FLORA AND FAUNA ASSESSMENT

Responsible water management by beneficially reusing recycled water from the Selwyn Wastewater Treatment Plant

Prepared by Dave Woods

for

Selwyn Snow Resort Pty Ltd

16th February 2023

Traditional Owner Acknowledgement

The author would like to pay his respects to the traditional owners, Wolgal, the original custodians of the land upon which this assessment and field work was carried out.

Documentation

Project Name	Flora and Fauna Assessment – Responsible water management by beneficially reusing recycled water from the Selwyn Wastewater Treatment Plant	
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BACKGROUND

A consequence of the January 2020 wildfire in the central section of Kosciuszko National Park (KNP) was the loss of most infrastructure at Selwyn Snow Resort (SSR). Since that event the company has rebuilt the resort including staff accommodation, resort operation centre, guest facilities, augmented the water supply, upgraded the snowmaking infrastructure and is soon to complete the sewage treatment plant (STP). Prior to the wildfire, the resort used to have a wastewater pump out system to accommodate grey water and effluent management. However, with the advent of a new STP, two discharge options were considered for treated wastewater:

1. point discharge into Clear Creek; and
2. recycle for reticulation in resort snowmaking operations following dilution with freshwater from Clear Creek and storage in the former quarry dam at the top of the resort.

Concerns raised about flow rates in Clear Creek compounded by water being locked up in winter snow at a time when resort visitation is highest, precluded point discharge as a favoured option with concurrence from EPA. In contrast, the preferred option is the use of recycled water that is diluted before being irrigated across ski runs as part of snowmaking operations.

The option for dispersal discharge is also premised on the dilution capacity of Clear Creek being sufficient to meet the Water Quality Objective of 'no changes to ambient water quality' as a result of effluent management. Evaluation of this option was supported in a STP Dilution Study by Advisian (5th February 2023) that concluded that the recycled water option should not result in **changes to ambient water quality** beyond natural variability. The estimated water quality within the snowmaking dam and the receiving Clear Creek included conservative and maximum inputs for a range of scenarios, including consideration of periods where snowmaking cannot occur for consecutive days. The key pollutant groups from the study that emanate from wastewater included aluminium sulphate, boron, cadmium, chorine residues and nitrogen. The risk assessment was conducted for each operational activity associated with storage and discharge node, the receiving environmental element (i.e., surface water, ground water, soil and sediment), environmental endpoint (i.e., aquatic biota, plants, sediments, surface water and groundwater) and potential impact (i.e., toxicity, eutrophication, contamination and/or nutrient imbalance).

While the report concluded a low risk to the environment based on preventative measures, including operational procedures and various monitoring actions for long-term water quality monitoring of Clear Creek and areas below snowmaking activities, there is currently no assessment or bridging appraisal for ecological entities identified under the *Biodiversity Conservation Act 2016* (BC Act), the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Fisheries Management Act 1994* (FM 1994). The purpose of this report is to advance some of that information to a level that provides confidence to the consent authority (Department of Planning) and referring agency (NPWS) to issue a conditional approval.

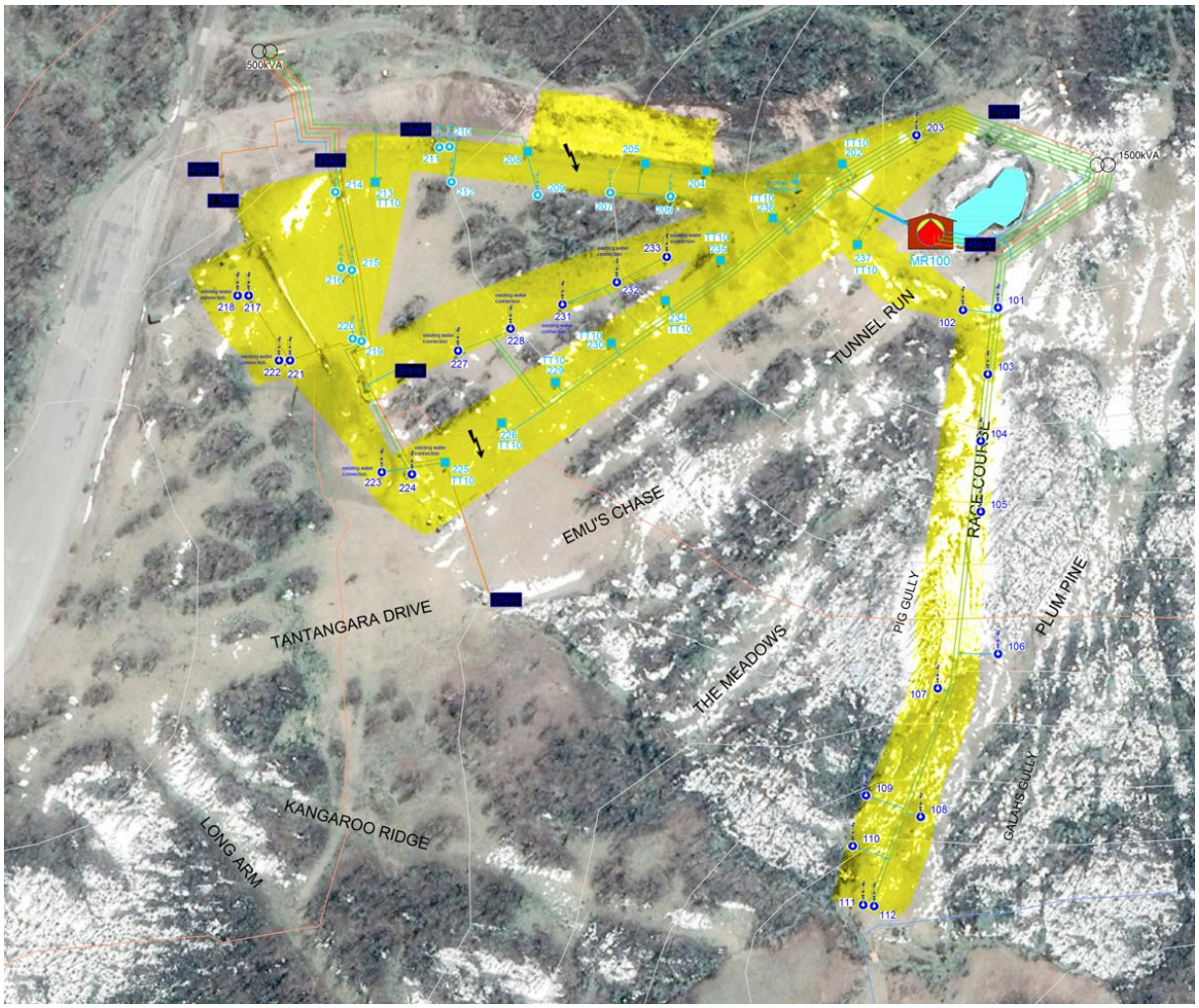

Figure 1: Map showing the location of hydrants that are part of the infrastructure to irrigate the treated and diluted effluent. Stationary and mobile snowguns will deliver the treated and diluted effluent across the ski slopes depicted in yellow shading. Dilution of treated effluent would take place in the former quarry that has become a snowmaking dam at the top of the hill (shaded blue).

AIM OF ECOLOGICAL ASSESSMENT

Due to time constraints, the author of this document was not able to conduct an assessment for the proposal that would usually result in a more detailed report like that prepared for other proposed activities associated with the redevelopment of SSR. Earlier contributions by the author included an assessment toward the redevelopment of staff accommodation, resort operations centre, guest facilities, potable water supply, asset protection zone and several other supplementary activities. While overlapping with the current proposal, these assessments were not conducted in some of the areas proposed for recycled water irrigation nor in the context of potential impacts associated with the current proposed activity to discharge diluted effluent. Therefore, it is reasonable for the consent authorities to require additional information to accompany the Development Application. However, unlike other proposed activities associated with the redevelopment, this activity has less qualifiable and quantifiable impacts as the consequences are speculative upon terrestrial and aquatic ecosystems without long term monitoring, assuming miscalculation in the predictive modelling, failure of STP

management and unsuitable discharge. The precedent in Australia for recycling diluted water for reticulation in snow making was set more than 10 years ago at Mt. Buller and Mt. Hotham ski resorts in Victoria. Both resorts continue to produce Class A recycled water for snowmaking reticulation and have incorporated monitoring relating to their use of Recycled Water into their respective Resort Environmental Management Systems.

Therefore, the aim of this assessment, in the first instance, is to prepare an inventory and appraisal of key ecological entities that currently exist in and adjacent to the proposed activity area. By virtue of statutory listing, threatened entities form the main focus and target for literature review and field survey. Secondly, some potential impacts may be secondary in nature or indirect and aligned to changes in vegetation that affects fauna through habitat transformation including occupancy and feeding opportunities, rather than directly through toxins or contaminants *per se*. Secondary impacts can also affect aquatic ecosystems, though consequences of toxins and eutrophication in waterways usually have detectable first level impact. Furthermore, this appraisal is made in the context of a landscape that experienced a high intensity wildfire in January 2020. From observations made in October 2020, this wildfire event, with very few exceptions, consumed most vegetation across the Selwyn resort and adjacent areas. In terms of ecosystem regeneration, three years following a high intensity wildfire is still considered early in the recovery phase, particularly at higher elevations consistent with SSR that ranges between approximately 1500 m to 1600 m asl. Therefore, determining significant impacts in the environment may also be difficult to discern where stable ecosystems have been disrupted including major structural changes to fauna habitat and the loss and/or displacement of some threatened species. That said, discernible impacts may only be an issue if the system does not perform to licenced discharge parameters. This assessment also considers contingencies to prevent unsuitable discharge from being released that could expose threatened entities to toxins or contaminants.

At the completion of this assessment, a layer of information is presented that will identify whether any significant ecological entity exists in or adjacent to the target area that could be impacted by this proposal. The assessment subsequently includes the application of a Test of Significance (ToS) upon those entities most at risk with a conclusion for any significant impact. The assessment is based on species or habitat interaction with the discharge, the likelihood of a species being present in the discharge area and run-off zone, the risk assessment of the pollutant group and environmental endpoint, contingencies for unsuitable discharge that circumvents any polluted water interacting with the threatened entities and other environmental components, and monitoring.

As a proposed Part 4 development activity, the assessment conditions are also predicated on whether the activity is subject to the Biodiversity Offset Scheme (BOS). BOS threshold levels are assessed and applied below.

BIODIVERSITY OFFSET SCHEME

Entry into the Biodiversity Offset Scheme (BOS) can be created by five triggers, though three are most commonly enacted for developments under Part 4 of the *Environmental Planning and Assessment Act 1979* (EPA Act).

The first is whether a proposed activity occurs on the Biodiversity Values Map (BVM) and whether the impact of the proposal involves the clearing of native vegetation or an impact prescribed under clause 6.1 of the *Biodiversity Conservation Regulation 2017* (BC Reg). The dispersal of diluted treated effluent does not involve the clearing of native vegetation independent of value areas on the BVM. This

contrasts with some of the impacts prescribed under clause 6.1 of the BC Reg that includes impacts of development on habitat of threatened species or ecological communities including non-native vegetation. At this stage there is doubt whether there are any threatened species that have an affinity to non-native vegetation; the only speculative species discussed is the alpine she-oak skink occupying open areas that are often dominated by exotic species. However, this species is unlikely to occur within the two shaded areas in Figure 2 nominated as BVM 1 and BVM 2. Both these mapped areas are recovering from the 2020 wildfire but are relatively dense contiguous wet plant community types aligning Clear Creek. Other prescribed impacts for these two shaded areas includes impacts of development on connectivity and movement of threatened species and ecological communities. The three entities that have an affinity, or potential affinity, with the two shaded areas includes alpine tree frog, broad-toothed rat and peatland communities. To date alpine tree frog have not been recorded in Clear Creek though there are habitat elements present. Impacts upon vegetation as habitat is not fully understood, but such an impact is highly unlikely considering the control options that prevents unsuitable discharge from being dispersed across the resort. Therefore, no vegetation impact also includes no barrier to habitat connectivity and movement. The entities considered for prescribed impacts based on the riparian areas along Clear Creek include broad-toothed rat, alpine tree frog and peatland vegetation.

The final prescribed impact with any relevance to the proposal is the 'impact of development on water quality, water bodies, and hydrological processes that sustain threatened species and ecological communities.' The entities most relevant to this prescription are alpine tree frog and peatland communities. However, it is unlikely alpine tree frog are present. It is currently speculative that the species is present and currently speculative that the proposal will operate, either permanently or occasionally, to a standard that would cause harm to threated species reliant on Clear Creek, or for adverse impacts to persist that would affect peatland communities that are strongly connected with water quality and hydrological processes.

At this stage there is no calculable impact, either because threatened entities are not present, or there is an assumption that the process will fail contrary to the dilution assessment undertaken by Advision (2023) and the contingencies available to prevent unsuitable discharge from being release from quarry dam. On the premise of uncertain impacts, the project will be subjected to water quality and soil monitoring as mediums for measuring any cumulated pollutants against discharge and licence thresholds.

The second potential entry into the BOS is based on the amount of native vegetation being cleared exceeding an area threshold; the area threshold based on the minimum lot size associated with a property. As no native vegetation is being cleared, this trigger is not activated.

Where the entry thresholds into the BOS have not been triggered by the BVM or exceed the area clearing threshold, a process is enacted that identifies a suite of threatened entities relative to the project area that are then assessed against the impacts or potential impacts of the project. This third possible entry into the BOS is based on assessment criteria against the Test of Significance (ToS) under Section 7.3 of the BC Act. Following the assessment of criteria against each relevant threatened entity, and the activity is then identified to have a significant impact, then Part 4 activities under the EPA Act are obligated to partake in the BOS. As the two primary triggers for entry into the BOS have not been met, most of the survey and reporting effort that follows this section is based on filtering candidate species for the ToS and consideration for any significant impact.

After a combination of literature review and field survey, four entities were identified that could be directly or indirectly impacted by the proposal, even though the impacts are at this stage speculative.

They include alpine she-oak skink, alpine tree frog, broad-toothed rat and peatland community. However, the presence of both alpine she-oak skink and alpine tree frog is also speculative and based on possible occurrence which is founded on habitat opportunity. Following the application of the ToS there was a justified confidence that the proposed diluted effluent dispersal would not have a significant impact. The justification for this conclusion is discussed below.

Figure 2: Biodiversity Values Map highlighting two patches that are within the run-off area. BVM 1 is approximately 100 m along Clear Creek and BVM 2 is at the bottom of Race Course. While BVM 1 is not within any snowmaking dispersal area, BVM 2 is located below hydrant/snow gun locations 111 and 112. Both areas could potentially receive diluted effluent dispersal as run-off in the more relative concentrated form associated with Clear Creek, and potentially as sheet melt on the ground where considerations are made for prescribed impacts under the Biodiversity Conservation Regulation 2017. However, this assumes occasional or prolonged discharge of unsuitable diluted effluent. The discharge process can be managed so that only recycled water is released that does not result in changes to ambient water quality.

METHODOLOGY

Prior to the field survey a desktop review was conducted that included DPE's BioNet Atlas, threatened entities listed under the Commonwealth's Protected Matters of National Significance (PMNS), DPE's BioNet plant community types (PCTs) and their associated threatened entities, threatened entities listed under the *Fisheries Management Act 1994*, and several environmental assessments and ecological surveys. Several key resources included the author's own assessment surveys undertaken in 2020 pertaining to the SSR redevelopment, the natural and cultural inventory of Selwyn Snowfields undertaken by ENFAC in 2009, and the 'Kosciuszko Resorts Vegetation Assessment' by Ecology Australia in 2003 that included vegetation mapping and explanatory report. For BioNet and PMNS data extraction, a 10 km radius was used although some species in BioNet were interrogated to a greater distance where there were habitat and/or community type similarities to that in the survey area. For PCT review and application, the NSW State Vegetation Type Map that was formally released on 24th

June 2022 was used. No attempt was made to review the former PCT classification even though it is still in use in the Biodiversity Offset Scheme (to be retired for new BOS projects as of 22nd February 2023).

The field work was undertaken on 11th February 2023 and involved contour traverses and working downslope across each proposed irrigation area. For some locations, a reverse traverse was made up the same slope. To account for runoff and surface spread beyond the irrigation zone, other areas of the resort were inspected, particularly lower areas of the resort and areas adjacent to the ski runs. Because the author had less survey history down 'Race Course' ski slope, this area was completed first before returning to Township Hill and traversing the upper ski slopes and snow making areas commensurate with 'Township', 'Home Run' and 'New Chum'.

The data extracted from the desktop review was used to guide survey targets and survey intensity. While surveying for threatened flora species, all vascular plants were recorded to give context to the survey effort. At regular intervals the vegetation community was assessed in terms of PCT, recovery status and habitat potential; the latter mostly aligned to the threatened entities reviewed in the databases. All vascular plants including exotic species were recorded according to nomenclature prescribed in the NSW Royal Botanical Database (PlantNET), though for expediency and greater clarity no common names were added (Appendix 1). In contrast, fauna was recorded with both scientific and common name according to DPE's BioNET database, though in discussion the common name was frequently used as most common names pertaining to fauna are unique and do not generate confusion (Appendix 2).

RESULTS

Literature Review

Table 1 is a list of threatened species filtered from the databases discussed in Methodology above. The table includes all species identified from data filtered from DPEs BioNET database as the records have been identified within 10 km of the survey area. Records from the Commonwealth's Protected Matters Report have also been reviewed. However, some of these are based on probability to occur in the area or loose habitat associations. Therefore, the author has arbitrarily filtered the report to account for species with a high probability for occurrence based on habitat types and to exclude those with a fidelity for lower altitudes and in community types not present in the Selwyn area. As two PCTs (PCT 3380 and PCT 3381) have been mapped across the resort, threatened entities associated with these PCTs were reviewed and species added to the table based on the same criteria above. However, the PCTs are also applied to other parts of the Snowy Mountains and include species with strong fidelities to other geographical areas not relevant to SSR, and consequently such data has also been excluded. Table 1 summaries the conservation status of each species, the number of records (where available) within a 10 km radius, and comments pertaining to the entity being at risk from the proposal as weighted by its presence and environmental interaction within the survey area, assuming untreated discharge.

Figure 3 is a clip of the NSW Vegetation Map showing relevant PCTs that have been assigned to the Selwyn area by DPE. The scale for the map application was never meant to be site-specific as some smaller communities or transitional communities may not have been captured, or sections of the map not benefiting from any field truthing. A good example is the absence in Figure 3 of a peatland-type PCT compared to Figure 4 that reflects the first vegetation mapping exercise across the Selwyn Resort

in 2003. During that exercise peatland was recorded at the edge of some ski runs, at the bottom of the resort and in pockets to the north.

Field Survey

There were no threatened plant species observed or had previously been recorded across the target area or in areas within the catchment culminating to the area adjacent to the Race Course T-bar. At the section of Clear Creek below Race Course T-bar, this would be the point of highest concentration for any cumulated run-off emanating from the proposed diluted effluent dispersal if there were contaminated elements in the discharge. Only a brief survey for approximately 100 m past this point was made to search for threatened plant species.

There were no TECs recorded across the target area excluding some depauperate remnants scattered across ski runs. Some residual vascular plant species consistent with former peatland communities were present, but these remnant peatlands had lost most of their composition and ecological condition. One site, though outside the target area but downhill in the run-off zone, included the bottom of the Powerline T-bar and water pumping station on Clear Creek. The other site was located within the irrigation area and approximately two-thirds downslope along the Race Course ski slope on the eastern side of the clearing. In contrast, an intact though fire-affected peatland community still exists along the eastern boundary of the Plum Pine ski run and along Clear Creek adjacent to the Race Course T-bar. The former is distant to the discharge and runoff area from the adjacent Race Course ski slope, but the latter is commensurate with the first vegetation community to potentially receive the catchment run-off of all diluted discharge, excluding ground and plant absorption, and potential evaporation further upslope. This peatland community was reported in the ENFAC study (2009) (see Figure 3) but was originally captured in the mapping exercise by Ecology Australia (2003). However, assuming the issue of scale and possibility that mapping took place after the 2020 wildfire event, the community is not captured as a PCT in the NSW Plant Community Map published by DPE (2022). That said, the peatland communities are still in an early stage of recovery, particularly with the wildfire having burned all the mature heath and wet tall shrub community that was transitional with the peatland. The fire may have also changed or disrupted the function of the peatland due to the high intensity nature of the event affecting run-off rates and peatland as a growing substrate for vascular plants and bryophytes. That said, the peatland community below Race Course T-bar is not independent of Clear Creek and the impacts the wildfire had on the riparian ecosystem, nor the potential for water quality impacts if the diluted effluent dispersal does not meet stringent discharge standards that will be licenced by EPA.

Excluding building envelopes and other hard-stand areas associated with resort infrastructure, the vegetation landscape can be divided and described into two components: the ski slope and adjacent natural areas. The ski slope is the open terrain that is devoid of a shrub and tree layer, contains a mosaic ground cover of native and introduced species that is annually maintained by slashing to an average height between 15 to 20 cm, and where snow is groomed in winter by oversnow machines. In contrast, the native adjacent areas reflect the original vegetation and community types from which the ski slopes have been created. At SSR the adjacent vegetation including small isolated patches are characterised by a woodland community where the dominant overstorey species is *Eucalyptus pauciflora* ssp*. debeuzevillei* (occasional pockets of *Eucalyptus stellulata* in areas of poor drainage at lower elevations), the understorey either shrubby, grassy or mix of both, and often there is a sharp ecotone between the slope vegetation and the adjacent native stratum. Depending on slope management and operational history, the integrity of the native vegetation stand, particularly at the interface and up to several metres deep, will vary and may include many of the exotic species present in the highly modified adjacent slopes.

At SSR, the author noted that after nearly two-and-a-half years, the ground composition of graminoids and forbs had re-established to the same density and broadly the same composition that was recorded in pre-fire surveys and assessments, particularly across the ski slope. It is possible that some species, particularly aggressive introduced perennial grasses, may be dominating areas where natives had a greater cover abundance before the wildfire event, but this is speculative without long-term monitoring sites. In contrast, there are areas to the south of the resort where vegetation clearing through the woodland serves the purpose for skiing and operational access but does not have a history of ground disturbance such as service trenching. In these areas, it was noted that there was a greater composition of native species compared to introduced plants.

For the standing woodland community, the wildfire consumed most trees to such an intensity that little epicormic response was observed and very little above ground tree tissue survived. As recorded and reported in October 2020, most trees did not die from the fire event *per se*, but the fire intensity resulted in most trees recovering by lignotuber regrowth and seedlings. During the survey it was noted that suckering regrowth in the upper areas of the resort had attained heights of approximately 50 to 200 cm and seedling regrowth between 20 to 100 cm. In contrast, lower resort areas attained suckering heights of approximately 100 to 350 cm (occasionally 500 to 600 cm) and seedling growth approximately 50 to 150 cm. The larger growth rates and heights at lower elevations, notwithstanding localised fire intensities, is likely due to the better moisture conditions found at the bottom of hills and slopes, and protection from more desiccating winds and solar radiation on exposed areas. Those trees taking advantage of better soil nutrients and moister conditions at the bottom of the hill, but also positioned in sunny environments while protected by the surrounding landscape, tended to be taller compared to those that were too sheltered and ultimately received less light and heat. Furthermore, the height of the shrubs in the vegetation patches and contiguous woodland had progressed between 60 to 120 cm; pending species. In contrast, nine months after the January 2020 wildfire, the shrub component in most areas across SSR did not exceed 15 to 20 cm.

The above description of the post-fire status of the vegetation also helps appraise the condition of fauna habitat across the resort, and in particular, the areas within, adjacent and downslope of the proposed dispersal areas. While several threatened woodland birds could still be expected to be present in the area, the condition of the vegetation is not commensurate with optimum habitat for any species while there is no concealing tree canopy, and while the height of the shrub understorey is relatively low. The growth status of most trees and shrubs means that these species are too immature to flower and fruit to attract seed-eating birds. Some smaller passerines may find enough cover to forage for insects, but nesting opportunities is currently limited. However, overtime as the vegetation recovers, many habitats and niches will return to pre-fire status, and possibly improve habitat complexity by an increase in hollow trunks and the accumulation of debris from stags and limbs.

Key habitat elements for both threatened skink species identified in Table 1 is partly present at SSR. Neither alpine she-oak skink or alpine skink have been recorded in SSR, however, relatively new records have been made for alpine she-oak skink in the Kiandra area to the north-east. While opportunistic reptile surveys have been conducted in the past at SSR, an opportunity exists for a more thorough survey effort that uses a combination of active searches in appropriate weather conditions, the placement and surveying of artificial habitat, and wildlife cameras. Though reptiles were not actively searched, three species were recorded including eastern three-lined skink, blotched blue-tongue lizard and highland copperhead. Both the eastern three-lined skink and highland copperhead were also recorded in October 2020.

No frogs were detected though the common eastern toadlet was recorded along Clear Creek and in the Quarry Dam in October 2020. There are several records of alpine tree frog in the vicinity of Three

Mile Dam and surrounding areas to the north, and more records around Kiandra to the north-east. The records are dated between 2010 and 2019 and appear to have come from systematic surveys by DPE. It is unknown whether Clear Creek has been surveyed in the past or whether alpine tree frog and other amphibian surveys have only taken place as part of proposed development areas. If alpine tree frog were present in the resort, excluding the soak and upper drainage area north of the building structures, it is most likely they would occupy the area south of the water pumping station. Much of the riparian vegetation along this section of creek down to the bottom of Race Course ski slope and T-bar has not been cleared, though it was severely impacted by the 2020 wildfire and still in an early stage of ecological recovery.

As summarised in Table 1, there are several threatened mammal species identified within 10 km of SSR. It is possible that microbats are present across SSR but highly unlikely to be breeding given the loss of overstorey structure since the 2020 wildfire, particularly eastern false pipistrelle that uses tree hollows. However, as post-fire regeneration advances, the ecosystem is likely to build up to increase the support of microbats, particularly with a greater range of insects. Several ground and semi-arboreal mammals including smoky mouse, eastern pygmy-possum and broad-toothed rat have also been recorded within 10 km of SSR, but excluding broad-toothed rat, the other species were found at lower altitudes. The overstorey environment includes habitat elements consistent with smoky mouse and eastern pygmy-possum, though not all optimum and heavily impacted by the 2020 wildfire. Without systematic surveys including Elliot trapping and wildlife cameras, it may not be possible to assert whether either of these species are present in SSR. In contrast, broad-toothed rat scats were again found approximately 50 m downstream of Race Course ski run which follows scats being found approximately 70 m along Clear Creek below the water pumping station in 2020. This evidence supports the notion that broad-toothed rat survived the 2020 wildfire though the scat density was low in this area. Mountain pygmy-possum were not considered as the species has a very narrow habitat niche requirement and the sites within 10 km pertain to the boulder and rock scree slopes above Happy Jacks River to the south.

As per the discussion on birds, it is highly likely that without further high intensity fire in this area, mammal fauna could benefit from the greater structural debris of fallen logs and stags with hollows. This also assumes that the ecosystem continues to recover with a replacement tree canopy, a mosaic of understorey stratum and shrub density, and enough species to have survived the fire or be close enough to recolonise from unburnt areas. However consistent with areas about 1500 m asl, growth rates are slow and nearly all trees will be establishing a canopy cover through lignotuber and seedling development. Using regrowth progress from historical fire events in similar subalpine environments where snowgum are the dominant overstorey, this will take several decades of recovery.

It is highly unlikely that any faulting effluent treatment and subsequent dispersal would have a toxic impact upon any mammal species because of the dispersed nature of the process. Assuming failure, concentrations would be at their highest below Race Course which is the lowest catchment point below the dispersal and runoff areas. However, terrestrial fauna impact, if any, is most likely through a consequence of habitat change. Unmanaged or faulting effluent processes may increase nutrients into the environment. Most introduced species and native ruderals would take advantage of extra nutrients leached into the soil. Depending on the native species, many vascular plants, particularly trees and shrubs, would not be affected and only use the elements in the soil they require. However, there are thresholds where over nutrification could impact vegetation through changes in soil biota and pH. The long term impact could include a benefit to some species and dieback in others. This scenario requires a relatively high concentration of nutrients at point source and assumes a complete failure of the treatment process over a long period of time. These comments are also made on a

theoretical discharge of partially untreated effluent. The process proposed is based on diluted treated effluent and released when the water quality is equivalent to the range variation recorded for Clear Creek.

There were two threatened entities under the FM Act that share similar environments to Clear Creek at the elevation ranges commensurate with SSR: Alpine Redspot Dragonfly (*Austropetalia tonyana*) and Stocky Galaxias (*Galaxias tantangara*). Distribution maps were reviewed for both species with the former occupying large catchment areas to the south and a small outlier in Tabletop Creek to the south-east, and the latter in a remote section of the upper Tantangara Creek to the east. Though Clear Creek is a tributary of Tumut River and flows south into the Tumut Pond Reservoir, there may be other aquatic entities including threatened and non-threatened, that may be at risk of concentrated diluted effluent discharge if the elements are not managed to licenced conditions.

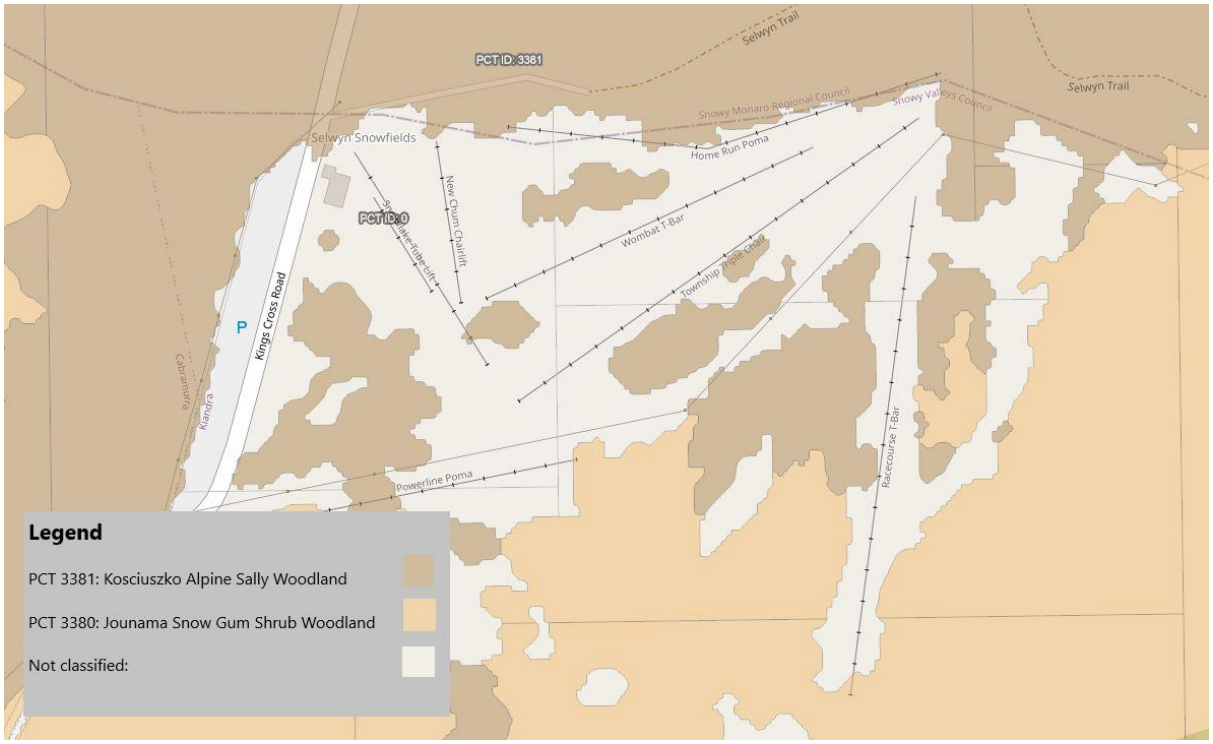

Figure 3: PCTs according to the NSW State Vegetation Type Map that was published on 24th June 2022 that replaced the previous PCT classification. The survey area has mostly been mapped with PCT 3381 in the upper areas and PCT 3380 in the lower areas. At this stage, the mapping application only applies to areas adjacent to ski runs and adjacent to other infrastructure. The highly modified slopes have not been classified due to vegetation structural changes, though ground composition is still highly influenced by native forbs and graminoids.

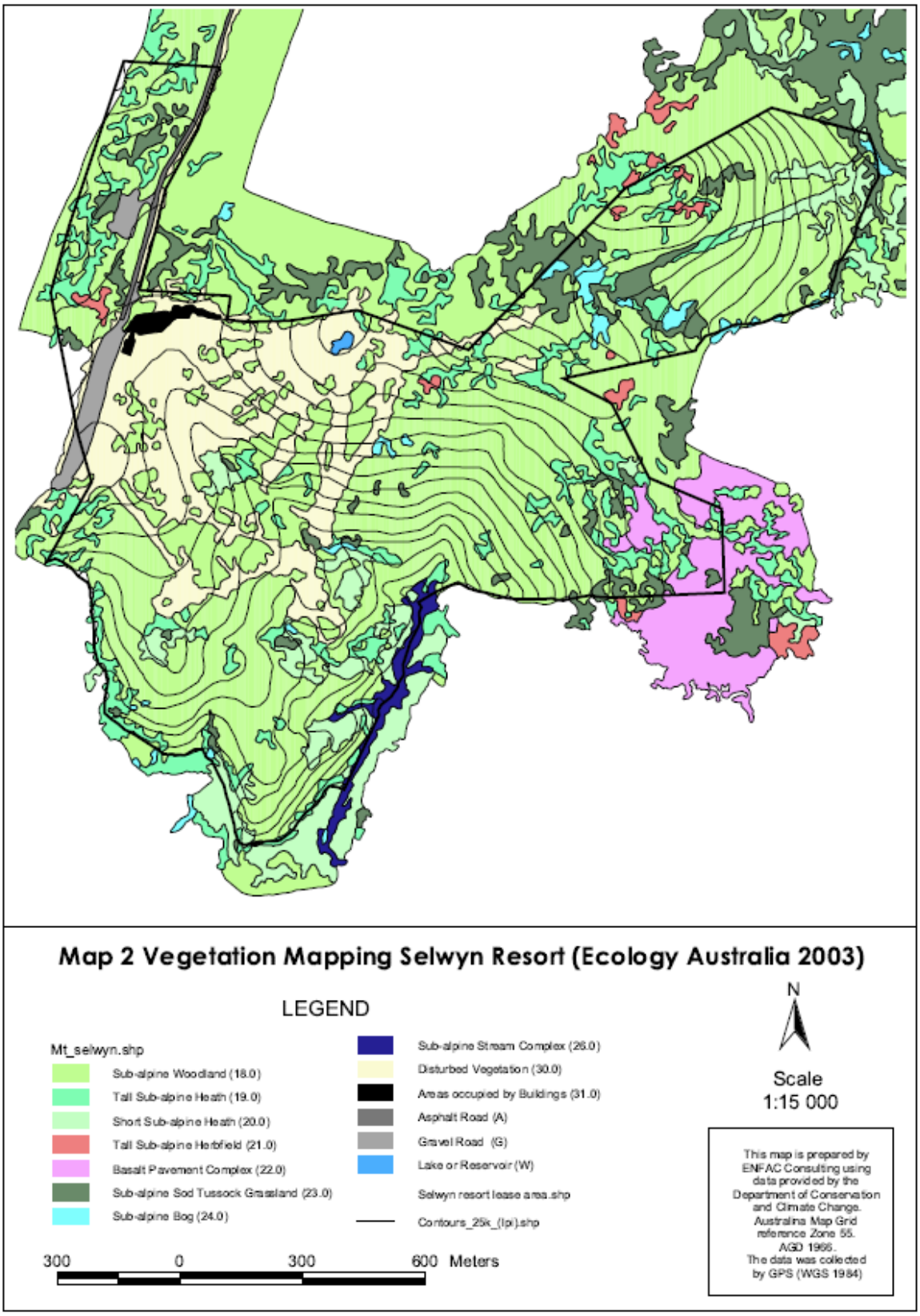

Figure 4: Vegetation Mapping of Selwyn Resort conducted in 2003. The purpose of the map was to facilitate environmental planning and assessments by the NSW Department of Planning following the NSW Government's decision to transfer responsibilities for development consent in resort areas from NPWS to DoP.

Table 1: List of threatened species filtered from database records for their known or potential occurrence in or adjacent to Selwyn Snow Resort. The table also includes the conservation status and justification for selection as a candidate species for field assessment. Where data has been extracted from NSW BioNet an indication of the number of site records has been provided within 10 km of the survey area.

Codes:

V – Vulnerable, E – Endangered, CE – Critically Endangered, EEC – Endangered Ecological Community, CEEC – Critically Endangered Ecological Community, J – Japan-Australia Migratory Bird Agreement, K – Republic of Korea-Australia Migratory Bird Agreement, C – China-Australia Migratory Bird Agreement

Scientific Name	Common Name	NSW Conservation Status	C'lth Conservation Status	Number of Site Records	Likely Occurrence	Justification and Impact Weighting
FLORA						
Prasophyllum retroflexum	Kiandra Leek Orchid	V	V	1	Moderate	Although only one record within 10 km of Selwyn Snow Resort (a record near Kiandra), the species occurs in sub-alpine grasslands and woodlands, consistent with some of the environment in the survey area. Most plants have been recorded in the Long Plain, Kiandra and Tantangara area. Although the ground vegetation within ski slopes is modified, there are areas of slope around SSR that still retain a reasonable native composition and structure. Moderate possibility of occurrence, but if present, it would require a large amount of nutrients to change the soil conditions for it to be at risk.
Pterostylis foliata	Slender Greenhood	V	-	1	Low	Although found in several other states, in NSW this species occurs mainly in the Southern Tablelands south from Batlow. The species grows in eucalypt forest amongst an understorey of shrubs, ferns and grasses. It grows on loam or clay loam soils on sheltered slopes and occasionally seepage areas. The one record from 1992 has been denatured, but it is unlikely to occur within SSR and probably occurs in the montane valleys to the west within 10 km of the study area. It is also unlikely to be a sub-alpine species. Low possibility of occurrence, but if present, it would require a large amount of nutrients to change the soil conditions for it to be at risk
Discaria nitida	Leafy Anchor Plant	V	-	4	Moderate	Records of this species tend to be scattered either on or close to rocky stream banks or on rocky areas. The species occurs in both woodland and heathy riparian vegetation and on treeless grassy sub-alpine plains. In the local area most records are along the Kiandra Plains. Some of these habitat elements are present in or adjacent to SSR. However, most populations survive in sites that appear to be rarely burnt 'fire refugia' as the species is known to be highly fire sensitive and recruitment infrequent. An easy plant to identify if present. There were several plants present before the wildfire in the adjacent Bloomfield and Four Mile catchments to the east. The author was engaged by DPE to resurvey these areas in 2020 and 2022. No plants were found. It is possible the species is or was present further down Clear Creek. If present, the species would occur as part of the riparian community. Although it occurs, or can occur, in the riparian zone, nutrification would have to be exceedingly high and concentrated to have any impact upon individual plants. Additional surveys along Clear Creek could easily qualify if this species is present, though few plants have survived the 2020 high intensity fire in adjacent catchments.
Thesium australe	Austral Toadflax	V	V	10	Moderate	Several records exist for this small straggling parasitic herb. Away from the coast the species occurs in grassland and grassy woodland, often in association with *Themeda triandra* (Kangaroo Grass). This species is a moderate candidate for occurring in the survey area as local records exist in the Cabramurra area to the west and in the Kiandra Plain area to the east. A good candidate if Kangaroo Grass was present. However, like other forbs and grasses, impacts of dispersed discharge would be low unless concentrations were high over a long period of time and which accumulated in drier vegetation types compared to wet or damp areas.
Pimelea bracteata	Rice Flower	CE	-	8	Moderate	Although only 8 site records exist in BioNet, one record is within 1 km to the north of SSR. However, due to the critically endangered status of this species, the location is likely to be denatured as the record is not commensurate with its known habitat. The species is a localised shrub occurring in wetlands and along waterways and stream edges in high altitude treeless subalpine valleys. If present

						within SSR, then a candidate site is Clear Creek below the water pumping station. The species has not been recorded in previous surveys and it is an easily identified species if present. An estimated 50% of the range of this species was burnt during the January 2020 bushfire. Similar to *Discaria nitida,* concentrations of elements and nutrient loading along Clear Creek would have to be intense and prolonged for a discernible impact, and it is likely that other surrounding species would also show signs of dieback. Targeted surveys would qualify if present along Clear Creek.
Calotis glandulosa	Mauve Burr-daisy	V	V	0	Low	No local records in BioNet but this species is found in sub-alpine grassland dominated by *Poa* spp. and in snow gum woodland. The species also often occurs in disturbed environments where ground disturbance can act as a precursor for seed germination. Habitat elements for this species can be expected around SSR. An easy plant to identify though it may blend in with other Asteraceae species. It is also unlikely to be a sub-alpine species. Low possibility of occurrence, but if present, it would require a large amount of nutrients to change the soil conditions for it to be at risk.
Diuris ochroma	Pale Gold Moths	E	V	0	Low	This terrestrial orchid is better known for its occurrence in the Kybeyan area on the Monaro Tableland, but a population also exists on the sub-alpine plains near Tantangara in Kosciuszko National Park (pers. obs). Habitat at Selwyn not typical of locations known for this species, but kept as a candidate as a precaution.
Leucochrysum albicans var. *tricolor*	Hoary Sunray	E	E	0	Low	Frequent populations occur along roadsides along the western fringe and central areas of the Monaro Tablelands. Often occurs in disturbed environments including bare areas. In less disturbed areas it is also known to colonise grassland, woodland and forests. An easy plant to identify when in flower. Although no records in BioNet, the species occurs along the Snowy Mountains Hwy at lower altitudes. Due to its predisposition to disturbed areas, it is kept as a candidate species, albeit low likelihood of occurrence. On the 27th January 2023, this species was gazetted as an endangered species. Prior to this gazettal the species was only listed as vulnerable under the EPBC Act. It is now classed as endangered under the EPBC Act. Though the species occurs on low nutrient substrates, if present, it would require a large amount of nutrients to change the soil conditions for it to be at risk.
Pterostylis oreophila	Blue-tongued Greenhood	CE	CE	0	Low	In Kosciuszko National Park this species is only known from a few small populations. It grows along sub-alpine watercourses under more open thickets of mountain tea-tree in muddy ground very close to water, but less commonly in peaty soils and sphagnum mounds. Highly unlikely to occur at SSR, but kept as a precaution. A species that could be targeted if additional flora surveys were conducted along Clear Creek below the water pumping station.
Rutidosis leiolepis	Monaro Golden Daisy	V	V	0	Low	In Kosciuszko National Park this species occurs in sub-alpine grasslands, but generally at lower elevations compared to the Selwyn area. Kept as a candidate as a precaution, though never recorded in previous surveys or assessments.
Calotis pubescens	Max Mueller's Burr-daisy	E	-	0	Moderate	No local records but grows in sub-alpine treeless plains in herb-rich grassland that is not subject to periodic inundation. The few populations that occur in Kosciuszko National Park include elevation ranges similar to SSR but often in frost hollow or open valleys (pers. obs). Kept as a candidate as a precaution.
FAUNA						
Litoria verreauxii alpina	Alpine Tree Frog	E	V	12	Moderate	In NSW alpine tree frog usually occur above 1100 m in a wide variety of habitats including woodland, heath, grassland and herbfield. It breeds in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing. Non-breeding habitat and overwintering refuges are poorly known but are likely to include flat rocks, fallen logs, leaf litter and other ground debris. The species was surveyed as part of the proposal to increase the height of the quarry dam. As the closest BioNet records are within 2 km to the north of the proposed development, this species has been included for further consideration. It is perhaps the most vulnerable species if toxins were to concentrate in Clear Creek. But to reiterate, this is premised on the species being premised and assumes discharge is above licenced conditions.
Cyclodomorphus praealtus	Alpine She-oak Skink	E	E	10	Moderate	Ten BioNet records were retrieved within 10 km of the proposed development. Until recently the species' northern distributional limit was thought to be in the Snowy Plains area, but surveys associated with Snowy Hydro 2 and a PhD study have identified Alpine She-oak Skink further north in the Long Plain and Kiandra area (Schroder pers. comm.). The species has specific habitat requirements preferring treeless or very lightly treed areas that contain tussock grasses, low heath or combination of both. Within this habitat the species shelters beneath litter, rocks, logs and other ground debris, and has been observed basking in tussocks (pers. obs – Rennix Gap). Broad habitat type includes alpine to sub-alpine grasslands in flat to gently sloping areas. Optimum habitat areas are generally lacking at SSR but there are elements across SSR that could support alpine she-oak skink. The presence of alpine she-oak skink has never been discounted although they don't appear to have been the subject of a targeted search (versus opportunistic daytime traverses commensurate with surveys for other species). However, if present, the species is unlikely to be impacted directly by diluted effluent dispersal as discharge and snowmelt would occur before this species aroused from brumation (if present). Changes

						in habitat opportunity may be a secondary impact through increased ground vegetation, but the impact could also be favourable in providing habitat consistent for this species in areas where the ground vegetation cover sparse.
Liopholis montana	Mountain Skink	-	E		Low	The mountain skink construct burrow networks beneath rocks. It lives in colonies and appears to exhibit stable pair bonds, with females giving birth to up to four young. It has an omnivorous diet that includes seasonal fruits. The mountain skink occupies habitats with granite and basalt boulders, rocks, slabs, rock screes or tors and large logs in tall open-forest, woodland, and heathland vegetation in montane and subalpine areas of south-east Australia from 600–1700m above sea level. Though not recorded in the area, or at least not uploaded into BioNET, this species should remain a possible entity in the subject area pending further survey effort. The optimum habitat that includes various size and arrangements of rocks and boulders preclude most of the SSR ski slopes and adjacent areas from being considered optimum habitat. With a low chance of occurrence, the species has low impact interaction with the proposal. Similar to alpine she-oak skink, if mountain skink were present, adverse impacts are more likely to be secondary through habitat change rather than directly through toxicity, assuming failure in the treatment of effluent and subsequent discharge.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	41	High	The conservation status of this species has changed from vulnerable to endangered under the EBPC Act since surveyed in 2020. This species is frequently observed in the area including snow gum woodland with numerous records over time showing persistence in the Snowy Mountains area. Nesting requirements are generally 10 cm diameter or larger hollows at least 9 m above the ground. In autumn and winter the species is likely to move to lower altitudes. The wildfires have likely increased nesting potential for this species by increasing tree hollows, but foliage is lacking across much of the landscape and will be void of canopy for many years. Gang-gang are more likely to be seen flying between sites and occasionally feeding on forbs and grass seeds, but most trees will not produce seeds for several years. High likelihood of being present, but a low candidate for impact by the proposal in terms of toxicity and habitat change.
Pachycephala olivaceae	Olive Whistler	V	-	5	Moderate	Olive Whistler prefer moist forests with a thick understorey such as along creek lines or contiguous vegetation in wet sclerophyll forests. The vegetation along the southern slopes including Clear Creek was likely to be favourable habitat before the wildfire. As the gully vegetation of contiguous shrubs continues to recover, it is highly likely olive whistler will return. However, the species interaction with the proposed effluent dispersal is low and any adverse interaction is likely to be secondary impacts through habitat change, which is also considered low unless highly concentrated and over long periods of time.
Petroica phoenicea	Flame Robin	V	-	60	High	Extending up to the alpine area, this species occupies a range of communities including wet sclerophyll forest, dry sclerophyll forests, woodlands, open woodlands and heathland. As a seasonal and altitudinal migrant, flame robin tend to be more prevalent in the area during non-winter months. Flame robin often forage from low perches (including fence posts and taller vegetation e.g., thistles) from which they sally or launch into the air, on the ground or on other features to pursue insects. Nests are often near the ground and are built in sheltered sites such as shallow cavities in trees, stumps or banks. The species occurs in recently burnt areas but habitat is usually unsuitable following regeneration that results in closed vegetation. As the vegetation recovers, nesting opportunities in some areas may improve for flame robin. However, impacts of effluent dispersal is considered low and only likely if vegetation habitat changed as a result of prolonged and concentrated contamination; a scenario that is unlikely for a species that does not have a niche requirement limited to riparian vegetation.
Petroica boodang	Scarlet Robin	V	-	2	Moderate	Less common in the subalpine areas compared to flame robin, and often confused with its congener, this species is likely to be present across SSR during the summer months, particularly in the woodland and possibly across the slopes, but unlikely to breed at this elevation. The species feeds in a similar manner to flame robin by perching then sallying for insects. Impacts of effluent dispersal is considered low and only likely if vegetation habitat changed as a result of prolonged and concentrated contamination; a scenario that is unlikely for a species that does not have a niche requirement limited to riparian vegetation.
Hirundapus caudacutus	White-throated Needletail	-	V, C, J, K	1	Low	A seasonal migrant, this species is occasionally observed feeding high above the canopy. Unlikely to come to ground or roost in the Snowy Mountains, though the records are likely to be an under representation compared to the number of records at similar elevation and habitat further south. No interaction between this species and any potential impacts identified by the proposal. No tangible interaction with the resort or the proposal.
Gallingago hardwickii	Latham's Snipe	-	J, K	10	Moderate	This species is not considered a threatened species under state or federal legislation, but it is part of international migratory bird agreements. The species, when present, is often flushed or spotted amongst wet grassland and along riparian zones, particularly those with grasses and other graminoids, but less so where the riparian areas are tall wet heath. Because of the species disposition for occupying ground vegetation including wetlands, potential impacts by the proposal on this species should be considered. That said, impacts are most likely to be secondary or indirect through impacts upon vegetation and food source. The species is not known to breed in KNP. Contamination is only likely from prolonged and concentrated effluent discharge above licenced conditions. It

						should also be noted as a wetland species, Latham's Snipe is frequently spotted in vegetated sediment retention areas and wetland effluent discharge areas at lower elevations.
Hieraaetus morphnoides	Little Eagle	V	-	1	Low	The few records reflect the low visitation and occupancy of these threatened raptors. Masked and Powerful Owl are likely to be most prevalent to the west in the taller moist forests associated with the Tumut River catchment. Little Eagle have been recorded at higher elevations including the Main Range at over 2,000 m asl, though the species has only been recorded to nest at much lower altitudes. Square-tailed Kites are less common in the Snowy Mountains area and the record could be considered vagrant. Potential Impacts upon these raptor species would only be considered secondary as it pertains to prey opportunities. However, the infrequent visitation of threatened raptors to upland areas should preclude these species from any further consideration as it pertains to the proposal. Issues of accumulated poison are a problem for top predators such as raptors, though the circumstance of prey opportunity around SSR and the infrequent presence of larger raptors in the area does not reconcile for a negative impact upon these species, which also assumes consistently high toxin levels and a concentrated flow-on effect.
Lophoictinia isura	Square-tailed Kite	V	-	1		
Tyto novaehollandiae	Masked Owl	V	-	2		
Cercartetus nanus	Eastern Pygmy-possum	V	-	14	Low	A suite of recent records to the west at lower elevations in montane dry and wet sclerophyll forest and woodland, are the result of recent surveys pertaining to the Snowy Hydro 2 project. The species has a low chance of occurrence in SSR pending a habitat assessment, particularly since the fires. Selwyn Snow Resort is at the upper altitudinal limit for this species which have been recorded in Thredbo Village, above which mountain pygmy-possum tend to occur, but in specific habitats. It is found in a broad range of habitats from rainforest to sclerophyll forest and woodland to heath, but in most areas woodland and heath appear to be preferred. It feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes. Also feeds on insects throughout the year which may be very important in habitats where flowers are less abundant, particularly after bushfire. Retained pending habitat assessment and the impact of the bushfire. If present in adjacent woodland areas, assuming pre-fire presence and post-fire persistence and/or colonisation, the species is unlikely to interact with any adverse impacts of the proposal assuming high levels of concentrated and prolonged toxins and other contaminants. Until more shrub species mature to flowering stage, this species would struggle to find enough food resource.
Matacomys fuscus	Broad-toothed Rat	V	V	19	High	There are several records near SSR and fresh scats were identified approximately 70 m south of the pump house on Clear Creek in 2020 and again during surveys associated with this proposal approximately 50 m downstream of the bottom of Race Course ski slope. Broad-toothed rat lives in a complex of runways through dense vegetation of wet grass, sedge, or heath, and under the snow in winter. Sheltering nests of grass are built in the understorey or under logs, where two or three pups are born in summer. Food is mostly gathered at night in summer and autumn and during the early evening in winter. The diet consists almost solely of grasses and sedges, supplemented by seeds and moss spore cases. The species has been recorded in and adjacent to the resort. Though the full distribution and abundance of broad-toothed rat has not been surveyed across SSR, this is one small ground mammal that could be impacted by the proposal due to its habitat preference for wet or damp areas that includes riparian strips and wet heath-bog communities. With concentrated toxins and increased nutrients assuming a failure of effluent treatment processes and subsequent discharge, it is possible that broad-toothed rat could be affected by direct and secondary impacts associated with the proposal. The species is a high candidate for further consideration.
Pseudomys fumeus	Smoky Mouse	CE	E	18	Low	Surveys associated with the Snowy Hydro 2 project have detected more Smoky Mouse populations. Most of these records are to the west at lower elevations. Up until the extra survey work, few sites existed. However, SSR is within the elevation range for this species known across south-eastern Australia, albeit in disjunct populations. The Smoky Mouse appears to prefer heath habitat on ridge tops and slopes in sclerophyll forest, heathland, and open forest, up to 1800 m asl. Seeds and fruits from leguminous shrubs form the main summer and autumn diet with some invertebrates. In winter and spring, hypogeal fungi with some flowers, seeds and soil invertebrates form the main diet. The species may occur singly or in pairs based around patches of heath. Nesting burrows have been found in rocky localities among tree roots (and Grass Trees where present). The species has been retained pending habitat appraisal. If present, it is also assumed to occupy the adjacent woodland and have very little occurrence on the modified ski runs and riparian areas, and therefore would not have large areas of interaction with potential impacts associated with dispersed diluted effluent.
Burramys parvus	Mountain Pygmy-possum	E	E	13	Low	This species has as strong fidelity to boulder fields that are often covered by espalier-like shrub cover. Surrounding areas also include a contiguous shrub cover. The population that's been filtered here pertains to discrete areas associated with the upper Tumut and Happy Jacks Rivers to the south. There are no habitat elements consistent with mountain pygmy-possum across the Selwyn slopes. Such boulder fields also provided some refuge from the 2020 wildfire (and the 2003 wildfire that consumed approximately 70% of KNP).

Microbats • *Falsistrellus tasmaniensis* • *Miniopterus orianae oceanensis*	• Eastern False Pipistrelle • Large Bent-winged Bat	V V	-	10 1	High	Two species that have been recorded within 10 km of SSR have been listed. However, where eastern false pipistrelle usually roost in eucalypt hollows, loose bark and buildings, Large bent-winged bat tends to favour caves, old mines, stormwater tunnels, buildings and other man-made structures. That said, both species are listed in the same appraisal based on existing records, but also under the auspices of 'microbats' as a vertebrate group to account for other bats not recorded but possibly present in the area. Microbats are cryptic and unless special detection methods are employed (e.g., ultrasonic detection and harp traps), then the group will continue to go unrecorded in many areas. Habitat appraisal will be used to account for roosting, breeding and overwintering opportunities in the survey area. Potential impacts will be assessed against the habitat opportunities for microbats in and adjacent to the survey area. If present, the species is only likely to occur outside of the snow season after diluted treated effluent has been dispersed. Most microbats hibernate during winter or migrate and over-winter at lower elevations.
Threatened Ecological Community						
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions		EEC	Alpine Sphagnum Bogs and Associated Fens - Endangered	-	High	The Montane Peatlands community is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. It occurs on undulating tablelands and plateaux, above 400-500 m elevation, generally in catchments with basic volcanic or fine-grained sedimentary substrates or, occasionally, granite. Several communities have been mapped in and adjacent to SSR. There is a peatland associated with Clear Creek catchment at the bottom of the resort as well as transitional and depauperate remnants higher up the slope. As a community strongly aligned to low lying areas and riparian environments, this vegetation community type could be an entity of any accumulated impacts that result from adverse discharge quality. Peatlands are often 'ecological sumps' due to localised geomorphology or broader landscape position based on poor drainage. They are often rich in nutrients because of drainage concentrations, and pH is acidic. At this juncture it is uncertain what parameters could be used to discern adverse impacts due to high toxin or other contaminant concentrations, other than water quality monitoring. Monitoring for dieback or increased growth rates of constituent species could be undertaken, though higher order investigative studies would be required to isolate any impacts related to diluted effluent dispersal. Nevertheless, as an EEC located at the bottom of the catchment where run-off could be at its highest concentration aligned to Clear Creek, the peatland downstream of Race Course should be an entity monitored if monitoring is to be part of this proposal, or at least water quality monitoring as an indicator of any pollutants that could enter a peatland community.

Image 1: An easterly view across the upper slopes inclusive of Township, Home Run and New Chum where most snowmaking infrastructure is located and where diluted treated effluent will be dispersed as part of snow making operations.

Image 2: The southward facing upper slopes of Race Course ski slope. Diluted treated effluent will also be dispersed down this slope during snow making operations.

Image 3: Quarry Dam. Treated effluent will be diluted with clean water pumped from Clear Creek, mixed within the quarry dam that serves as a snowmaking reservoir, before being discharged through snowmaking infrastructure. 'Advision' recommend that the quarry dam be a licence monitoring point as no pollutants are to be charged within the snowmaking infrastructure for dispersal across the ski slopes. Retention of diluted effluent in the dam also allows recirculation through the STP if licence standards are not met or the second backup option by pump-out and transport from the resort.

Image 4: One of the few trees where part tree canopy remains after the 2020 wildfire. The landscape of dead trunks and limbs dominates the current overstorey, though technically most individual trees survived and responded by suckering new shoots to account for the loss of above ground live tissue. The other recovery response frequently observed is germination of the soil seedbank.

Image 5: An easterly view down Clear Creek from the bridge crossing adjacent to Race Course T-bar. Though impacted by a high intensity wildfire, the elements of a peatland community are still present and slowly regenerating. Near the end view within the image along the creekline, fresh broad-toothed rat scats were found. This record compliments the scats found in 2020 approximately 300 m upstream. The area within the image also depicts the lowest catchment point in the resort where runoff associated with diluted effluent dispersal is assumed to be most concentrated, notwithstanding absorption by soil and plants, and potentially evaporation. Past this point no further inputs from snowmaking operations are received and other tributaries enter Clear Creek that contribute to dilution.

Image 6: Adjacent woodland aligning modified ski slopes is important habitat for a range of threatened and non-threatened species, though post-fire recovery is still in an early stage with the shrub stratum yet to attain heights and densities similar to pre-fire levels.

DISCUSSION

This appraisal was greatly curtailed by the time available to undertake the literature review, field work and furnish a report. However, unlike most development proposals that have a clear development footprint including an operational perimeter, as well as more tangible and clearly identified impacts associated with the proposal and environmental entities, this project is premised on no environmental impacts because the potential is managed to 'low risk' with no pollutants. A projected modelling study by Advision on the effluent treatment process, the dilution of treated effluent with fresh water, the broadacre distribution as part of snow making operations and the subsequent increased run-off into Clear Creek at a time when discharge is at its highest associated with snowmelt, identified that there would be no changes to ambient water quality beyond natural variability. Truthing this during the operational period would be relatively easy as most toxins and contaminants have been identified and can be monitored at each operation node including treatment plant, quarry dam, reticulation outlets and selective points across the resort including Clear Creek. Notwithstanding a broader monitoring regime, Advision recommend that the EPA set their licence monitoring point at quarry dam as unsuitable water quality is not meant to be transferred from recycled water storage into the dam. However, if that circumstance eventuated, the system has the capacity to recirculate water back through the STP for refinement and/ or transported from site.

Underlying this ecological assessment and potential broader environmental impacts associated with diluted effluent dispersal across the ski slopes, is the total management of sewage effluent and grey water to the highest possible water quality standards before reticulated in snowmaking operations. The proponent is confident that through a combination of operational procedures and protocols, recycled water engineering processes, backup contingencies and monitoring, that only water equivalent to the quality of Clear Creek will be used for snowmaking and subsequently discharged into the environment. Therefore, it is also a consequence of this process and stated outcome that no threatened species or ecological community, both terrestrial and aquatic, would interact with potential toxins, contaminants and nutrient accumulations that would have an adverse ecological impact.

Nevertheless, this assessment has considered a suite of threatened species and communities that exist in the area, and through a combination of species' behaviour and habitat interactions, attempted to identify those that would most likely interact with the pollutants should there be a catastrophic failure of the effluent treatment process and subsequent discharge into the environment. This scenario could also be complicated by a combination of concentrated run-off into gullies and ultimately Clear Creek, and a broader spread across the slope and adjacent areas. Such contaminated snow could melt and be absorbed into the soil and possible uptake by plants, pending time of year. Though the snowmaking irrigation zone is closely aligned to the sections of ski slope with hydrants and snow guns, further distribution of snow, besides snowmelt, may occur by mechanical distribution (i.e., snow grooming) into areas where snow accumulation is inadequate for resort operations. This approach, though tonally pessimistic, is an earnest attempt to identify relevant species with potential interaction with the proposal, otherwise there is no relevant impact due to 'clean water' being reintroduced to the environment.

Therefore, the interactive impacts associated with catastrophic failure upon biological entities downslope of any snow making dispersal areas is identified:

- through snowmaking and snowmelt as it pertains to potential toxins
- as a result of concentrated diluted effluent along the creek and riparian zone, with potential impact for habitat change assumed through nutrient increase

- as a result of increased nutrients in adjacent native woodland vegetation and the consequences for habitat change
- in relation to species' occupancy and seasonal behaviour in upland areas, including those that overwinter and those that are altitudinal migrants, and
- in relation to vegetation communities, particularly adjacent woodland stands, that are in an early phase of ecological recovery after the 2020 high intensity wildfire.

To facilitate the discussion as to which entities could be considered, the relationship to the environment was assessed for known or possibly occurring species. The following species and communities were filtered because of their possible interaction with the environment commensurate with any diluted effluent dispersal including runoff. Consequently, the same species also became candidates for assessment through the ToS.

- Alpine Tree Frog (*Litoria verreaxii alpina*) – not recorded but if present, may be the most sensitive threatened entity for any adverse impacts from diluted effluent discharge.

- Alpine She-oak Skink (*Cyclodomorphus praealtus*) – not recorded but recent survey effort at nearby Kiandra has identified new populations. Some habitat elements for this species may overlap with SSR.

- Broad-toothed Rat (*Mastacomys fuscus*) – scats recorded along Clear Creek in 2020 and again at a different location during this appraisal. The species' habitat includes damp areas and vegetation that could accumulate toxins, contaminants or extra nutrients. The species could be affected directly and indirectly.

- Peatland Communities (as titled 'Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions') – primarily to account for any impacts to the peatland adjacent to Clear Creek downstream of Race Course and a smaller mapped peatland approximately 100 m downstream of the water pumping station on Clear Creek.

Besides threatened entities, the consequence of increased nutrients to the environment could be expressed in a greater composition and density of introduced species. While there are large areas of modified slope that are dominated by introduced plants, there is still a mix of native grasses and forbs within the composition. Only in the most highly disturbed areas around building footprints and road easements are there few, if any, native species. The upper slopes and ski runs adjacent to lifts and other resort infrastructure are also dominated by introduced species, though native plants persist. Native species composition increases further downslope and in some areas are the dominant ground cover. Where ski runs and access areas lack any historical work activity, particularly those involving soil disturbance, native species tend to be more prolific in terms of frequency and cover abundance. Where there has been slope grooming such as rock removal and contour adjustments, and tree removal that required the excavation of stumps, these activities have increased the opportunity for colonising introduced plants. This situation would have been exacerbated where the traditional 'alpine seed mix' was used to consolidate a vegetation cover over exposed soil. The mix that was devised by the NSW Soil Conservation Service in the 1960s for use on stabilising eroded areas on the Main Range,

and subsequently endorsed by NPWS for use in resort areas throughout the 1970s and 1980s, retains a legacy by the persistence of **Trifolium repens, *Trifolium pratense, *Trifolium ambiguum, *Poa pratensis, *Poa annua* and **Festuca rubra* (amongst several other species). All species were present during the survey for this appraisal and had been recorded in other assessments. Other exotic perennial grasses that are listed as a Key Threatening Process under the BC Act and are present across the ski slope within and downslope of the dispersal area include **Dactylis glomerata, *Holcus lanatus, *Phleum pratense, *Anthoxanthum odoratum, *Agrostis capillaris, *Festuca stolonifera and *Festuca arundinaceae.*

Assuming the diluted effluent dispersal was discharged above EPA licence conditions either in part or in in full (the latter a catastrophic incident), it may be difficult to establish any species-specific or community monitoring program that could confidently link any adverse impacts or causal effect as a result of the discharge. This is in part due to the variable nature of interacting toxins and contaminants between different species, particularly at low concentrations, other ecological pressures at the species, population and community level, as well as background variability due to an ecosystem that is an early phase of post-fire recovery. The most robust and replicative monitoring for potential adverse impacts is through easily measured 'receiving environments' of water and soil. The survey design could include stratified sampling across different community types or some other gradient or feature including Clear Creek, and the parameters to be monitored are the same pollutant groups consistent with the targets in the effluent treatment process. Any incidents could then be more effectively monitored across the resort, and additional monitoring or investigations tailored to species or sites commensurate with polluted areas.

However, to avoid contamination incidents and institute best operational and discharge procedures and parameters, Dr Megan Priestley of Advision has collated key points supporting the proposal and which ameliorate any impact upon the threatened species identified above. These include:

- the Dilution Study found that the recycled water will be 'fit for recycled water application' but will then be significantly diluted in a controlled manner within the Quarry Dam and then further on the snow fields. As such no changes beyond natural variability are expected to Clear Creek or to terrestrial runoff during snowmelt. Within the Quarry Dam there would be significant dilution well below the EPA license limits;

- The potential pathway/s of impact on the terrestrial environment is via potential changes to water and soil quality, and therefore alteration of habitat for terrestrial plants and animals. The Dilution Study provides an assessment that supports the notion that there will be no expected high risk impacts on water or soils;

- For the above reason, typically for this type of irrigation of recycled water schemes, the reliance is more on soil and water monitoring. Regular water quality and annual soil monitoring is proposed using the Australian Guideline for Recycled Water (AGWR) framework for assessing environmental impacts. The water quality program includes thresholds for assessing impacts on plants (including grasses and Australian natives), soils and water quality;

- A baseline terrestrial ecology survey would be useful to identify whether there are native plant or tree species that have thresholds in the AGWR to provide a site specific assessment. However, at present the modelling has adopted the most sensitive species as a conservative scenario;

- The recycled water is estimated to be well below the thresholds for chloride and sodium, and the soils are not predominantly clays. Cumulative salinity impacts in soils are not expected, but some salinity thresholds in soil for plants are more relevant to operational cumulative impacts. This will be built into the program and soil amendment measures can be recommended if required;

- The Human Health and Environmental Risk Assessment (including the detailed ERA) is based on estimated concentrations of key pollutant/groups in recycled water (aluminium, boron, cadmium, chlorine and chlorine by-products, nitrogen, phosphorous, sodium, chloride, surfactants and hydraulic loading). It also identifies the critical control points and measures that will be in place to minimise risk scenarios (such as insufficient quality of recycled water being stored in the dam or being used for snowmaking). With these measures in place, all environmental risks are considered to have been reduced to low;

- There are operational and engineering control measures to ensure that unsuitable water quality will not be transferred from the recycled water storage to the dam. There is the option to reticulate back through the STP for refinement or transported from the resort. Advision have proposed to the EPA that the dam should be a licence monitoring point;

- Advision have also recommended a 'Validation Study 'to demonstrate that the water quality modelling used to predict water quality was accurate. As there are many conservative assumptions built into the modelling, there is an expectation that the concentrations have been overestimated as a layer of protection and confidence; and

- The Recycled Water Management Plan and risk assessment identifies the preventative measures and monitoring that will be in place to minimise risks as required to reduce them to acceptably 'low' level, or as low as reasonably practical.

On the basis of managing diluted effluent discharge to licence conditions commensurate with unpolluted water, and conversely, to predict potential impacts upon the four threatened entities listed above based on a catastrophic incident of polluted discharge, both scenarios were assumed when assessed through the ToS. Though there are potential interactions with toxins and contaminates emanating from potential diluted effluent, and some unknown impacts without greater scientific enquiry, there is still enough information to justify a conclusion that a discharge incident contrary to licence conditions is unlikely to have a significant impact (see Appendix 3 – Test of Significance). This is discussed for each threatened entity, with the justification aligned to the species' and communities' likely level of interaction and exposure to the discharge, which is also based on a species' behaviour and occupancy within the area over the snow season, and the conservation impact for each entity in the context of the local and regional landscape.

In summary, the proposal to recycle water for reticulation in resort snow production following dilution with freshwater from Clear Creek and storage in the former quarry dam has several environmental benefits including a diffuse discharge rather than point source. There are also environmental sustainability benefits to not have wastewater stored and transported from the resort in the same way the resort used to function before the 2020 wildfire. The assessment undertaken by Advisian (2023) estimated water quality within the snowmaking dam and receiving Clear Creek showed that the recycled water should not result in 'changes to ambient water quality' beyond natural variability. This assertion includes scenarios based on conservative and maximum inputs including consideration of periods where snow making cannot occur for consecutive days. Regular water quality and annual

soil monitoring is proposed that is the most efficient and confident way to determine whether the discharge parameters are being met and the degree of diffusion across the resort and downstream. Advision have also assessed the risks associated with key pollutants and critical controls points and measures that will be in place to minimise risk scenarios with all environmental risks considered to have been reduced to low.

This ecological appraisal is confident that the ecological entities discussed in this report would not incur an impact based on diluted effluent dispersal where there are no changes to ambient water quality beyond natural variability. Furthermore, though a discharge incident is unlikely to have a significant impact on alpine she-oak skink, broad-toothed rat and peatland communities, concerns are raised for the persistence of alpine tree frog if a population existed along Clear Creek. However, snowmelt that happened to contain unsuitable discharge is likely to pass through the aquatic ecosystem before arousal of alpine tree frog from brumation and the subsequent use of the aquatic habitat.

Therefore, following the application of the 'Test of Significance' upon the endangered alpine she-oak skink, endangered alpine tree frog, vulnerable broad-toothed rat and endangered 'montane peatland' under the *Biodiversity Conservation Act 2016*, no significant impact was identified and subsequently entry into the BOS has not been triggered.

APPENDIX 1:

Species within and adjacent to the proposed diluted effluent snowmaking zone

The following species were recorded while searching for threatened entities and undertaking a habitat assessment for potential threatened fauna within and adjacent to the irrigation area where snowmaking machines will disperse diluted effluent across ski slopes and ski runs.

Data was collected on 11th February 2023. Scientific nomenclature follows that prescribed in the NSW PlantNet Database managed by the Royal Botanical Gardens.

Scientific Name	
SPHAGNACEAE	**ASPHODELACEAE**
Sphagnum cristatum	*Bulbine bulbosa*
(FERN-LIKE)	**PHORMIACEAE**
LYCOPODIACEAE	*Dianella tasmanica*
Lycopodium fastigiatum	
	ORCHIDACEAE
(FERNS)	*Prasophyllum tadgellianum*
BLECHNACEAE	*Prasophyllum* sp.
Blechnum penna-marina	*Spiranthes australis*
DRYOPTERIDACEAE	**LOMANDRACEAE**
Polystichum proliferum	*Lomandra longifolia*
(MONOCOTYLEDONS)	**RESTIONACEAE**
CYPERACEAE	*Baloskion australe*
Carex appressa	*Empodisma minus*
Carex breviculmis.	
Carex gaudichaudiana	**POACEAE**
Carex hebes	*Agrostis avenaceae*
Carex jackiana	*Agrostis* sp.
?*Isolepis* sp.	*Anthosachne scaber*
	Deyeuxia monticola
JUNCACEAE	*Dichelachne crinita*
Luzula modesta	*Dichelachne micrantha*
Luzula novae-cambriae	*Festuca muelleri*
Juncus phaeanthus	*Poa clivicola*
Junucs sp.(< 10 cm, wet areas)	*Poa constiniana*
**Juncus effusus*	*Poa ensiformis*
	Poa helmsii
ANTHERICACEAE	*Poa phillipsiana*
Arthropodium milleflorum	*Poa sieberiana* var. *sieberiana*
	Rytidosperma eriantha
AMARYLLIDACEAE	*Rytidosperma penicillata*
?**Narcissus* sp.	*Rytidosperma nivicola*
	Rytidosperma ?*nivicola*

**Agrostis capillaris*	*Olearia erubescens*
**Aira* sp.	*Olearia phlogopappa ssp. flavescens*
**Anthoxanthum odoratum*	*Olearia phlogopappa* ssp. *serrata*
**Dactylis glomerata*	*Ozothamnus cupressoides*
**Festuca arundinaceae*	*Ozothamnus secundiflorus*
**Festuca nigrescens*	*Picris angustifolia* ssp. *merxmuelleri*
**Festuca rubra*	*Podolepis laciniata*
**Holcus lanatus*	*Rhodanthe anthemoides*
**Phleum pratense*	*Senecio gunnii*
**Poa annua*	*Senecio linearifolius*
**Poa pratensis*	*Senecio* sp. (likely one of the revised)
	Xerochrysum bracteatum
Unidentified grass 1 (no inflorescence)	*Xerochrysum subundulata*
Unidentified grass 2 (no inflorescence)	**Achillea millefolium*
Unidentified grass 3 (annual)	**Cirsium vulgare*
	**Crepis ?foetida*
	**Hypochaeris glabra*
(DICOTYLEDONS)	**Hypochaeris radicata*
	**Leucanthemum x superbum*
APIACEAE	**Taraxacum officionale*
Aciphylla simplicifolia	**Tragopogon dubius*
Gingidia harveyana	
Hydrocotyle algida	**BETULACEAE**
Oreomyrrhis argentea	*Betula pendula*
Oreomyrrhis eriopoda	
	BORAGINACEAE
ARALIACEAE	**Myosotis discolor*
Polyscias sambucifolius	
	BRASSICACEAE
ASTERACEAE	*Cardamine lilacina*
Brachyscome aculeata	**Erophila verna*
Brachyscome decipiens	
Brachyscome diversifolia or B. nivalis	**CAMPANULACEAE**
Brachyscome spathulata	*Lobelia pedunculata*
Brachyscome sp.	*Lobelia surrepens*
Cassinia monticola	*Wahlenbergia ceracea*
Celmisa tomentella	*Wahlenbergia sticta*
Celmisia sp.	
Coronidium rutidolepis	**CARYOPHYLLACEAE**
Coronidium scorpioides	*Scleranthus biflorus*
Coronidium waddelliae	*Scleranthus fasciculatus*
Cotula alpina	*Stellaria pungens*
Craspedia ?coolaminica (linear basal leaves)	**Cerastium glomeratum*
Craspedia jamesii	**Spergularia rubra*
Craspedia sp.	
Erigeron sp.	**CRASSULACEAE**
Euchiton japonicus	*Crassula sieberiana*
Leptorhynchos squamatus ssp. *alpinus*	
Microseris lanceolata	**ELATINACEAE**
Olearia algida	*?Elatine gratioloides*
Olearia brevipedunculata	

ERICACEAE	*Kunzea muellerie*
Acrothamnus hookeri	
Acrothamnus maccraei	**ONAGRACEAE**
Epacris microphylla	*Epilobium billardierianum* ssp. *billardierianum*
Epacris paludosa	*Epilobium billardierianum* ssp. *hygrophilum*
Richea continentis	*Epilobium gunnianum*
	Epilobium sp.
EUPHORBIACEAE	
Poranthera microphylla	**OXALIDACEAE**
	Oxalis ?*perennans*
FABACEAE	**Oxalis corniculata*
Acacia obliquinervia	
Bossiaea foliosa	**PLANTAGINACEAE**
Daviesia ulicifolia	*Plantago varia*
Hovea asperifolia ssp. *asperifolia*	**Plantago lanceolata*
Hovea montana	**Veronica anagallis-aquatica*
Oxylobium ellipticum	
Podolobium alpestre	**POLYGONACEAE**
**Lotus uliginosus*	**Acetosella vulgaris*
**Trifolium ambiguum*	**Polygonum arenastrum*
**Trifolium arvense*	**Polygonum aviculare*
**Trifolium* ?*campestre*	**Rumex crispus*
**Trifolium* ?*dubium*	**Rumex obtusifolius*
**Trifolium fragiferum*	
**Trifolium pratense*	**PROTEACEAE**
**Trifolium repens*	*Grevillea australis*
**Trifolium* ?*subterraneum*	*Hakea microcarpa*
	Orites lancrifolia
GERANIACEAE	
Geranium antrorsum	**RANUNCULACEAE**
Geranium potentilloides	*Ranunculus graniticola*
Geranium solanderi var. *solanderi*	*Ranunculus* sp.
**Erodium cicutarium*	
GOODENICACEAE	**ROSACEAE**
Goodenia hederaceae ssp. *alpestris*	*Acaena novae-zelandiae*
Scaevola hookeri	*Aceana agnipila*
	Geum urbanum
HALORAGACEAE	*Rubus parvifolius*
Gonocarpus montanus	**Malus pumila*
	**Potentilla recta*
HYPERICACEAE	
**Hypericum peforatum*	**RUBIACEAE**
	Asperula gunnii
LINACEAE	*Asperula scoparia*
Linum marginale	
	RUTACEAE
MYRTACEAE	*Phebalium squamulosm* ssp. *ozothamnoides*
Baeckea gunniana	
Baeckea utilis	**STYLIDIACEAE**
Eucalyptus pauciflora ssp. *debeuzevillei*	*Stylidium montanum*
Eucalyptus stellulata	

THYMELEAECEAE
Pimelea biflora
Pimelea linifolia
VIOLACEAE
Viola betonicifolia
**Viola arvensis*
WINTERACEAE
Tasmannia xerophila ssp. *xerophila*

**denotes introduced species*

APPENDIX 2:

Fauna Records – Incidental Species List

Vertebrate fauna detected across Selwyn Snow Resort while conducting vegetation surveys and habitat assessments on 11th February 2023. Scientific nomenclature follows that used by the NSW Department of Planning and Environment.

Detection Codes: O – Observed, H – Heard, S – Scats, C – Carcas or identifiable body parts

Birds

Common Name	Scientific Name	Detection
Nankeen Kestral	*Falco berigora*	O/H
Sulphur-crested Cockatoo	*Cacatua galerita*	O/H
Crimson Rosella	*Platycercus elegans*	H
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	O/H
Brown Thornbill	*Acanthiza pusilla*	O/H
Grey Shrike-thrush	*Colluricincla harmonica*	H
White-throated Treecreeper	*Cormobates leucophaea*	H
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	O/H
Black-faced Cuckooshrike	*Coracina novaehollandiae*	O/H
Australian Magpie	*Cracticus tibicen*	O
Pied Currawong	*Strepera graculina*	O/H
Willie Wagtail	*Rhipidura leucophrys*	O/H
Australian Raven	*Corvus coronoides*	H
Welcome Swallow	*Hirundo neoxena*	O
Fairy Martin	*Petrochelidon ariel*	O
Australasian Pipit	*Anthus novaeseelandiae*	O/H
Common Starling	**Sturnus vulgaris*	O/H
Unknown Bird 1		H
Unknown Bird 2		H
Unknown Bird 3		H

Mammals

Common Wombat	*Vombatus ursinus*	S
Macropod (Red-necked Wallaby or Swamp Wallaby)		S
Possum?	*Fur consistent with possum found in fox scat.*	C
Broad-toothed Rat	*Mastacomys fuscus*	S
Red Fox	*Vulpes vulpes*	S
European Hare	**Lepus europaeus*	S
Rabbit	**Oryctolagus cuniculus*	S

Amphibians

No frogs were detected during the survey. *Crinia signifera* were detected at the Quarry Dam and along Clear Creek in October 2020.

Reptiles

Eastern three-lined Skink	*Acritoscincus duppereyi*	O
Blotched Blue-tongue Lizard	*Tiliqua nigrolutea*	O
Highland Copperhead	*Astrelaps ramsayi*	O

**denotes introduced species*

APPENDIX 3:

TEST OF SIGNIFICANCE (BC Act)

Alpine She-oak Skink (*Cyclodomorphus praealtus*)

Alpine Tree Frog (*Litoria verreauxii alpina*)

Broad-toothed Rat (*Mastacomys fuscus*)

Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions

The approach taken in this test of significance is to address each species and, where relevant, threatened ecological community under the same criteria heading. Neither alpine she-oak skink or alpine tree frog have been recorded at Selwyn Snow Resort (SSR), but records in the past five years have identified both species in adjacent catchments and there are habitat elements consistent for both species present within SSR.

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Alpine She-oak Skink (*Cyclodomorphus praealtus*)

The alpine she-oak skink appears to have specific habitat requirements, preferring tree-less or very lightly treed areas that contain tussock grasses, low heath or a combination of both. Within this habitat the species shelters beneath litter, rocks, logs and other ground debris, and has been observed basking on grass tussocks. In NSW, BioNet data indicates that alpine she-oak skinks occur in alpine to sub-alpine grasslands in flat to gently sloping areas. The species is considered to have relatively small home ranges and remain in the same area for long periods of time. Research indicated the largest dispersal distance of approximately 45 m based on mark-recapture studies in Victoria. The diet of alpine she-oak skink is largely carnivorous consisting mostly of small invertebrates but potentially consumes plant material.

Little is known about the breeding biology of the species as it is difficult to detect, spending much of its time sheltering within tussock clumps. The species gives birth to live young and a study of preserved museum specimens found several females, which had been collected during summer, pregnant with between two and nine embryos, suggesting a summer breeding period.

Until recently, records of alpine she-oak skink were limited to the alpine and subalpine areas in Kosciuszko National Park (KNP), across scattered locations between Thredbo and Schlink's Pass. In recent years, as a result of targeted surveys, the species' distribution in KNP is understood to range between the Big Boggy areas south of Dead Horse Gap and north as far as Long Plain. Within this range, more records have been captured in the Kiandra area and in alpine areas around the Main Range. That said, the species has not been recorded at SSR and following the ecological inventory by ENFAC (2009), though suitable habitat was acknowledged at SSR, it was considered a low likelihood of occurrence due to the restricted altitude range of what was then understood to be between 1600 m to 2100 m. Some populations have since been discovered below that elevation and arguably the resort

operational area between approximately 1500 to 1600 m asl too marginal to discount the species based on elevation alone.

On the premise that the species is present, the proposal would not affect this species on the basis that the project proposes to disperse 'clean' water that is no different to the water quality already present in Clear Creek. It is possible the species could interact with discharge as its preferred habitat is commensurate with the irrigation zone and subsequent runoff areas. However, any interaction would not occur at the time of discharge or during the snow season as the species brumates over winter. Subsequent interaction would only occur if the discharge included any of the toxins and contaminants from an unmanaged release, and this also assumes that such pollutants persist in ground vegetation where she-oak skink occupy. It is uncertain how the pollutants would affect individual animals and it is assumed that the concentration would have to be high. The more plausible scenario would be a circumstance of excess nutrients increasing vegetation growth rates, though this is more likely to favour introduced species. However, in open areas vegetation density and height is managed by annual ski slope maintenance where the ground cover is slashed to a height between 15 to 20 cm.

That said, a catastrophic release is unlikely with the operation and contingency options in place, and it is hard to escalate a sequence of impacts where the toxins identified by Advision would be available for ingestion or absorption by alpine she-oak skink. Furthermore, it also assumes that the species is present, and though surveys in the past 20 years have been limited to development areas, much of assessment area is commensurate with the species' habitat and no record has yet been captured.

The main current threats to this species that overlap with resort areas include changes in vegetation structure within preferred habitat brought about by wildfire, weed invasion and climate change, and the construction of infrastructure resulting in the loss and fragmentation of habitat. The proposal does not affect alpine she-oak skink with these threats, except the potential for weed growth facilitated by excess nutrients; though countered by an annual slashing program.

Therefore, it is unlikely that the proposed development or activity is likely to have an adverse effect on the life cycle of alpine she-oak skink such that a viable local population of the species is likely to be placed at risk of extinction. Furthermore, water and soil monitoring will indicate whether any toxins or contaminants interact with potential habitat areas possibly occupied by alpine she-oak skink.

Alpine Tree Frog (*Litoria verreauxii alpina*)

The alpine tree frog is a relatively small frog with poor climbing ability that mostly occur in the alpine and subalpine zones of NSW and Victoria, with some records as low as 1100 m asl. Habitats include woodland, heath, grassland and herbfields, where they breed in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing. The diet includes beetles, flies, spiders and moth larvae. Breeding occurs in December where males call from the water at the edge of pools, and eggs are attached to submerged vegetation. Tadpoles metamorphose into froglets in late summer. Non-breeding habitat and overwintering refuges are poorly known but are likely to include flat rocks, fallen logs, leaf litter and other ground debris.

Records for this species exist in nearby Three Mile Dam and surrounding wetlands, and at Kiandra. Given the proximity of records to the north and north-west, there is a high possibility that the species may have once occurred within Clear Creek catchment though no animals have been recorded at SSR. The author did record common eastern toadlet in the quarry dam in October 2020 and heard other

animals calling from below the water pumping station along Clear Creek. However, no animals were detected while assessing this proposal in February 2023.

Chytrid fungus, increased UV-B radiation from climate change and habitat modification are some of the threats recognised for this species in NSW. When the species was gazetted in 2002, it was based on a dramatic decline in the population over its known range since the 1990s, having disappeared in the alpine zone and becoming increasingly rare in subalpine areas. In the early 2000s, NSW populations were only known from two artificial ponds and five natural ponds, all within KNP. Since then, more discoveries have been made though the number of populations remain small.

Any impacts upon alpine tree frog as a result of diluted effluent discharge is speculative as it assumes the species is present and assumes a discharge above licence conditions and assumes an adverse interaction. Because of the fidelity of alpine tree frog to occur close to water and require waterbodies for breeding, Clear Creek is an obvious concentration point for any incident and interaction with this species. Arguably concentrations would be at their theoretical highest below Race Course as all runoff would collect in the catchment and past this point. Because the species spends much time in the riparian zone and waterways, and being amphibian, toxins and contaminants could have a dire impact upon alpine tree frog, both in the first instance from direct poisoning, and secondary impacts based on habitat change from nutrification/eutrophication and possibly food chain impacts. This is a worst case scenario that assumes concentrated contaminants finding their way into Clear Creek and also excludes absorption and breakdown.

However, similar to alpine she-oak skink, the alpine tree frog also brumates over winter in dry vegetation types, so any incident is unlikely to interact with alpine tree frog until post-snowmelt which is outside of the discharge operation period. Concerns would be for any residual or cumulative impacts of toxins and other contaminants which are likely to have diminished by the time alpine tree frog become active.

However, it is also possible that further progression down the creek past Race Course could result in a further dilution of any pollutant as other tributaries in the catchment enter Clear Creek. This assumes an incident whereas the proposal includes operational procedure and infrastructure reducing such risks with both water and soil monitoring to account for discharges across the slope. Furthermore, there are contingencies to recycle unsuitable water from the water storage tank and dam back through the treatment plant, as well as the final option to transport wastewater from the resort.

Of the threatened entities reviewed from around SSR including those that have been recorded and those that are speculatively based on habitat opportunity, alpine tree frog is considered the most sensitive. Though habitat elements are present along Clear Creek and extant populations exist within 2 km to the north-east, all habitat along Clear Creek was impacted by the 2020 wildfire. Riparian vegetation recovery is progressing for forbs and graminoids, but riparian shrubs will take at least 10 years to provide any structural complexity. On the speculation that frogs may be present in Clear Creek including areas below the resort, it also assumes survival of animals from the high intensity wildfire. The lack of targeted surveys precludes a stronger conclusion of impacts under catastrophic incident conditions.

But notwithstanding actual site recordings of this species in Clear Creek catchment, there is enough information to support the notion that diluted effluent discharge in the upper ski slope area and Race Course ski run, is unlikely to have an adverse effect on the life cycle of alpine tree frog that a viable local population of the species is likely to be placed at risk of extinction. This is based on the probability that operational procedures including management of critical control points before final discharge

through snowmaking reticulation incurs a low risk. Furthermore, water and soil monitoring will indicate whether any toxins or contaminants interact with potential habitat areas possibly occupied by alpine tree frog.

Broad-toothed Rat (*Mastacomys fuscus*)

In NSW broad-toothed rat occurs in two widely separated areas: the wet alpine and subalpine heaths and woodlands in Kosciuszko National Park, adjacent Nature Reserves (Bimberi and Scabby NR) and State Forest (Buccleuch SF) in the south of the state, and on the Barrington Tops, north-west of Newcastle. In Victoria - South Gippsland and the Otways - and western Tasmania, it can be found in wet sedge and grasslands at low elevations. Broad-toothed rat live in a complex of runways through dense vegetation of wet grass, sedge or heath environment, and under snow in winter. This relatively warm under-snow space enables animals to remain active throughout winter. A male's home range overlaps those of several females. Sheltering nests of grass are built in the understorey or under logs, where two or three young are born in summer. In winter the rats huddle together in nests for warmth. Food is mostly gathered at night in summer and autumn, and during the afternoon and early evening in winter. The diet consists almost solely of greenery - grass and sedge stems, supplemented by seeds and moss spore cases.

Most records in the area include pre and post 2020 wildfire sites. Some of these are the result of assessment surveys for the Snowy Hydro 2 project, while others include targeted surveys by NPWS following the fire. Within SSR, the author recorded scats approximately 70 m below the water pumping station on Clear Creek in 2020, and approximately 50 m below Race Course along Clear Creek in riparian vegetation. In both circumstances the species was detected by its unique scat. In both areas the vegetation was severely impacted by the 2020 wildfire, with perennial grasses and sedges regenerating to approximately 1 m. Shrubs and nearby seedlings and tree suckers were of similar or greater height but lacked density. Encouragingly, broad-toothed rat was detected nine months after the wildfire when there was very little vegetation cover, and again three years after the wildfire where cover abundance and shrub stratum had commenced to reform.

For the SSR records, broad-toothed rat was found in the riparian vegetation aligning Clear Creek. The species is also known to occupy wet heath and peatland complexes, and occasionally sod-tussock communities. During winter, these community types allow a subnivean space to form from cumulative snow events. Such habitat is important for broad-toothed rat that does not hibernate during winter. However, the formation of subnivean habitat is highly unlikely on groomed slopes where the vegetation is maintained at less than 20 cm in height and where oversnow machines compress and groom the snow cover for a better snow-use experience. Winter habitat is most likely in adjacent woodland where debris and other ground complexity helps create subnivean spaces, and along the riparian strip where ground vegetation is not managed, allowing denser plants to form, which is also protected and supported by riparian shrubs.

Therefore, when diluted effluent discharge is released during snowmaking activities, broad-toothed rat is still active and foraging in areas adjacent to the ski slopes. Because of the highly disturbed nature and small islands of vegetation at the top of the resort, it is unlikely broad-toothed rat are present in this area. However, it is possible animals may occupy areas in the adjacent woodlands further down the resort, including Race Course, and obviously along Clear Creek from the existing records. What is less certain is the degree of interaction with any discharge. It is highly unlikely the species would interact with any discharge on the slopes but rather movement and behaviour could overlap with any melt water moving toward Clear Creek.

In the first instance, any detrimental impacts would be premised on ingestion of toxins and contaminants under the worst case scenario involving an incident. Though it is uncertain how the toxins may affect individual animals, it assumes high concentrations for any adverse reaction. Secondary impacts from incident-based releases may take the form of habitat alterations such as increased plant growth. For broad-toothed rat, denser vegetation may not necessarily be detrimental where it grows in communities occupied by this species.

However, as per the discussion for other threatened entities, the proponent is prescribing a recycled treatment process that includes monitoring and options to divert unsuitable water from being discharged. With a capacity to delay, divert or totally transport any unsuitable wastewater from snowmaking reticulation, provides a low risk activity against any misadventure. Therefore, the proposed diluted effluent dispersal is unlikely to have an adverse effect on the life cycle of broad-toothed rat that a viable local population of the species is likely to be placed at risk of extinction. Furthermore, water and soil monitoring will indicate whether any toxins or contaminants interact with potential habitat areas occupied by broad-toothed rat.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions

(the TEC and reference to bog or bog-heath complex is collectively referred to as montane peatland)

In 2002, Ecology Australia on behalf of Planning NSW undertook a vegetation plant community survey and mapping exercise across Selwyn resort lease areas. The project identified the resort to contain 3.1 ha of subalpine bog. Larger bog community patches were located to the east of the resort in non-operational areas. However, several smaller patches were mapped including the edge of Plum Pine Run and at the bottom of Race Course that includes approximately 100 m of riparian vegetation along Clear Creek. Though not mapped by Ecology Australia nor ENFAC in 2009, a small patch of peatland was captured as part of the Biodiversity Values Map approximately 70 m along Clear Creek below the water pumping station. This patch has elements of remnant peatland and is likely to have diminished due to historical resort operational impacts. A small remnant patch was also noted on Race Course which is now highly modified.

It is highly likely that other small peatlands were present across the slope but have since diminished in size or have dried and transitioned to other community types due to historical ski slope grooming. As an ecological community, montane peatland is the only type of wetland that may contain more than trace amounts of *Sphagnum* spp. and typically have a dense groundcover of sedges, grasses and forbs, except where a dense cover of tall shrubs casts deep shade. The montane peatlands community is associated with accumulated peaty or organic-mineral sediments on poorly drained flats in the headwaters of streams. It occurs on undulating tablelands and plateaux, above 400-500 m elevation,

generally in catchments with basic volcanic or fine-grained sedimentary substrates or occasionally granite.

Montane peatland are important substrates for other vascular and non-vascular plant species, some of which are unique to peatlands at different elevations and others commensurate with transitional wetland communities. They are also important parts of the hydrological cycle and can regulate water flow and filter catchment inputs. In stable peatland environments, peatland sediments can accumulate over thousands of years and provide a stratigraphy record of past climatic conditions and landscape vegetation patterns.

There are several threatening processes that have diminished the size, and in some cases, presence, of montane peatlands in NSW. In resort areas clearing of peatland or disturbance through slope grooming and other infrastructure projects have been implicated, including edge effects where impacts are not as blatant as truncating by roads and trenches, but changes in the upslope surface and subsurface drainage that subsequently dries a peatland, or nearby activities that increase colonisation by weed propagules. Other threats that are more tangible to the proposal include pollution and eutrophication of peatlands caused by run off or drift of fertilisers, pesticides, wastewater, storm water and other pollutants. This results in the replacement of native peatland vegetation by exotic weeds at a rate determined by the chemical composition and input rate of the pollutants. The consequence of wastewater discharge beyond licenced conditions could also include a change in species composition to the peatlands within the runoff zone below the dispersal area, with the largest of these at the bottom of the resort along Clear Creek where most unmanaged pollutants could concentrate.

Unlike animal species that may be impacted by toxins or pollutants in the first instance, or susceptible to secondary impacts such as habitat change, ecological communities such as montane peatlands are more susceptible to changes over time. For an impact that results in a change in native species composition because of increased nutrients that increase the growth and spread of introduced species, is unlikely to be the result of one incident but rather cumulative impact, otherwise the early concentration of nutrients are likely to be flushed. In contrast, inputs such as hydrocarbons into peatland communities is an example where the constituent plant composition could die including the substrate that is often dominated by *Sphagnum* sp. Therefore, a circumstance involving an unsuitable discharge of diluted effluent dispersal that is above licence conditions is very unlikely to have an impact on the peatlands downhill of the resort. Theoretically, if an uncontrolled discharge occurred within the first year after the wildfire, it is possible the extra nutrient load could provide a pulse in the growth rates of many weed species that are present in the area, and in an environment open to first colonising plants. This circumstance is now closed along the creek line where ground vegetation has covered the ski slopes and riparian strip, though adjacent woodland still has relatively large unvegetated patches that were previously dominated by trees and shrubs.

That said, the most likely outcome due to proposed control measures ensuring unsuitable water quality does not enter the snowmaking system is the reticulation and dispersal of water consistent with the water quality of Clear Creek. This would be monitored at the dam as a licence monitoring point, but also other water monitoring points across the resort and soil samples to account for ground absorption.

Based on the discussion above, the diluted effluent discharge is unlikely to have an adverse effect on the extent of the montane peatland patches downslope such that a local occurrence is likely to be placed at risk of extinction, nor would the composition be substantially modified such that its local occurrence is likely to be placed at risk of extinction. The consequence for this impact is assessed for

both the proposed qualified discharge and a circumstance if unsuitable wastewater enters the catchment. The peatlands pertain to the smaller patch below the water pumping station which is highly degraded, and the larger patch below Race Course. The larger patch, while currently exhibiting native species commensurate with a peatland community, also contains a suite of introduced plants. By the robust growth of some of the introduced perennial plants, it is highly likely that these species were present before the 2020 wildfire and were quick to regenerate after the event as opposed to being recent colonisers. The propensity for disturbed areas associated with Race Course and infrastructure at the bottom of the ski run, is a likely reason for the diverse abundance of introduced species in this area. Furthermore, such species are aligned with riparian vegetation that it influenced by Clear Creek. Variations in waterflow, particularly end of season snowmelt and heavy rainfall events, facilitate weed transport and stream erosion for the establishment of weed propagules. Therefore, the receiving environment in this part of the catchment already displays a degree of historical disturbance. In contrast, the dry vegetation above the southern embankment, excluding the ski slope and access easement, are dominated by native species with very little influence from exotic species, excluding naturalised forbs such as sheep sorrel.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

This criterion was inherently addressed above. To reiterate, the potential disturbance pathway assuming a catastrophic discharge as the worst case scenario, is first divided into either terrestrial habitat or aquatic habitat. For the three threatened species and threatened montane peatland listed in this assessment, all entities include a terrestrial component as part of their habitat. Prolonged discharge of nutrients above licence conditions could possibly enhance the growth rates of some vegetation communities and vegetation components, particularly introduced species. However, for terrestrial communities, the critical circumstance for a potential impact is cumulative, as the diluted effluent discharge through snow making would occur during the snow season with subsequent runoff as part of melt water. Most of the resort would be devoid of snow and subsequently pollutants such as nutrients, excluding those that have been absorbed into the soil, assumed to enter Clear Creek. Any benefit to weeds in terrestrial ecosystems is based on extra nutrients persisting in the soil and being utilised in plant growth during spring and summer. Assuming resort slope management undertakes annual slashing of ski runs in February and March to a height between 15 to 20 cm, then habitat on ski slopes will remain the same. However, extra nutrients entering adjacent woodlands that are mostly native in structure, but still incur a large proportion of weeds at the interface and particularly during the early years of post-fire recovery, then weed species could be enhanced and improve their competitive dominance over many native species. But like the open ski slopes, this scenario assumes cumulative impacts and residual nutrients absorbed into the soil at a time when most nutrients will be lost in snowmelt.

In contrast, the same catastrophic discharge scenario into aquatic environments would mostly enter Clear Creek during snowmelt, and under higher water flow associated with melt water and runoff and

pass rapidly down stream. Where water pools or eddies in the creek, or at times of reduced creek flow with higher concentrations of contaminants including excessive nutrients, then the aquatic habitat may affect alpine tree frog (if present) or accumulate into peatland communities. However, the time of year that alpine tree frog is likely to interact with the aquatic environment is most likely to be after any unplanned even takes place and following snowmelt from the resort, so the risk is diminished for this species.

Notwithstanding the consequences of the above scenario to terrestrial and aquatic environments, but the risk is low as reiterated in earlier parts of the Test of Significance and in the body of the report. The wastewater engineering to remove toxins and contaminants as well as the operational procedures that manage each stage before further dilution in quarry dam, as well as the opportunity to recycle water that does not meet required discharge standards, culminates in a group of measures where all environmental risks are considered low. Frequent water quality monitoring and annual soil sampling will provide information as to any irregularities after discharge, which is preceded by the licence monitoring point to be located at the dam. Furthermore, as standard practice, A 'Validation Study' has been recommended by Advision to demonstrate that the water quality monitoring was accurate in predicting water quality. According Advision, there were many conservative assumptions built into the modelling and the expectation is that the concentrations have been overestimated as a layer of protection and confidence.

On the premise of the system being managed and operating as prescribed, and to account for any unsuitable discharge that is not repeated, then this assessment concludes that no habitat of threatened species or ecological community is likely to be removed, modified, fragmented or isolated.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).

The site has not been declared an area of outstanding biodiversity value nor are there areas adjacent that could be impacted by the proposal.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

There are 39 key threatening processes listed in NSW. There is no key threatening process pertaining to discharge of treated effluent. However, increased nutrients through unsuitable discharge could adversely affect threatened species or ecological communities by facilitating the 'invasion of native plant communities by exotic perennial grasses'. However, unsuitable discharge is not the aim nor consequence of the proposal as diluted effluent dispersal as part of snowmaking operations would only occur when the licence discharge parameters have been met. Any activity outside of licence condition discharge would be unplanned, unauthorised and likely accidental. Therefore, there are no key threatening processes nor the activity part of a key threatening process.

Following the application of the 'Test of Significance' upon the endangered alpine she-oak skink, endangered alpine tree frog, vulnerable broad-toothed rat and endangered 'montane peatland' under the Biodiversity Conservation Act 2016, no significant impact was identified. Therefore, entry into the BOS has not been triggered.