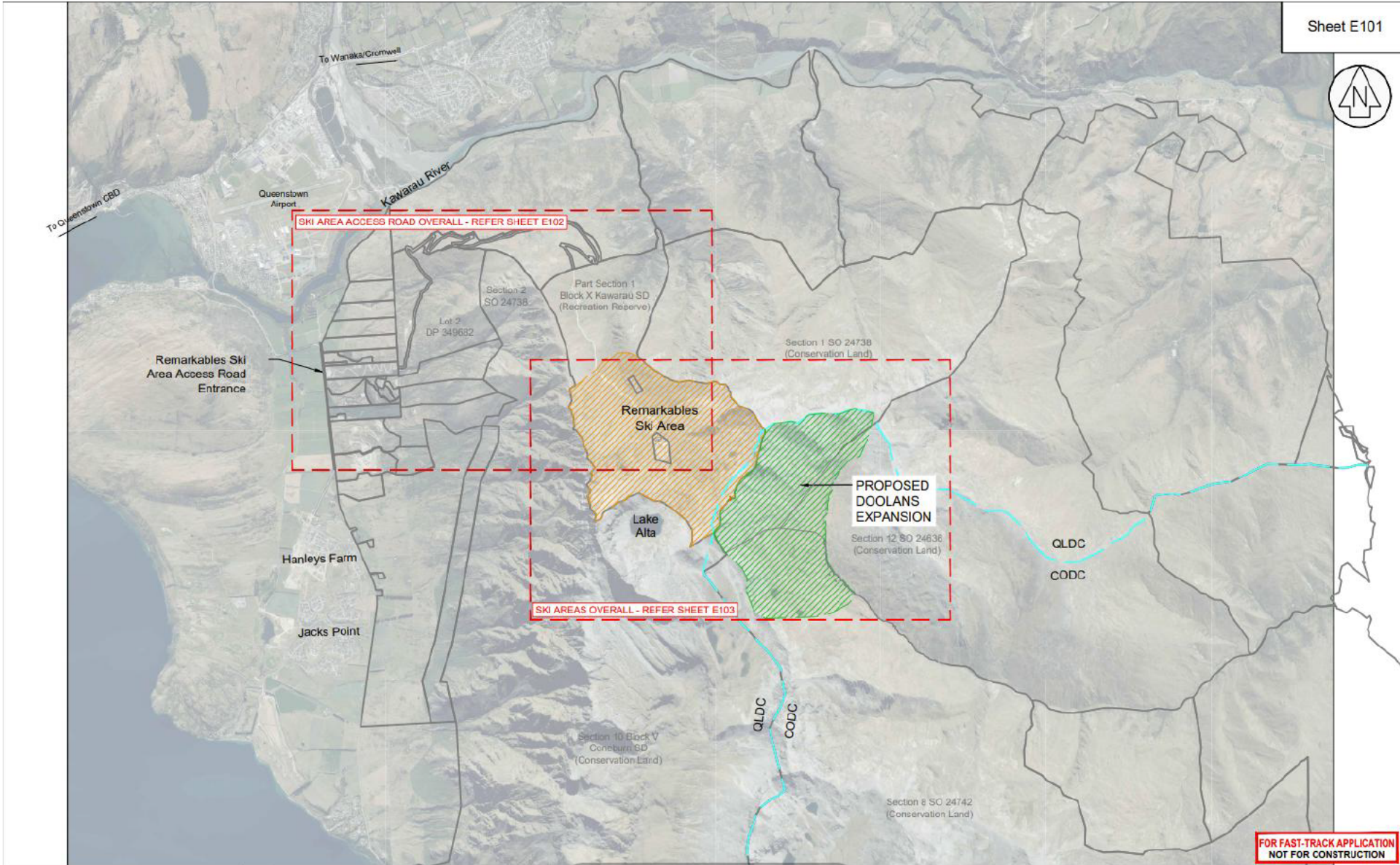


Figure 2.1 Overall site plan

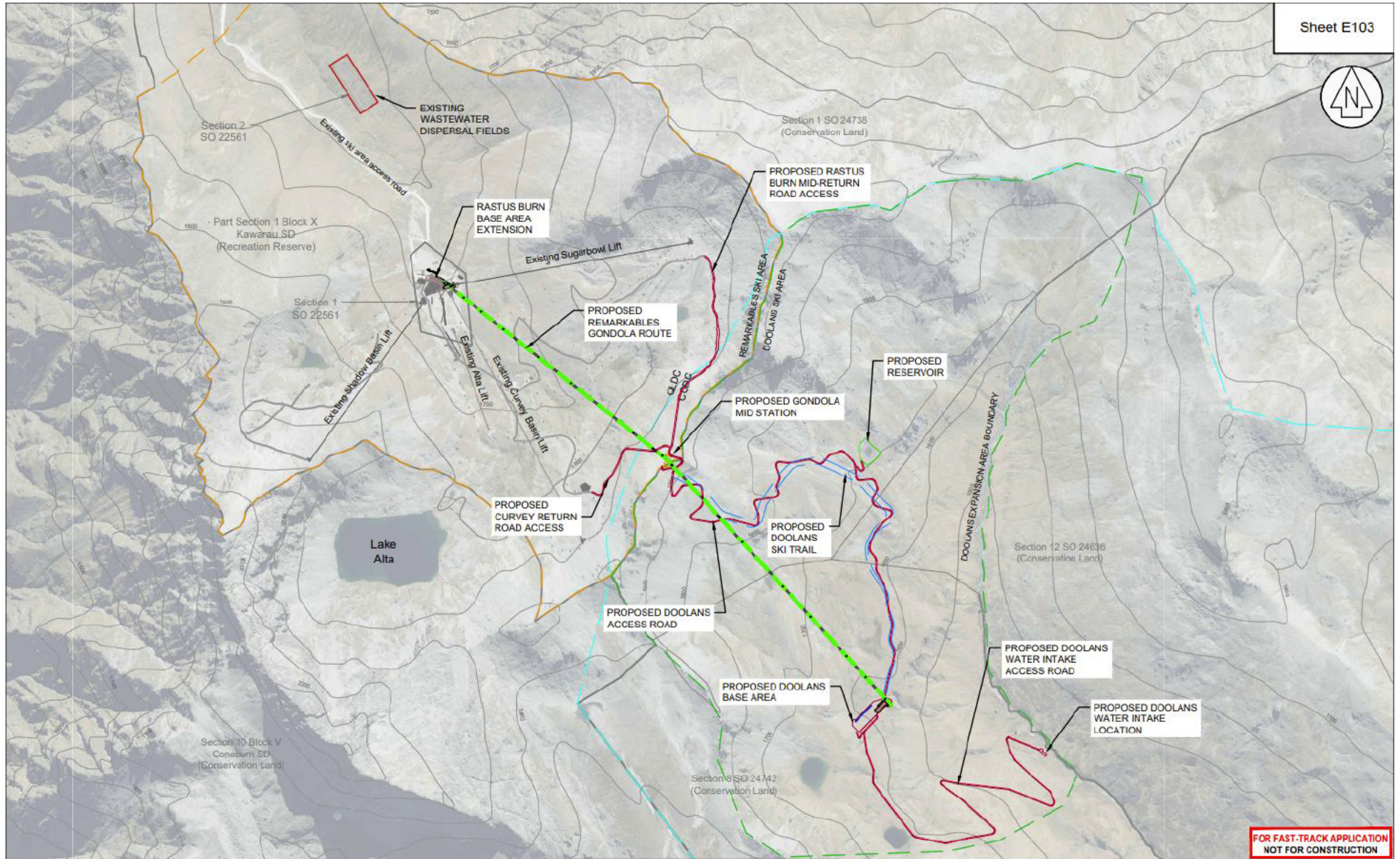


Figure 2.2 Key elements of the existing Remarkables Ski Area and Doolans Basin Expansion ski area

2.1.1 Existing Remarkables Ski Area

The key Project works proposed within the existing Remarkables Ski Area include:

- Upgrades to existing infrastructure services and associated structures including upgrades to mains power supply, infield power distribution, water, wastewater, stormwater, communications, and snowmaking.
- Expansion of the existing Rastus Burn Base Building and reconfiguration of the arrival surrounds.
- Construction and use of the new Doolans gondola providing skier access into the Doolans Basin, including construction of the new Base Station (adjacent to the Rastus Burn Base Building), the new Helicopter Ridge Midstation (the Midstation) and the new Doolans Return Station.
- Upgrades to existing internal access roads and establishment of new access roads and ski trails to provide vehicular access and ski return trails to and from the Doolans Basin.
- Installation of new operational controls to maintain the health and safety of ski field users, including wayfinding signage, barriers/gates, permanent safety fencing/netting, snow fences, avalanche control, boundary markers.

The approximate location of above works within the Rastus Burn ski area and site access (carpark and access road) are shown in Figure 2.3 and Figure 2.4.

2.1.2 Lower Carpark Area

The key Project works proposed within the Lower Carpark Area include:

- Upgrades to existing lower Remarkables carpark (Carpark A), including reconfiguration of the existing carparks and provision of additional bus/shuttle and ride sharing facilities.
- Construction of a new lower carpark (Carpark B) to accommodate an increase in vehicle parking demand.
- Repurposing of the existing storage yard to a carpark (Boneyard carpark).

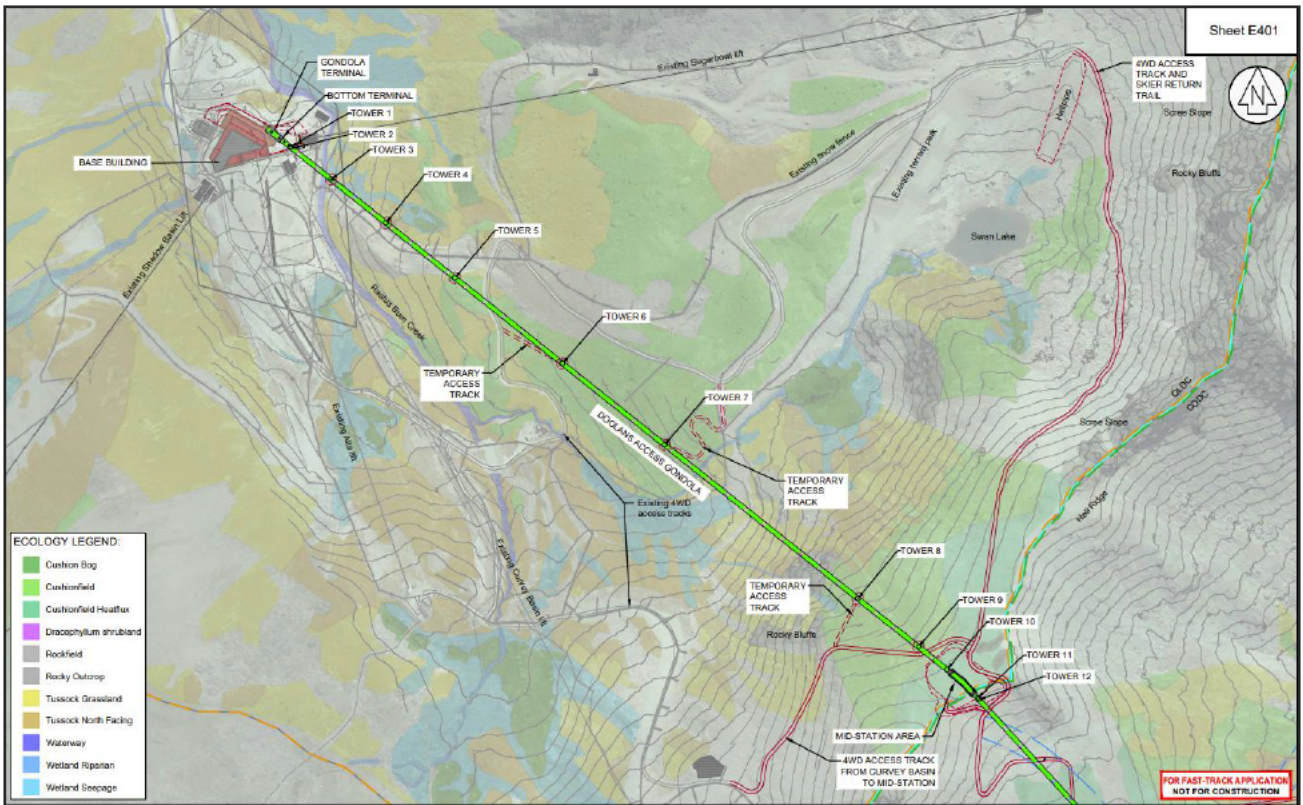


Figure 2.3 Rastus Burn ski area work locations

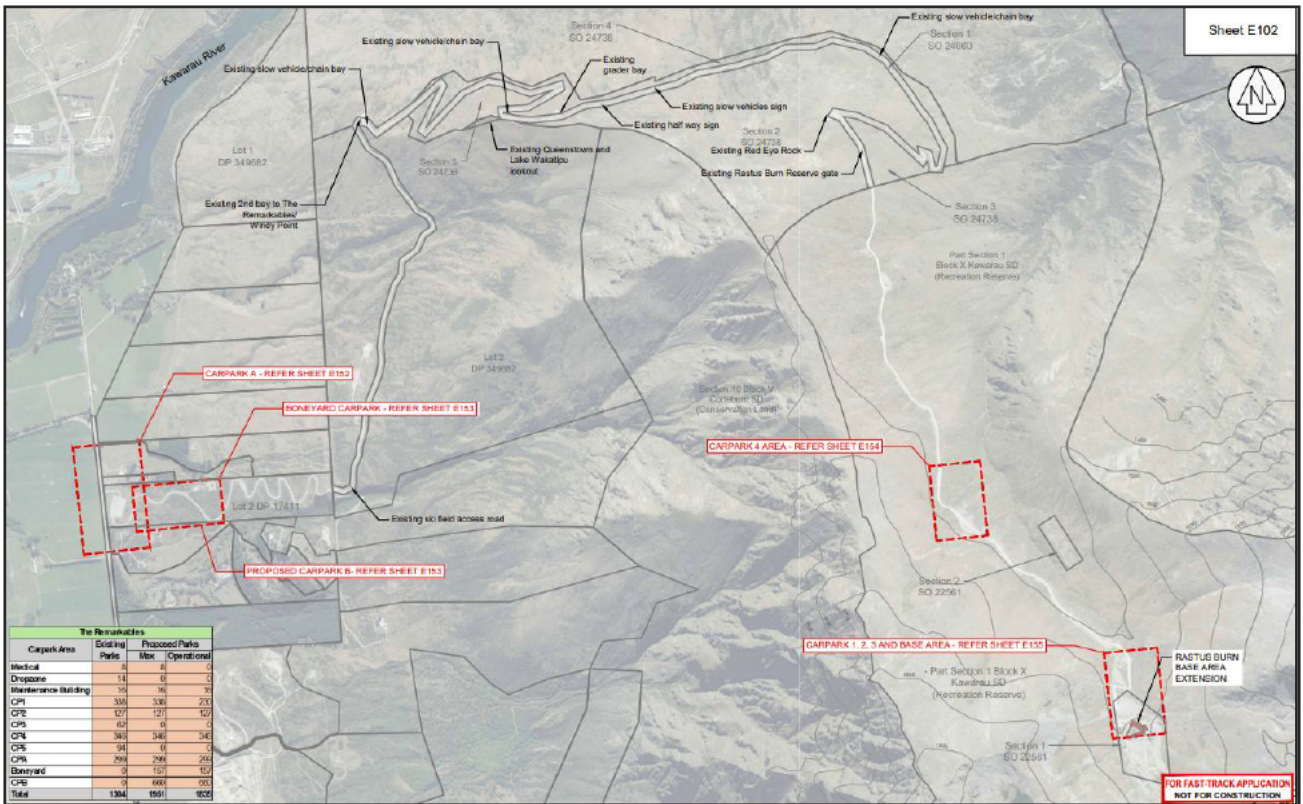


Figure 2.4 Site access (carparks and access road)

2.1.3 Establishment of the Doolans Basin Ski Expansion Area

The key Project works proposed within the Doolans Basin Ski Expansion Area include:

- Establishment and use of the new Doolans gondola from the Rastus Burn Base Station into the Doolans Basin. The new gondola includes an access point at the new Base Station directly adjacent to the existing Rastus Burn Base Building, the new Midstation (with a patrol hut), and the new Doolans Return Station directly adjacent (and connected) to the new Doolans Cabin Building. It also includes construction of gondola towers, cables, cabins and associated infrastructure.
- Establishment and use of a new multi-purpose Doolans Cabin Building, designed to accommodate gondola cabin parking, integrated cabin maintenance, storage, bathroom facilities, café facilities and emergency shelter space.
- Establishment and use of ski trails and access roads between the Midstation, the Doolans Cabin Building and associated infrastructure. Where practicable, ski trails and access roads will be co-located to minimise the level of ground disturbance.
- Construction of a learners snowsports area adjacent to the Doolans Cabin Building with a covered passenger conveyor lift, supported by snowmaking infrastructure.
- Establishment of supporting services and facilities in the Doolans Basin, including power, water, wastewater, stormwater, communications and snowmaking facilities.
- Installation of new operational controls to maintain the health and safety of ski field users. Such controls include wayfinding signage, barriers/gates, permanent safety fencing/netting, snow fences, avalanche control and boundary markers.

The approximate location of these works within the Doolans Basin Ski Expansion Area is shown in Figure 2.5.

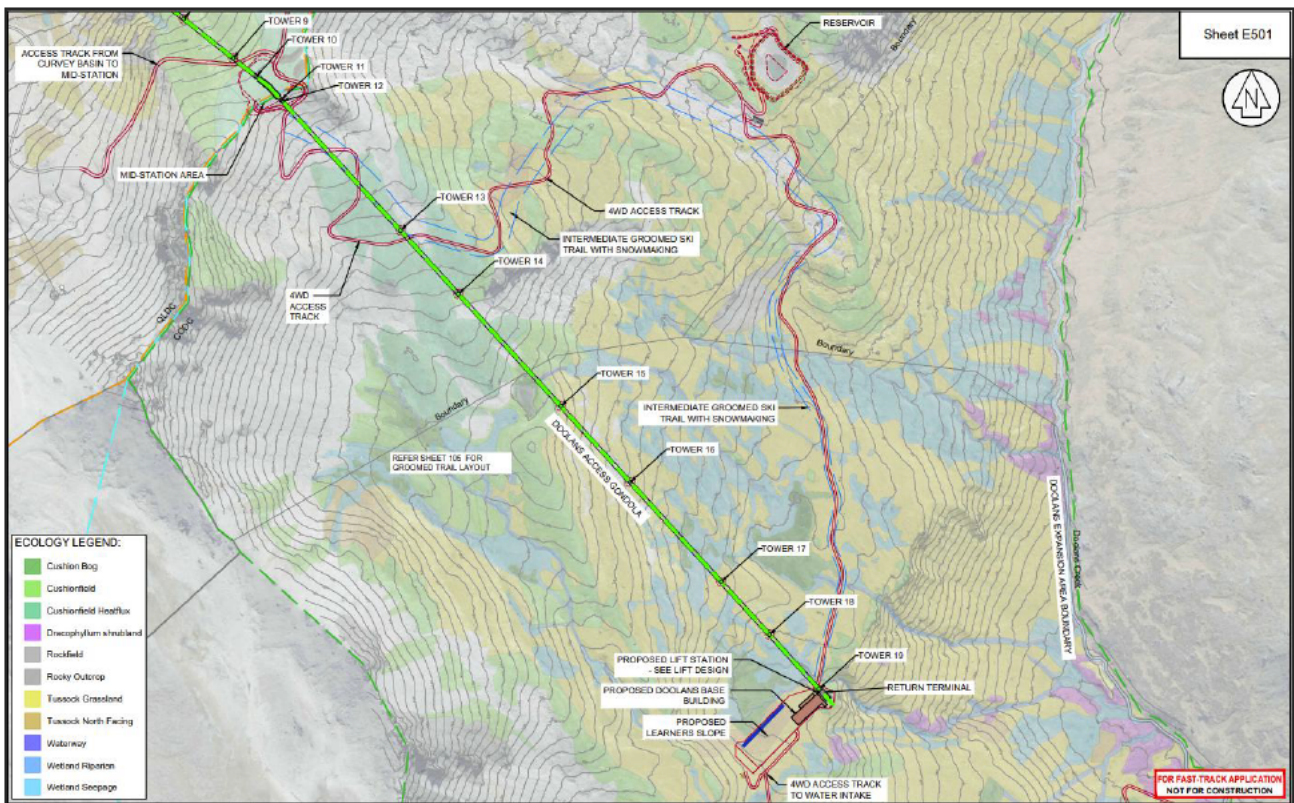


Figure 2.5 Doolans Basin Ski Expansion Area work locations

2.2 Construction

2.2.1 Overview

The pre-development, construction and active closure works are anticipated to take approximately four years (over four construction seasons). Construction is planned to occur in a series of stages that reflects alpine seasonal constraints, operational ski field requirements, progressive increases in capacity and functionality, and the need to manage construction effects incrementally.

Each construction stage will be defined by distinct and expected construction outcomes. Each construction stage will be undertaken in line with defined ‘staging principles’ to maintain compatibility with current alpine operations, maintain feasibility and resiliency of construction, and minimise adverse effects during each stage. The staging principles are as follows:

- Construction is undertaken in logical, self-contained stages.
- Each stage delivers a defined outcome or enables subsequent works.
- Effects are managed and mitigated progressively, as the effects arise.
- Disturbance is consolidated where practicable.
- Sites are stabilised and made safe at the end of each construction season.
- Construction staging remains adaptable to weather, ground conditions, and operational requirements to ensure safe working conditions.
- The interface between operational ski areas, public access and construction activities is safely managed.

2.2.2 Staging of works

The Project construction stages are designed to be progressive over four consecutive construction seasons (four years), during the summer alpine season between November and May. The four stages are defined as preparation, enabling, installation, and expansion works. Whilst it is planned for each stage to be completed within each construction season, due to the nature and constraints of working within an alpine environment, the staging of works is indicative. Construction works indicatively proposed to be completed under each stage are summarised in Table 2.1.

Table 2.1 Construction stages and proposed works

Preparation works 2026–2027 season	Enabling works 2027–2028 season	Installation works 2028–2029 season	Expansion works 2028–2030 season
Base area excavations and service diversions	33kV power upgrade	State Highway 6 intersection	Doolans cabin food and beverage
Base building and gondola foundations	Superstructure base building and gondola stage 1	State Highway 6 carpark transit hub	Snow play zone, conveyor and snowmaking infrastructure
Midstation/Rastus Burn access roads, laydown areas and construction platforms	Midstation earthworks and foundations	Carpark expansions	Trail development and operational improvements
Gondola towers in Rastus Burn	Gondola towers in Doolans Basin	Superstructure base building and gondola stage 2	Rastus Burn wastewater onsite disposal stage 2
Doolans access and services stage 1	Doolans access and services stage 2	Midstation gondola and patrol hut structure	
	Reservoir and pump shed	Doolans gondola and cabin building	
	Doolans ski trails and snowmaking infrastructure	Water storage tanks	
	Doolans base area earthworks and water storage tanks	Water intake access, pump stations and weir	
		Reservoir, water intake, and snow making commissioning	
		Rastus Burn wastewater onsite disposal stage 1	

2.2.3 Access and site logistics

Construction access will be undertaken using a combination of permanent and temporary access routes, aligned with the approved design and adapted to terrain, access constraints, and constructability requirements. Primary construction access routes will be progressively established and have been designed to form the permanent operational access infrastructure for the Project. Construction access and logistics arrangements are proposed to be directly aligned with the staged delivery of the Project and structured to:

- support the efficient delivery of construction stages by progressively establishing access and logistics areas as the construction works progress and being adaptable to weather, ground condition conditions, and operational constraints
- avoid duplication of disturbance by using existing access routes where possible and aligning construction access, permanent service access, ski trails and infrastructure where possible

- consolidate access corridors where practicable to minimise disturbance
- enable safe transitions between construction seasons and ski field operations by clearly separating construction activities from public areas and ensuring access and logistics areas are safely secured/stabilised between construction seasons.

Temporary access will be limited to discrete locations where permanent access cannot reasonably service works, and where direct permanent access is not practicable or necessary. All temporary access measures (roads or construction platforms) will be progressively removed, stabilised, and rehabilitated upon completion of construction works.

Construction activities proposed in steep, remote, or access-constrained terrain will be supported by helicopter, including the delivery and placement of materials, components, and equipment.

2.2.4 Construction hours

Construction is proposed to generally occur during daylight hours appropriate to an alpine environment and seasonal constraints.

Construction is proposed seven days a week, from Monday to Sunday within the Rastus Burn and Doolans Basin. Construction activities will generally commence from 7:00 am and be undertaken during daylight hours, up until 9:00 pm. An extension of time outside of these hours will require the prior approval of the Department of Conservation.

In the Lower Remarkables carparks, construction is proposed six days a week, from Monday to Saturday. Construction activities in this area of the site have been assessed as occurring between 7:00 am and 10:00 pm; thereafter, they are considered night-time works where assessment criteria are generally more stringent.

It is noted that night-time works are not anticipated, but may be required on a limited contingency basis where necessary due to the following reasons:

- weather delays
- programme constraints
- access limitations
- continuous construction activities (e.g. concrete pours).

Mitigation and management measures would be implemented to minimize noise effects during out of-hours (night) works, where necessary; for example, noise intensive works in identified sensitive areas would be restricted to daytime hours only.

Any construction works outside of normal working hours would be temporary and managed in accordance with relevant consent conditions.

2.3 Operation

2.3.1 Overview

The Project operation will generally be a continuation of existing Remarkables Ski Area activities, within the Rastus Burn and the new expanded Doolans ski area. Ski field users will access to the Midstation and Doolans ski area via the new Doolans gondola. Proposed new access tracks and ski trails to the Midstation and Doolans ski area will provide vehicular access (for operational, maintenance and emergencies) and ski return trails to and from the Doolans Basin.

Once the Project has been constructed, the Remarkables Ski Fields will be able to accommodate a maximum of approximately 6,000 skiers per day; the Rastus Burn ski area will accommodate approximately 3,500 people and the new Doolans Basin ski area will accommodate 2,500 people.

The expanded Remarkables Ski Area will provide essential staff facilities, public food beverage and service areas, bathrooms, snow play storage, maintenance and plant areas, and back of house storage.

2.3.2 Lower Remarkables Transit Facility

i Transport infrastructure

Upgrades are proposed to the lower Remarkables carpark (Carpark A) to improve internal circulation and to accommodate the anticipated visitor growth, as shown in Figure 2.6.

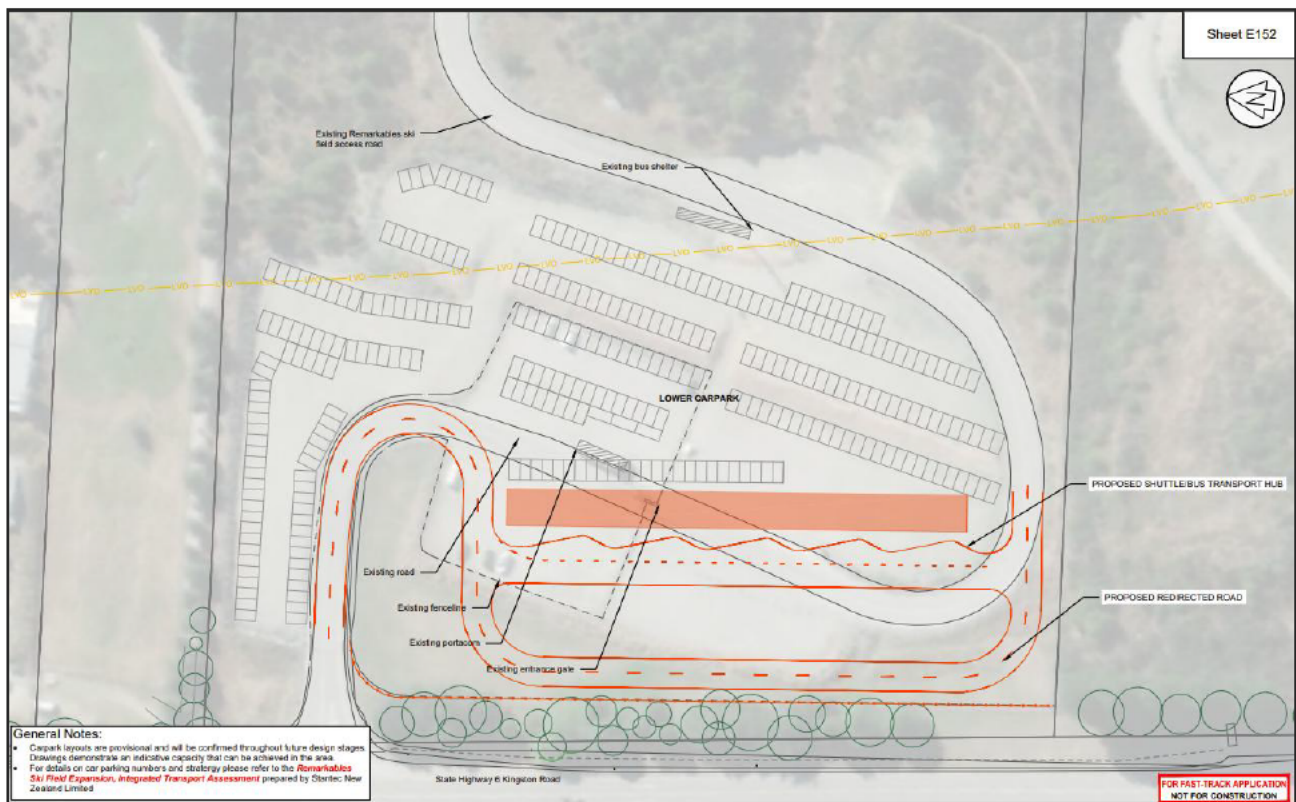


Figure 2.6 General arrangement of the lower Remarkables carpark (Carpark A) upgrades

The works include a minor reconfiguration of Carpark A to improve car parking efficiency and capacity, development of a transit hub (park-and-ride facility) with additional shuttle/bus drop-off and pick-up zones and improved ride share transition zones. These works will enable NZSki to work towards its modal shift of visitors from private cars to shared bus, shuttles and cars.

Further, a new carpark (Carpark B) is proposed immediately to the east of Carpark A. Construction works associated with Carpark B will primarily include area establishment activities (earthworks).

A third carpark (Boneyard carpark) will also be established within an existing storage and utility yard. This will only require the removal of items stored in this area, with no construction works proposed. The location and layout of the new Carpark B and Boneyard carpark are shown in Figure 2.7 and Figure 2.8.

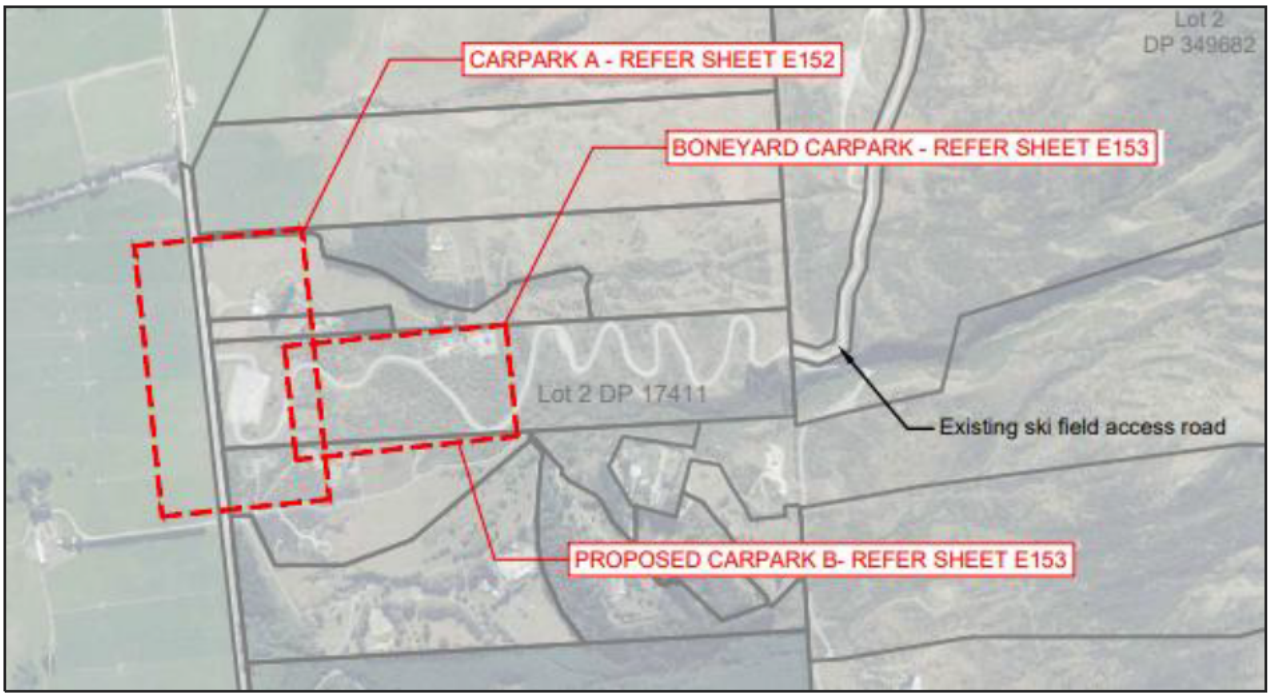


Figure 2.7 Location of proposed Carpark B and Boneyard carpark



Figure 2.8 Proposed layout for Carpark B and Boneyard carpark

To manage peak flows through the State Highway 6 (SH6) intersection, NZSki propose to implement temporary traffic control measures for the duration of the ski season. Successfully implemented for the last season, the traffic control measures impose a temporary speed reduction and a left out only turn from the Remarkables site entrance. This temporary mechanism is proposed while the Queenstown Lakes District Council (QLDC) and the New Zealand Transport Agency (NZTA) work through the wider implementation of the Te Tapuae Southern Corridor strategy.

2.3.3 Upgraded Remarkables Ski Area

i Rastus Burn Base Building

Expansion of the existing Rastus Burn Base Building is proposed to increase existing capacity to cater for the increased capacity of the ski field, and during peak periods and adverse weather events. The proposed extensions will nearly double the existing internal floor area and have been designed to tie into the existing building structure and roof form.

The transport drop off zone for buses and customers outside the front of the existing base building will be reconfigured to accommodate the base building extension and the Doolans Gondola Base Station.

ii New substation

A new 33/11 kilovolt (kV) on-site substation with transformers, switchgear, and three emergency diesel generators will be installed within Carpark 3 to allow for electricity distribution around the ski field. The substation will occupy a footprint of approximately 150 m² and will be contained within a building.

The emergency generators are required to ensure the Rastus Burn Base Building, the Doolans gondola, the Doolans Cabin Building, the Doolans Learner Conveyor and all on-site wastewater treatment and pumping can continue to operate in the case of a power outage. The generators will be connected to a transfer pump and underground pipe from the existing on-site diesel tanks. A dedicated transformer will be located adjacent to the generators to connect to the main 11 kV switchboard.

Two additional transformers will be installed at the Rastus Burn Base Building. These will service the increased electrical load for the Base Building and the Doolans gondola. Each transformer would be fed directly from the new 11 kV switchboard in the new substation via underground cables.

iii New wastewater treatment plant

A new wastewater treatment plant (WWTP) is proposed within Carpark 3, immediately to the south of the new substation. The Rastus Burn WWTP and associated equipment (e.g. pumps) will be housed within buildings.

2.3.4 The Doolans Basin Ski Expansion Area

i Doolans gondola and Midstation

Access to the Doolans ski fields will be via the new Doolans gondola, from the Rastus Burn Base Station. Other gondola access points and facilities are proposed at the Midstation, the Doolans Cabin Building Return Station. Refer to Figure 2.5 for the indicative gondola alignment in the Doolans Basin.

The Midstation will have a level platform for skiers and sightseers. Access grades for the main access road, Doolans return trail and Doolans ski trail will be improved for vehicles and skiers. The Midstation gondola facilities will include the gondola drive station and control box. Adjacent to the Midstation, the patrol hut will store emergency medical equipment and act as a sheltered holding base for patrollers.

ii Doolans Cabin Building and Return Station

The Return Station gondola facilities will include the gondola drive station and control room. An overhead conveyor will take cabins offline into the adjacent Doolans Cabin Building for storage and maintenance.

A multi-purpose gondola cabin parking and hospitality building will be constructed immediately adjacent to the Doolans Gondola Return Station. The Doolans Cabin Building will be 62 metre (m) long x 18 m wide and approximately 16 m tall, and consolidates operational and hospitality facilities in the Doolans Basin. It will contain gondola cabin parking and maintenance facilities, essential staff facilities, public food beverage and service areas, bathrooms, snow play storage, maintenance and plant areas, and back of house storage.

The Doolans Cabin Building will be multi-levelled. The upper area will be dual-use; used for cabin parking and maintenance during non-operational hours and as a public seating/resting area during open hours of the ski field. An overhead conveyor between the Doolans gondola drive station and the building will allow cabins to be driven into the building, up a purpose-built entrance area, and into the upper floor for maintenance and/or parking. The lower sub-floor will house the staff facilities, public food beverage and service areas, bathrooms, storage, maintenance and plant areas.

iii Learners zone

A learners snowsports area (slope) will be established to the west of the Doolans Cabin Building. The learners slope will occupy a footprint of approximately 5,000 m². The area will be serviced by a covered passenger conveyor lift of approximately 100 m in length.

The area will be supported by snowmaking facilities which are anticipated to consist of at least two snow guns to support use of the learners zone in low snowfall conditions.

iv Main Doolans Basin ski trail and access road

A dual-purpose ski trail and access road will be constructed in the Doolans Basin, originating at the Midstation and ending at the Doolans Cabin Building.

The ski trail will be the only formed ski trail in the Doolans Basin and will be the primary route for skiers to descend through the basin. The trail will be supported by snowmaking facilities. Other trails will be established using snowpack (artificial and natural), with off-piste skiing available throughout the Doolans Basin when snow conditions allow.

v Infrastructure services

a Power infrastructure

A new underground power supply into the Doolans will be routed along the Curvey Basin access road and extension up to the Midstation and down into the Doolans Basin along the proposed main access road to the Doolans Cabin Building. The power supply will be provided across the site, and up to five transformers will be required.

b Water supply

A new water take will be established from Doolans Creek via a new Tyrolean Weir. The water will be used within the Doolans ski area for potable water supply, firefighting and snowmaking purposes.

The system is designed to withstand a 1:100-year flood event. The Tyrolean Weir system is suitable for the alpine environment due to its effectiveness in handling sediment and bedload and robust design with low maintenance requirements, ensuring consistent water availability.

The overflow chamber will contain a submersible pump which will pump the water to a nearby larger pump station. The proposed pump station will be enclosed inside a building, made of clad in coloursteel and will contain two skid mounted pumps and control equipment that will pump water to the proposed reservoir and water treatment plant, respectively.

c Water reservoir

A new reservoir for the purposes of snow making will be established using an existing tarn. A dedicated rising water main will be constructed from the Doolans Creek water intake pump building to the proposed reservoir.

A 138 m² (18.2 m x 7.6 m) snow making pump station will be constructed to the south of the reservoir to pump water from the reservoir to the snowmaking network via dedicated snow making mains. The pump station will be enclosed inside a building, made of clad in coloursteel.

d Potable and firefighting water provision

The daily water demand for the proposed Doolans Basin expansion is proposed to be obtained from the Doolans Creek water intake. The water provision system comprising raising/falling mains, storage tanks and pumps will supply water for potable and firefighting use to key areas within the Doolans Cabin Building and gondola Return Station.

e Wastewater infrastructure

Wastewater captured from the Doolans Cabin Building is proposed to be pumped to the Rastus Burn WWTP for treatment and disposal via a three-stage rising wastewater main (each with an associated pump station) up to Helicopter Ridge.

The first pump station will be a macerating pump to intercept non-waste solids with the following two being progressive cavity pumps staged to provide the necessary lift to reach the receiving tank at the Helicopter Ridge.

From the Helicopter Ridge, the receiving tank and pump station will discharge into a falling main, discharging to the existing Rastus Burn WWTP.

3 Assessment requirements

The regulatory assessment requirements pertinent to the Project and NVEA include legislation, district plans, standards and guidelines. These are discussed in the following sections.

3.1 Resource Management Act 1991

Section 16 (1) of the *Resource Management Act 1991* (RMA) refers to duty to avoid unreasonable noise, and states the following:

Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level.

A best practicable option (BPO) is defined in section 2 of the RMA as follows:

best practicable option, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—

- (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and
- (b) the financial implications, and the effects on the environment, of that option when compared with other options; and
- (c) the current state of technical knowledge and the likelihood that the option can be successfully applied.

The RMA also imposes a duty on every person to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by, or on behalf of, that person. The RMA defines noise to include vibration.

3.2 NZ standards for the assessment of environmental noise

The NZ Standard 6801:2008 'Acoustics – Measurement of environmental sound' (NZS 6801:2008) defines basic quantities to be used for the description of sound in community environments and describes procedures for the measurement of these quantities.

The NZ Standard 6802:2008 'Acoustics – Environmental Noise' (NZS 6802:2008) sets out procedures for the assessment of noise (excluding construction noise) for compliance with noise limit and provides guidance for the setting of noise limits for consent conditions, rules or national environmental standards.

Construction noise shall be assessed in accordance with the NZ Standard 6803:1999 'Acoustics – Construction Noise' (NZS 6803:1999). NZS 6803:1999 sets out procedures for the measurement and assessment of noise from existing and proposed construction work. Further, NZS 6803:1999 recommends noise limits for construction noise and provides guidance on methods on predicting and managing construction noise.

Noise from helicopters is assessed in accordance with the NZ Standard 6807:1994 'Noise management and land use planning for helicopter landing areas' (NZS 6807:1994). NZS 6807:1994 provides guidance on the assessment of noise from helicopter landing areas and acceptable noise levels at residences.

3.3 District Plan noise and vibration provisions

The Remarkables Ski Area and Doolans Basin Expansion ski area are located in the Queenstown Lakes District and Central Otago District areas, respectively.

The following District Plans are relevant to the Project:

- Operative Queenstown Lakes District Plan (OQLDP) (2005).
- Proposed Queenstown Lakes District Plan (PQLDP) (2026).
- Central Otago District Plan (CODP) (2026).

It is important to note that QLDC currently has both an Operative District Plan (OQLDP) and a Proposed District Plan (PQLDP). Both plans remain relevant; however, the applicability of the PQLDP noise provisions is limited to those rules that are not under appeal. In this interim period, the PQLDP provisions take precedence where the relevant rules have taken legal effect, while the remaining operative provisions of the OQLDP continue to apply where rules are subject to appeal.

Accordingly, this NVEA has been undertaken with reference to both the OQLDP and PQLDP noise frameworks, applying the PQLDP provisions where they have legal effect, and the OQLDP provisions where they remain operative.

Noise related District Plan provisions relevant to the Project for inclusion in Fast-track applications are summarised in the following sections.

3.3.1 Land zoning

Land zoning in the OQLDP, PQLDP and CODP relevant to the Project are summarised in Table 3.1.

Table 3.1 Planning information

Zoning	Overlays
Operative Queenstown Lakes District Plan	
<ul style="list-style-type: none"> • Rural General Zone • Ski Area Subzone 	
Proposed Queenstown Lakes District Plan	
<ul style="list-style-type: none"> • Rural Zone • Ski Area Subzone (Type 8) 	<ul style="list-style-type: none"> • Outstanding Natural Landscape (Northern Remarkables) • Significant Natural Area (Rastus Burn SNA B)
Central Otago District Plan	
<ul style="list-style-type: none"> • Rural Resource Area 	<ul style="list-style-type: none"> • Outstanding Natural Landscape • Significant Natural Landscape

3.3.2 Noise rules

Noise rules extracts from the OQLDP, PQLDP, and CODP pertinent to the Project are provided in Table 3.4, Table 3.3 and Table 3.4, respectively.

Table 3.2 OQLDP noise rules

Rule	Standards									
Section 5.2 Rural General and Ski Area Sub-Zone – Rules										
Rule 5.3.5.2 (v) Noise	<p>a. Sound from non-residential activities measured in accordance with NZS 6801:2008 and assessed in accordance with NZS 6802:2008 shall not exceed the following noise limits at any point within the notional boundary¹ of any residential unit, other than residential units on the same site as the activity:</p> <table border="1"> <tbody> <tr> <td>Daytime</td> <td>(0800 to 2000 hrs)</td> <td>50 dB L_{Aeq} (15min)</td> </tr> <tr> <td>Night-time</td> <td>(2000 to 0800 hrs)</td> <td>40 dB L_{Aeq} (15min)</td> </tr> <tr> <td>Night-time</td> <td>(2000 to 0800 hrs)</td> <td>70 dB L_{AF max}</td> </tr> </tbody> </table> <p>b. Sound from non-residential activities which is received in another zone shall comply with the noise limits set in the zone standards for that zone².</p> <p>c. The noise limits in a. shall not apply to construction sound which shall be assessed in accordance and comply with NZS 6803:1999.</p> <p>d. The noise limits in a. shall not apply to sound associated with airports or windfarms. Sound from these sources shall be assessed in accordance and comply with the relevant New Zealand Standard, either NZS 6805:1992, or NZS 6808:1998. For the avoidance of doubt the reference to airports in this clause does not include helipads other than helipads located within any land designated for Aerodrome Purposes in this Plan.</p> <p>e. When associated with farming and forestry activities, the noise limits in a. shall only apply to sound from stationary motors and stationary equipment.</p> <p>f. The noise limits in a. shall not apply to sound from aircraft operations at Queenstown Airport.</p>	Daytime	(0800 to 2000 hrs)	50 dB L _{Aeq} (15min)	Night-time	(2000 to 0800 hrs)	40 dB L _{Aeq} (15min)	Night-time	(2000 to 0800 hrs)	70 dB L _{AF max}
Daytime	(0800 to 2000 hrs)	50 dB L _{Aeq} (15min)								
Night-time	(2000 to 0800 hrs)	40 dB L _{Aeq} (15min)								
Night-time	(2000 to 0800 hrs)	70 dB L _{AF max}								
Section 22 - Earthworks										
22.3.3 (vii) Construction Noise	<p>a. Construction noise arising from earthworks activities shall be subject to the limits in, and shall be measured and assessed in accordance with, NZS 6803:1999 “Acoustics – Construction Noise”. This standard covers sound from construction work which is of a limited duration.</p> <p>b. Where the sound from a construction activity is part of the overall sound emission from an ongoing land use activity, then the overall sound level shall meet the relevant standard within the zone in which the activity is located, or the higher of the two values for the duration of the earthworks activity.</p>									

Notes: 1. This means a line 20 m from the façade of any residential unit or the legal boundary whichever is closer to the residential unit.

2. The nearest allotment that is in a different zone to the Rural General Zone include the Resort Zone at Jack’s Point (approximately 5 km to the west) and the Shotover Country Special Zone (approximately 5 km to the northwest across the Kawerau River).

Table 3.3 PQLDP noise rules

Rule	Standards												
Specific Standards													
<p>36.5.10 Vibration</p> <p>Vibration from any activity shall not exceed the guideline values given in DIN 4150-3:1999 Effects of vibration on structures at any buildings on any other site.</p>	<p>On any structures or buildings on any other site.</p>												
<p>36.5.11 Helicopters</p> <p>Sound from any helicopter landing area must be measured and assessed in accordance with NZ 6807:1994 Noise Management and Land Use Planning for Helicopter Landing Areas.</p> <p>In assessing noise from helicopters using NZS 6807: 1994 any individual helicopter flight movement, including continuous idling occurring between an arrival and departure, shall be measured and assessed so that the sound energy that is actually received from that movement is conveyed in the Sound Exposure Level (SEL) for the movement when calculated in accordance with NZS 6801: 2008.</p> <p>For the avoidance of doubt this rule does not apply to Queenstown Airport and Wānaka Airport.</p> <p>Advice Note: See additional rules in Rural Zone Chapter at 21.10.1, 21.10.2 and 21.10.3.</p>	<p>At any point within the notional boundary of any residential unit, other than residential units on the same site as the activity.</p> <p>For any landing area in the Hills Resort Zone, the assessment location is any point within the notional boundary of a residential unit outside the Hills Resort Zone.</p> <p>For any landing area in the Hogans Gully Resort Zone, the assessment location is any point within the notional boundary of a residential unit outside the Hogans Gully Resort Zone.</p> <p>*Note: The applicable noise limit in this rule and in rule 36.5.12 below for informal airports/landing strips used by a combination of both fixed wing and helicopters shall be determined by an appropriately qualified acoustic engineer on the basis of the dominant aircraft type to be used.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">36.5.11.1</td> <td style="width: 20%;">At all times</td> <td style="width: 20%;">50 dB L_{dn}</td> </tr> <tr> <td colspan="3">All locations except identified in 36.5.11.2 (below)</td> </tr> <tr> <td>36.5.11.2</td> <td>At all times</td> <td>40 dB L_{dn}</td> </tr> <tr> <td colspan="3">Suburban Residential Zone, Medium Density Residential Zone, Medium Density Residential A Zone, High Density Residential Zone, High Density Residential A Zone, Arrowtown Residential Historic Management Zone, Large Lot Residential Zone, Rural Zone, Rural Residential Zone and Rural Lifestyle Zone.</td> </tr> </table>	36.5.11.1	At all times	50 dB L _{dn}	All locations except identified in 36.5.11.2 (below)			36.5.11.2	At all times	40 dB L _{dn}	Suburban Residential Zone, Medium Density Residential Zone, Medium Density Residential A Zone, High Density Residential Zone, High Density Residential A Zone, Arrowtown Residential Historic Management Zone, Large Lot Residential Zone, Rural Zone, Rural Residential Zone and Rural Lifestyle Zone.		
36.5.11.1	At all times	50 dB L _{dn}											
All locations except identified in 36.5.11.2 (below)													
36.5.11.2	At all times	40 dB L _{dn}											
Suburban Residential Zone, Medium Density Residential Zone, Medium Density Residential A Zone, High Density Residential Zone, High Density Residential A Zone, Arrowtown Residential Historic Management Zone, Large Lot Residential Zone, Rural Zone, Rural Residential Zone and Rural Lifestyle Zone.													
<p>36.5.13 Construction Noise</p> <p>Construction sound must be measured and assessed in accordance with NZS 6803:1999 Acoustics - Construction Noise. Construction sound must comply with the recommended upper limits in Table 2 and Table 3 of NZS 6803. Construction sound must be managed in accordance with NZS 6803.</p>	<p>At any point within any other site.</p>												

- Notes:
1. Note this rule does not have immediate legal effect.
 2. Means an L_{Aeq,15min} OR L_{Amax} sound level in decibels that is not to be exceeded.
 3. Means a line 20 m from any side of residential unit or the legal boundary whichever is closer to the residential unit.

Table 3.4 CODP noise rules

Rule	Standards				
Section 04 – Rural Resource Area					
Rule 4.7.6 E – Noise	<p>a. All activities shall be conducted so as to ensure the following noise limits are not exceeded at any point within the notional boundary¹ of any dwelling, resthome or hospital, or at any point within any Residential Zone or any Rural Settlements Resource Area:</p> <table border="1" data-bbox="710 495 1436 640"> <tr> <td data-bbox="710 495 1197 546">On any day 7.00 am to 10.00 pm</td> <td data-bbox="1197 495 1436 546">55 dBA L₁₀</td> </tr> <tr> <td data-bbox="710 546 1197 640">10.00 pm to 7.00 am the following day</td> <td data-bbox="1197 546 1436 640">40 dBA L₁₀ 70 dBA L_{max}</td> </tr> </table> <p>Provided that the above noise limits shall not apply to</p> <ol style="list-style-type: none"> 1. any temporary activity (as defined) 2. devices used to protect crops from birds or frost (see b-c below sirens associated with emergency service activities). 	On any day 7.00 am to 10.00 pm	55 dBA L ₁₀	10.00 pm to 7.00 am the following day	40 dBA L ₁₀ 70 dBA L _{max}
On any day 7.00 am to 10.00 pm	55 dBA L ₁₀				
10.00 pm to 7.00 am the following day	40 dBA L ₁₀ 70 dBA L _{max}				
Section 12 – District Wide Rules and Performance Standards					
Rule 12.7.4 – Noise	<p>Measurement and Assessment of Noise</p> <p>Except where expressly provided elsewhere in this Plan, noise shall be measured in accordance with the provisions of NZS 6801:1991 Measurement of Sound and assessed in accordance with the provisions of NZS 6802:1991 Assessment of Environmental Sound. For the purposes of this Plan the following additional provisions shall limit the application of NZS 6802:1991.</p> <ol style="list-style-type: none"> a. Adjustments for special audible characteristics, if present, as provided for in clause 4.3 and 4.4 of the Standard, shall apply and will have the effect of imposing a numerical noise limit 5 dB more stringent than those L10 numerical limits stated in the plan. b. Where measured noise levels are averaged as provided for in Clause 4.5 of the Standard, the L10 value shall be determined by an energy average (inverse logarithmic mean) of any four L10 measurement sample time intervals on the same day. Sample time intervals must include the sound of interest. The total measurement period should be representative of any variations in the character and range of sound levels for the noise of interest during any period of concern. Such a period may relate to a specific time of day when a noise is alleged to be a problem, or to a particular type of noise source. The total time interval over which measurements for the purpose of determining an average sound level are made shall not exceed four consecutive hours in any 24-hour period including night-time. c. Measurement time intervals as provided for in Clause 5.1 of the Standard shall be limited to 10–15 minutes excluding pause times. For steady noise received at a particular location, a period of two hours will usually be adequate if compliance monitoring is the purpose. Where the noise of interest is cyclic or occurs for time intervals less than 15 minutes in duration, the sample intervals may be less than 10–15 minutes excluding pause times and an average level shall be determined by the method described in b. but at least ten events should be measured. 				

Rule	Standards
<p>Rule 12.7.4 – Noise (continued)</p>	<p>Construction Noise</p> <p>Construction noise within the district which is ancillary to the principal use of the site shall not exceed the recommended limits in and shall be measured and assessed in accordance with the provisions of NZS 6803P:1984 The Measurement and Assessment of Noise from Construction, Maintenance, and Demolition Work. Discretionary adjustments provided in Clause 6.1 shall be mandatory within the district.</p> <p>Construction noise is permitted to occur only between the hours of 7:00 am and 6:00 pm within an urban area (as defined in Chapter 18).</p> <p>Any activity that does not comply with this rule shall be considered as a discretionary (restricted) activity. Council shall restrict the exercise of its discretion to the effect on the amenity values of the neighbourhood.</p> <p>Blasting</p> <ol style="list-style-type: none"> a. Vibration from any site due to blasting shall not exceed a peak particle velocity of 5 mm/sec measured in the frequency range 3–12 Hz measured at any point within the notional boundary of any dwelling, residential institution or educational facility. b. Airblast overpressure from blasting on any land or in water shall not exceed a peak sound pressure level of 115 dBC measured at any point within the notional boundary of any dwelling, residential institution or educational facility.

4 Recommended noise criteria

The noise provisions provided in the RMA, district plans, standards and guidelines listed in Section 3 have been reviewed. The recommended criteria for the assessment of noise and vibration effects are provided in the following sections.

4.1 Construction noise

4.1.1 General construction works

Construction noise is generally of limited duration and hence people and communities will usually tolerate higher noise levels provided it is no louder than necessary and occurs within appropriate hours of the day.

Consistent with noise rules provided in the OQLDP (Rule 5.3.5.2 (v) Noise), PQLDP (Rule 36.5.13 Construction Noise) and CODP (Rule 12.7.4 – Noise), construction noise will be assessed in accordance with NZS 6803:1999.

It is noted that the CODP (Rule 12.7.4 – Noise) refers to the superseded NZS 6803P:1984 ‘The measurement and assessment of noise from construction, maintenance, and demolition work’ (NZS 6803P:1984) for the assessment of construction noise. As stated in the Foreword section of NZS 6803:1999 84, NZS 6803P:1984 was a provisional standard and significant updates were made in NZS 6803:1999 to more adequately address emerging construction noise issues. A key change was the transitioning from the L_{A10} to the L_{Aeq} descriptor, the energy-averaged noise level, aligning with contemporary international standards on noise measurement and assessment.

NZS 6803:1999 provides recommended noise limits that should apply depending on the type of land use, duration of construction activities and time of day. Construction works are generally of limited duration and hence NZS 6803:1999 recommends different noise limits for construction projects with different durations, including:

- short-term – construction work at any one location for up to 14 calendar days
- of typical duration – construction work at any one location for more than 14 calendar days but less than 20 weeks
- long-term – construction work at any one location for more than 20 weeks.

Construction activities associated with the Project are generally expected to occur at any one location for longer than 20 weeks. In some cases, construction activities in certain areas will last less than 20 weeks (e.g. lower carpark upgrades). As a conservative approach, however, construction noise from the Project has been assessed against the more stringent long-term construction (more than 20 weeks) noise limits.

Recommended upper noise limits provided in Table 2 of NZS 6803:1999 for long-term construction noise received in residential zones and dwellings in rural areas are reproduced in Table 4.1.

Table 4.1 Recommended upper limits for long-term construction noise received in residential zones and dwellings in rural areas

Time of week	Time period (hours)	Long-term duration ¹ noise limits	
		L_{Aeq} dB	L_{Amax} dB
Weekdays	6:30 am to 7:30 am	55	75
	7:30 am to 6:00 pm	70	85
	6:00 pm to 8:00 pm	65	80
	8:00 pm to 6:30 am	45	75

Time of week	Time period (hours)	Long-term duration ¹ noise limits	
		L _{Aeq} dB	L _{Amax} dB
Saturdays	6:30 am to 7:30 am	45	75
	7:30 am to 6:00 pm	70	85
	6:00 pm to 8:00 pm	45	75
	8:00 pm to 6:30 am	45	75
Sundays and public holidays	6:30 am to 7:30 am	45	75
	7:30 am to 6:00 pm	55	85
	6:00 pm to 8:00 pm	45	75
	8:00 pm to 6:30 am	45	75

Notes: 1. Construction work at any one location with a duration exceeding 20 weeks.

Recommended upper noise limits provided in Table 3 of NZS 6803:1999 for long-term construction noise received in industrial or commercial areas are reproduced in Table 4.2.

Table 4.2 Recommended upper limits for long-term construction noise received in industrial or commercial areas

Time of week	Time period (hours)	Long-term duration ¹ noise limits
		L _{Aeq} dB
Any day	7:30 am to 6:00 pm	70
	6:00 pm to 7:30 am	75

Notes: 1. Construction work at any one location with a duration exceeding 20 weeks.

In accordance with NZS 6803:1999, construction noise limits apply at 1 m from the most affected façade of the occupied building. Noise is typically assessed over a representative 15-minute period.

Upon consideration of all relevant district plans, including relevant limits and times they apply, noise limits presented in Table 4.1 (L_{Aeq} and L_{Amax}) and Table 4.2 (L_{Aeq}) have been adopted for the assessment of construction noise from the Project, across both jurisdictions.

4.1.2 Helicopter noise

The OQLDP does not provide noise rules specific to the assessment of helicopter noise. The PQLDP (Rule 36.5.11 Helicopter) provides limits for helicopter noise applicable at residences, as reproduced in Table 4.3. The L_{dn} descriptor is the day-night average level and represents the average noise level over a 24-hour period.

Table 4.3 Helicopter noise limits at residences

Time of week	Time period (hours)	Noise limit ¹
		L _{dn} , dB
Any day	At all times	40

Notes: 1. Apply at any point within the notional boundary of any residential receiver, which is defined as 20 m from the façade of any residential receiver or the legal boundary whichever is closer to the residential receiver.

The PQLDP also refers to NZS 6807:1994 for the assessment and management of helicopter noise at residences and therefore has been considered for this assessment. The CODP does not provide specific helicopter noise assessment guidance or limits and therefore the noise limits (L_{dn}) recommended in NZS 6807:1994 have been considered for this assessment. NZS 6807:1994 helicopter noise limits for residential land use are reproduced in Table 4.4.

Table 4.4 NZS 6807:1994 helicopter noise limits for residential land use

Land use	Noise limit ¹
	L _{dn} , dB
Residential	50

Notes: 1. Apply at any point within the notional boundary of any residential receiver, which is defined as 20 m from the façade of any residential receiver or the legal boundary whichever is closer to the residential receiver.

It is noted that the PQLDP (Rule 36.5.11 Helicopter) noise limits presented in Table 4.3 are more stringent than the noise limits recommended in NZS 6807:1994 for residential receivers (Table 4.4). Therefore, noise limits presented in Table 4.3 have been adopted for the assessment of helicopter noise (L_{dn}) received at all residential receivers.

NZS 6807:1994 provides recommended maximum noise limits (L_{Amax}) for the protection of sleep during the night period. The use of helicopters during construction is not proposed to occur during the night period and hence sleep disturbance limits have not been adopted.

4.2 Construction vibration

The PQLDP (Rule 36.5.10 Vibration) refers to the DIN 4150-3:2016-12 'Vibration in buildings – Part 3 - Effects on structures' (DIN 4150-3) for vibration guideline emission values for the effects on structures. There are no other vibration related rules or provisions in the OQLDP or CODP and no New Zealand standard for the assessment of vibration effects. Consistent with the PQLDP, guidance has been sought from DIN 4150-3 (effects on buildings) and other relevant international standards. Potential vibration effects on human comfort and buildings and relevant assessment standards are discussed in the following sections.

4.2.1 Effects on human comfort

The British Standard BS 5228-2:2009 ‘Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration’ (BS 5228-2) has been adopted for the assessment of vibration effects on human comfort (annoyance).

Humans can perceive vibration levels which are well below those causing any risk of damage to a building or its contents. The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual’s response to that perception, and whether the vibration is ‘normal’ or ‘abnormal’, depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as ‘normal’ in a car, bus or train is considerably higher than what is perceived as ‘normal’ in a shop, office or dwelling.

Construction vibration is generally quantified in peak particle velocity (PPV) in millimetres per second (mm/s). This is the instantaneous maximum velocity reached by the vibrating surface as it oscillates from its normal position. The PPV can be quoted individually for one or more of the three orthogonal directions (at right angles) at a measurement point and is referred to as ‘component PPV’.

Construction vibration (component PPV) guide values for human perception (from BS 5228-2) are shown in Table 4.5. These apply at the person position inside the building.

Table 4.5 BS 5228-2 construction vibration guide values (component PPV) for human perception

Vibration level (component PPV)	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for vibration frequencies associated with construction and maintenance. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

The guide values in BS 5228-2 have been adopted for the assessment of potential effects on human comfort at residential receivers from proposed construction activities.

4.2.2 Effects on buildings

The German Standard DIN 4150-3:2016-12 ‘Vibration in buildings – Part 3 - Effects on structures’ (DIN 4150-3) has been adopted for the assessment of vibration effects on buildings (structural and cosmetic damage). The guideline values presented in DIN 4150-3 are generally recognised to be conservative.

The vibration velocity guideline values from DIN 4150-3, which are presented as maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor, are reproduced in Table 4.6.

Table 4.6 DIN 4150-3 structural damage guideline values of vibration velocity

Line ¹	Type of structure	Vibration velocity (mm/s)			
		Foundation ²			Horizontal plane of uppermost floor
		1-10 Hz	10-50 Hz	50-100 Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	5 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Notes: 1. Refers to the curves in Figure 1 of DIN 4150-3 which have been reproduced in Figure 4.1.
 2. For frequencies above 100 Hz, the higher values in the 50-100 Hz column should be used.

Construction plant and equipment operational frequencies typically range between 10 Hz and 30 Hz (at the source). According to DIN 4150-3, as shown in Table 4.6, safe vibration velocity limits (ranges) for which ‘damage’ from vibration effects is unlikely to occur are as follows:

- dwellings – 5 to 15 mm/s
- commercial and industrial type buildings (reinforced) – 20 to 50 mm/s
- sensitive structures – 3 to 10 mm/s.

The term ‘damage’ is defined in DIN 4150-3 to include even minor non-structural effects such as the superficial cracking in cement render, enlargement of cracks already present and the separation of partitions or intermediate walls from load bearing walls.

As indicated by the vibration velocity values in Table 4.6, vibration of same velocity has a lower potential to cause damage at higher frequencies than at lower frequencies. The vibration velocity values in Table 4.6 are shown graphically in Figure 4.1.

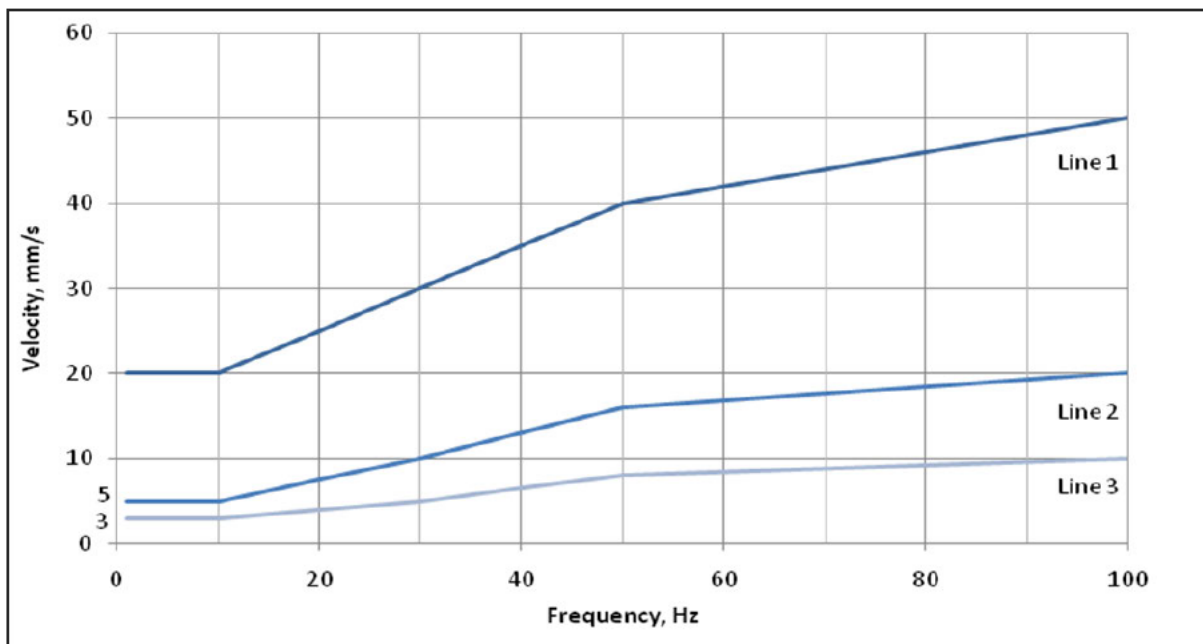


Figure 4.1 DIN 4150-3 structural damage guideline values of vibration velocity

The guideline values in DIN 4150-3 have been adopted for the assessment of potential structural damage from proposed construction activities on residential buildings and infrastructure items.

4.3 Blasting

The objectives for blasting emissions provided in Rule 12.7.4 of the CODP have been adopted for the whole project since the QLDP does not provide any guidance in this regard. Vibration and airblast overpressure limits are summarised as follows:

- a) Vibration from any site due to blasting shall not exceed a peak particle velocity of 5 mm/s measured in the frequency range 3–12 Hz measured at any point within the notional boundary of any dwelling, residential institution or educational facility.
- b) Airblast overpressure from blasting on any land or in water shall not exceed a peak sound pressure level of 115 dBC measured at any point within the notional boundary of any dwelling, residential institution or educational facility.

These limits are based on preserving amenity for people inside dwellings or educational facilities and are significantly below those that would cause damage to property.

4.4 Operational noise

The assessment of operational noise has considered the noise rules provided in the OQLDP (Rule 5.3.5.2 (v) Noise) and CODP (Rule 4.7.6 E – Noise – Rural Resource Area and Rule 12.7.4 – Noise – District Wide Rules and Performance Standards). District noise rules also refer to assessment requirements from NZS 6801:2008 and NZS 6802:2008.

NZS 6802:2008 states that noise limits are normally set on the basis of compatibility with human activities and land use, and the protection of community health and/or amenity. Noise limits may depend on many factors such as the time of day, the activities to be protected, the type of noise source, and other factors. The results of sound level surveys, planning expectations, or the need for protection of a particular type of amenity, can guide the setting of noise limits.

Operational noise limits from the OQLDP (Rule 5.3.5.2 (v) Noise) for residential receivers located inside the Queenstown Lakes District have been adopted in this assessment and are reproduced in Table 4.7.

Table 4.7 OQLDP – Noise limits from non-residential activities at residential receivers

Assessment period	Time period (hours)	Noise limits ¹	
		L _{Aeq} , dB	L _{Amax} ² , dB
Day	8:00 am to 8:00 pm	50	-
Night	8:00 pm to 8:00 am	40	70

- Notes:
- 1. Apply at any point within the notional boundary of any residential receiver, which is defined as 20 m from the façade of any residential receiver or the legal boundary whichever is closer to the residential receiver.
 - 2. Applies during the night period only.

Operational noise limits applicable at residential receivers located inside the Central Otago District within the Rural Resource Area (Rule 4.7.6 E) are relatively similar to those in the OQLDP (refer to Table 4.7). However, they are based on the L_{A10} descriptor, the noise level exceeded for 10% of the time. The L_{A10} descriptor was used in NZS 6802:1991, the previous (superseded) version of NZS 6802. Significant updates were made from NZS 6802:1991 to NZS 6802:2008, which included the transitioning from the L_{A10} to the L_{Aeq} descriptor, the energy-averaged noise level. A stricter standardised assessment time of 15 minutes is also introduced in NZS 6802:2008, which recommends setting noise limits based on the $L_{Aeq,15min}$, or the L_{Amax} where sleep protection is required.

Given the preceding, the OQLDP noise limits shown in Table 4.7 have been adopted for the assessment of operational noise at all residential receivers in this assessment.

Consideration of special audible characteristics, that is where the noise being assessed has a distinctive character which may affect its subjective acceptability. Noise that has special audible characteristics such as tonality or impulsiveness is likely to cause adverse community response that noise without such characteristics. To account for this and where identified as present, the representative noise level shall be adjusted.

It is noted that noise limits from the District Plans adopted in this assessment are more stringent than the residential upper noise limits recommended in Table 3 of NZS 6802:2008.

4.5 Road traffic noise

At the completion of the Project, the expanded Remarkables Ski Area will accommodate up to 6,000 visitors per day. With a current occupancy of approximately 3,500 people per day, the Project will lead to an increase in vehicle movements on the public road network. Access to the site is via SH6 which currently has an average daily traffic volume of approximately 17,700 vehicles per day.

There are no road upgrades or realignments proposed as part of the Project. During the later stages of the Project, traffic movements are anticipated to increase by up to 3,042 light vehicles (1,521 each way) and 66 buses (33 each way) per day. This will mean an increase in total traffic movements on SH6 of less than 17% (since existing traffic movements include traffic associated with the existing Remarkables Ski Area), which equates to an increase in average road traffic noise levels of less than 2 dB. A change in noise levels of this magnitude would not be discernible to most people and therefore is considered negligible. Hence, road traffic noise has not been considered further in this assessment.

It is anticipated that road traffic movements generated during Project construction would be significantly less than those generated during operation. Acknowledging that the road traffic noise criteria applicable to construction and operation are the same and given that road traffic noise during operation is unlikely to cause effects, it can be determined that potential effects from road traffic noise during construction would also be unlikely.

The assessment of noise from vehicles on the site access road and carparks within the Project area has been considered as part of the operational noise assessment.

5 Existing environment

5.1 Land use and noise environment

The Project is located approximately 2 km south of Queenstown Airport and is characterised by an alpine environment. The area is predominantly used for recreational outdoor activities including snowsports in the winter seasons and hiking throughout the year.

The project area can be separated into two main areas; the ski area where most of the existing and proposed active ski field infrastructure are located, and the transit area which includes the main access point from the site entrance to the ski fields.

The ski area is characterised by high-altitude, rugged and steep alpine terrains, and no sensitive residential receivers. It includes the existing ski area which comprises the Rastus Burn Base Station and facilities (food services, rentals and ski school), various lifts, snow making equipment and ski parks and trails. The existing noise environment is likely to be dominated by noise from activities associated with the operation of the ski fields, including vehicle noise and noise from users. Outside of the alpine ski season, the existing noise environment is likely to be dominated by natural sounds.

The transit area comprises the site entrance from the SH6, the lower Remarkables carpark, the 13 km site access road and additional carparks to the Rastus Burn Base Station. The land use surrounding the transit area is generally characterised as predominantly rural, pasture and farmland. Industrial and commercial sites are also present immediately north and south of the site entrance. Residential developments further to the south of the site entrance are under construction. The existing noise environment is likely to be dominated by natural sounds, although noise from road traffic and nearby industrial sites would also contribute to the ambient noise environment, particularly during the day period.

Aircraft noise is also part of the existing environment, particularly closer to the Queenstown Airport and along flight paths. In 2025, the following number of flights were recorded:

- 19,149 passenger plane flights (1,878 flights recorded during the peak Summer month)
- 16,419 general aviation (up to 7,500 ft altitude) flights (2,579 flights recorded during the peak Summer month)
- 449 private jet flights (85 flights recorded during the peak Summer month)
- 30,931 helicopter flights (3,495 flights recorded during the peak Summer month).

5.2 Assessment locations

5.2.1 Residential and commercial/industrial receivers

The nearest representative sensitive locations to the Project have been identified for the purpose of assessing potential noise and vibration effects. They are referred to in this report as assessment locations. It is noted that if noise levels are predicted to satisfy the criteria at the assessment locations, they are expected to satisfy the criteria at receivers within the same catchment or more distant receivers.

Several receivers were identified surrounding the Project, particularly in the vicinity of the site entrance and access road. These include residential and commercial/industrial receivers, with some residential receivers situated on properties adjacent to the Project site boundary. The nearest receivers to the Project site boundary are located at least 3.6 km away from the Remarkables Ski Area (i.e. Rastus Burn Base Station) and are generally shielded by the mountainous alpine terrain.

Residential receivers were also identified further to the north of the site, on the northern side of the Kawarau River, in Shotover Country and Lake Hayes Estate. These are the nearest residential receivers to the north of the Project and have been included for completeness.

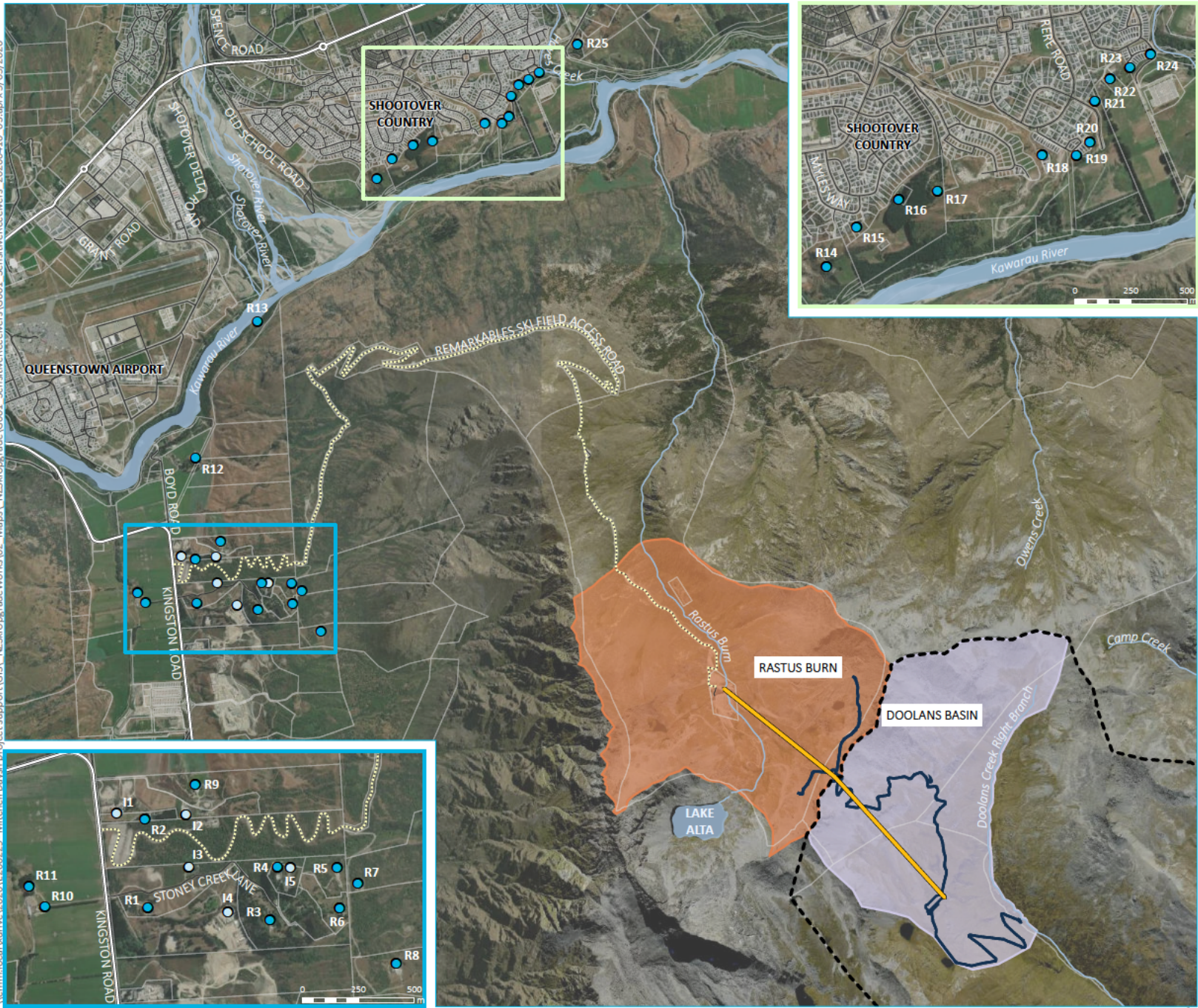
Assessment locations adopted in this assessment are listed in Table 5.1 and their location shown in Figure 5.1 along with proposed project elements.

Table 5.1 Assessment locations

Assessment location ID	Land use and description	Coordinates	
		Northing	Easting
I1	Commercial/industrial - 247 Kingston Road, Kawarau Falls	1265579	5003795
I2	Commercial/industrial - 247 Kingston Road, Kawarau Falls	1265889	5003790
I3	Commercial/industrial - Stoney Creek Lane, Kawarau Falls	1265902	5003556
I4	Commercial/industrial - 285 Kingston Road, Kawarau Falls	1266076	5003356
I5	Commercial/industrial - Stoney Creek Lane, Kawarau Falls	1266356	5003553
R1	Residential - 10 Stoney Creek Lane, Kawarau Falls	1265719	5003375
R2	Residential - 249 Kingston Road, Kawarau Falls	1265706	5003769
R3	Residential - 68 Stoney Creek Lane, Kawarau Falls	1266264	5003320
R4	Residential - 83 Stoney Creek Lane, Kawarau Falls	1266298	5003555
R5	Residential - 86 Stoney Creek Lane, Kawarau Falls	1266565	5003552
R6	Residential - 281 Kingston Road, Kawarau Falls	1266575	5003372
R7	Residential - Remarkables Ski Area Access Road, Kawarau Falls	1266656	5003484
R8	Residential - 216 Remarkables Ski Area Access Road, Kawarau Falls	1266828	5003126
R9	Residential - 247 Kingston Road, Kawarau Falls	1265930	5003923
R10	Residential - 284 Kingston Road, Kawarau Falls	1265260	5003379
R11	Residential - 284 Kingston Road, Kawarau Falls	1265189	5003468
R12	Residential - Kawarau Falls Road, Kawarau Falls	1265706	5004669
R13	Residential - Kawarau Falls Road, Kawarau Falls	1266260	5005887
R14	Residential - Keble Lane, Lower Shotover	1267328	5007163
R15	Residential - 64 Myles Way, Lower Shotover	1267462	5007338
R16	Residential - 442 Frankton-Ladies Mile Highway, Lake Hayes Estate	1267650	5007462
R17	Residential - Douglasvale Rise, Lake Hayes Estate	1267823	5007498
R18	Residential - 2 Alpine Avenue, Lake Hayes Estate	1268291	5007659
R19	Residential - 35 Alps View Place, Lake Hayes Estate	1268444	5007657
R20	Residential - 23 Alps View Place, Lake Hayes Estate	1268504	5007717
R21	Residential - 7A Widgeon Place, Lake Hayes Estate	1268526	5007900
R22	Residential - 50 Judge And Jury Drive, Lake Hayes Estate	1268594	5008000

Assessment location ID	Land use and description	Coordinates	
		Northing	Easting
R23	Residential - 10 Huxley Place, Lake Hayes Estate	1268683	5008049
R24	Residential - 28 Huxley Place, Lake Hayes Estate	1268775	5008109
R25	Residential - 111 Alec Robins Road, Lake Hayes Estate	1269117	5008359

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- KEY**
- Industrial/commercial receiver
 - Residential receiver
 - Proposed gondola
 - Existing site access road
 - Proposed access roads
 - QLDC/CODC boundary
 - Ski area boundary
 - Doolans Basin
 - Rastus Burn
 - Existing environment
 - Major road
 - Minor road
 - Named watercourse
 - Named waterbody
 - Cadastral boundary

Project overview and receivers

Remarkables Ski Area Upgrades
Noise and Vibration Effects
Figure 5.1



Source: EMM (2026); ESRI (2025); LINZ (2026); MDP (2026)

0 0.5 1 km
NZGD 2000 New Zealand Transverse Mercator

5.2.2 Recreational users

Recreational values exist in the Rastus Burn and Doolans Basin. This is particularly true for the Doolans Basin, due to its undeveloped natural character, winter snow sports opportunities and accessibility via the existing Remarkables Ski Area road and facilities.

In the Winter months, during the Remarkables alpine season, the number of recreational users (unrelated to the ski area) in one day can reach between 20 and 50.

In the Summer months, which coincide with the proposed construction seasons, the number of recreational users is significantly lower as other recreational value areas outside of the Remarkables Ski Area are targeted (e.g. Wye Creek area).

During proposed construction works, given they are limited to the Summer months and to four consecutive seasons (with the most noise intensive activities proposed to be completed by the third season), potential effects of construction noise and vibration on recreational users will potentially occur. However, potential noise and vibration effects are likely to be temporary and transient (e.g. helicopter flybys). This will be more noticeable to recreational users (although limited) in the Doolans Basin due to its undeveloped natural character.

During the operational stage of the Project, following commissioning the Doolans Basin Ski Expansion Area, the recreational value of the once 'untouched' Doolans Basin will decrease for existing users, partially due to increased noise from built ski infrastructure and visitors. However, new recreational opportunities as a result of lift-accessed activities will be created during the Winter months, particularly for skiers. During the Summer months, negligible effects are anticipated due to the relatively low use of the area.

To mitigate potential effects to recreational users during construction and operation, it is recommended that NZSki implement a communication strategy to inform recreational users of proposed construction and operational activities and to ensure that user experience remains relatively high and safe. A communication strategy could include website updates, on-site signage and/or stakeholder briefings.

6 Assessment methodology

6.1 Noise modelling

Noise levels were predicted using a computer-generated noise model within the proprietary DGMR Software, iNoise. The program utilises the International Standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors' (ISO 9613-2:1996) prediction algorithm. Section 1 of ISO 9613-2:1996 states the following:

The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.

These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The model calculates total noise levels at assessment locations from concurrent operation of multiple sources. It considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receiver distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions.

The model was populated with 3-D topography of the project area and its surrounds, extending out to all assessment locations. Plant and equipment representing a range of proposed scenarios were modelled to represent worst-case noise levels throughout the Project construction and operational phases.

6.2 Construction noise

6.2.1 Modelled scenario overview

A review of the proposed construction approach and staging of works (refer to Table 2.1), the location of activities relative to the assessment locations and noise emissions of activities (sound power levels) was completed.

The review identified that the main construction activities will be predominantly centred around the ski area that include the Rastus Burn Base Station, the Midstation, the Doolans Base Station and proposed infrastructure (including the new Doolans gondola, access road and formed ski trails) connecting each of these Project elements. There will be some exceptions, where construction activities are proposed to occur in relatively separate areas, including the lower Remarkables carpark upgrades (Carpark A) and expansion (Carpark B and Boneyard carpark).

As described in Section 2.2.4, construction works will predominantly be undertaken during daylight hours only; seven days a week from Monday to Sunday within the Rastus Burn and Doolans Basin, and six days a week from Monday to Saturday in the lower Remarkables carparks. To ensure that major delays in the construction schedule (refer to Table 2.1) are avoided and to minimise the duration of potential construction effects, works outside normal working hours may be necessary (e.g. during night-time hours). While the lead contractor selected for construction will ultimately determine the construction programme, approval is being sought for works outside normal working hours should it be required.

The noise modelling of proposed construction activities has been separated into several scenarios that represent potential worst-case situations. These are detailed in the following section along with relevant plant and equipment sound power levels. Construction noise levels have been predicted at 1 m from the most affected façade of an occupied building in accordance with NZS 6803:1999 and include a façade reflection adjustment of +3 dB.

6.2.2 Construction plant and equipment sound power levels

i Time averaged construction noise

The assessment has adopted construction plant and equipment sound power levels from the United Kingdom Department of Environment, Food and Rural Affairs (DEFRA) *Update of Noise Database for Prediction of Noise on Construction and Open Sites* (2005), where available. Otherwise, data was sourced from an EMM sound power database for similar plant and equipment, which is based on measurements for similar construction activities.

Acoustically significant plant and equipment items were considered for each construction scenario, and worst-case activities were adopted for modelling. Construction works are proposed to be undertaken during daylight hours, however night-time works (between 10:00 pm and 7:00 am) may be required on a limited contingency basis (refer to Section 2.2.4).

A summary of the sound power level (L_w) for each scenario modelled is presented in Table 6.1. This assumes that all plant and equipment within each scenario operate concurrently. A detailed list of construction plant and equipment modelled for each worst-case activity is provided in Appendix A.

Table 6.1 Summary of modelled worst-case construction scenarios and sound power levels

Construction scenario	Indicative modelled locations ¹	Modelled worst-case activities	Adopted L _w , L _{Aeq} dB
Rastus Burn Base Building expansion, Midstation construction, Doolans Base Building construction	Rastus Burn Base Building, Midstation, Doolans Base Building	Area establishment/site clearing ²	115
		Concrete pour	113
		Footings and foundation works	110
		Structural erection works	108
Gondola construction	Rastus Burn gondola drive station	Concrete pour	113
		Installation of towers – crane	95
Expansion access roads and earthworks	Access roads/infrastructure areas	Bulk earthworks ²	122
New substation and WWTP area establishment	Carpark 3	Bulk earthworks ²	122
Heavy vehicle (HV) deliveries	Site access road	Road truck and concrete truck movements	109
Carpark A upgrades	Existing site entrance carpark	Area establishment/site clearing/compaction ²	115
New Carpark B earthworks	Carpark B immediately to the east to Carpark A	Area establishment/site clearing/compaction ²	115
New Boneyard carpark establishment	Existing utility storage yard immediately to the east to Carpark B	Removal of existing stored items (heavy vehicles)	103

Notes: 1. Refer to Figure 2.2 for the location of key Project elements.
2. Includes the transport of spoil by dump trucks to relevant stockpile areas.

ii Maximum noise level (L_{Amax}) assessment

Limited contingency construction works may be necessary during the night period between 10:00 pm to 7:00 am. Therefore, maximum noise levels from night-time activities at residential assessment locations have been assessed against the L_{Amax} limits applicable during the night period (refer to Table 4.1).

A maximum sound power level of 120 dB L_{Amax} was adopted and is representative of a worst-case maximum noise level from relevant activities, including the assessment of sleep disturbance effects at residential assessment locations.

6.2.3 Helicopter noise

Helicopters will be used to support construction works in difficult terrain, where access for typical plant and equipment is not practical. Helicopters will be used primarily for the Doolans gondola tower installation (material delivery and tower installation), and concrete transfer and placement to remote work areas such as the Midstation, Doolans Base and water infrastructure areas.

The use of both large helicopters (Class H2.1) and smaller helicopters (Class H1.1) are proposed during the construction; a 'Black Hawk' helicopter (Class H2.1) for heavy tower lifts and a 'Squirrel' helicopter (Class H1.1) for light to medium lifts such as the transfer and placement of concrete and material. Adopted sound power levels are based on the relevant aircraft class and calculation method provided in the German Standard DIN 45684-1:2013 'Acoustics - Determination of aircraft noise exposure at airfields - Part 1: Calculation method' (DIN 45684-1:2013).

Based on data provided by NZSki, up to 88 days of helicopter activity days will be required for the Project. This includes 57 helicopter activity days during the peak activity season (season 2); up to four Black Hawk activity days and up to 53 Squirrel activity days. Daily, this is unlikely to translate to a 15-hour helicopter activity. As a conservative scenario, it is assumed that helicopter noise is occurring for the majority of the day (excluding the night period). Due to the relatively short distance from the helicopter collection location (i.e. main logistics area near the Rastus Burn Base Station) to the work areas (placement locations), helicopter noise was modelled assuming 'hovering' over the collection and placement locations.

A summary of the modelled worst-case helicopter construction scenarios and sound power level (L_w) for each helicopter type are presented in Table 6.2.

Table 6.2 Summary of modelled worst-case helicopter construction scenarios and sound power level

Construction scenario	Modelled worst-case activities	Indicative modelled locations ¹	Operating hours ²	Adopted L_w , L_{Aeq} dB
Gondola construction	Installation of towers	Rastus Burn gondola	Daylight hours	139
		Midstation		
		Doolans Basin gondola		
	Concrete placement	Rastus Burn gondola	Daylight hours	134
Midstation construction	Concrete placement	Midstation		
Doolans Base Building construction	Concrete placement	Doolans Base Building		
Water infrastructure construction	Concrete placement	Doolans reservoir, Doolans pumping station		

Notes: 1. Refer to Figure 2.2 for the location of key Project elements.

2. Daylight hours construction is assumed to occur between 7 am and 10 pm, six days a week (Monday to Saturday).

6.3 Construction vibration

Vibration levels will vary depending on the operating plant or equipment, local geotechnical conditions and relative distance to buildings (residences) and other structures (infrastructure items).

A review of proposed construction works and vibration generating activities (plant and equipment) identified that worst-case vibration generating activities will include the following:

- A rock breaker (20 tonne (t) excavator with a 1.5 t rock hammer attachment) and a bulldozer for the Midstation and Doolans Base Building construction sites and relevant access tracks.
- Excavators (up to 50 t), a bulldozer and a roller where bulk earthworks are required for the lower carparks.

Source reference data adopted for the vibration generating equipment is detailed in Table 6.3.

Table 6.3 Vibration source reference data

Equipment	Reference distance (m)	Measured PPV (mm/s)	Source
Large hydraulic hammer (1.6 t – 18 to 34 t excavator)	22	7.5	Construction Noise and Vibration Guideline (roads) (Transport for New South Wales, Australia)
Vibratory roller (13–18 t)	20	7.5	
Vibratory roller (>18 t)	25	7.5	
Roller	10	6	Environmental Noise Management Manual (Roads and Traffic Authority for New South Wales, Australia)
Excavators	40	0.2	Guideline for the Management of Noise and Vibration: Construction and Maintenance Activities (Government of South Australia, Australia)
Bulldozers	5	2	

6.4 Blasting

It is expected that blasting may be required for the construction of the access tracks in both the Rastus Burn and Doolan Basin areas; approximately 4 km from the nearest sensitive receivers. Specific information about blast locations and design is not yet available and will be subject to detailed design when more information is obtained regarding the geological conditions in the area. Given the nature of the activities and based on information provided by NZSki, a maximum of 60 kg of explosives is expected to be required for each day of blasting.

Prediction methods provided in Australian Standard AS2187.2:2006 *Explosives – Storage and use Part 2: Use of Explosives* have been adopted to estimate the potential effects of vibration and airblast overpressure from blasting. For free-face, average field conditions, the vibration limit of 5 mm/s is expected to be met at distance of approximately 200 m from the blast based on a maximum instantaneous charge (MIC) of 60 kilograms (kg). It is noted that 60 kg is the likely maximum daily charge to be used and would not likely be the MIC per blast and hence providing a high level of conservatism in this prediction.

There is a very high level of uncertainty associated with the prediction of airblast overpressure. Factors that influence the level of airblast overpressure from a specific blast include blast design, local geological conditions, weather conditions and intervening topography between the blast location and sensitive receiver.

Although there is a high level of uncertainty in these predictions, given the significant separation distance between the likely blast locations and the nearest sensitive receivers as well as the small-scale nature of the proposed blasts, the effects of blasting activity associated with the Project is expected to be minimal.

6.5 Operational noise

6.5.1 Overview of operational activities

A review of the existing and proposed site operations was completed, including the key noise sources (including their sound power levels) and their location relative to the assessment locations.

The review identified that the key operational noise sources are predominantly centred around the ski area that include the Rastus Burn Base Station, the Midstation, the Doolans Base Station and proposed infrastructure (including the new Doolans gondola) connecting each of these Project elements. The exception will be vehicle movements from the site entrance (SH6) and lower carparks to the multiple upper carparks to the Rastus Burn Base Station.

6.5.2 Noise sources and operating hours

The Remarkables Ski Area will continue to operate during the winter alpine season between June and October. The Rastus Burn Base Building and associated facilities (café, rentals, retail, etc.), ski fields and lifts are generally open between 9:00 am and 4:00 pm, Monday to Sunday.

Operational noise sources associated with Rastus Burn Base Station activities; ski field services such as the Doolans gondola (drives) or lifts will generally operate within the Remarkables Ski Area opening hours. The majority of vehicle movements associated with skier or visitor arrivals and departures would generally occur around the opening and closing times. Other operational noise sources associated with the Project include ancillary activities such as the new substation, WWTP, electrical and mechanical plant and pumping stations, which would generally be operating 24 hours per day and seven days a week (24/7).

In accordance with NZS 6802:2008, special audible characteristics from operational noise sources were considered. Special audible characteristics can include tonality, impulsiveness or other annoying sounds from high-speed cutting or grinding. Noise with special audible characteristics is required to be adjusted before comparison to the relevant limit. Noise emissions with such characteristics were not identified from the majority of operational noise sources. The exception are the transformers (electrical plant) at the new substation, Rastus Burn Base Building, Doolans Base Building and pumping stations which have the potential to result in tonal noise at receivers.

6.5.3 Assessment approach

i Ski area operations

Due to the large distances and significant terrain between the nearest receivers and the majority of the operational noise sources, noise emissions (inclusive of adjustments for special audible characteristics) are anticipated to be negligible. Therefore, operational noise from the ski area has not been assessed further.

ii Carpark and site access road movements

Based on the Integrated Transport Assessment report (ITA) (Stantec 2026) prepared of the Project, peak vehicle movements associated with visitor arrivals generally occur between 7:00 am and 9:00 am, before the Remarkables Ski Area opening time of 9:00 am. Vehicle movements associated with visitor departures generally occur from 3:30 pm, and around the Remarkables Ski Area closing time of 4:00 pm.

At the completion of the Project, the expanded ski field will accommodate up to 6,000 visitors per day which is a 71% increase from the existing occupancy of approximately 3,500 visitors per day. To accommodate the growth in visitors travelling to the expanded Remarkables Ski Area, NZSki is proposing to upgrade the existing lower carpark (Carpark A) to a transit hub (park-and-ride facility) (refer to Figure 2.6) and expand car parking capacity with the new Carpark B and the Boneyard carpark immediately to the east (refer to Figure 2.8). The three lower carparks will provide a significant increase in carpark spaces, including 299 spaces in Carpark A, 660 spaces in Carpark B and 157 spaces in the Boneyard carpark.

Furthermore, the increase in visitor capacity will increase road traffic movements on the access road between the lower carparks, the upper carparks and the Rastus Burn Base Station. Based on the ITA, peak arrival times are generally between 7:00 am and 9:00 am. It is estimated that a maximum of 26 buses and 350 light vehicles will be travelling on the access road to the ski area during the peak hour, which has been assumed to occur between 8:00 am and 9:00 am. Between 7:00 am and 8:00 am (night period as per the OQLDP), no buses are expected to arrive during this time based on scheduled departure times for NZSki bus services and travel times to the site entrance. Visitor arrivals in light-vehicles are expected between 7:00 am and 8:00 am (night period), however these will be significantly less than after 8:00 am.

Based on the ITA, visitor peak departure times are from 3:30 pm. There is generally a larger number of bus and light vehicle movements during peak departure times compared to peak arrival times. Maximum movements estimated from carpark capacity for buses (40 spaces) and light vehicles (1,000 spaces) were adopted to predict daytime noise levels from lower carparks and vehicles movements.

Noise (L_{Aeq}) from both carpark and access road vehicle movements associated with visitor arrivals and departures (in buses and light vehicles) has been predicted based on the aforementioned assumptions.

Maximum noise level (L_{Amax}) from night-time carpark and access road vehicle movements associated with visitor arrivals (before 8:00 am) have also been assessed against the relevant L_{Amax} limit (refer to Table 4.7). A maximum sound power level of 115 dB L_{Amax} was adopted for the assessment of sleep disturbance effects at residential assessment locations during these activities and is considered worst-case.

7 Assessment of noise effects

7.1 General construction noise

Construction noise was modelled in accordance with the assessment method outlined in Section 6.2. Noise predictions for modelled worst-case scenarios are summarised in the following sections. Noise ($L_{Aeq,15min}$) predictions represent the energy averaged noise level over a 15-minute period and assumes all plant and equipment in each scenario are operating concurrently.

Where exceedances of the noise limits have been identified, the construction contractor will implement mitigation measures to minimize noise effects. Noise mitigation and management are discussed in Section 9.

7.1.1 Remarkables Ski Area construction

Construction noise from general construction works (excluding helicopter noise – refer to Section 7.3) within the Remarkables Ski Area, that is within the existing Rastus Burn and proposed Doolans expansion areas, was predicted at all assessment locations. Modelled worst-case construction scenarios and activities included the following:

- Rastus Burn Base Building expansion – area establishment, concrete pour, footings and foundations works and structural erection.
- Midstation construction – area establishment, concrete pour, footings and foundations works and structural erection.
- Doolans Base Station construction – area establishment, concrete pour, footings and foundations works and structural erection.
- Doolans gondola construction – area establishment, concrete pour, footings and foundations works, installation of towers (crane).
- Expansion access roads and earthworks – bulk earthworks (excavation, material haulage and rock breaking where required).
- Carpark 3 earthworks for new substation and WWTP – bulk earthworks (excavation, material haulage and rock breaking where required).

Noise from general construction works proposed in the Remarkables Ski Area is predicted to be negligible (<20 dB $L_{Aeq,15min}$) at all assessment locations during all assessment periods. Therefore, noise from general construction works is predicted to satisfy the relevant limits (Refer to Table 4.1 and Table 4.2 as per NZS 6803:1999) at all receivers and unlikely to cause noise effects.

7.1.2 Heavy vehicle deliveries during construction

Noise from construction HV deliveries, that is from peak road truck and concrete truck movements on the site access road, was predicted at all assessment locations. Noise ($L_{Aeq,15min}$) predictions from these activities are predicted to satisfy the relevant limits at all assessment locations during all assessment periods, as summarised in Table 7.1. Therefore, noise effects from construction related heavy vehicle deliveries will be negligible.

Table 7.1 Predicted noise levels from construction HV deliveries

Assessment locations	Predicted noise levels L _{Aeq} dB	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
		6:30 am– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 8:00 pm	8:00 pm– 6:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am
R2	45	55	70	65	45	70	45	55	45
R4	43	55	70	65	45	70	45	55	45
R5	41	55	70	65	45	70	45	55	45
R9	40	55	70	65	45	70	45	55	45
All other residences	<40	55	70	65	45	70	45	55	45
All industrial/ commercial receivers	<45	75	70	75	75	70	75	70	75

7.1.3 Lower Remarkables carparks

i Existing carpark upgrades (Carpark A)

Noise from the lower Remarkables carpark upgrades (Carpark A) was predicted at all assessment locations. Noise (L_{Aeq,15min}) predictions are summarised in Table 7.2. Highlighted values in the table indicate potential for construction noise above the limit during the subject period.

Table 7.2 Predicted noise levels from lower Remarkables carpark upgrades (Carpark A)

Assessment locations	Predicted noise levels L _{Aeq} dB	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
		6:30 am– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 8:00 pm	8:00 pm– 6:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am
R1	58	55	70	65	45	70	45	55	45
R2	61	55	70	65	45	70	45	55	45
R3	48	55	70	65	45	70	45	55	45
R4	48	55	70	65	45	70	45	55	45
R5	45	55	70	65	45	70	45	55	45
R6	44	55	70	65	45	70	45	55	55
R7	41	55	70	65	45	70	45	55	55
R8	41	55	70	65	45	70	45	55	55
R9	52	55	70	65	45	70	45	55	45
R10	55	55	70	65	45	70	45	55	45
R11	54	55	70	65	45	70	45	55	45
R12	44	55	70	65	45	70	45	55	55

Assessment locations	Predicted noise levels	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
	L _{Aeq} dB	6:30 am–7:30 am	7:30 am–6:00 pm	6:00 pm–8:00 pm	8:00 pm–6:30 am	7:30 am–6:00 pm	6:00 pm–7:30 am	7:30 am–6:00 pm	6:00 pm–7:30 am
All other residences	<40	55	70	65	45	70	45	55	45
All industrial/commercial receivers	<66	75	70	75	75	70	75	70	75

Construction noise (L_{Aeq,15min}) from the Carpark A upgrades is predicted to satisfy the relevant limits at most assessment locations during all assessment periods. The exceptions are at assessment locations R1, R2, R3, R9, R10 and R11, where construction noise (L_{Aeq,15min}) is predicted to exceed the limits for works outside normal working hours. The assessment periods when construction noise (L_{Aeq,15min}) is predicted to satisfy the relevant limits include 7:30 am to 8:00 pm on weekdays and 7:30 am to 6:00 pm on Saturdays.

Given the noise exceedances predicted, it is recommended that construction activities associated with the Carpark A upgrades be restricted to the hours between 7:30 am and 8:00 pm on weekdays and 7:30 am and 6:00 pm on Saturdays. Provided construction activity remains within the recommended hours, noise effects from the Carpark A upgrades are expected to be negligible.

ii **New lower Remarkables carpark – Carpark B**

Noise from the new Carpark B construction was predicted at all assessment locations. Noise (L_{Aeq,15min}) predictions are summarised in Table 7.3. Highlighted values in the table indicate potential for construction noise above the limit.

Table 7.3 Predicted noise levels from the new Carpark B construction

Assessment locations	Predicted noise levels	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
	L _{Aeq} dB	6:30 am–7:30 am	7:30 am–6:00 pm	6:00 pm–8:00 pm	8:00 pm–6:30 am	7:30 am–6:00 pm	6:00 pm–7:30 am	7:30 am–6:00 pm	6:00 pm–7:30 am
R1	54	55	70	65	45	70	45	55	45
R2	61	55	70	65	45	70	45	55	45
R3	51	55	70	65	45	70	45	55	45
R4	53	55	70	65	45	70	45	55	45
R5	49	55	70	65	45	70	45	55	45
R6	45	55	70	65	45	70	45	55	45
R7	43	55	70	65	45	70	45	55	45
R8	40	55	70	65	45	70	45	55	45
R9	56	55	70	65	45	70	45	55	45
R10	49	55	70	65	45	70	45	55	45
R11	49	55	70	65	45	70	45	55	45
R12	44	55	70	65	45	70	45	55	45

Assessment locations	Predicted noise levels	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
	L _{Aeq} dB	6:30 am– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 8:00 pm	8:00 pm– 6:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am
All other residences	<40	55	70	65	45	70	45	55	45
All industrial/ commercial receivers	<70	75	70	75	75	70	75	70	75

Noise (L_{Aeq,15min}) from Carpark B construction is predicted to satisfy the relevant limits at most assessment locations during all assessment periods. The exceptions are at assessment locations R1, R2, R3, R4, R5, R9, R10 and R11, where construction noise (L_{Aeq,15min}) is predicted to exceed the limits for works outside the normal working hours. The assessment periods when construction noise (L_{Aeq,15min}) is predicted to satisfy the relevant limits include 7:30 am to 8:00 pm on weekdays and 7:30 am to 6:00 pm on Saturdays.

Given the noise exceedances predicted, it is recommended that construction activities associated with the new Carpark B be restricted to the hours between 7:30 am and 8:00 pm on weekdays and 7:30 am and 6:00 pm on Saturdays. Provided construction activity remains within the recommended hours, noise effects from Carpark B construction are expected to be negligible.

iii New lower Remarkables carpark – Boneyard carpark

Noise from the new Boneyard carpark establishment was predicted at all assessment locations. Noise (L_{Aeq,15min}) predictions from this activity are predicted to satisfy the relevant limits at all assessment locations during all assessment periods, as summarised in Table 7.4. Therefore, noise effects from the new Boneyard carpark establishment are predicted to be negligible.

Table 7.4 Predicted noise levels from the new Boneyard carpark establishment

Assessment locations	Predicted noise levels	Noise limits							
		Weekdays				Saturdays		Sundays/PH	
	L _{Aeq} dB	6:30 am– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 8:00 pm	8:00 pm– 6:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am
R2	45	55	70	65	45	70	45	55	45
R9	43	55	70	65	45	70	45	55	45
All other residences	<40	55	70	65	45	70	45	55	45
All industrial/ commercial receivers	<49	75	70	75	75	70	75	70	75

7.2 Maximum construction noise levels

Maximum noise levels (L_{Amax}) from construction in any proposed work areas predicted at residential assessment locations are provided in Table 7.5.

Table 7.5 Predicted maximum noise levels (L_{Amax}) from construction

Assessment locations	Predicted noise levels L_{Amax} dB	Noise limits ¹							
		Weekdays				Saturdays		Sundays/PH	
		6:30 am– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 8:00 pm	8:00 pm– 6:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am	7:30 am– 6:00 pm	6:00 pm– 7:30 am
All residences	<75	75	85	80	75	85	75	87	75

Notes: 1. The night period for construction works is between 10:00 pm and 7:00 am, where at 75 dB L_{Amax} criterion applies.

Construction L_{Amax} levels are predicted to satisfy the L_{Amax} limits at all residential assessment locations during all assessment periods. This includes construction L_{Amax} levels from night-time works and therefore sleep disturbance effects are unlikely at all residential assessment locations.

7.3 Helicopter noise

Helicopter noise during construction works was predicted at all assessment locations in accordance with the assessment method outlined in Section 6.2.3.

Construction noise from helicopter use within the Remarkables Ski Area, that is within the existing Rastus Burn and proposed Doolans expansion areas, was predicted at all assessment locations. Modelled worst-case activities included the following:

- Large helicopter (Black Hawk) lifts and placements of the Rastus Burn gondola towers, Midstation gondola towers and Doolans Base gondola towers.
- Smaller helicopter (Squirrel) lifts and placements of concrete (and other lighter loads) the Rastus Burn gondola tower locations, Midstation gondola tower locations, Doolans Base gondola tower locations and water infrastructure locations.

Noise from helicopter use during construction was predicted at all assessment locations. Noise predictions represent the worst-case helicopter noise levels (from either the Black Hawk or Squirrel) and energy-averaged noise level over a 15-minute period at assessment locations. These are compared to the L_{dn} noise limit, as presented in Table 7.6.

Table 7.6 Predicted noise levels from helicopter use during construction

Residential assessment locations	Predicted noise level L_{Aeq} dB	Noise limit ¹ L_{dn} dB
All residences	<40	40

Notes: 1. Adopted from the PQLDP (Rule 36.5.11 Helicopter). This is more stringent than the limit applicable to helicopter noise in NZS 6807:1994 (refer to Table 4.4).

Noise ($L_{Aeq,15min}$) from helicopter supported construction works is predicted to be below the L_{dn} limit. The $L_{Aeq,15min}$ noise level is more conservative than the L_{dn} noise level (average over the day and night periods). Therefore, helicopter noise during construction works is unlikely to cause effects at all receivers. Notwithstanding, noise management strategies associated with helicopter use during construction are provided in Section 9.

7.4 Ecological construction noise effects

Potential noise and vibration effects from Project construction on ecological habitats has been assessed in the ecological assessment report.

7.5 Operational noise

Operational noise (L_{Aeq} and L_{Amax}) from the ski area is anticipated to be negligible at all receivers due to the large distances to the operational noise sources (refer to Section 6.4).

Operational noise (L_{Aeq} and L_{Amax}) from the Project carpark and access road vehicle movements was modelled in accordance with the assessment method outlined in Section 4.3 and Section 6.4. This has been assessed against the relevant L_{Aeq} limits at all residential assessment locations, as summarised in Table 7.7. Noise predictions represent the energy averaged noise level over a 15-minute period.

Table 7.7 Predicted L_{Aeq} noise levels from carpark and access road vehicle movements

Assessment locations	Predicted noise levels, L_{Aeq} dB			Noise limits, L_{Aeq} dB	
	Arrivals		Departures	Day (8:00 am–8:00 pm)	Night (8:00 pm–8:00 am)
	Before 8:00 am (Night)	After 8:00 am (Day)	After 3:30 pm (Day)		
R1	<30	39	41	50	40
R2	<30	46	47	50	40
R3	<30	38	40	50	40
R4	<30	43	45	50	40
R5	<30	42	44	50	40
R7	<30	39	41	50	40
R9	<30	41	43	50	40
All other residences	<30	<37	<40	50	40

Noise ($L_{Aeq,15min}$) predictions from these activities during peak visitor arrivals and departures are predicted to satisfy the relevant limits at all residential assessment locations during all assessment periods. Therefore, noise effects from carpark and access road vehicle movements are predicted to be negligible.

Maximum noise levels from Project carpark and access road vehicle movements during the night period (visitor arrivals before 8 am) have been assessed against the relevant L_{Amax} limit at residential assessment locations, as summarised in Table 7.8.

Table 7.8 Predicted L_{Amax} noise levels from carpark and access road vehicle movements

Residential assessment locations	Predicted noise levels, L_{Amax} dB	
	Arrivals before 8:00 am (Night)	Noise limit, L_{Amax} dB Night (8:00 pm–8:00 am)
R2	68	70
R4	61	70
All other residences	<60	70

Noise (L_{Amax}) predictions from these activities are predicted to satisfy the relevant limit at all residential assessment locations. Therefore, noise effects from L_{Amax} potentially generated from carpark and access road vehicle movements are predicted to be negligible.

8 Assessment of construction vibration

Vibration levels will vary depending on the operating plant or equipment, and local geotechnical conditions as well as many other factors including operating method. There is generally a higher level of uncertainty in the prediction of vibration compared to noise due to the many influencing factors on vibration transmission.

Notwithstanding the preceding, given the significant separation distance between the construction areas (including access tracks) and residences, vibration generated from operation of equipment in these areas will not cause vibration effects.

As shown in Figure 8.1, the minimum distance from the lower carpark construction area (Carpark A and Carpark B) to a residence is approximately 75 m and to a commercial/industrial building in 20 m. Based on these separation distances, the vibration generated at the nearest residence will unlikely be perceptible and vibration generated at the nearest buildings will be significantly below the levels likely to cause building damage.

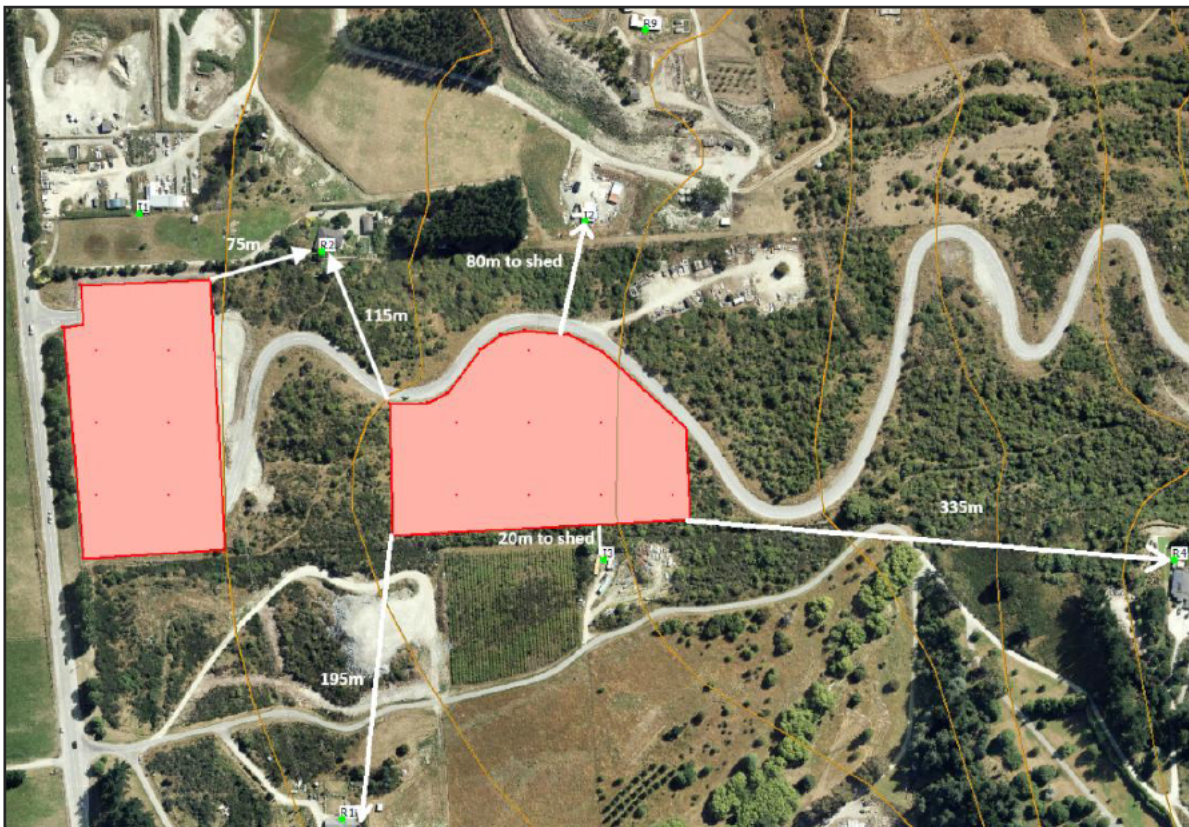


Figure 8.1 Indicative location of the lower carparks and approximate distance to nearest residences and other buildings

Construction methods should be reviewed if vibration generating plant and equipment are used in the vicinity of any building or structure. Mitigation or management measures may include limiting the size of plant and equipment for excavation, compaction or removal of rock, and re-assessing the significance or sensitivity of the building/structure to vibration prior to construction commencing in the area.

9 Mitigation and management measures

9.1 Construction noise and vibration management overview

This assessment has shown that noise and vibration emissions associated with the Project construction will generally comply with relevant requirements and noise limits at sensitive receivers. The exception is during the Carpark A upgrades and Carpark B construction where potential exceedances are predicted at up to eight residential receivers. The restriction of these activities to less sensitive time periods will ensure limits are satisfied and potential noise effects minimised at the nearest residences.

NZS 6803:1999 acknowledges that there will be situations during construction when the recommended noise limits will be exceeded, and hence the best practicable option (BPO) is required to be implemented to minimise noise to an acceptable level.

Section 8 of NZS 6803:1999 provides strategies to manage construction noise. These include:

- Noise management planning – good project management is essential to minimizing problems arising from construction noise (e.g. implementing a noise management plan).
- Noise reduction at source – control of noise at source including the appropriate selection of plant and equipment to minimize noise emissions, as well as the implementation of noise enclosures and screens.
- Good community relations – good relations between site personnel and the nearest noise-sensitive receivers are important during the construction period. Effective engagement by the contractor with the nearest noise-sensitive receivers before and during construction can help reduce adverse reactions to noise by developing an understanding of and responding to their concerns.
- Understanding site factors – understanding the factors that can contribute to construction noise issues, such as the existing noise environment (background noise), distance between activities and nearest noise-sensitive receivers, sensitivity of nearest receivers (residential, industrial or commercial), duration and operating hours (e.g. day, night or weekends).

Site-specific noise and vibration mitigation and management measures that will be considered during construction works are summarised in the following sections.

9.2 Mitigation and management measures

9.2.1 Site-specific construction mitigation

Given the potential for noise exceedances during the Carpark A upgrades and Carpark B construction, when construction activities will be closest to receivers, construction activities associated with these will be restricted to the hours between 7:30 am and 8:00 pm on weekdays and 7:30 am and 6:00 pm on Saturdays. This will ensure construction limits are satisfied and potential noise effects are minimised at the nearest residences during the most sensitive times of the day.

Furthermore, the following measures should be considered during construction works associated with the lower carpark areas, with the aim of reducing construction noise and vibration levels and mitigating effects where practicable:

- Minimise the number of plant and equipment items operating concurrently when in proximity to sensitive receivers (e.g. at the site boundaries adjacent to residential properties).

- Personnel should be informed about the need to reduce noise and potential hazards of excessive noise. Special attention should be given to the following:
 - Proper selection, use and maintenance equipment, and related noise control devices.
 - Positioning of equipment on site.
 - Avoidance of unnecessary noise.
 - Procedures for receiving and investigating complaints.
- Conduct community consultation with the nearest noise sensitive receivers to determine the least sensitive work periods.
- Notification for residences nearest to the proposed construction to inform residents of planned construction activities, time periods and expected durations, potential effects and proposed mitigation measures.
- Consideration of noise and vibration monitoring as a management strategy during more intensive construction activities.

These measures will be outlined in a construction environmental management plan (CEMP) which will be implemented to minimise adverse environmental effects during construction.

9.2.2 Helicopter noise

Helicopters during construction should be operated in general accordance with the “Fly Neighbourly” guide prepared by the Helicopter Association International and recommended by the New Zealand Helicopter Association. The guide provides recommendations on noise abatement operations (e.g. flyover height and speed, avoidance of noise-sensitive areas), community engagement, and safe operations to minimize disturbance.

9.2.3 General noise and vibration management practices

This section provides general mitigation and management best practices for construction and operation of a development.

i Universal work practices

Universal work practices for consideration include:

- regular reinforcement (e.g. pre-start briefings) of the need to minimise noise and vibration
- regular identification of noisy or vibration intensive activities and adoption of improvement techniques where possible
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily effect nearby residents, in particular during the night period
- developing routes for the delivery of materials and parking of vehicles to minimise noise
- avoiding the use of plant and equipment that generate tonal noise and impulsive noise where possible
- minimising plant and equipment.

ii Plant and equipment

Additional measures for consideration related to plant and equipment include:

- choosing plant and equipment based on the optimal power and size to perform most efficiently the required tasks and reduce potential effects
- using temporary noise barriers (e.g. in the form of plywood hoarding or similar) to shield intensive construction noise activities from residences
- operating plant and equipment in the quietest and most efficient manner.

iii Work scheduling

Additional measures for consideration related to work scheduling include:

- scheduling activities to minimise effects by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events
- scheduling noisy activities to coincide with high levels of ambient noise so that noise from activities is partially masked and not as intrusive
- optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours
- designating, designing and maintaining site access routes to minimise effects
- include contract conditions that include penalties for non-compliance with reasonable instructions by the contractor to minimise noise or arrange suitable scheduling.

iv Relative effectiveness of noise measures

Typical reductions achieved by various forms of noise measures are provided in Table 9.1.

Table 9.1 Relative effectiveness of various forms of noise measures

Noise measures	Nominal noise reduction possible
Increase source-to-receiver distance	approximately 6 dB for each doubling of distance
Screening (e.g. noise barriers)	normally 5 to 10 dB, maximum 15 dB
Enclosure	normally 15 to 25 dB, maximum 50 dB
Silencing (e.g. exhaust mufflers)	normally 5 to 10 dB, maximum 20 dB

9.3 Community consultation and complaints handling

A program to engage in active community consultation and maintain positive relations with residents should be implemented for the Project. Proactively seeking out and addressing community concerns would minimise complaints.

To effectively manage any requests for information or respond to any public concerns in relation to the Project construction activities and operation, the following systems should be considered:

- Notify nearest noise-sensitive receivers and provide details on proposed works, their timing and duration.
- Supply the relevant stakeholders with contact details and names of the site manager during construction to receive complaints or enquiries.
- Use a complaint handling system to monitor environmental noise and vibration complaints. A register should be kept that records information such as the date and time of complaint, complainant details (i.e. full name, address and contact details), nature and source of complaint, action(s) taken, investigation outcome and follow-up actions with complainant.
- Endeavour to respond to any complaint within a reasonable short timeframe.
- Make the complaint register available to regulatory authority upon request.

10 Conclusion

EMM has prepared an assessment of noise and vibration effects for the construction and operation of the Remarkables Ski Area Expansion Project. The assessment considered the potential for noise and vibration effects from the Project and has been prepared in accordance with the methodology outlined in the relevant district plans, standards and guidelines.

10.1 Construction noise

10.1.1 General construction

Construction noise levels from the Project were assessed at the nearest receivers surrounding the proposed works.

Construction noise levels from works proposed within the main ski area are predicted to satisfy the relevant L_{Aeq} noise limits. Construction noise levels from the lower carpark (Carpark A) upgrades and new lower carparks (Carpark B and Boneyard carpark), which will be further away from the main ski area and closest to receivers, potential noise (L_{Aeq}) exceedances are predicted at up to eight residential receivers, during the more sensitive times of the day. Given the predicted noise exceedances, construction activities in these areas will be restricted to the hours between 7:30 am and 8:00 pm on weekdays and 7:30 am and 6:00 pm on Saturdays, hence ensuring construction limits are satisfied and potential noise effects are minimised.

Maximum noise (L_{Amax}) levels from any of the proposed construction works are predicted to satisfy the relevant noise limits at all residential receivers, including during the more sensitive night period.

10.1.2 Helicopter noise

Helicopter noise ($L_{Aeq,15min}$) during construction works is predicted to be below the relevant limits and therefore unlikely to cause effects at all receivers.

10.2 Operational noise

Operational noise levels associated with the daily operation and maintenance of the Project are predicted to satisfy the L_{Aeq} limits and sleep disturbance L_{Amax} limit at all receivers.

10.3 Recreational users

During proposed construction works, potential noise and vibration effects on the relatively small number of recreational users are likely to be temporary and transient.

During operation, in the Summer months, negligible effects are anticipated due to the relatively low use of the area currently. In the Winter months, new recreational opportunities in the Doolans Basin will be created as a result of lift-accessed activities.

To mitigate potential effects to recreational users during construction and operation, a communication strategy is recommended to be implemented to inform recreational users of potential noise and vibration effects from proposed construction and operational activities. This could include website updates, on-site signage and/or stakeholder briefings, and will ensure a relatively high and safe user experience.

10.4 Road traffic noise

Following the expansion, the Project will generate additional road traffic movements on the public road network during the ski season. During the peak of the ski season, this will mean a marginal increase in total traffic movements on SH6 and less than 2 dB increase in average road traffic noise levels at receivers along the transport routes. A 2 dB increase in road traffic noise levels would not be discernible to most people and hence is considered negligible. Therefore, road traffic noise effects during Project operation are considered unlikely.

Road traffic movements generated during Project construction will be significantly less than those generated during operation, and therefore potential effects from road traffic noise during construction is unlikely.

10.5 Construction vibration

The assessment considered potential vibration effects from the Project construction.

The assessment showed that, given the distances between the construction work areas and the nearest buildings, vibration emissions are unlikely to be perceptible at the nearest residence and will be significantly below the levels likely to cause building damage.

10.6 Blasting

There is a high level of uncertainty in the prediction of blasting emissions; vibration and airblast overpressure. Notwithstanding, given the significant separation distance between the likely blast locations and the nearest sensitive receivers, as well as the small-scale nature of the proposed blasts, the effects of blasting activity associated with the Project is expected to be minimal.

10.7 Mitigation and management

A range of project-specific and general noise and vibration mitigation and consultation measures have been provided herein, in particular for construction activities. These measures will be considered and where practicable implemented via a CEMP, hence ensuring relevant limits are satisfied and minimising the potential noise and vibration effects at nearby sensitive receivers.

Glossary

Technical terms typically utilised in a noise and vibration assessment report are explained in Table G.1.

Table G.1 Glossary of acoustic terms and abbreviations associated with the Project

Abbreviation or term	Description
Airblast overpressure	The sudden increase in air pressure, generated by a shock wave, produced when an explosive charge is detonated.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
A-weighting	There are several different weightings utilised for describing noise, the most common being the 'A-weighting'. This attempts to closely approximate the frequency response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
BS 5228-2	The British Standard BS 5228-2:2009 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'
CEMP	Construction environmental management plan
Contractor	The company (and its employees) who will be contracted by NZSki to undertake the construction of the Project
Day period	7 am to 10 pm on any day for the assessment of construction noise
dB	Noise is measured in the unit called the decibel (dB).
DEFRA	United Kingdom Department of Environment, Food and Rural Affairs
DIN 4150-3	DIN 4150-3:2016-12 'Vibration in buildings – Part 3 - Effects on structures'
EMM	EMM Consulting Pty Limited
FTAA	New Zealand Fast Track Approvals Act 2024
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
L_{A10}	The A-weighted noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{Aeq}	The A-weighted energy average noise level. This is the equivalent continuous sound pressure level over a given period. The $L_{Aeq,15min}$ descriptor refers to an L_{Aeq} noise level measured over a 15-minute period.
L_{Amax}	The maximum A-weighted sound pressure level received during a measurement interval.
L_{dn}	The average day-night noise level, that is the 24-hour L_{Aeq} with a +10 dB adjustment to the night L_{Aeq} .
L_w	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Maximum Instantaneous Charge (MIC)	The MIC is the maximum explosive charge mass (kg) detonated per delay in the blasting sequence.
Night period	10 pm to 7 am on any day for the assessment of construction noise and sleep disturbance

Abbreviation or term	Description
NZS 6801:2008	NZ Standard 6801:2008 'Acoustics – Measurement of environmental sound'
NZS 6802:2008	NZ Standard 6802:2008 'Acoustics – Environmental Noise'
NZS 6803:1999	NZ Standard 6803:1999 'Acoustics – Construction Noise'
NZS 6807:1994	NZ Standard 6807:1994 'Noise management and land use planning for helicopter landing areas'
NZTA	Waka Kotahi NZ Transport Agency
CODP	Central Otago District Plan (2026)
OQLDP	Operative Queenstown Lakes District Plan (2025)
PQLDP	Proposed Queenstown Lakes District Plan (2026)
PPV	For some projects vibration levels can be given in terms of Peak Particle Velocity (PPV) which can be measured in a number of ways.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
RMA	Resource Management Act 1991
SH6	State Highway 6
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.
Vibration	Cyclic or transient motion of a physical body or medium, typically quantified in its displacement, velocity or acceleration.

It is useful to have an appreciation of decibels (dB), the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels are provided in Figure G.1.

Table G.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	Just perceptible
5	Noticeable difference
10	Twice (or half) as loud
15	Large change
20	Four times (or quarter) as loud

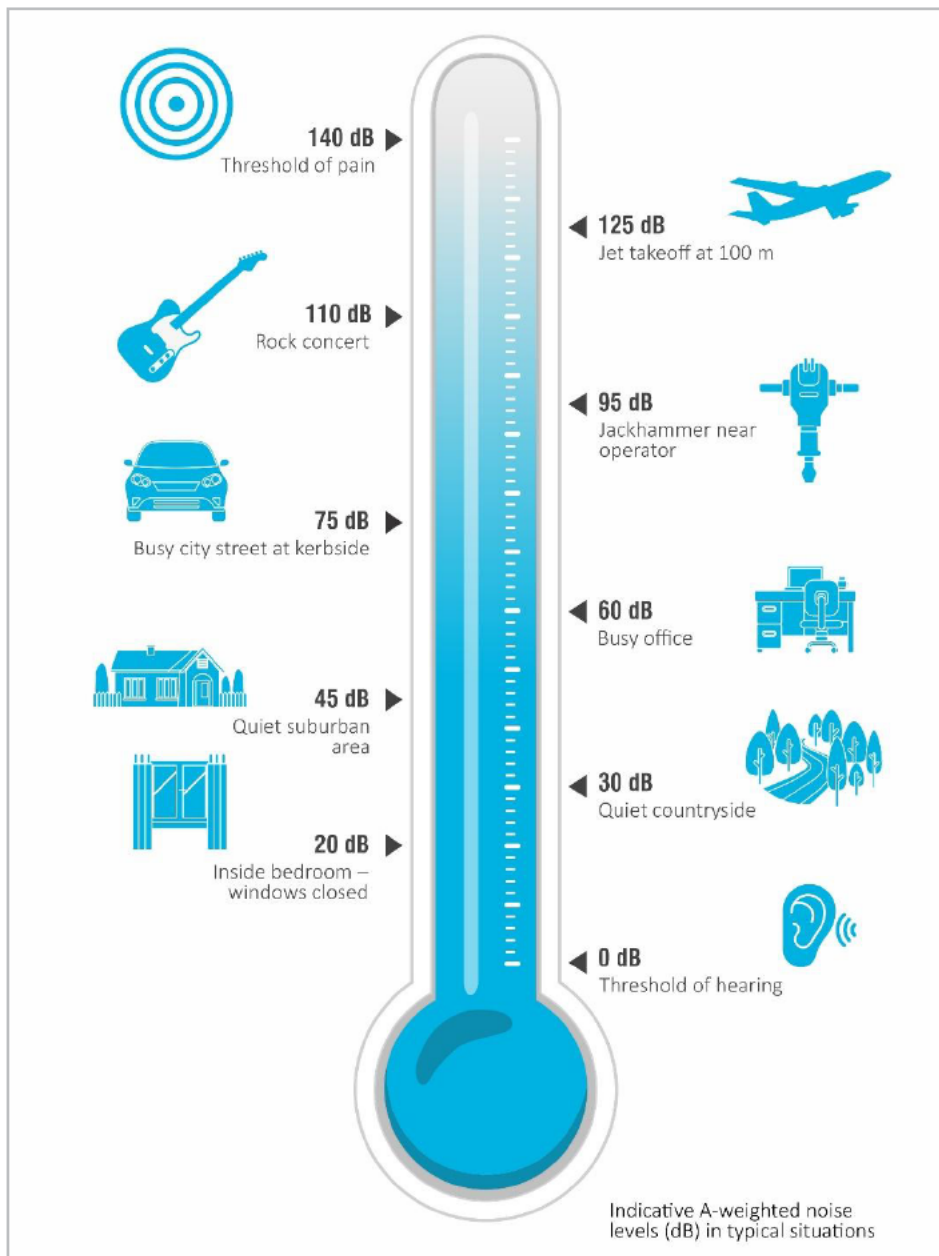


Figure G.1 Common noise levels

Appendix A

Construction plant and equipment

A.1 Modelled construction plant and equipment

Construction plant and equipment items for each modelled construction activity are provided in Table A.1.

Table A.1 Modelled construction plant and equipment items and individual sound power levels

Construction activity	Plant and equipment	Quantity	Sound power level ¹ , dB(A)
Concrete pour	Concrete truck (agitator) – discharging	1	113
Footings and foundations works	Compactor	1	106
	Bobcat	1	95
	Power tools	1	114
	Hand tools	1	101
Structural erection works	Crane	1	95
	Elevated work platform	1	94
	Scissor Lift	1	96
	Telehandler	1	98
	Pneumatic tools	1	105
	Power tools	1	114
	Hand tools	1	101
Installation of gondola towers – crane	Crane (50 t)	1	95
Bulk earthworks	Excavator (50 t)	2	109
	Bulldozer (50 t)	1	113
	Excavator (35 t)	3	107
	Excavator (20 t)	3	104
	Dump truck (40 t)	2	107
	Grader	1	110
	Rock breaker (20 t excavator with 1.5 t hammer)	1	118
Container truck and concrete truck delivery	Heavy vehicle (deliveries)	1	103
	Concrete truck (agitator) – driving	1	108
Area establishment/site clearing/compaction	Excavator (20 t)	1	104
	Dump truck (40 t)	2	107
	Bulldozer (50 t)	1	113
	Roller	1	109
Removal of existing stored items	Heavy vehicle	1	103

Notes: 1. Per unit of quantity.

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