

Before the Fast-track Panel

Under: Fast-track Approvals Act 2024

In the matter of: FTAA-2605-1236 – Remarkables Ski Area Upgrade and Doolans
Expansion

Statement of advice: Dr Christopher Kavazos

Freshwater

Senior Technical Advisor – Department of Conservation

12 October 2026



Department of
Conservation
Te Papa Atawhai

**Te Kāwanatanga
o Aotearoa**
New Zealand Government

Introduction

1. My full name is Dr Christopher Ronald James Kavazos.

Instruction

2. I have been requested to provide expert advice to the Director-General of Conservation (DOC/the Department) for the purposes of his comments on the Remarkables Ski Area Upgrade and Doolans Expansion Fast-track application application.
3. My advice will be used to inform DOC's s51 reporting and s53 comments on the application.

Qualification and Experience

4. I am a Senior Technical Advisor in the Freshwater Ecosystems and Threats Team at the Department of Conservation. I am based in Alexandra. I have 11 years of experience working as an ecologist, having also worked as a Research Associate at the Centre for Ecosystem Management (Edith Cowan University) and the School of Biological, Earth & Environmental Sciences (University of New South Wales).
5. I have been working at the Department of Conservation for 6 years as a Freshwater Ranger (2020-2023) and have been in my current substantive role since 2023. I have been based out of the Alexandra office during this time and am very familiar with Otago's freshwater environments.
6. I have a BSc with Honours from the University of Wollongong (2010) in Biological Sciences (Advanced) and a PhD in microbiology and salt lake ecology from Edith Cowan University (2016).
7. I have published 11 peer reviewed scientific articles, mostly dealing with the ecology of aquatic ecosystems.
8. My role in this project to date has included reviewing both draft and substantive application documents, visiting the Doolans basin and attending meetings with

the applicant. I attended a site visit on the 1st April with NZSki, e3 Scientific staff and experts representing Central Otago District Council and Otago Regional Council.

9. I attended the following meetings with the applicant to discuss the proposed activity:
 - a. 31 March 2026 – Workshop on freshwater Ecology and Terrestrial Ecology with DOC
 - b. 4 August 2026 – Feedback on Wetlands, Streams and Crossings
 - c. 7 August 2026 – Feedback on Terrestrial Ecology
 - d. 15 September 2026 – Discussion of effects management hierarchy and compensation
10. I have a wide technical and general knowledge of the ecology of freshwater species and ecosystems found in the Remarkables region, particularly *Galaxias* 'nevis' as well as the freshwater habitats and ecosystems in the Nevis Valley and Remarkables area.

Code of conduct

11. Whilst it is acknowledged this is not an Environment Court Proceeding, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. I have complied with the Code of Conduct in the preparation of this advice. Unless I state otherwise, this advice is within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Scope of advice and expert opinion

12. My expert advice relates to the following:
 - i. Adequacy of the Applicant's assessment of freshwater species and ecosystems, including identification of any values that have not been assessed or have been insufficiently characterised (Part 2).

- ii. Adequacy of the Applicant's assessment of effects on freshwater species and ecosystems with specific reference to any effects that are incomplete, understated, or not addressed (Part 3).
- iii. Adequacy of the Applicant's proposed mitigation, rehabilitation and management measures as they relate to freshwater species and ecosystems (Part 3).
- iv. Alternative mitigation or management approaches, where appropriate, including clarification of my recommended or preferred measures including where these differ from those proposed by the Applicant. This includes the appropriateness and adequacy of any proposed offsetting and compensation (Part 4).
- v. Alignment of the proposed activity with the Department's Wetland Action Plan (Part 5).
- vi. Comments on conditions.

Material Considered

13. In preparing this advice I have reviewed the following documents as part of the substantive application:

14. Part A – Substantive Application - Updated documents 4 September 2026
A-10 – Substantive Application Report Section 3 - Project Description updated 3 September 2026
A-13 – Substantive Application Report Section 6 - Assessment of Environmental Effects updated 3 September 2026
A-14 - Substantive Application Report Section 7 – Management and Monitoring of Actual and Potential Effects updated 3 September 2026
A-16 - Substantive Application Report Section 9 – Approvals Relating to the Resource Management Act 1991 Effects updated 3 September 2026
A-21 – Effects Management and Compensation Overview Addendum
Part B – Technical Reports Updated documents 4 September 2026
B-08 – Doolans Creek Water Take Assessment of Effects 26 Aug 26
B-09 – Freshwater Ecological Impact Assessment 27 Aug 26
B-10 – Rastus Burn Wastewater Freshwater Ecological Impact Assessment 28 Aug 26
B-11 – Wastewater Discharge Impact Assessment 28 Aug 26
B-12 – Terrestrial Ecology Impact Assessment 26 Aug 26
B-14 – Tracks, Crossings, Stormwater Freshwater Ecological and Hydrological Impact Assessment updated 27 Aug 26
B-16 Remarkables Ski Area Upgrade and Doolans Expansion Stormwater Concept Report
B-18 Remarkables Ski Area Upgrade and Doolans Basin Expansion - Wastewater Treatment and Disposal Feasibility Report
B-19 Remarkables Ski Area Upgrade and Doolans Expansion - Potable Water Supply Infrastructure Concept Report
B-20 Remarkables Ski Area Upgrade and Doolans Expansion Reservoir Concept Report_Part1
B-20 Remarkables Ski Area Upgrade and Doolans Expansion Reservoir Concept Report_Part2
B-21 Remarkables Ski Area Upgrade and Doolans Expansion Water Intake Concept Report
B-27 Remarkables Ski Area Upgrades and Doolans Expansion - Erosion and Sediment Control Assessment
B-28 Remarkables Ski Area Upgrades and Doolans Expansion - Construction Environmental Management Plan
Part C

Project Maps and Drawings C-00 – C-11

Part D

D.02 Regional Consent RM11.368.03 & RM11.368.04 - Lake Alta and Rastus Burn Snow Making Water Take

Part F

F.02 – Remarkables Ski Area Upgrades and Doolans Expansion – Construction Environmental Management Plan (May 2026)

Updated application documents

Further information requests

Request for Further Information FTAAQ-2605-1236 Climate Change Resilience and the Remarkables Ski Area Upgrades and the Doolans Expansion Project

Site Visit

15. I attended a site visit to the Doolans Basin on 1st April 2026 in the company of e3 Scientific ecologists and ecologists representing Central Otago District Council and Otago Regional Council. This site visit was accompanied by Ross Lawrence (NZSki).
16. This visit enabled me to follow the proposed track alignment from Helicopter Ridge to the base building area via Tarn 3 before roughly following the proposed alignment of the gondola past Tarn 2.

Summary of key freshwater conclusions

17. This section records the ecological values I have assigned to the freshwater features of the Doolans Creek Right Branch Basin, and what I consider are the levels of adverse effect from the proposed ski-field extension. This section states my conclusions only. The evidence and my reasoning, for each conclusion are set out in Parts 1 to 5 that follow.
18. **Ecological values:** The Doolans Basin is an essentially unmodified pristine alpine reference catchment in which streams, tributaries, tarns and wetlands form a hydrologically connected mosaic, including naturally uncommon cushion bog, seepage and string mire wetlands and tarns. I assess the tributaries, wetland complex and tarns as Very High ecological value, Doolans Creek at the weir reach as High, and the Rastus Burn as Moderate. I assess the tributaries and Tarn 3

higher than the applicant, principally because I give weight to the intactness and connectivity of the basin as a whole.

19. **Scale of assessment:** My principal disagreement with the applicant is the scale at which magnitude of effect is assessed. In most cases the applicant has assessed magnitude against a much larger extent than that at which value was assessed or the effects can be expected to occur, such as the full 14.1 km of the Doolans Creek Right Branch or the total tarn habitat of the basin. I provide an assessment of magnitude of effects at scales I believe are relevant to the ecological values and proposed activities.
20. **Effects that can be managed:** The water take, weir construction and the Rastus Burn wastewater discharge can, in my opinion, be managed to a Low level of effect, but only with firm conditions. These include a 33.5 L/s residual flow with telemetered recording, strict construction controls in Doolans Creek, and annual nitrogen and phosphorus load limits for the Rastus Burn set below those proposed.
21. **Significant residual effects:** Three effects remain significant as the application stands:
 - a. the total, permanent and irreversible loss of Tarn 3, a Very High level of effect;
 - b. the loss, fragmentation, hydrological disconnection and sedimentation of the wetland complex, including the seepage, cushion bog and string mire wetlands, a Very High level of effect; and
 - c. the combined effects on the tributaries, including the permanent loss of approximately 95 m of natural stream, stormwater metals and new didymo transfer pathways, a High level of effect.
22. **Effects not adequately assessed:** The application does not assess the ongoing operational effects of grooming and snowmaking on the peat wetlands, the cumulative effects of the Project on the basin, or the implications of climate change for flows in Doolans Creek. None of these can be assumed to be Low.
23. **Avoidance:** Avoidance of the loss of Tarn 3 has not, in my opinion, been adequately addressed. Servicing snowmaking from another source, such as the existing Lake Alta take, would avoid the reservoir, access track and pumping infrastructure. The proposed take is conservatively estimated by me at about 2.2% of the volume of Lake Alta and the applicant has not compared the ecological effects of the two options.

24. **Compensation:** The applicant accepts that its compensation does not adhere to principles of biodiversity compensation. In my opinion, avoidance of the loss of Tarn 3 and peat wetlands is the most appropriate response due to their irreplaceability. In the event the impact cannot be avoided, the proposed \$20,000 boardwalk contribution is inadequate to compensate for the permanent loss of the high-value tarn (in addition to other impacts noted by this and other expert reports). No additional compensation has been offered to address the loss of, and adverse effects on, other freshwater and wetland values that will result from the Project. The proposal also appears to be in tension with DOC's Wetland Action Plan 2026–2035.
25. **Overall:** In my opinion the Project as proposed will result in significant residual adverse effects on freshwater features of Very High ecological value, which should be avoided as they cannot be adequately addressed through the mitigation and compensation proposed. Unless avoidance of the loss of Tarn 3 and the unassessed effects are able to be properly addressed, I do not consider that the freshwater effects of the Project can be adequately assessed or managed.
26. My assessments of ecological value and level of effect for each feature are summarised in the table below.

Feature	My assessment of ecological value	My assessment of the level of effect
Doolans Creek (weir and take reach)	High	Low for the water take in isolation, conditional on the residual flow; Low to Moderate for weir construction and in-stream bed disturbance
Tributaries	Very High	High (crossings, the reservoir inflow diversion, construction sediment, stormwater contaminants and biosecurity vectors, taken together)
Wetland complex	Very High	Very High (direct loss, fragmentation, hydrological disconnection and sedimentation from the track and services corridor)
Tarns	Very High	Very High for the total, permanent and irreversible loss of Tarn 3, for which the applicant identifies no avoidance, mitigation, remediation or offset
Rastus Burn	Moderate	Moderate for the wastewater discharge under the proposed load limits of 750 kg N/year and 100 kg P/year; Low if annual nitrogen and phosphorus load limits are set at or below the loads associated with good–excellent macroinvertebrate conditions
Ongoing operational effects (grooming and snowmaking)	Receiving wetlands, tributaries and tarns Very High	Not assessed in the application. Magnitude cannot be assigned with confidence on the current material, but cannot be assumed to be Low
Cumulative effects	—	Not assessed for the Project’s freshwater, tarn and wetland effects in combination

PART 1. Existing freshwater environment and ecological values

27. The Doolans Creek Right Branch Basin (the basin) is an unmodified valley with very high natural values. These values reflect the basin’s location being part of a transition zone between the wetter west Southern Divide ranges and the drier Central Otago landscape to the east. The basin is the headwaters of the Doolans Creek Right Branch, which is heavily incised, with steep lower sections that confluence with the Nevis River.
28. These waters are part of the Kawarau River catchment which is covered by the Water Conservation (Kawarau) Order 1997¹. This Water Conservation Order

¹ <https://www.legislation.govt.nz/secondary-legislation/pco-drafted/1997/38/en/latest/#DLM227686>

recognises the outstanding intrinsic values of Nevis River tributaries, which includes the Doolans Creek Right Branch.

29. The majority of the Doolan's Creek Right Branch basin is located within the Remarkables Conservation Area and is managed by the Department of Conservation. The land was once part of Glenroy Station and became Public Conservation Land through Tenure Review which reported "The entire area has significant inherent landscape values" and "The proposal contains a near-intact altitudinal sequence from alluvial river bed vegetation and shrublands near the Doolans Creek Right Branch, to mid altitude tussocklands, wetlands, short stature shrublands and fellfields to *Dracophyllum prunum* shrubland/short grassland/fellfield on the summit ridge"².

Freshwater ecology of the wetlands, streams and tarns³

30. The basin contains a variety of wetland types, including cushion bogs, string mires, seepages, together with tarns. These wetland ecosystems are naturally uncommon, formerly described as originally rare ecosystem types, with seepages considered Endangered ecosystems⁴.
31. Water quality in the tributaries within the proposed Doolans Basin operation ski field area is characteristic of a high-elevation alpine environment, with cold, clear, well-oxygenated and generally low-nutrient waters. The stream habitats appear to be cobble bedded streams with riffle runs sections punctuated by steeper sections. Conductivity is particularly low, which reflects the local hydrology being dominated by recent rainfall, snowmelt, shallow groundwater and short flow paths through acidic alpine substrates.
32. The Doolans Creek reaches in this basin have higher conductivity than the upper tributaries and tarns, which suggests a different, or more integrated, source-water signature. The higher conductivity is consistent with longer flow paths, greater groundwater or mineral contact, and larger catchment integration. Although conductivity remains low compared with many lower-elevation waterways, that is

² DOC Conservation Resources Report on Tenure Review of Glenroy Special Lease (PAL 14-12-03) Under Part 2 Crown Pastoral Land Act

³ Unless otherwise stated, this information is summarised from B-08 – Doolans Creek Water Take Assessment of Effects 26 Aug 26, B-09 – Freshwater Ecological Impact Assessment 27 Aug 26, B-12 – Terrestrial Ecology Impact Assessment 26 Aug 26 and B-14 – Tracks, Crossings, Stormwater Freshwater Ecological and Hydrological Impact Assessment updated 27 Aug 26.

⁴ Holdaway, R.J., Wiser, S.K., Williams, P.A., 2012. Status Assessment of New Zealand's Naturally Uncommon Ecosystems. *Conserv. Biol.* 26, 619–629.

expected in a high-elevation alpine catchment where source waters are dominated by rainfall, snowmelt and relatively short residence times.

33. The stream macroinvertebrate communities similarly reflect the alpine setting where abundance and taxonomic richness are relatively low, but communities contain a high proportion of sensitive EPT⁵ taxa which is consistent with comparatively unmodified, near-pristine conditions. These taxa include representatives from the genera *Deleatidium*, *Nesameletus*, *Zelandobius*, *Zelandoperla* and *Acroperla*.
34. The zooplankton assemblage recorded from three tarns in the Doolans Basin was of low taxonomic richness and was dominated by calanoid copepods which were generally abundant or common. Cladocerans were represented by *Ceriodaphnia* sp. and an alonine taxon, both of which occurred sporadically and, with one exception, at low abundance. Ostracods were recorded in a single sample only. Calanoid copepods of the genus *Boeckella* are characteristic of alpine and glacially formed lakes and ponds in the central and southern South Island⁶, and aquatic species richness in New Zealand tarns is known to decline with increasing altitude⁷. On the basis of these samples, the assemblage appears consistent with an oligotrophic alpine tarn system as it lacks the rotifer or small-bodied cladoceran dominance associated with elevated trophic state in New Zealand lakes⁸, and no non-indigenous zooplankton taxa were identified.
35. Conventional indices such as MCI, QMCI and ASPM need some caution in alpine environments because they were developed principally to detect responses to organic enrichment and related land use pressures and may not fully represent ecological quality in naturally low-productivity alpine streams.
36. Of note is the detection of the data-deficient stonefly *Zelandobius macburneyi*.
37. Fish values are less relevant in the upper Doolans Creek reach because it is naturally fishless above the downstream waterfalls, with the nearest fish records

⁵ EPT taxa are aquatic insects from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). Because many species within these orders have relatively narrow environmental tolerances and are sensitive to pollution, sedimentation, altered flow regimes, and habitat degradation, EPT richness and abundance are commonly used as indicators of stream and river ecological condition.

⁶ Jolly, V.H., 1957. A Review of the Copepod Genus *Boeckella* in New Zealand. Trans. R. Soc. N. Z. 84, 855–865.

⁷ <https://www.landcareresearch.co.nz/publications/naturally-uncommon-ecosystems/wetlands/tarns>

⁸ Chapman, M.A., Green, J.D., 1999. Crustacean zooplankton communities in a New Zealand lake during four decades of trophic change. N. Z. J. Mar. Freshw. Res. 33, 361–373.

approximately 7.5 km downstream. Native and sports fish are normally restricted to waterways lower than 1,000m, although *Galaxias 'nevis'* has been recorded at higher altitudes in the nearby Duffers Saddle area (1,100 m a.s.l.). I consider fishless streams to be of high value generally as the reduced predation pressure from fishes can support higher valued macroinvertebrate assemblages⁹.

38. The freshwater faunal values potentially affected by activities in this part of the basin are therefore primarily the quality and integrity of the aquatic invertebrate communities and their physical habitats, rather than fish habitat or passage.

PART 2. Assessment of ecological value

39. For consistency with the applicant's assessment, I apply the EIANZ ecological value criteria¹⁰. These criteria assess ecological value by considering representativeness, rarity and distinctiveness, diversity and pattern, and ecological context. I sequentially assess ecological value in the following sections and explain why my conclusions differ from the applicant's.

Representativeness

40. Under the EIANZ framework, representativeness assesses the extent to which the vegetation, habitats and taxa at a site are typical or characteristic of what would naturally occur for that type within the Ecological District. For freshwater systems this is assessed through attributes such as catchment size, stream order, permanent/intermittent/ephemeral character and standing-water characteristics. Because the Guidelines treat representativeness as broadly equivalent to "naturalness", with 1840 the usual baseline and unmodified sites recognised as better representative examples than modified ones, the degree of human modification is the primary driver of the score.
41. On that basis I have assigned a Very High representativeness value to the tributaries, the wetland complex and the tarns. These features are essentially unimpacted by human activity beyond a small amount of cross-country skiing,

⁹ McIntosh, A.R. & Townsend, C.R. (1996). *Interactions between fish, grazing invertebrates and algae in a New Zealand stream: trophic cascade mediated by fish-induced changes to grazer behaviour?* *Oecologia*, 108, 174–181.

¹⁰ Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). *Ecological impact assessment: EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems* (2nd ed.). Environment Institute of Australia and New Zealand.

hunting and hiking, and are therefore representative of the natural alpine ecological communities present in 1840.

42. I have assigned Doolans Creek a lower value of High, because the FEClA records that the creek has been invaded by didymo and that its lower reaches are occupied by non-native brown trout. The creek otherwise appears to be in near reference state.
43. The Rastus Burn is assigned Moderate, reflecting the modification and fragmentation of its upper catchment by the existing ski-field infrastructure. The basin retains high value tarn, wetland and stream sequences.
44. Across the wider Doolans Basin, indigenous species dominate, pest species are largely absent, and the waterbodies retain their natural hydrological character. Given this high degree of naturalness across the full range of aquatic and wetland habitat types present, the habitats within the Doolans Basin represent a largely unmodified reference example of an alpine catchment.

Rarity and distinctiveness

45. The rarity and distinctiveness component assesses the scarcity and distinctiveness of species, communities, habitats and ecosystem types. Its purpose is to identify features that, by way of limited distribution or unusual character, are more prone to local or national loss and so warrant higher ecological value. Critically, it requires the reason for rarity (natural versus human-induced) and the scale (Ecological District versus national) to be made explicit, and it draws on both the naturally uncommon ecosystems classification¹¹ and the New Zealand Threat Classification System.
46. Applying this to the Doolans Basin, the wetlands (cushion bog, riparian wetland and seepage, together with a string mire peatland enclosed within the cushion bog) are all naturally uncommon ecosystem types¹² that are distinctive but classified “Not Threatened” at the ecosystem level, with the exception of seepages, which are classified Endangered.

¹¹ Holdaway, R.J., Wiser, S.K., Williams, P.A., 2012. Status Assessment of New Zealand’s Naturally Uncommon Ecosystems. *Conserv. Biol.* 26, 619–629.

¹² Williams, P. A., Wiser, S., Clarkson, B., & Stanley, M. C. (2007). New Zealand’s historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology*, 31, 119–128.



Figure 1. String mire wetland, which is a naturally uncommon ecosystem, located adjacent to proposed track route (left of photograph). Photo credit: DOC (2026).

47. The rarity of these ecosystems is natural rather than human-induced.
48. String mire¹³, in my opinion, is the most distinctive as it is a patterned, periglacial upland mire of naturally restricted (Otago/Southland) distribution that supports naturally uncommon plants and therefore warrants a high distinctiveness value (Figure 1).
49. The species records reinforce a Very High score for the wetland complex. The TEcIA records Nationally or Regionally Threatened plants alongside numerous At Risk species across the cushion bog (3 Threatened, 20 At Risk), seepage (5 Threatened, 28 At Risk/Data Deficient) and riparian (4 Threatened, 19 At Risk) communities. Under Table 5 of the EIANZ Guidelines, the presence of Threatened

¹³ Manaaki Whenua – Landcare Research. (n.d.). *String mires*. Naturally uncommon ecosystems. <https://www.landcareresearch.co.nz/publications/naturally-uncommon-ecosystems/wetlands/string-mires>

taxa is sufficient to place these wetlands in the upper part of the range independent of the ecosystem-level threat status.

50. The tarns are also scored Very High, as a naturally uncommon ecosystem type¹⁴, some of which supporting the data-deficient stonefly *Zelandobius macburneyi*.
51. I consider Tarn 3 to be best described as an intermittently dry tarn basin with wetland characteristics, rather than as a permanently inundated tarn. Its fluctuating water level, seasonal inundation and drawdown, and associated shallow-margin habitats are part of the natural hydrological diversity of the tarn system and contribute to its ecological value and distinctiveness (Figure 2). An intrinsic feature of Tarn 3 is its location on a late glacial moraine sequence, which has created the specific geomorphological and hydrological conditions to enable this system to evolve. Tarn 3 is therefore an important representative of the range of tarn environments present within the ecological district, and possibly nationally.

¹⁴ Williams, P. A., Wiser, S., Clarkson, B., & Stanley, M. C. (2007). New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology*, 31, 119–128.



Figure 2. Tarn 3, located on a late-glacial moraine sequence, is an intermittently dry tarn that is characterised by fluctuating water levels. Photo credit: DOC (2026).

52. In my opinion, the tarn meets the NPS-FM test for a natural wetland. Based on the NPS-FM test, a natural wetland is a wetland (as defined by the RMA) that is not:
- a. A wetland constructed by artificial means; or
 - b. A geothermal wetland; or
 - c. Any area of improved pasture that is dominated by exotic pasture species and is subjected to temporary rain-derived water pooling.
53. The Resource Management Act definition requires that the area is “permanently or intermittently wet” and supports “a natural ecosystem of plants and animals adapted to wet conditions”.
54. As reported in the FEClA, Tarn 3 provides habitat for some macrophytes, and wetland associated fauna (zooplankton) and has fluctuating water levels that I believe are an expression of surrounding groundwater levels. It therefore meets the RMA definition of a wetland.

55. Doolans Creek and the tributaries are scored Moderate, as there are no rare or Threatened fish or macroinvertebrates recorded, although the data-deficient stonefly is present. I consider the creek and tributaries typical of other waterways in the Hector Mountains.
56. The Rastus Burn is scored Moderate based on the presence of the At Risk – Naturally Uncommon caddisfly *Costachorema hebdomon* upstream of the discharge location and the Nationally Critical *Montia miniscula* inhabits upstream wetlands¹⁵, recognising that this reflects distinctiveness at both the Ecological District and national scale.

Diversity and pattern

57. The diversity and pattern component measures the number of different species and habitat types present relative to the range that would be expected for the Ecological District, together with the extent to which the distribution of biological components reflects natural underlying physical patterns.
58. Importantly, the EIANZ Guidelines recognise that naturally low-diversity systems, such as high-altitude, low-fertility or extreme environments, are not to be penalised, since diversity is judged against what is natural for the setting, and “pattern” expressly includes altitudinal sequences, ecotones and temporal gradients.
59. Within any single habitat in the Doolans Basin, taxonomic diversity is naturally low, reflecting the altitude, cold winters and extreme alpine conditions that limit the source pool of taxa. This is a natural and expected pattern rather than a sign of degradation.
60. I have scored the single Doolans Creek reach Moderate. This score s naturally low-diversity and low-productivity instream community but reflects the fact that the habitat has been invaded by didymo.
61. Across the tributaries, wetland complex and tarns, I have assigned Very High, giving appropriate weight to physical and habitat diversity and to the intact natural

¹⁵ See DOC Expert Statement – Terrestrial flora, vegetation and ecosystems by Dr Susan Walker

patterning of the system. The basin comprises a connected mosaic of streams, tributaries, tarns, cushion bog, string mire, seepage and riparian wetlands arranged across natural topographic and hydrological gradients, with clear altitudinal sequences.

62. For the tarns in particular, this score reflects the range of tarn types present, including deep and shallow waterbodies with tussock, herbfield and bare-rock margins, and the turnover in zooplankton and macroinvertebrate communities between them. This shows that each tarn provides an important contribution to the diversity of the basin.
63. On this basis, although Tarn 3 was assessed as having lower biodiversity values than the other tarns in the FEClA, I believe the habitat makes a distinct contribution to the range of hydrological regimes represented across the basin. Its strongly fluctuating water level is part of the natural diversity and patterning of the tarn system, and its loss would reduce that range.
64. The Rastus Burn is scored Low. It is likely some elements of the wetland communities don't exist in the Rastus Burn given the degree of modification and fragmentation which has occurred within the current ski field operational area.

Ecological Context

65. Ecological context concerns a site's role in wider ecosystem functioning. It includes the habitat's condition, integrity and resilience, its size, shape and buffering, its connectivity to surrounding habitats, and the role its species and habitats play in ecosystem processes such as providing food resources or supporting critical life-cycle stages.
66. The wetlands, tarns and tributaries of the Doolans Basin form an intact, interconnected system in which seepages and riparian wetlands link the larger freshwater features and surrounding terrestrial habitats (Figure 3). The basin sits within the wider protected Kawarau/Remarkables Conservation Area, which is large, intact and resilient to pest invasion, providing both resilience and landscape-scale connectivity at a whole of basin scale. Ecosystem condition is high, and the habitats support indigenous communities and provide food and life-cycle resources within this alpine system.



Figure 3. An example of the high degree of connectivity of wetland systems in the Doolans Basin. Tarn 2 in the foreground is hydrologically linked to the downstream wetland habitats, including the string mire in the background. These intact sequences of freshwater habitats are an important component of why I consider the “Diversity and Pattern” component of the ecological values assessment as Very High for the Doolans Basin.

67. On this basis I have assigned Very High ecological context to the tributaries, wetland complex and tarns, and High to Doolans Creek.
68. The Rastus Burn is scored Moderate, reflecting a fishless, low-productivity alpine community that is typical of, and connected to, other alpine streams in the region but whose context has been reduced by catchment modification.

My assessment of overall ecological value

69. The approach I have taken is directly from the EIANZ guidelines Table 6¹⁶ which provides a framework for deriving an overall ecological value by combining the ratings assigned to the four ecological matters of representativeness and distinctiveness, rarity and uniqueness, diversity and pattern, and ecological context. Sites are assigned a value ranging from Negligible to Very High based on the number and combination of High, Moderate, Low, and Very Low ratings across these matters. In general, sites receiving High ratings for multiple matters are assigned High or Very High overall value and are considered regionally or nationally important, whereas sites with predominantly Low or Very Low ratings are assigned Low or Negligible value. The framework recognises that ecological value is determined by the collective contribution of multiple ecological attributes rather than any single characteristic in isolation.
70. I consider the tributaries, wetland complex and tarns to all be of Very High ecological value (Table 2). This assessment reflects the near reference condition of the freshwater ecosystems, their diversity and connectivity and the rarity of the wetland types occurring within the project area.

Table 2: Summary of ecological value from my application of the EIANZ Guidelines.

	Doolans Creek	Tributaries	Wetland complex	Tarns	Rastus Burn
Representativeness	High	Very High	Very High	Very High	Moderate
Rarity and Distinctiveness	Moderate	Moderate	Very High	Moderate	Moderate
Diversity and Pattern	Moderate	Very High	Very High	Very High	Low
Ecological context	High	Very High	Very High	Very High	Moderate
Overall	High	Very High	Very High	Very High	Moderate

¹⁶ Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment: EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2nd ed.). Environment Institute of Australia and New Zealand.

71. Generally, my ecological values assessment agrees with the applicant's. I assess the Tributaries as Very High which differs from the applicant's assessment of High. I also consider all the tarn systems to be of Very High ecological value while the applicant considers only Tarn 2 to be of High Value.
72. The applicant and I largely agree on the ecological value Doolans Creek, the wetland complex, tarns 1 and 2 and the Rastus Burn (Table 3). Importantly, the Very High ecological values assessed within the proposal's footprint recognise the national importance of the freshwater habitats in the Doolans Basin.
73. The applicant's assessment values each habitat type largely in isolation and does not, in my opinion, give adequate weight to the intactness, naturalness and connectivity of the Doolans Basin as a whole. The basin is an essentially unmodified alpine system in which the streams, tributaries, tarns and wetlands form an interconnected mosaic, hydrologically linked and set within the wider protected Kowarau/Remarkables conservation area. This intactness and connectivity are themselves ecological values, which support the mosaic and diversity of habitats, hydrological functioning and provide the ecosystem resilience to disturbances. This is the primary basis on which I have assigned higher representativeness and diversity and pattern values to the tributaries, wetland complex and tarns than the applicant.

Table 3: Differences of ecological values between my application of the EIANZ Guidelines and e3 Scientific's assessment of ecological value.

	My Assessment	e3 Scientific Assessment
Doolans Creek	High	High
Tributaries	Very High	High
Wetland complex	Very High	Very High
Tarns	Very High	Very High (Tarn2) High (Tarns 1 & 3)
Rastus Burn	Moderate	Moderate

PART 3: Assessment of effects

Scale at which magnitude of effect is assessed

74. The scale at which magnitude of effect is assessed is the principal point of difference between my assessment and the applicant's. I explain the difference here rather than repeating it in each section below.
75. The EIANZ Guidelines¹⁷ require ecological value and magnitude of effect to be assessed at an ecologically appropriate scale. The subsequent EIANZ Explanatory Note¹⁸ on interpretation of scale clarifies that magnitude will generally be assessed at the same scale as the value assessment, and that wider ecological context should inform the assessment but should not be used to dilute or amplify effects by substituting a different spatial scale for that used in the value assessment.
76. The Explanatory Note provides an example similar to this assessment, which it identifies as not aligning with the EIANZ Guidelines: "aquatic values assessed at a short-reach scale, with the magnitude of effect then amplified to a much larger extent such that the effect resolves to a very small percentage, and the effects assessment is discontinued before minimisation, mitigation, offsetting or monitoring are properly considered".
77. The Explanatory Note requires that any departure from assessing magnitude at the scale of the value assessment be treated with extreme caution, be clearly explained, be supported by ecological information of equivalent quality and detail and be expressly stated as no longer aligning with the Guidelines.
78. Where I depart from the applicant's magnitude conclusions, that difference in scale is the principal reason. I identify the scale I consider ecologically relevant at the start of each effects section. In most cases, I consider that the applicant has assessed the magnitude of effects at an inappropriately large scale.

¹⁷ Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment: EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2nd ed.). Environment Institute of Australia and New Zealand.

¹⁸ <https://www.eianz.org/resources/practice-guides/explanatory-note-on-ecological-impact-assessment-ecia-eianz-guidelines-for-use-in-new-zealand-terrestrial-and-freshwater-ecosystems>

79. Amplifying of the scale for assessing magnitude and the extent of the effect serves to reduce the overall level of effect in the assessment and not apply adequate effects management appropriately.

Water take in the Doolans Creek Right Branch

80. The proposed take is a maximum of 30 L/s (2,592 m³/day; 41,240 m³/year)¹⁹. The modelled²⁰ mean annual low flow (MALF) at the intake is 67 L/s, the lowest measured flow was 65.1 L/s on 25 February 2026, and the lowest 7-day low flow in the extended record was 53 L/s. On those figures, 30 L/s is 46% of modelled MALF at the point of take, and the proposed residual flow of 33.5 L/s is 50% of modelled MALF.
81. Despite the limited number of flow gauging measurements, the close agreement between the modelled MALF and the lowest measured flow gives me confidence that 67 L/s is robust for the purpose of setting a residual flow.
82. The effects of water abstraction are concentrated in the reach between the intake and the next significant tributary inflow, approximately 600 m downstream, at which point inflows increase flow by about 13 L/s (~20%). The applicant models the take as equivalent to 32% of MALF at 600 m downstream, 16% of MALF within 2.5 km, 16% at the lowest waterfall barrier (~1,000 m a.s.l.), 10% at the closest downstream fish record (~6.7–7.4 km), and 8% at 9.6 km.
83. The affected reach for the purposes of assessing instream habitat effects is therefore mostly limited to the ~600 m immediately below the intake, which is naturally fishless due to downstream barriers and altitudinal limitations.

¹⁹ Remarkables Ski Area Upgrade and Doolans Expansion - B.08 Remarkables Ski Area Upgrade and Doolans Expansion – Doolans Creek Water Take Assessment of Effects Document ID: 25047D.

²⁰ Whitehead, A.L., Booker, D.J. (2020). NZ River Maps: An interactive online tool for mapping predicted freshwater variables across New Zealand. NIWA, Christchurch. <https://shiny.niwa.co.nz/nzrivermaps/>

Whitehead, A.L., Booker, D.J. (2019) Communicating biophysical conditions across New Zealand's rivers using an interactive webtool. New Zealand Journal of Marine and Freshwater Research 53: 278–287.

84. Dr Allibone's SEFA physical habitat modelling²¹ at DC3 shows that predicted wetted width drops below 80% of the width present at MALF once flow is reduced to between 50% and 40% of MALF, and that width declines steeply once flow falls below 30% of MALF (at 50% MALF / 33.5 L/s, 85.6% of width is retained; at 30% MALF / 20 L/s, 70.6%).
85. For the dominant mayfly *Deleatidium* and *Nesameletus* species, modelled habitat declines across the range and very steeply below 10 L/s.
86. There are two limitations to Dr Allibone's habitat modelling:
- a. it is built on a single run habitat cross section, and Allibone notes that riffle habitat is more sensitive to flow reduction and would lose habitat at a higher flow; and
 - b. *Zelandoperla* had no modelled habitat at the run site.
87. The modelling establishes 30% of MALF as the threshold below which habitat loss becomes rapid at the modelled run site. Dr Allibone further advises that maintaining 45% of MALF should retain approximately 80% of the stream width present at MALF.
88. Because riffle habitat is more sensitive to flow reduction than the modelled run habitat, I consider a residual flow in the range of 45–50% of MALF to be the appropriate protective range.
89. On that basis I accept that the proposed residual flow of 33.5 L/s, being 50% of modelled MALF, is adequate to manage instream habitat effects in the affected reach, and I recommend that it be secured as a consent condition.
90. The take is limited to the equivalent of 16 days at the maximum rate, confined to the May–October snowmaking season, with abstraction otherwise dormant or buffered by the 19,000 m³ reservoir. I accept Dr Allibone's point that the short abstraction duration during autumn and winter conditions reduces the risk for adverse effects, however, I also note that the take occurs during the season when Doolans Creek is at or near its natural baseline flow.

²¹ Appendix D: Doolans Creek (DC3) Physical habitat modelling. Remarkable Ski Area Upgrade and Doolans Expansion Freshwater Ecological Impact Assessment Document ID: 25047.1

91. Furthermore, the take should be considered consumptive as flow will not be returned to the creek until spring melt when flows are naturally higher (the hydrograph shows flows rising well above 100 L/s during snowmelt against a ~65 L/s winter baseline) and the channel is in an entirely different hydraulic regime. The returned flow is therefore negligible in the context of basin snow melt flows.
92. Because the residual flow is the measure on which the management of abstraction effects depends, the consent conditions will need to be robust enough to demonstrate compliance with the 33.5 L/s residual flow. I recommend consent conditions requiring:
- a. automated telemetered cut off tied to the residual flow, and
 - b. real time reporting, so that compliance is demonstrable when under ice.
93. For the reasons set out under *Scale at which magnitude of effect is assessed* above, the ecologically relevant scale to consider magnitude of effect in this case is at the point of take and 600 m downstream, not the entire 14.1 km length of the Doolans Creek Right Branch. The reach between the point of take and 600 m downstream is the reach that will be exposed to flows up to 46% below MALF.
94. The ecological value of Doolans Creek at the weir reach is High (agreed). The proposed abstraction removes 46% of MALF from the affected reach for up to 16 days in the low flow season with a residual flow of 50% of MALF that meets Dr Allibone's riffle protective recommendation, over a short, naturally fishless reach of ~600 m. I therefore assess the magnitude of effect as Low, giving an overall Low level of effect for the water take in isolation. This conclusion is conditional on:
- a. the 33.5 L/s residual flow being secured as a firm condition set by reference to riffle habitat, and
 - b. reliable, telemetered verification of the residual flow, including under snow and ice.

Weir construction and in-stream bed disturbance

95. Ecological value in the FEClA was assessed at the Doolans Creek weir and water take location, using habitat, macroinvertebrate and eDNA data specific to that reach. Magnitude was then benchmarked against the 14.1 km Doolans Creek Right Branch, giving 0.05% of streambed and a Low magnitude of effect. This is an

inappropriate scale to assess magnitude of effect. The great majority of that 14.1 km has not been surveyed, mapped or valued nor would the effects of the weir be expected to extend throughout the entire 14.1 km reach.

96. In my opinion the ecologically appropriate scale is the reach extending from the intake to the first significant tributary confluence approximately 600 m downstream. I consider that reach appropriate because it is where ecological value was assessed and where the effects will be experienced. It is bounded upstream by the intake and downstream by a tributary inflow that increases flow and alters the hydraulic regime of the creek.
97. Further, Dr Allibone's habitat modelling distinguishes this reach on geomorphological grounds as the creek is a consistent channel form for 250–300 m below the modelled site followed by a cascade section to the confluence. It is also the reach supporting the pristine, EPT-dominated macroinvertebrate community described in my assessment of ecological value.
98. Installation of the Tyrolean weir will permanently remove approximately 20 m² of streambed through placement of the concrete and steel structure, with excavation of the bed required to seat the precast flume unit. The 20 m² disturbance area captures only the weir footprint and excludes the temporary disturbance associated with excavator access and operation within the channel, backfilling and reinstatement upstream and downstream of the flume, the training walls, the low-head pump chamber excavation, and the flushing line outfall approximately 45 m downstream.
99. Doolans Creek carries almost no fine sediment. The habitat survey records no silt at any stream site, with sand comprising 5% of the bed at the weir site and the remainder gravel, cobble, boulder and bedrock. Turbidity at the weir site was 0.35 NTU with clear visual clarity. The macroinvertebrate community is correspondingly adapted to a clean, coarse, interstitially open substrate, and is dominated by EPT taxa which is indicative of pristine conditions. The data-deficient stonefly *Zelandobius macburneyi* is present at the site. Mayflies and stoneflies are highly sensitive to deposited fine sediment, which smothers substrate, clogs gills and infills the interstitial habitat they depend upon. The applicant acknowledges that sediment inputs can have greater effects in alpine streams where sediment occurs at naturally low levels.

100. The weir will be constructed from steel, precast concrete and some *in situ* concreting to fill voids and secure the foundation. Alkaline leachate from fresh uncured concrete, slurry, cement and washings is acutely toxic to aquatic life and can cause localised mortality of macroinvertebrates, particular sensitive taxa that reside in Doolans Creek. The applicant proposes to manage this by dewatering the works area with a short diversion, isolating cement use, and pumping high-alkalinity water to a tanker for offsite disposal.
101. I accept this as an appropriate approach to minimising effects on the freshwater environment and want to emphasise that the applicant should rely on prefabricated concrete structure as far as possible to reduce the need for *in situ* concreting.
102. Didymo was detected at the weir site in January 2026. Construction plant, vehicles and in-water equipment will be vectors for upstream spread within an otherwise didymo-free basin unless effectively controlled. The new tracks will also improve access to Doolans Creek, so increased movement between the creek and the uninfected tarns and tributaries during the operational phase is a further vector, and it is not clear how the risk arising from increased recreational visitation will be, or can be, managed. The applicant has agreed that explicit Check-Clean-Dry protocols be included in the EMP for construction and ongoing operational use. I assess the didymo risk and its consequences in full under Biosecurity in the assessment of tributary crossings, stormwater and water quality.
103. The ecological value of the affected reach is High. Assessed at the scale of that reach rather than against the entire 14.1 km Right Branch, the works involve permanent placement of a structure across the channel, excavation and reinstatement of the bed, a new flushing outfall 45 m downstream, and construction-phase sediment and cement pathways discharging into a stream with naturally negligible natural fine sediment and a sensitive EPT-dominated macroinvertebrate community.
104. I consider the combined magnitude of effect of the weir construction and associated in-stream bed disturbance is Low to Moderate when considered at the more appropriate reach scale. This leads to an overall level of effect of Low to Moderate against the High ecological value of the reach. I therefore agree with the assessment that a Low residual effect is achievable, but this is dependent on:

- a. no concrete or cement washings entering the creek;
- b. suitable erosion and sediment control and dewatering measures, with construction limited to naturally low flow periods with supervision by a suitably qualified ecologist during in-water works; and
- c. backflushing timed to coincide with elevated flows so far as practicable and avoided during the abstraction period other than at season start-up.

Reservoir construction and loss of the Tarn 3 ecosystem

105. The proposal will permanently remove Tarn 3, a waterbody of approximately 4,450 m², and replace it with a fully lined water storage reservoir of 19,000 m³ capacity.
106. This proposal is not a modification of the tarn ecosystem. The proposed activity will cause the total, permanent and irreversible loss of that ecosystem and of its ecological value. The design provides for excavation to a depth of 9 m, lining of the entire basin with an impermeable geomembrane anchored in crest trenches, ballast or cemented riprap over the liner, a concrete pump rail face on the internal slope, and a geocomposite underdrainage layer beneath the liner.
107. The proposed reservoir will retain no element of the tarn's natural ecological functioning or value. Its substrate will be a geomembrane, with no littoral margin, no sediment, no macrophyte or algal habitat, and no hydrological connection to the surrounding environment. Water levels will be driven entirely by abstraction from Doolans Creek and snowmaking demand rather than by any natural regime, and a proposed bubbler system to prevent ice formation will further remove the seasonal thermal and ice dynamics that characterise an alpine tarn.
108. The applicant's assessment records that rehabilitation options such as placing cobbles and boulders on the liner were considered and discounted because of liner wear and pump blockage risk. In my opinion such measures, if incorporated, would not mitigate or remedy the loss of ecological value.
109. The proposed activity will disturb the late-glacial moraine sequence on which Tarn 3 is located. I refer to the evidence of David Barrell for the significance of this landform feature.
110. The applicant assigns a Moderate magnitude of effect on the basis that the loss represents approximately 16% of tarn habitat within the Doolans Basin. In my opinion this misapplies the EIANZ magnitude criteria, because magnitude should

be assessed at the scale at which the effects should be expected rather than against the number or extent of surrounding habitats. The assessment derived ecological value within each tarn, which I consider appropriate, because that process distinguishes Tarn 3 from the other tarns in the basin. It follows from the EIANZ Explanatory Note that magnitude should then be assessed at the same scale at which value was assessed, and at the scale of the area the proposed activity affects. In my opinion the appropriate scale at which to consider magnitude and level of effect is the scale of Tarn 3.

111. Considering Tarn 3 at the appropriate scale, the proposed activity meets the EIANZ Very High magnitude descriptor as it represents the "total loss of, or very major alteration to, key elements/features of the existing baseline conditions, such that the post development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether". There is no residual ecological function or value remaining after the proposed activity and the change is irreversible. It is my opinion that this is the clearest possible case of total loss.
112. The applicant has assigned the tarns a High ecological value and a Moderate magnitude of effect, which leads to a High level of effect. I assess the ecological value as Very High and the magnitude as Very High, giving a Very High level of effect. I therefore disagree with the applicant's conclusion of a High level of effect.
113. The FEClA records that, given the high naturalness of aquatic habitat within the Doolans Basin and the engineering requirement for the tarn to be fully lined, "no avoidance, mitigation, remediation nor offset is available to manage the effects of this activity."
114. Alternative reservoir locations were considered and discounted, largely because the terrestrial habitat elsewhere was assessed as having very high ecological values. Offsetting was discounted because the other tarns in the basin are themselves pristine, leaving no degraded receiving site to improve. Compensation is accordingly the only tool the applicant identifies, and the FEClA concludes that the effect "remains high, prior to the details of the compensatory measures being confirmed and implemented".

115. Tarns are classified as historically rare, or naturally uncommon, ecosystems²².

Such ecosystems occur in limited circumstances and are often highly irreplaceable because they arise from unique combinations of geology, hydrology, climate and ecological processes. Table 13 and Appendix 9 of the EIANZ Ecological Impact Assessment Guidelines²³ recognises that biodiversity compensation is not appropriate where affected biodiversity values are "irreplaceable or vulnerable", or where there are no technically feasible options to secure equivalent gains within acceptable timeframes. In these circumstances ecological losses cannot be adequately offset or compensated for. The Guidelines therefore place greatest emphasis on avoidance through application of the mitigation hierarchy, recognising that project redesign may be necessary where impacts on irreplaceable values cannot otherwise be avoided.

116. The NPS-FM (2020) takes the same position on offsetting for such values, which is "not appropriate in situations where, in terms of conservation outcomes, the extent or values cannot be offset to achieve no net loss, and preferably a net gain, in the extent and values", including where:

- a. residual adverse effects cannot be offset because of the irreplaceability or vulnerability of the extent or values affected;*
- b. effects on the extent or values are uncertain, unknown, or little understood, but potential effects are significantly adverse;*
- c. there are no technically feasible options by which to secure proposed no net loss and preferably a net gain outcome within an acceptable timeframe.*

117. The NPS-FM also states that compensation should only be undertaken "after steps to avoid, minimise, remedy, and offset adverse effects are demonstrated to

²² Williams, P. A., Wiser, S., Clarkson, B., & Stanley, M. C. (2007). New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology*, 31, 119–128.

Holdaway, R.J., Wiser, S.K., Williams, P.A., 2012. Status Assessment of New Zealand's Naturally Uncommon Ecosystems. *Conserv. Biol.* 26, 619–629.

²³ Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment: EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2nd ed.). Environment Institute of Australia and New Zealand.

have been sequentially exhausted", and that "aquatic compensation is not appropriate where, in terms of conservation outcomes, the extent or values are not able to be compensated for", including where:

- a. the affected part of the natural inland wetland or river bed, or its values, including species, are irreplaceable or vulnerable;*
- b. effects on the extent or values are uncertain, unknown, or little understood, but potential effects are significantly adverse;*
- c. there are no technically feasible options by which to secure gains within an acceptable timeframe.*

118. These tests are set out in Appendices 6 and 7 of the NPS-FM, which contain the principles for aquatic offsetting and aquatic compensation respectively.

119. The application material provides very limited information on how the applicant considered avoiding the loss of Tarn 3²⁴. The applicant provides two reasons for discounting alternatives which included the loss of other high-value ecosystems at alternative locations, and cultural constraints associated with mixing waters from different catchments.

120. On the second of those reasons, it is my understanding that the position on mixing waters between catchments is less clear-cut than the application material suggests and Kā Rūnaka are best placed to speak about whether this is a genuine inhibitor to this option for avoidance.

121. The applicant seeks to take 41,240 m³ from Doolans Creek to service 26 snowmaking machines annually. The applicant also holds a current consent²⁵ to take 400,000 m³ annually from Lake Alta to service snowmaking machines in the Rastus Burn. The conditions of that consent require a minimum lake level to be maintained in Lake Alta and a residual flow to be maintained at the outlet of the Rastus Burn, and the consent holder must monitor both to demonstrate compliance.

²⁴ Remarkables Ski Area Upgrade and Doolans Expansion - B.08 Remarkables Ski Area Upgrade and Doolans Expansion – Doolans Creek Water Take Assessment of Effects Document ID: 25047D

²⁵ https://www.fasttrack.govt.nz/_data/assets/pdf_file/0023/29156/D.02-Regional-Consent-RM11.368.03-and-RM11.368.04-Lake-Alta-and-Rastus-Burn-Snow-Making-Water-Take.pdf

122. In my opinion, servicing the proposed Doolans Basin snowmaking from the existing Lake Alta take would remove the need for the reservoir, and so avoid the Very High level of effects on Tarn 3 altogether. It would also remove the need to build the access track and associated water pumping infrastructure down to Doolans Creek.
123. The applicant has responded to this point²⁶. They record three existing consents in the Rastus Burn catchment and explain that snowmaking there is constrained not by consented volume. Instead, they state the water take is constrained by conditions requiring abstraction to cease when Lake Alta falls to or below 1799.4 m a.s.l. and requiring a residual flow of 15 L/s to be maintained in the Rastus Burn at the point of take. The applicant notes that the Rastus Burn catchment above the take is 244 ha (less than half the Doolans Creek catchment above DC3), that modelled MALF there is 35 L/s, and that the Otago Regional Council lists the Rastus Burn as an over-allocated catchment. On that basis the applicant concludes that increasing the existing takes is not viable.
124. That response addresses the current availability of water from Lake Alta. However, it does not compare the ecological effects of the two options. The application material contains no assessment of whether the effects of increasing abstraction from an already modified and already abstracted catchment would be greater or less than the total and permanent loss of a tarn of Very High ecological value, together with the access track and pumping infrastructure required to take water from Doolans Creek.
125. Lake Alta has been reported to have a surface area of approximately 13 ha and a maximum depth of 34.5 m. Based on a conservative assumption that mean depth is equivalent to 40% of maximum depth, I estimate the lake volume to be approximately 1.8 million m³. The proposed take from Doolans Creek of 40,000 m³ per annum would therefore represent approximately 2.2% of the estimated lake volume. Given the conservative nature of the assumed mean depth, this percentage is likely to overestimate the proportion of the lake volume represented by the proposed take.

²⁶ NZSki Limited. 2026. *Response to Department of Conservation comments re B.08 Doolans Creek water take*. 26 August 2026

126. In my opinion this information is required, because use of water from Lake Alta is a genuine pathway to avoid effects on ecological values I have assessed as Very High level of effect. Until the availability of that allocation and the relative effects of the two options are assessed, I do not consider that avoidance has been adequately addressed for the significant effect on tarn 3.

Wetland loss, fragmentation and hydrological disconnection

127. Based on Table 14 the TEclA, the proposed access track, ski trails and associated services corridor will directly disturb approximately 0.295 ha of cushion bog wetland, riparian wetland and seepage within the Doolans Basin, against a mapped basin wetland extent of 58.8 ha. These habitats are all mapped along the corridor alignment in the design drawings and all of which the TEclA assessed as having Very High ecological value.

128. The lower faces of the Doolans Basin are covered in numerous interconnected cushion bog, riparian and seepage wetlands, with approximately a 0.8 Ha formation of a remarkable string mire wetland. Seepages drain to and from other wetland classes, connecting the larger freshwater features of the basin. This is a continuous, hydrologically integrated mosaic rather than a series of discrete wetland units, and it is the intactness of that mosaic which underpins the Very High ecological value I have assigned.

129. A formed track and buried services corridor would bisect the wetland mosaic and create three direct ecological consequences:

- a. Permanent loss of peat-forming wetland structure. Excavation through cushion bog peat and vegetation would remove high-water-table, peat-forming structures that have developed over very long timeframes and are effectively irreplaceable.
- b. Reduced movement and resilience of wetland communities. The track would fragment habitat for specialised wetland flora and fauna, reducing dispersal opportunities and weakening the system's capacity to recover from disturbance.
- c. Loss of ecological integrity and connectivity. The track would interrupt the continuous cushion bog, riparian wetland and seepage network that links

terrestrial and freshwater ecosystems and supports ecological function across elevation gradients.

130. I acknowledge that the applicant has attempted to demonstrate avoidance as far as practicable in routing the track and associated infrastructure through the basin and has sought to minimise effects on hydrological connectivity by routing the track to avoid wetland disturbance so far as possible. That routing reduces the extent of wetland lost and maintains a degree of hydrological connectivity.
131. In my opinion, however, significant adverse effects will remain and will disrupt the functioning and value of the present intact wetland complex.
132. The design relies on permeable track sections to maintain seepage flow across the corridor. Whether those measures will in fact maintain the shallow, diffuse, low gradient subsurface flow that sustains these systems is, in my opinion, uncertain. The consequence if the measures underperform is a change in the water level range and hydroperiod of the downgradient wetland areas, which for peat forming and cushion communities could mean desiccation, peat oxidation and shrinkage, and compositional shift toward drier tolerant species.
133. That change would be progressive and require detailed monitoring to identify, as well as adaptive management plans to remediate wetlands areas if hydrological changes across the track are detected.
134. A further risk is that the services trench becomes a preferential drainage path. The corridor carries potable water, a rising main, wastewater, a snowmaking main, underground power and telecommunications, installed in a trench beneath the track. Trench backfill is typically more permeable than the surrounding peat or shallow soil. Where a trench runs downslope, it can therefore intercept and convey shallow groundwater along its length rather than allowing that water to continue its natural path.
135. The applicant proposes to install concrete bulkheads (trench plugs) in sections of the services trench where it may act as a preferential drainage path. I am uncertain how effective these bulkheads will be at maintaining the shallow subsurface flow that sustains the surrounding wetlands, and I am not aware of studies demonstrating their effectiveness in peat or alpine seepage wetlands. I also note that the bulkheads will require concrete to be poured *in situ* within or adjacent to these wetlands. Fresh, uncured concrete releases highly alkaline

leachate, which is acutely toxic to aquatic life and has the potential to alter the chemistry of acidic, base-poor peat²⁷. I therefore recommend that prefabricated (precast) bulkheads be used to avoid the adverse effects associated with pouring concrete *in situ*. This will be of greater importance where trenches are traversing wetland areas with peaty soils.

136. Wetlands downgradient of the corridor will be exposed to sediment from track runoff during operation and from earthworks during construction. The receiving wetlands are peat and cushion communities in which fine sediment is naturally virtually absent. Sediment deposition can smother low growing cushion and turf vegetation, alter substrate and introduce nutrients.
137. I note that the TEcIA reaches a Moderate level of effect for sedimentation even with erosion and sediment controls in place. I consider sedimentation impacts on the wetlands are not limited to the construction phase but will continue into the operation phase. For example, the string mire, which is located within a depression with very low surface flows, is likely to retain any sediment inputs which will alter the system over time. It is unclear how the applicant will manage these effects apart from finishing bare earth trails with coarse rock and implementing a sediment and erosion control management plan.
138. In my opinion, it will not be possible to effectively manage sediment inputs from a bare earthed track in this environment. The track will act as a permanent source of sediments to downstream receiving environments as either dust or in surface runoff. The proposed mitigation measures may be effective at minimising the sedimentation effects, but sediment inputs will be unavoidable and likely alter the sensitive wetland communities for at least the life of the consent.
139. The wetland complex has a Very High ecological value, confirmed by the TEcIA for each of the cushion bog, riparian and seepage communities. My own assessment also assigns Very High value to the wetland complex.

²⁷ Law, D.W., Evans, J., 2013. Effect of Leaching on pH of Surrounding Water. ACI Mater. J. 110, 291–296.

Setunge, S., Nguyen, N., Alexander, B.L., Dutton, L., 2009. Leaching of alkali from concrete in contact with waterways. Water Air Soil Pollut. Focus 9, 381–391.

140. The direct footprint of approximately 0.295 ha is a small proportion of the 58.8 ha mapped within the basin. However, I do not consider the effect to be confined to the area directly disturbed by the activity. The activity's effect can be summarised as the bisection of a continuous and hydrologically integrated wetland mosaic. The effects will be permanent, with impacts on high-value peat and cushion structures that cannot be reinstated. There remains uncertainty about the effects associated with trenching, the long-term performance of track permeability measures, and sedimentation, which I consider unavoidable in this environment.
141. Assessed at the scale of the wetland complex through which the tracking corridor passes, and considering the direct loss, edge effects, fragmentation, the risk of hydrological disconnection, sedimentation, compaction and altered water inputs, I assess the magnitude of effect as High. This is largely because the effects on the sensitive wetland habitats are likely to be permanent and there is uncertainty on the degree of change the activity may induce. When combined with the Very High ecological value, I consider the effects of wetland loss, fragmentation and hydrological disconnection caused by the construction of the track and associated infrastructure as a Very High level of effect.
142. The TEclA also reaches a Very High level of effect for sedimentation on cushion bog, riparian wetland and seepages, but concludes that with appropriate sediment and erosion control management plans in place this can be mitigated to Moderate. The proposed mitigation is to finish all unvegetated trail surfaces with large coarse rock and to implement a sediment and erosion control management plan.
143. Having reviewed the Construction Environmental Management Plan²⁸, I disagree with the TEclA that the erosion and sediment control plan and the water discharge criteria reduce the mitigated magnitude of effect to Medium. The CEMP will

²⁸ https://www.fasttrack.govt.nz/_data/assets/pdf_file/0017/29150/F.02A-Remarkables-Ski-Area-Upgrades-and-Doolans-Expansion-Construction-Environmental-Management-Plan-Redacted_Part1.pdf

maintain turbidity of discharge to ≤ 150 NTU²⁹ which is orders of magnitude greater than the natural state of 0-0.35 NTU.

144. A turbidity of 150 NTU represents highly turbid water with substantially reduced clarity. At this level, the water would typically appear visibly muddy or discoloured, with underwater visibility reduced to only a few centimetres to tens of centimetres depending on the nature of the suspended material. Turbidity is an indirect measure of suspended particles and therefore does not equate directly to suspended sediment concentration.
145. In my opinion, and for the reasons outlined above, the proposed CEMP is insufficient at mitigating the impacts of sedimentation throughout the construction phase of this project and the level of effect remains Very High.
146. In my opinion, and for the reasons outlined above, the proposed CEMP is insufficient to mitigate sedimentation effects during the construction phase of this Project, and the level of effect therefore remains Very High. Additional controls are required to ensure that discharged water does not exceed an ecologically appropriate turbidity threshold. These controls should include continuous upstream and downstream monitoring, with defined triggers for investigating and remediating any adverse effects.

Tributary crossings, stormwater and water quality

147. The proposal involves three types of watercourse crossing within the Doolans Basin including culvert crossings, splash crossings (fords) and permeable access track sections, together with four armoured swales (A–D) conveying stormwater around the proposed reservoir.
148. The assessment identifies Culvert Crossings A to I and Splash Crossings A to F, with culverts sized for a 1 in 50 year return period storm and inlet and outlet protection provided to avoid overtopping and scouring. The applicant assesses permanent stream habitat loss as 40 m.

²⁹ NTU (Nephelometric Turbidity Unit) is a measure of water turbidity, or how cloudy the water is due to suspended particles such as silt, clay, organic matter, algae, or fine sediment. It is measured by shining a light through a water sample and quantifying how much light is scattered by particles in the water.

149. Several splash crossings are proposed at locations where no surface water was observed during the assessments. At Splash Crossings B and C water was not visible at the surface but was heard running beneath large boulders; at Splash Crossing D no stream was visible and no water was heard, the stream having apparently infiltrated to ground upgradient; and at Splash Crossings E and F no water was seen or heard. These are sites where flow is subsurface, and care is required to ensure that armouring and compaction of a boulder-bedded channel does not alter the hyporheic and subsurface flow path that constitutes the stream at that location.
150. The applicant proposes that stream and wetland hydrological function and connectivity will be "maintained" using appropriate crossings, with designs and methodologies for each crossing to be provided later and reviewed by a hydrologist and ecologist before works, followed by inspection after completion and a further check twelve months later. I propose that ongoing monitoring will be required, particularly through wetland areas, to monitor for adverse effects and manage them accordingly.
151. The proposed vehicle access track, crossings and associated works corridor also pass through the moraine field that forms part of a late-glacial moraine sequence. Although my assessment in this section is focused on freshwater ecological effects, earthworks in this area may also disturb or compromise the geomorphological record associated with that moraine system³⁰.
152. There are locations within the proposed alignment where a clear span structure would be ecologically preferable to a culvert. A bridge or clear span crossing retains the natural bed, banks and riparian margin, maintains continuity of substrate and hyporheic exchange, avoids the perched outlet and scour risks associated with culverts, removes the ongoing debris blockage maintenance obligation, and does not require inlet and outlet armouring extending into the channel.
153. In my opinion, a bridge crossing at the proposed culvert H will avoid adverse effects that will be required to build a splash crossing given the steep banks at

³⁰ Refer to statement of advice provided by David Barrell for further information on the significance of this moraine.

that site. I recommend more detail on each stream crossing and for key constraints of design to be incorporated into consent conditions to ensure effects are managed appropriately

154. The reservoir inflow diversion results in the loss of approximately 55 m of intermittent stream length, with the natural channel replaced by armoured swales conveying flow around the reservoir to three discharge points.
155. In my opinion a constructed armoured swale is not an ecological substitute for an intermittent alpine stream channel. The two differ in substrate, in hydraulic and thermal behaviour, and in biological function. An intermittent alpine channel retains interstitial habitat within natural bed material, supports a specialised invertebrate and floral assemblages adapted to intermittent wetting, and exchanges water with the surrounding shallow subsurface across its length. A riprap lined swale designed for hydraulic conveyance and scour resistance does none of those things.
156. Intermittent reaches such as the intermittent alpine stream channel are within the definition of a river for the purposes of the NES-F and the RMA. The loss should therefore be treated as a permanent loss of 55 m of natural stream and not as a realignment of the channel. This is additional to the 40 m being proposed to be lost through culverting and crossing activities.
157. Stormwater from the Gondola Base building complex is proposed to be discharged to Tributary A, with estimated roof runoff of approximately 16 L/s from the Gondola Return Station. Secondary buildings, including the snowmaking, raw water and wastewater pump stations, will have no guttering and will discharge directly to ground.
158. Baseline water quality in Doolans Creek is exceptionally clean with total zinc and total copper both below laboratory detection limits in the single sample collected. The applicable guideline values adopted are the ANZG (2018) default guideline values for 99% species protection. The thresholds, 1 µg/L copper and 2.4 µg/L zinc, are approximately twice the detection limit for these metals. In my opinion, a lower threshold at detection limit is more appropriate given the receiving waterways are currently pristine with no evidence of any contaminant loading.

159. The modelled metal concentration uses new Colorsteel® at 139 µg/L dissolved zinc. The same source gives 745 µg/L for a roof in poor condition, and the assessment acknowledges that if roofing is not maintained, in stream concentrations could reach 16 µg/L zinc, approximately seven times the 99% protection DGV of 2.4 µg/L and nearly 15 times the detection limit of 1.1 µg/L.
160. If the applicant uses other materials for construction, then the contaminant loadings could be higher, and the risks identified in the Tracks, Stream Crossings and Stormwater Freshwater Ecological and Hydrological Impact Assessment may actually be higher. I therefore recommend consent conditions requiring the use of new Colorsteel, or another material with metal and TSS loads and concentrations equal or lower than Colorsteel for roofing structures. Furthermore, it must be a matter of consent conditions to maintain the roofing materials over the life of the consent to ensure the roofing material doesn't deteriorate and increase contaminant loadings over time.
161. The assessment concedes that the ANZG (2018) 99th percentile default guidelines will be marginally exceeded during a stormwater event, and relies on acute values not being exceeded. Acute criteria protect against short term lethality³¹. They do not address chronic exposure, bioaccumulation, or the accumulation of metals in deposited fine sediment, and they are not the appropriate benchmark for a waterbody presently below detection limits and assessed as of High to Very High ecological value.
162. The applicant proposes monitoring of zinc, copper and dissolved carbon during spring snowmelt and two first flush rainfall events, for the first two years following building establishment, with instream sampling upstream and downstream of the outlet triggered only if discharge concentrations approach or exceed the DGV, and further treatment proposed only if receiving water concentrations are then exceeded. Annual summer macroinvertebrate surveys upstream and downstream are proposed for the same two year period.

³¹ Gadd J.B., Hickey, C.W., Snelder, A.H. (2024) Acute copper and zinc water quality guideline values for Aotearoa. Technical report of the derivation including bioavailability model evaluation. Report prepared for Ministry for the Environment. (260 pp).

163. The applicant's assessment shows that zinc leaching increases with roof age, and that the main risk arises from a roof in poor or unmaintained condition. A monitoring programme restricted to the first two years of a new roof will sample the period of lowest expected contaminant release. Further, treatment is proposed only after ecological deterioration has been detected, which for a Band A, EPT dominated tributary means accepting some degree of adverse effect as the trigger for management.

164. I recommend conditions requiring the following in regard to managing effects from stormwater inputs into the Doolans Creek tributaries:

- a. confirmation of final roofing, flashing, gutter and fixing materials before construction;
- b. maintenance of roofing materials over the life of the consent to ensure the roofing material doesn't deteriorate and increase contaminant loadings over time;
- c. installation of first flush diversion or treatment at commissioning;
- d. monitoring extended across the life of the consent at a reducing frequency rather than ceasing at two years;
- e. periodic assessment of roof condition with a defined replacement or treatment trigger; and
- f. monitoring of metals in deposited fine sediment, which integrates exposure over time and is a better indicator of chronic accumulation than event based water sampling.

165. I have assessed the tributaries as being of Very High ecological value, and the applicant's assessment records the streams as of High ecological value. The effects considered in this section are:

- a. permanent modification of stream habitat at each crossing, including loss of approximately 40 m of stream habitat for culverting;
- b. permanent loss of approximately 55 m of intermittent stream to the reservoir inflow diversion;
- c. construction sediment delivery at multiple construction locations;

- d. contaminant discharge to a headwater tributary presently below detection limits for zinc and copper;

166. Assessed at the scale of the affected tributary reaches rather than against 8.2 km of basin stream network, and taking those effects together rather than crossing by crossing, I assess the magnitude of effect as Moderate, giving a High level of effect against the Very High ecological value of the tributaries. In my opinion, it will be very difficult to provide mitigation steps that will lower this magnitude of effect given the sensitivity of the wetland environments to sediment inputs and the difficulty in preventing didymo spread throughout the basin.

167. I recommend the following being secured as consent conditions that deal with the tributary crossings, stormwater and water quality effects:

- a. site specific designs for every culvert, splash crossing, ford, permeable track section and drainage structure certified before works commence;
- b. measurable hydrological performance outcomes that maintain existing surface and shallow subsurface flow along with long-term performance monitoring established from pre-construction baseline states;
- c. confirmation of final roofing, flashing and gutter materials, installation of first-flush diversion or treatment at commissioning, and metals monitoring extending across the life of the consent, including deposited sediment, with thresholds appropriate to the current state; and
- d. Water quality discharge criteria in the erosion and sediment control plan that reflects the very high ecological value and sensitivity of receiving environments to sediment inputs, with supervision during all in water works.

Freshwater biosecurity

168. Didymo (*Didymosphenia geminata*) is an invasive freshwater diatom that is present at the Doolans Creek weir site and in the Rastus Burn but was not observed or detected in eDNA at upstream sites in the Doolans Basin in April 2025. The tributaries, and on present evidence the tarns, are therefore uninfected.

169. The conditions in these waterbodies are, however, those in which didymo performs best (cold, clear, low nutrient alpine water over stable cobble and boulder substrate, with an open canopy).

170. Where it establishes, didymo forms thick, persistent mats of extracellular stalk material that smother the bed, infill the interstitial spaces between cobbles and eliminate the clean, open substrate on which the basin's sensitive macroinvertebrate community depends. Presence of didymo changes macroinvertebrate community composition. Mat dwelling chironomids and oligochaetes typically increase, while the mayflies and stoneflies that currently characterise these streams, such as *Deleatidium*, *Nesameletus*, *Zelandobius* and *Zelandoperla* (including the data deficient *Zelandobius macburneyi*) decline in abundance as their grazing and interstitial habitat is lost.
171. Infestation is also effectively irreversible as there is no established method of eradicating didymo from an open waterway once it has established. The loss of the tributaries' present ecological value would be permanent.
172. The Project creates multiple new transfer pathways into those tributaries from construction plant and vehicles moving between the Rastus Burn Basin and the Doolans Basin and between crossings on uninfected waterways. Much of this traffic will continue into the operational phase. There is also a risk of didymo being introduced in waterways from the proposed reservoir which will be filled with water sourced from Doolans Creek where didymo is present. Water released from the overflow of this tarn, or during maintenance or leaks of piping infrastructure, is likely to introduce didymo to downstream waterways. It is unclear how this risk will be managed.
173. I record that the applicant reaches a similar conclusion on the significance of this risk. Their assessment assigns didymo a Moderate magnitude against a High ecological value, giving a High level of effect, reduced to a Moderate residual effect only on the assumption that biosecurity measures are implemented and it is reached without taking into account the additional pathway created by the reservoir, which I describe above.
174. Otherwise, I support the Check Clean Dry protocols the applicant has agreed to include in the EMP for construction and operational plant, and consider they should be secured by condition rather than left to a management plan. They should apply to all plant, vehicles and equipment moving between the Rastus Burn and Doolans Basins and between waterbodies within the Doolans Basin both during construction and operation phases.

Rastus Burn wastewater discharge

175. The applicant proposes to increase the volume of treated wastewater discharged to the Rastus Burn from 127 m³/day to 204 m³/day, an increase of approximately 60%. The applicant states that treatment upgrades will hold the annual nutrient load at or below existing levels. Because the discharge volume is increasing, this can only be achieved if nutrient concentrations in the treated wastewater are reduced substantially.
176. The load the applicant proposes to maintain is 750 kg of nitrogen and 100 kg of phosphorus per year. This nitrogen figure is higher than the 601 to 701 kg N/year discharged between 2016 and 2023. Holding the load at 750 kg N/year would therefore permit up to approximately 150 kg N/year more than was discharged during that period, rather than maintaining the status quo.
177. Over the same 2016 to 2023 period, the applicant records a decline in freshwater ecological condition in the Rastus Burn, with the Macroinvertebrate Community Index (MCI) falling from the good–excellent band to the fair–good band. That decline occurred while annual nitrogen loads were between 601 and 701 kg N/year, below the 750 kg N/year the applicant now proposes to maintain. Other pressures in the modified upper catchment may also contribute. However, based on the applicant’s data, recent nutrient loads have not been low enough to maintain good–excellent macroinvertebrate condition.
178. For these reasons, I consider it unlikely that freshwater ecological values in the Rastus Burn will improve under the proposal, and they may decline further. The proposed load limits would maintain, and potentially increase, the nutrient loads under which the recorded decline has occurred. The larger discharge volume will also form a greater proportion of flow in the Rastus Burn, particularly during low-flow periods.
179. I recommend conditions that set annual nitrogen and phosphorus load limits for the discharge to the Rastus Burn at or below the loads associated with good–excellent macroinvertebrate condition, rather than at the proposed 750 kg N/year and 100 kg P/year. Without such limits, I assess the magnitude of effect as Moderate, giving a Moderate level of effect against the Moderate ecological value of the Rastus Burn. With load limits set on that basis, I consider the magnitude of effect would reduce to Low, giving an overall Low level of effect.

Ongoing operational effects on freshwater environment

180. In this section I describe the effects from snow grooming and snow making which are a feature of the operational activity being proposed and will recur every season for the life of the consent. In my opinion the effects of these activities have not been assessed in the application. New Zealand and international literature identify ski-field operational activities like grooming and snowmaking as a persistent driver of change in alpine vegetation and soils, and the Applicant should therefore have been aware of these effects. Here I will discuss the potential effects that the operational phase may have on the wetland ecosystems.

181. The snow beneath a groomed ski field is very different from a natural snowpack. Grooming compacts the snowpack, and denser machine-made snow accumulates on trails, which reduces insulation to the underlying soil and delays the onset of snowmelt which reduces soil temperature, limits root growth, increases soil compaction, reduces infiltration and raises erosion susceptibility, causing shifts in vegetation communities³².

182. These effects are likely to be significant for peat wetland systems such as cushion bogs, where the community depends on how freely water moves through the peat (its hydraulic conductivity) and on the structure of the rooting layer³³. In sensitive peat areas, the compaction caused by snow grooming will affect the soil and hydrological processes on which continued peat accumulation depends, and will affect the wetland areas, including the string mire, that lie beneath the proposed ski trails.

183. Piste preparation also consolidates the snow cover and produces an artificial thawing pattern³⁴, so the date at which vegetation becomes snow-free differs from

³² Hudek, C., Barni, E., Stanchi, S., D'Amico, M., Pintaldi, E., Freppaz, M., 2020. Mid and long-term ecological impacts of ski run construction on alpine ecosystems. *Sci. Rep.* 10, 11654.

³³ Morris, P. J., Baird, A. J., & Belyea, L. R. (2015). Bridging the gap between models and measurements of peat hydraulic conductivity. *Water Resources Research*, 51, 5353–5364.

³⁴ Fahey, B., & Wardle, K. 1998. Likely impacts of snow grooming and related activities in the West Otago ski fields. *Science for Conservation* 85. Department of Conservation, Wellington.

Rixen, C., Haeberli, W., & Stoeckli, V. 2004. *Ground temperatures under ski pistes with artificial and natural snow*. *Arctic, Antarctic, and Alpine Research*, 36(4), 419–427.

natural conditions, causing changes in plant growth and species composition³⁵.

Cushion bog and string mire species are adapted to a particular length of snow cover, a particular growing season and a particular timing of release³⁶. A

systematic shift in melt date is therefore a chronic selective pressure operating over the whole life of the consent, which may alter the floral composition of these high-value wetlands over time.

184. In my opinion the extensive string mire is the element of the wetland mosaic most vulnerable to these effects, because its most distinctive ecological feature, the pond and peat island formations, depend on a surface microtopography of low ridges across a peat substrate that is highly susceptible to compaction. Long term snow grooming above this wetland system is very likely to induce physical changes which will compromise its ecological functioning as a peat cushion bog and disrupt the string mire formation.

185. I note that a groomed trail is proposed to be maintained over the string mire system³⁷. It is otherwise unclear from the application where grooming is proposed in relation to the distribution of other wetland types in the Doolans Basin nor are there any proposed interventions to minimise or monitor the effects.

186. I recommend that sensitive wetland areas, such as the string mire, should be excluded from proposed grooming areas and ski trail formation, and that a suitable minimum snow depth requirement be imposed over other sensitive wetland areas before snow grooming equipment can operate over them. Long term monitoring should be undertaken to ensure the wetlands maintain their ecological integrity.

187. These wetlands are presently fed solely by rainfall, snowmelt and shallow groundwater. Snowmaking will introduce water abstracted from Doolans Creek

³⁵ Wipf, S., Rixen, C., Fischer, M., Schmid, B., & Stoeckli, V. (2005). Effects of ski piste preparation on alpine vegetation. *Journal of Applied Ecology*, 42, 306–316.

³⁶ Winkler, D. E., Butz, R. J., Germino, M. J., Reinhardt, K., & Kueppers, L. M. (2018). Snowmelt timing regulates community composition, phenology, and physiological performance of alpine plants. *Frontiers in Plant Science*, 9, 1140.

³⁷ https://www.fasttrack.govt.nz/_data/assets/pdf_file/0018/29142/H.03A-Concession-Doolans-Expansion-Redacted_Part2.pdf

which will be distributed across the main trail by 26 snow guns and grooming equipment³⁸.

188. Cushion bogs are ombrotrophic to weakly minerotrophic systems, meaning that nutrients are derived primarily from rain and snow water and only weakly from surface water interacting with groundwater. Their characteristic species are adapted to acidic, base-poor, low-conductivity conditions, and cushion bogs and string mires are particularly associated with water and peat that are very low in nutrients³⁹.

189. Ongoing addition of water carrying higher concentrations of calcium, magnesium and other base cations have the potential to raise pH within the peat⁴⁰ and alter peat formation processes, which may alter the cushion and turf species composition that define these communities⁴¹. This potential effect has been unexplored by the applicant.

190. Studies in Arctic tundra provide a relevant analogue. Calcium-rich road dust raised soil pH in adjacent acidic, moss-dominated wetlands from approximately 4 to above 7, and over more than two decades caused the near loss of *Sphagnum* mosses and a shift towards vegetation tolerant of less acidic conditions. In my opinion the direction of change under the proposed activity is likely to be similar, although the magnitude and rate of change are likely to be smaller and slower, because the calcium loads delivered by road dust in those studies were considerably greater. The extent of change will depend on the area over which machine-made snow is distributed and on the flow paths taken by meltwater, which I consider further below.

191. The applicant's data demonstrates that water from Doolans Creek is chemically different to the tributaries of the upper basin where snowmaking is proposed.

³⁸ https://www.fasttrack.govt.nz/_data/assets/pdf_file/0020/29117/C-08-Remarkables-Ski-Area-Upgrade-and-Doolans-Expansion-Doolans-Access,-Trails-and-Utilities.pdf

³⁹ Johnson, P., Gerbeaux, P., 2004. Wetland Types in New Zealand. Department of Conservation, Wellington.

⁴⁰ Wang, M., Moore, T. R., Talbot, J., & Riley, J. L. (2015). The stoichiometry of carbon and nutrients in peat formation. *Global Biogeochemical Cycles*, 29, 113–121.

⁴¹ Lamers, L. P. M., Smolders, A. J. P., & Roelofs, J. G. M. (2002). The restoration of fens in the Netherlands. *Hydrobiologia*, 478, 107–130.

Conductivity, a proxy for total dissolved ions, was recorded at 35 to 67 $\mu\text{S}/\text{cm}$ across the Doolans Creek sites, compared with 12.6 and 12.9 $\mu\text{S}/\text{cm}$ in Tributaries A and C and 9.6 to 26.3 $\mu\text{S}/\text{cm}$ in the tarns. Snowmaking water will be abstracted from the creek, which on these measurements is some three to five times more ionically concentrated than the tributaries and tarns of the upper basin, and will be distributed across the surfaces of the main trail upslope of cushion bog, seepage and riparian wetlands.

192. Water quality data for Doolans Creek⁴² record a conductivity of approximately 55 $\mu\text{S}/\text{cm}$, a pH of 7.4, an alkalinity of 24 g/m^3 and a total calcium concentration of 8.6 g/m^3 . This is dilute, calcium-dominated bicarbonate water, which is the combination of base cations and alkalinity to which acid peat communities are most sensitive. At the proposed maximum annual take of 41,240 m^3 , snowmaking would deliver approximately 355 kg of calcium and approximately 990 kg of alkalinity (as CaCO_3) each year to the snowmaking area. Over the 35-year life of the consent, this amounts to approximately 12 tonnes of calcium and 35 tonnes of alkalinity added to a catchment whose wetlands are presently fed only by rain, snowmelt and shallow groundwater.
193. The effect of these loads on the receiving wetlands will depend on the area over which the snow is distributed and on the flow paths taken by meltwater, neither of which is described in the application. As an illustration, if the snowmaking water were spread evenly over 10 ha, it would add the equivalent of approximately 0.4 m of water and 3.5 g/m^2 of calcium to that area each year. In my opinion this is likely to be many times greater than the calcium these ombrotrophic systems currently receive from rain and snow. The input will also not be delivered evenly. A large proportion of the dissolved ions held in a snowpack is released in the first meltwater, so the wetlands immediately downslope of the trails, and low-flow depressions such as the string mire, are likely to receive concentrated pulses of base-rich water each spring.
194. The buffering capacity of the peat will slow any change in porewater chemistry, but the input recurs every season and its effects are cumulative. In my opinion, sustained over the life of the consent, these inputs have the potential to progressively enrich the surface peat in base cations and raise porewater pH beneath and downslope of the snowmaking trails, with the rain-fed cushion bog and string mire the most exposed.

⁴² Appendix A: Water quality sample results, Remarkables Ski Area Upgrade and Doolans Expansion – Doolans Creek Water Take Assessment of Effects, Document ID: 25047D

195. To enable this risk to be assessed, the applicant should determine meltwater flow paths, the full ionic and nutrient chemistry of Doolans Creek, tributaries and wetland porewater, then calculate a mass balance of the kind set out above. This will enable the applicant to estimate any changes in alkalinity likely to occur due to snow making using Doolans Creek derived water.
196. My concern is that the machine-made snow input will be enriched relative to the receiving systems, that it will be delivered annually over the full operational life of the Project, and that it will be concentrated onto defined trail surfaces. Over time, in my opinion, the receiving environments, which include the sensitive cushion bogs and string mire, have potential to be altered from their natural state in response to chemical changes in the soil induced by machine made snow inputs.
197. In my opinion, the operational effects of snow making and grooming on the wetlands has not been assessed. The ecological assessments address construction disturbance and the permanent footprint but provide no information on the pressures this activity will induce during the operation phase over the life of the consent. The wetland complex, tributaries and tarns have Very High ecological value, and it is my opinion that the operational effects described above are cumulative and have the potential to induce permanent changes to them over the 35-year life of the proposed consent.
198. Because the effects are unassessed and unquantified, I am not able to assign a magnitude with confidence. My opinion is that, based on the current assessments and available literature, it is not certain that operational effects will be Low and they should be assessed by the applicant. I recommend the following be secured by condition:
- a. An Operational Environmental Management Plan covering grooming, snowmaking, machinery exclusion zones, reservoir operation and maintenance, and vehicle movement, certified before operation commences;
 - b. Exclusion zones (i.e. mapped no-groom areas) for all mapped cushion bog, string mire and seepages;

- c. Preclusion of snow making additives⁴³;
- d. Baseline and ongoing monitoring of water chemistry (conductivity, pH, nutrient status) and of vegetation composition in permanently marked plots within cushion bog, string mire and seepage within and outside the snowmaking and grooming footprint, established before operation and continuing at a defined frequency across the consent term; and
- e. A defined management response where monitoring exceeds defined thresholds in water chemistry, compositional change, soil compaction or altered melt timing.

Climate change

199. The applicant has not provided any recent scientific information on how it predicts climate change will affect the environment and alter the Project's effects on the ecological values.

200. The applicant acknowledges that maintaining ski-field operations under future climate-change scenarios will depend increasingly on snowmaking technology and other adaptation measures, and that such measures will be important to the long-term viability of the ski field⁴⁴. This is directly relevant to the freshwater assessment, because machine-made snow is to be produced from water abstracted from Doolans Creek.

201. It is unclear from the application material how climate change will alter flows in Doolans Creek and what the consequences of that will be on the ability to abstract sufficient water for snow making while maintaining the residual flow. This becomes more pertinent as the field becomes increasingly reliant on machine-made snow and (presumably) flows in Doolans Creek reduce with the effect of Climate Change.

202. Published modelling of snow-affected catchments in the upper Clutha indicates that climate change is likely to alter the seasonal distribution of alpine streamflow.

⁴³ Tetu, S. G., & Haynes, P. A. (2024). Assessing the impacts of Snomax®, an ice-nucleating bacterium for creating artificial snow, on the Australian Alpine environment: Year 2 progress report. Macquarie University.

⁴⁴ https://www.fasttrack.govt.nz/_data/assets/pdf_file/0018/30168/FTAA-2605-1236-Remarkables-and-Doolans-RFI-Response-Climate-Change.pdf

Projected warming and changes in precipitation phase result in less water being stored as seasonal snow, more winter precipitation falling as rain, earlier runoff, increased winter flows and reduced summer flows. In the Kawarau catchment, projected ensemble-mean summer runoff reductions of approximately 10% by the 2050s and 24% by the 2090s, alongside a shift in the historic snowmelt-driven flow peak to earlier in spring⁴⁵. Although these results cannot be transferred quantitatively to Doolans Creek without site-specific hydrological modelling, they provide a reasonable basis for anticipating that summer and autumn water availability in small snow-influenced alpine streams may decline or become less reliable under future climate scenarios.

203. I consider that expert advice on the likely impacts of climate change over the 35-year life of the proposed consent is needed. This advice should consider:

- a. The likely changes in the base flow of Doolans Creek and how abstraction might be impacted;
- b. The likely changes in the availability of water at Lake Alta, in order to inform consideration of the option of taking water from Lake Alta instead of Doolans Creek; and
- c. The expected reduction in natural snowpack depth and potential increase in water abstraction and storage required to make snow.

PART 4: Compensation for residual effects

204. In Part 3 I concluded that the Project will leave Very High residual effects on Tarn 3 and the wetland complex, a High residual effect on the tributaries, and operational and cumulative effects that have not been assessed. In this Part I consider whether the compensation proposed by the applicant addresses those residual effects, whether compensation is an appropriate response to them at all, and the minimum principles any compensation package would need to meet.

205. The applicant accepts that the compensation proposed "does not adhere to the principles of compensation in the NPS-IB and NPS-FM "" and that the Project "does not, therefore, strictly conform to the requirements of the NPS-IB and NPS-

⁴⁵ Jobst, A.M., Kingston, D.G., Cullen, N.J., Schmid, J., 2018. Intercomparison of different uncertainty sources in hydrological climate change projections for an alpine catchment (upper Clutha River, New Zealand). *Hydrol. Earth Syst. Sci.* 22, 3125–3142.

FM / NES Freshwater"⁴⁶. The applicant further accepts that the Project will result in "moderate to high residual adverse effects on a number of terrestrial ecological and wetland values " and that the compensation package "does not fully address the loss of habitat extent and ecological value associated with all affected ecosystem types and species." These concessions apply directly to the freshwater values I have assessed, because Tarn 3, the cushion bog, seepage and riparian wetlands, and the tributaries are among the features for which I have identified residual effects.

206. The applicant therefore accepts that the compensation proposed does not fully address the loss of extent and value of the affected ecosystems. In my opinion, the compensation proposed is inadequate in ecological terms.

207. In my opinion, several of the residual effects identified in Part 3 fall on values that are irreplaceable and therefore cannot be offset or compensated for. These are the total loss of the Tarn 3 ecosystem and the permanent loss of peat-forming cushion bog within the wetland complex, both of Very High ecological value. Consistent with the EIANZ Guidelines and Appendices 6 and 7 of the NPS-FM, as discussed in Part 3, these effects should be addressed by returning to the effects management hierarchy, in particular avoidance, including the Lake Alta alternative.

208. However, for completeness and to assist the Panel, should it consider that compensation is available for some or all of these effects, I set out below my opinion, on compensation the applicant has proposed for the loss of tarn 3. This does not alter my opinion that compensation is not an appropriate response to the loss of Tarn 3 or the peat wetlands.

209. The \$20,000 contribution toward construction of a boardwalk over the wetland leading to Lake Alta does not, in my opinion, constitute biodiversity compensation and should not be counted toward compensation for residual biodiversity effects. It is not directed to a specific, measurable ecological outcome, and it delivers no identified gain in the extent or condition of the tarn, wetland or stream values the

⁴⁶Effects Management and Compensation Overview Addendum

Project will lose. At most, a boardwalk may reduce trampling of an existing wetland, which is a visitor management benefit rather than a gain commensurate with the values lost.

210. I refer to the DOC Expert Statement from Dr Fleur Maseyk on the principles any approach to developing a compensation package to manage the effects associated with this proposal should adhere to.

PART 5: Wetland Action Plan

211. The proposed activities are in tension with the strategic direction of DOC's Wetland Action Plan 2026–2035⁴⁷. The Plan seeks to halt wetland loss, improve the health of threatened and at-risk wetlands, and protect wetlands as part of the wider hydrological and ecological landscape. It expressly includes ephemeral wetlands, including tarns, within its scope and identifies drainage, hydrological modification, development, sedimentation and climate-related pressures as key threats.

212. Most directly relevant, Goal 2.1 directs DOC to engage in planning and permitting processes to prevent or reduce the direct and indirect effects of land use and development on threatened wetland ecosystems and species. The proposed permanent loss of Tarn 3, direct disturbance of cushion bog, seepage and riparian wetlands, fragmentation of the connected wetland mosaic, and risks of altered hydrology and sedimentation would introduce several of the pressures the Plan seeks to avoid or reduce within an otherwise largely intact alpine wetland system.

213. The proposal is also arguably at odds with the Action Plan's emphasis on protecting high-value wetlands before they deteriorate, conserving ecosystem connectivity and responding cautiously to climate change.

214. The Action Plan recognises that restoring wetlands after degradation is substantially more costly than protecting them in the first place, and prioritises management of threatened wetlands where loss is imminent.

215. Although its climate objectives focus particularly on peatlands and coastal wetlands, they also recognise wetlands as vulnerable to altered water availability, temperature and rainfall patterns. In this case, the proposed activities would

⁴⁷ <https://www.doc.govt.nz/nature/habitats/wetlands/wetland-action-plan-2026-2035/>

permanently remove one wetland feature, disturb peat-forming wetland communities, and create recurring operational pressures through grooming and machine-made snow across a system already exposed to climate-related change.

216. An obvious way for the proposal to better align with the Wetland Action Plan, would be through giving greater priority to avoidance, particularly by reconsidering where the reservoir and associated infrastructure are located. This would be supported by measures that protect hydrological connectivity, exclude grooming from sensitive wetland areas, and provide for long-term monitoring and adaptive management of wetland condition.

PART 6: Conclusion

217. The Doolans Creek Right Branch Basin is an unmodified alpine catchment in which streams, tributaries, tarns and wetlands form a hydrologically connected mosaic. I assess the tributaries, the wetland complex and the tarns as of Very High ecological value, Doolans Creek at the weir reach as High, and the Rastus Burn as Moderate. The intactness and connectivity are themselves ecological values, and they are the principal reason my value assessment differs from the applicant's.

218. Three effects can, in my opinion, be managed to a Low level of effect if adequate conditions are imposed:

- a. The water take gives a Low level of effect, conditional on the 33.5 L/s residual flow being set by reference to riffle habitat and verified by telemetry, including under snow and ice.
- b. Weir construction and in-stream bed disturbance give a Low to Moderate level of effect. A Low residual effect is achievable, conditional on the exclusion of cement and concrete washings from the creek, appropriate erosion and sediment control and dewatering measures, ecological supervision of in-water works during low-flow periods, timing of backflushing, and Check-Clean-Dry protocols.
- c. The Rastus Burn wastewater discharge gives a Moderate level of effect under the proposed load limits of 750 kg N/year and 100 kg P/year, which would maintain, and potentially increase, the nutrient loads under which the recorded decline in macroinvertebrate conditions occurred. The level of effect reduces to Low only if annual nitrogen and phosphorus load limits are set at or below the loads associated with good–excellent macroinvertebrate condition.

219. Three effects remain significant after the measures to minimise effects proposed and, in my opinion, cannot be adequately managed as the application stands:

- a. The loss of the Tarn 3 ecosystem is total, permanent and irreversible, and I assess it as a Very High level of effect against a Very High ecological value. The applicant's assessment identifies no avoidance, mitigation, remediation or offset for it. Because Tarn 3 is part of an irreplaceable, naturally uncommon ecosystem type, compensation is not, in my opinion, an appropriate response, and avoidance is the only means of addressing this effect.
- b. The loss, fragmentation and hydrological disconnection of the wetland complex, including the string mire, is a Very High level of effect. The track and services corridor will bisect a continuous wetland mosaic and permanently remove peat and cushion structures that cannot be reinstated, and the effectiveness of the permeable track sections and trench bulkheads in maintaining shallow subsurface flow is uncertain. Sedimentation also remains a Very High level of effect during construction, and potentially operationally because the track will be a permanent sediment source and the CEMP discharge criterion of 150 NTU is orders of magnitude above the natural state of 0–0.35 NTU.
- c. The combined effects on the tributaries give a High level of effect. These include the permanent loss of approximately 95 m of natural stream (40 m to culverting and crossings and 55 m to the reservoir inflow diversion), construction sediment, stormwater metals discharged to headwaters currently below detection limits, and new didymo transfer pathways, including from filling the reservoir with water from the infected Doolans Creek. Didymo infestation would be irreversible. The conditions I recommend would reduce these risks, but in my opinion it will be very difficult to reduce the magnitude of effect further, given the sensitivity of the receiving environments to sediment and the difficulty of preventing didymo spread throughout the basin.

220. Furthermore, four effects have not been adequately assessed in the application, and their level of effect cannot be determined on the information provided:

- a. The ongoing operational effects of grooming and snowmaking on the peat wetlands are not assessed, and cannot be assumed to be Low. Compaction, altered melt timing and the annual addition of approximately 355 kg of calcium and 990 kg of alkalinity in machine-made snow (approximately 12 tonnes and 35 tonnes respectively over the 35-

year consent term) will recur every season on wetlands presently fed only by rain, snowmelt and shallow groundwater. The rain-fed cushion bog and string mire are the most exposed.

221. The implications of climate change for flows in Doolans Creek, and for the ability to maintain the residual flow as reliance on machine-made snow increases, are not addressed. The applicant accepts that its compensation package does not fully address the loss of extent and value of the affected ecosystems. In my opinion the compensation proposed is inadequate in ecological terms, and the \$20,000 contribution toward a boardwalk to Lake Alta is significantly inadequate to compensate for the permanent loss of Tarn 3. For Tarn 3 and the peat wetlands (for which nothing has been offered), avoidance is the appropriate response. For the remaining adverse effects, including the loss of approximately 95 m of natural stream, compensation should only be accepted if it meets the principles set out in Part 4 and is secured by conditions.
222. The proposal is in tension with DOC's Wetland Action Plan 2026–2035, in particular Goal 2.1, because it would introduce within a largely intact alpine wetland system several of the pressures the Plan seeks to avoid or reduce, including wetland loss, hydrological modification and sedimentation.
223. On the evidence set out in this document, the matters I consider require attention are:
- a. whether avoidance of the loss of Tarn 3 has been adequately addressed, given that the applicant's response on the Lake Alta alternative does not compare the ecological effects of the two options, and that the proposed Doolans Creek take would conservatively represent approximately 2.2% of the estimated volume of Lake Alta;
 - b. whether compensation should be available at all for the irreplaceable, naturally uncommon ecosystems that occur in the basin, (see Dr Maseyk Statement of advice) ;
 - c. whether annual nitrogen and phosphorus load limits for the Rastus Burn discharge should be set at or below the loads associated with good–excellent macroinvertebrate condition; and
 - d. whether further information should be required on operational and climate change effects before the application is determined.
224. Overall, it is my opinion that the Project as proposed will result in significant residual adverse effects on freshwater features of Very High ecological value, and that those effects cannot be adequately addressed through the mitigation and compensation proposed. Until avoidance of the loss of Tarn 3 has been properly

assessed, and the operational, cumulative and climate change effects have been assessed, I do not consider that the freshwater effects of the Project have been adequately assessed or managed.