



Remarkables Ski Area Upgrade & Doolans Expansion - Tracks, Stream Crossings and Stormwater Freshwater Ecological and Hydrological Impact Assessment

Prepared NZSki Ltd

August 2026



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Tracks, Stream Crossings and Stormwater Freshwater Ecological and
Hydrological Impact Assessment**

Prepared by e3Scientific Limited for NZSki Limited

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Version 2



Executive Summary

NZSki Limited (NZSki) proposes to extend the Remarkables Ski Area into the Doolans Basin, requiring new access infrastructure, utilities, and associated earthworks. This report provides a hydrology and freshwater ecology assessment of the proposed activities on the Doolans Creek and Rastus Burn tributaries and wetlands.

The tributary streams of the Doolans Basin exhibit very high naturalness, with no historical modification and biota dominated by indigenous alpine species representative of near-reference (1840) conditions. These steep, high-altitude headwaters are naturally fishless, and support low-diversity but high-quality macroinvertebrate communities dominated by sensitive EPT taxa. A freshwater ecological survey completed in April 2025 provides a characterisation of the perennial tributaries. The basin lies within the large, intact Kawarau/Remarkables conservation landscape, reinforcing the ecological integrity of its streams and wetlands.

The Rastus Burn is a cold, low nutrient alpine stream draining steep cirque basins, with low baseflows, winter freezing, and spring snowmelt peaks. The Rastus Burn catchment supports the ski field, intact alpine wetlands and the picturesque Lake Alta, although didymo has been confirmed within Rastus Burn.

The Stormwater Plan (Stantec New Zealand, 2026) and Construction Environmental Management Plan (CEMP) with Erosion and Sediment Control Plan (ESCP) (Enviroscope, 2026) incorporated were reviewed and the effects of the proposed controls and mitigations on river and wetland hydrology, earthworks and associated discharges were assessed as minor. As long as the design principles in Section 3.3.1.2 and recommendations in Section 3.4 and 5.9 (summarised below) are implemented the extent of loss of rivers will be limited to around crossings and loss of wetlands to the area already assessed by e3s (e3Scientific, 2026c). The design principles, recommendations and implementation of the finalised CEMP and ESCP will ensure earthworks and land disturbance do not result in complete or partial drainage of natural inland wetlands between 10 m and 100 m and that any temporary diversion of water does not change the water level or hydrological function of natural inland wetlands within 100 m.



Under the EIANZ (2018) framework, the tributary streams are assessed as having High ecological value, while wetlands hold Very High ecological value due to their extent, naturalness, and regional significance. Collectively, the freshwater habitats form a resilient alpine ecosystem with minimal departure from natural baseline conditions.

Physical works will disturb small, localised areas of stream and wetland habitat. Instream works affect approximately 136 m of streambed across Doolans Creek tributaries and the Rastus Burn, with 40 m of Doolans Creek tributaries permanently modified by culverts equivalent to 0.5% of the tributary network. Wetland disturbance totals 0.233 ha (e3Scientific Ltd, 2026) with permeable track designs maintaining hydrological connectivity. A Wetland Management Plan will be prepared as part of the Vegetation, Weed, Invertebrate, and Wetland Management Plan as required by e3Scientific (2026c) which aims to ensure mitigation actions are completed to achieve high plant survival rates, no weed introduction, retention of hydrological function, and preservation of invertebrate biodiversity. With adherence to MfE (2021) in-water works guidance and best-practice erosion and sediment control outlined in the associated CEMP and ESCP, effects from dewatering, sediment mobilisation, stormwater, and cement use are assessed as ranging from Low to Moderate in magnitude. Where effects are assessed to be greater than Low, mitigation actions are recommended.

Overall, the works occur within a high value alpine setting within the Doolans Basin and moderate value alpine Rastus Burn but are limited in scale, duration, and intensity, and supported by robust mitigation. Hydrological effects from temporary diversions are short-lived; stormwater will remain predominantly as sheet flow filtered through tussock vegetation; and sediment generation is expected to be minimal. Residual effects on streams, wetlands, hydrology, and sedimentation are assessed as Low, and cumulative effects remain Low. Management actions and validation monitoring are proposed regarding the in-water bed disturbance activities and wetland hydrological effects and are summarised below:

Recommendations to Maintain Ecological Stream Values

1. Earthworks should be undertaken during a dry period where stream flow is stable and low.
2. The Construction Environmental Management Plan (CEMP) and the Erosion and Sediment Control best practice approaches outlined in Enviroscope (2026) are to be followed.



3. The CEMP will incorporate relevant in-water works guidelines (MfE, 2021) such as working from the banks where possible and limiting the works area to the extent practical.
4. The works area should be dewatered with a short diversion in place to ensure the works area is isolated, and sediment laden water is pumped nearby sediment control devices e.g. sediment sump or turkey nest.
5. Any disturbed streambanks shall be protected with geotextile matting and are to be replanted with dense plantings of eco-sourced native tussock grasses. This rehabilitation work will reduce the likelihood of bank erosion.
6. Soil binding polymers are not to be used.
7. The works area should be dewatered and ensure cement use is isolated, and any high alkalinity water pumped to a tanker and trucked offsite for disposal into a tradewaste system. This method should be included in the CEMP.
8. The use of cement for bulkheads and how to minimise effects from its use is to be included in the CEMP.
9. Biosecurity measures are in place after the last Rastus Burn stream Crossing to ensure didymo is not transferred to Doolans Basin tributary streams. These measures should be included in the CEMP.
10. Biosecurity measures are in place for any equipment used within the Doolans Creek before it is used/driven back through the Doolans Basin tributary streams.
11. Post construction signage and decontamination stations should be established to minimise the risk of members of the public utilising the tracks spreading didymo to the Doolans Basin tributaries.
12. Wetland Management Plan is to be prepared and implemented as per the Vegetation, Weed, Invertebrate, and Wetland Management Plan (e3Scientific, 2026c).

Monitoring of Stream Ecological Value

Stormwater Runoff

1. Deposited fine sediment cover is to be assessed within 2 months of tracking earthworks completion (if alpine conditions allow otherwise within 1 year) downstream of Culvert B at Trib C site and at the Doolans Creek Weir using the SAM 2 method and should remain within 10% of pre works levels.

Stormwater Discharge



1. Water quality monitoring recommended for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events in Trib A, for the first two years post building establishment.
2. Water quality monitoring recommended for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events at the stormwater outlet, for the first two years post building establishment.
3. If elevated zinc and/or copper above DGV 99% threshold is found within stormwater then further receiving water sampling is recommended.
4. Deposited sediment (if present) in Trib A and at the Doolans Creek weir site is to be collected, and zinc and copper levels characterised annually for first 2 years post building establishment.
5. Instream macroinvertebrate community to be assessed upstream and downstream of Gondola Base building stormwater outlet to Trib A during summer months annually for 2 years. Downstream %EPT abundance, %EPT Taxa richness, %mayfly abundance are to remain within 10% of upstream proportions.
6. If monitoring indicates macroinvertebrate community change or elevated levels of copper or zinc are present in the water or sediment, then management such as diverting first flushes to ground soakage or installing universal pollutant treatment (UPT) would need to be implemented to decrease concentrations.

Recommendations to Maintain Stream and Wetland Hydrology

1. Prior to construction, the boundaries of wetlands within 10 m of the planned track should be marked out to ensure that all contractors are aware of the location of wetlands and to ensure they are not damaged.
2. If there is significant water present within any cuts that are not already designated for crossings, work should be paused to assess the need for further mitigations to maintain hydrological connectivity in these locations, e.g. such as Permeable Access track.
3. Photo points should be established adjacent to tracks for wetlands within 10 m of track works. Photographs should be taken of the wetlands prior to works commencing, within one week of works completion, and one year later. If effects to wetlands appear to be extending beyond the area of direct loss assessed by e3s (2026c) then action must be taken to ensure hydrological connectivity of the wetland and that earthworks and



discharges are not impacting wetland vegetation beyond this assessed direct loss.

4. Clean material should be used for splash crossings and for inlet and outlet protection at culverts.
5. Maintenance of culvert protection is required and culverts must be kept clear of debris.
6. Appropriate sediment control is implemented on the downgradient side of Permeable Access tracks to reduce discharges into wetlands.
7. The footprint of earthworks for the Curvey trench installation shall not exceed that of the existing Curvey access track. Where the trench crosses a stream or wetland the original hydrology must be maintained.

Crossing specific recommendations to maintain stream and wetland hydrology:

1. Splash Crossing B; installed downgradient of where the wetland turns into a waterway to minimise wetland disturbance.
2. Review integration of Armoured Swale C with Splash Crossing F.
3. Culvert B and I; assess direction of water flow to the wetland to determine if a Permeable Access track is required to maintain wetland hydrology.
4. Culvert B; two culverts will likely better maintain stream hydrology than a single culvert.
5. Armoured Swale D; a Permeable Access track is required to maintain wetland hydrology. Conveyed stormwater is to be dispersed past the wetland boundary so that it does not enter the wetland and to avoid generating scour and releasing sediment.
6. Armoured Swale A; to intersect the stream downgradient of the transition from riparian wetland to a stream to avoid loss of wetland area.
7. Armoured Swale C; dispersion of stormwater discharge using appropriate permanent measures to avoid scouring and channelisation of discharge water.

Recommended Management Actions

1. Undertake earthworks during dry, stable-flow periods.
2. Implement the CEMP and ESCP best-practice controls (Enviroscope, 2026).
3. Apply MfE (2021) in-water works guidance, minimising the active works footprint.
4. Dewater works areas using short diversions and pump sediment-laden water to appropriate control devices.



5. Stabilise disturbed streambanks with geotextile matting and eco-sourced native tussock plantings.
6. Avoid the use of soil-binding polymers.
7. Isolate cement use; collect and remove high-alkalinity water for off-site disposal via tradewaste.
8. Include cement-use management procedures in the CEMP.
9. Biosecurity measures are in place after the last Rastus Burn stream Crossing to ensure didymo is not transferred to Doolans Basin tributary streams.
10. Prepare and implement a Wetland Management Plan as part of the Vegetation, Weed, Invertebrate, and Wetland Management Plan

Recommended Monitoring

1. Monitoring recommended for zinc and copper during the spring snow melt and two first flush summer/autumn rainfall events in Trib A for the first two years post building establishment.
2. Deposited sediment (if present) in Trib A is to be collected and zinc and copper levels characterised annually for first 2 years post building establishment.
3. Instream macroinvertebrate community to be assessed upstream and downstream of Gondola Base building stormwater outlet to Trib A during summer months annually for 2 years. Downstream %EPT abundance, %EPT Taxa richness, %mayfly abundance are to remain within 10% of upstream proportions.
4. If monitoring indicates macroinvertebrate community change or elevated levels of copper or zinc are present in the water or sediment, then management such as diverting first flushes to ground soakage or installing universal pollutant treatment (UPT) would need to be implemented to decrease concentrations.
5. Deposited fine sediment cover is to be assessed following year 1 tracking earthworks downstream of culvert B at Trib C site and at the Doolans Creek Weir and should remain within 10% of pre works levels.



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1 Introduction

1.1 Overview

NZSki Limited (NZSki) are proposing to upgrade the Remarkables Ski field and expand into the Doolans Basin located east of the existing ski field (Figure 1). The development of this proposed ski field requires the construction of access tracks in the Remarkables Basin to access the Gondola mid station, and in the Doolans Basin to access the Gondola base building and the water take in the Doolans Creek. Associated works include the installation of lift towers for the gondola, new buildings associated with the Gondola and pump sheds associated with the water take. This proposed development requires instream earthworks and culverting to enable stream crossings and earthworks within and within 100 m of wetlands. Utility infrastructure (power and telecommunications) and water pipes (potable, snowmaking, and wastewater) are proposed to be trenched below the access tracking. Stormwater is to be managed along the access track to minimise sediment input to streams and maintain site hydrology. Stormwater from the Doolans Basin Base Building roof is to be discharged to an unnamed tributary of Doolans Creek. Figure 1 provides an overview of these activities.

1.2 Scope of Work

e3Scientific Limited (e3s) was commissioned by NZSki to complete the following scope of work:

- Review the Construction Environmental Management Plan (CEMP) and Erosion and Sediment Control Plan (ESCP) (Enviroscope, 2026) and Stormwater report (SP) (Stantec, 2026b).
- Assess the potential hydrological impacts of the proposed stream crossings, stormwater discharges and the effects of earthworks and associated discharges on wetlands and streams; comment on any loss of wetland or river extent and value.
- Complete a freshwater ecological impact assessment (FEcIA) regarding the proposed track, crossings and stormwater run-off on the Doolans Creek tributary streams and Rastus Burn; outline the ecological level of effect of the various activities and recommend management actions, where required.



This report provides the methodology, results and findings of the assessments undertaken. Fieldwork associated with this characterisation was completed on the 12th and 13th April 2025 and 30 April 2026.

Note that the Doolans Basin ski field extension also requires a water take from Doolans Creek, establishment of a small weir at the water take site and development of a reservoir for water storage. Hydrological and freshwater ecological assessments of these activities are covered within separate reports (e3Scientific, 2026a & 2026d). Ecological values of wetlands are not included in this report and are discussed in e3scientific (2026c).



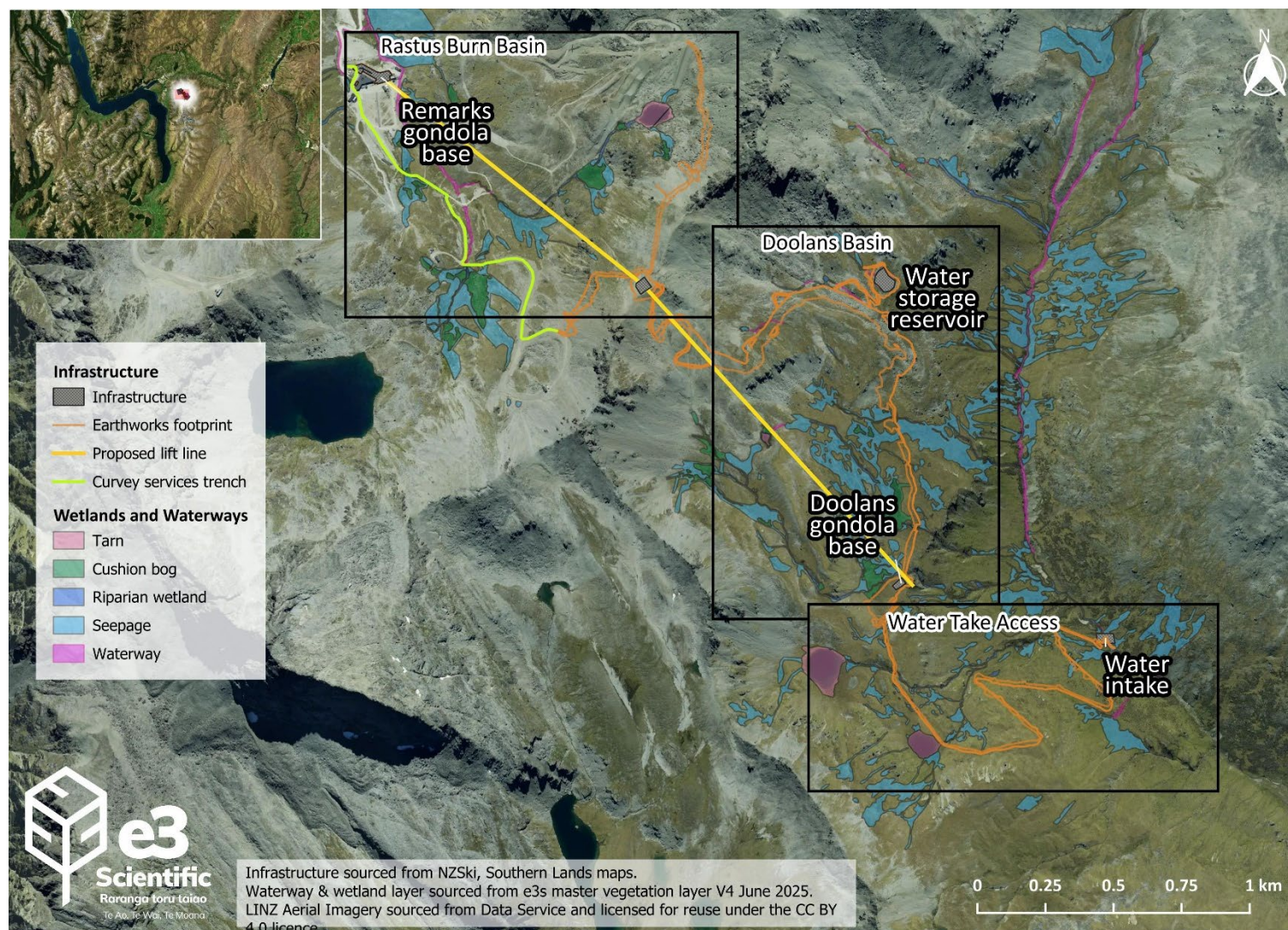


Figure 1: Study area overview, with location in inset.

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1.2.1 Report Structure

This hydrology assessment and FEClA report is structured as follows:

Section 2: Description of the proposed activity and environmental context.

Section 3: Hydrological assessment of effects including of earthworks and discharges on stream and wetland hydrology.

Section 4: Freshwater ecological values assessment.

Section 5: Freshwater ecological impact assessment.

Section 6: Conclusions and recommendations.

Section 7: References.

1.3 Limitations

e3s performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental science profession. No warranties, express or implied, are made. The confidence in the findings is limited by the Scope of Work, and limited data due to the large site and difficult access. A full range of biota that are present at this site may not have been seen or recorded; however, desktop research was utilised to aid the assessment.

The results of this assessment are based upon site inspections conducted by e3s personnel, and information provided in scientific literature. All conclusions and recommendations regarding the properties are the professional opinions of e3s personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, e3s assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside e3s, or developments resulting from situations outside the scope of this project.

1.4 Code of Conduct

The authors of this report are Mark Hamer and reviewer Bryony Miller for Freshwater Ecology and Alexandra Badenhop and Nicole Freeman for Hydrology.

Bryony Miller is the Technical Director of Marine and Freshwater Ecology at e3s and is a professional ecologist with over 15 years' experience. She regularly completes freshwater and marine ecological impact assessments on behalf of



regional and district councils, private companies, national governmental organisations, not-for-profit and research groups. She has been an expert witness at Environment Court and hearings and has been involved in mediation and expert caucusing. She currently is a member of the NZ Freshwater Science Society, NZ Marine Science Society, NZ Science Diving Committee and is an executive committee board member of the NZ Coastal Society.

Mark Hamer is a professional freshwater ecologist with over 17 years' experience working in the freshwater ecology and monitoring industry. Freshwater biomonitoring proficiency and experience includes wetland delineation, water and sediment quality assessments, eDNA, river periphyton, aquatic plant identification, riparian habitat assessment, macroinvertebrate collection and analysis. Freshwater fish monitoring using electric fishing, netting or spotlighting methods along with associated fish handling, analysis and fish passage assessments. At e3s for the past 3 years Mark's focus has been on ecological value assessments and reviewing and producing ecological impact assessments in the consenting process. He has been an expert witness at consent hearings and is a current member of the New Zealand Freshwater Sciences Society.

Alexandra Badenhop is the Technical Director of Water & Environmental Management at e3Scientific Ltd and holds a Bachelor of Engineering (Environmental) (Hons) (1999) and a Masters of Engineering Science (Groundwater Studies) (2008) from the University of New South Wales (UNSW). Alexandra is a member of the International Association of Hydrogeologists and New Zealand Hydrological Society. She has over 20 years experience working in the water industry in Australia and New Zealand. As the Technical Director - Water & Environmental Management team at e3Scientific, she carries out groundwater and surface water supply and water quality assessments, technical reviews for regional councils, assessing and reviewing discharges to land, assessment of environmental effects, project management and contributes hydrological and water quality expertise to multidisciplinary assessments across the business. She has acted as an Expert Witness in consent hearings in New Zealand for the past ten years in Otago and Southland, providing expertise in the fields of hydrogeology, groundwater and surface water quality and environmental monitoring plan design.



Nicole Freeman is an environmental scientist with a Bachelor of Science (Hons) majoring in soil science and 10 years of experience across a range of environmental disciplines from soil science, agronomy and farm planning to assessing water quality of discharges and flow. At e3s she is responsible for undertaking water quality, quantity and flow investigations including field work, results analysis and reporting. Stormwater experience includes monitoring stormwater and assessing contaminant loads against guideline values. Wetland hydrology experience includes assessing soil characteristics to determine the presence of wetland soils. Stream hydrology experience includes flow monitoring and hydrological impact assessment.

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



2 Description of the Activity and Environmental Context

2.1 Environmental Context

The Doolans Basin is an alpine environment located to the east of the existing Remarkables Ski Field and is crown land administered by the Department of Conservation (DOC). The catchment is undeveloped, with the Doolans Basin remaining largely free of anthropogenic influences.

There are several alpine tarns and creeks with intermittent headwaters throughout the basin which drain towards Doolans Creek Right Branch (Doolans Creek) at the valley floor. The tussock covered basin is buried by snow in winter and experiences hot dry summers, therefore the waterways are largely fed by snow meltwater. The area has a cold wet climate and hard sedimentary geology (Snelder, *et al.*, 2010). Doolans Creek catchment is characterised by steep slopes, shallow soils and schist bedrock with the geomorphology undergoing both glacial and fluvial processes. Moraine remnants are visible on site, with active scree zones and confined channel forms.

The streams have a high gradient valley landform with an elevation of 1380-1750 m above sea level (a.s.l.) across the site and 240 km distance to the sea (Snelder, *et al.*, 2010). Doolans Creek flows downstream to join the Nevis River just before its confluence with the Kawarau River within the Kawarau Gorge above Lake Dunstan and the Clyde Dam. No regional council nor Land and Water Aotearoa (LAWA) water quality sites are nearby (within 20 km), but the water is known to be generally clear and cool.

A flow monitoring site (Nevis River at Wentworth Station) managed by Contact Energy is situated in the Nevis River just upstream of its confluence with the Kawarau River. The Nevis River typically has a lower flows period from January to August and high flows between September and November during the spring snow melt (Figure 2) (ORC Website, accessed February, 2026).



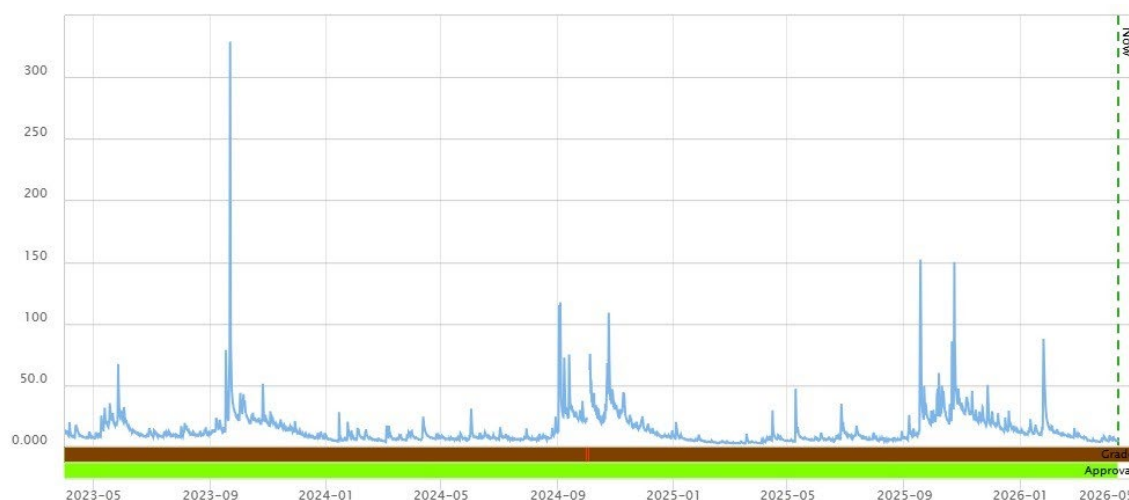


Figure 2: Hydrograph for the Nevis River at Wentworth Station for the last 3 years (Source ORC Website, accessed February 2026).

2.1.1 Rastus Burn

The Rastus Burn catchment has been developed to support the Remarkables ski field with lifts, tracking and buildings present. However, it still contains pockets of undisturbed wetlands, lakes, alpine terrain and a cool clear low nutrient stream. Its headwaters arise in three small cirque basins and the catchment ranges from 315 to 2,300 m a.s.l. Upstream of the Remarkables Gondola Base the Rastus Burn is a small (2-3 m wide), mountain stream with low baseflows (~25 L/s) with winter freezing and very low flows, and late-spring snowmelt/westerly storm peaks. Vegetation is typical alpine tussock, spear grass and *Dracophyllum* with boggy turf and mound wetlands that are hydrologically sensitive. Lake Alta (13 ha, ~34 m deep) drains to the Rastus Burn and *Didymosphenia geminata* (Didymo) has been confirmed in the outlet.

2.1.2 Doolans Creek Tributary Streams

Thirteen small steep tributary streams feed into the Doolans Creek within Doolans Basin. Seven of the 13 streams flow permanently while the remaining six are intermittent, flowing only during spring and early summer snow melt. Three of the permanent streams and one intermittent stream have tarns at or near their headwaters and then drain eastwards down to the Doolans Creek below.



2.1.3 Wetlands

In addition to the streams there are a number of wetland areas that cover 58.8 ha within the Doolans Basin that also slowly drain toward Doolans Creek. The wetlands have been delineated and their wetland type and ecological value assigned in the terrestrial ecological impact assessment (EcIA) (e3Scientific, 2026c). Riparian wetlands, seepage wetlands and cushion bogs have been mapped and are identified in Figure 1 for reference. The freshwater ecological impact assessment (FEcIA) is confined to permanent and intermittent stream effects, however this report does consider the hydrological effects of works on wetlands.

2.2 Description of Activity

The development of the ski field extension in the Doolans Basin requires the following activities:

- Earthworks associated with temporary access track to lift towers for a new lift line.
- Earthworks associated with permanent tracking (including stormwater swale establishment and utility trenching).
- Utility trenching under existing Curvey track to Remarkables Base.
- Culverts and stream crossings.
- Development of a new base building and associated stormwater run-off.
- A water take, weir and storage reservoir to allow for snow production, potable water and firefighting (assessed separately within e3scientific (2026d) and e3Scientific Ltd, (2026a))ⁱ.

The 'Stormwater Concept Report' developed by Stantec (2026b) provides the location of the proposed tracking, the methods to be used for trenching utilities, and the locations and methods of stream crossings. The Erosion and Sediment Control Plan (ESCP) developed by Enviroscope is included within the Construction Environmental Management Plan (CEMP) (Enviroscope, 2026). An ESCP is required as part of the project to minimise the potential for sediment input to wetlands and flowing waterways. The CEMP and ESCP has more specific detail in relation to the tracking, stormwater and associated sediment and erosion control devices and

ⁱ The water abstraction, tarn habitat reclamation activities, and associated in-stream earthworks are not considered within this report. These are covered in a separate report specific to those activities (see e3Scientific, 2026d)



locations. The activity descriptions and controls reviewed in this report are based on these designs and controls.

Figure 1 shows the entire area and provides context for the following figures. Figure 3 shows the proposed access tracks in the Rastus Burn Basin, Figure 4 shows the proposed access track through the Doolans Basin to the Doolans gondola base building and Figure 5 shows the proposed access track from the Doolans gondola base building to the water take in the Doolans Creek. Each of these figures includes delineated wetlands and waterways and Stantec's (2026b) proposed waterbody crossings and stormwater controls.

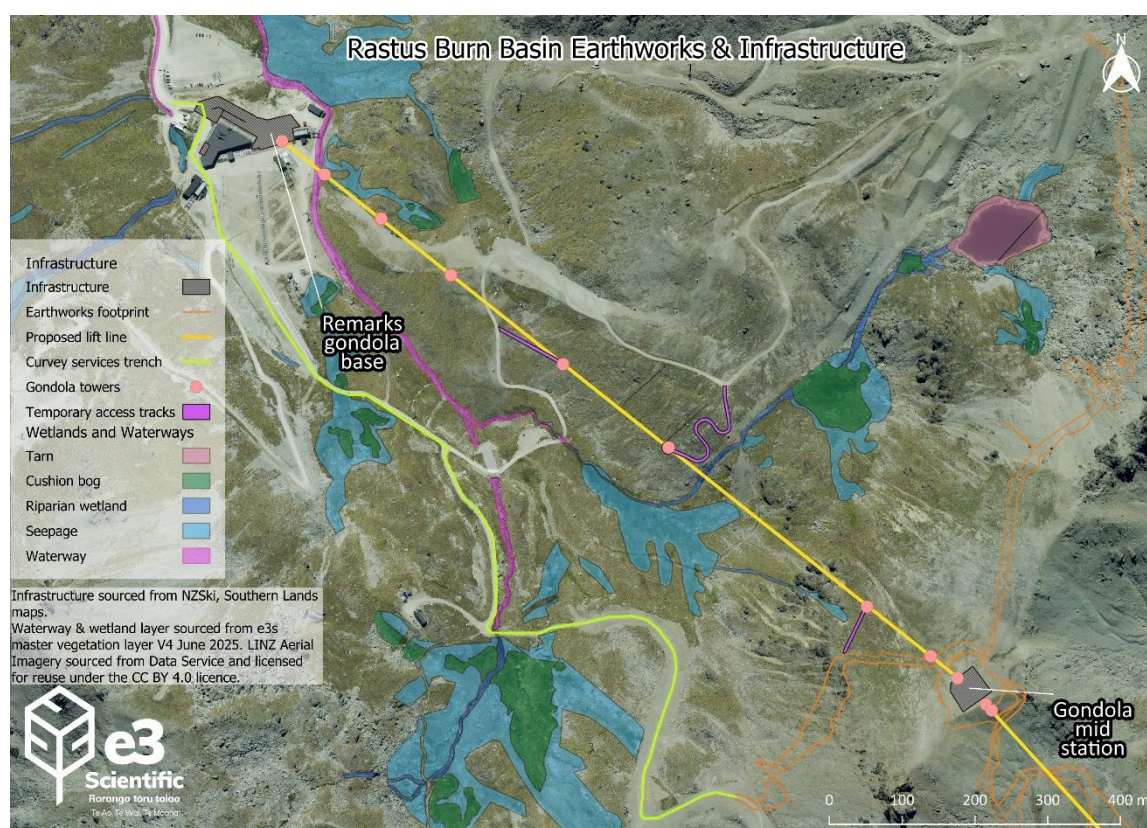


Figure 3: Proposed infrastructure in the Rastus Burn Basin



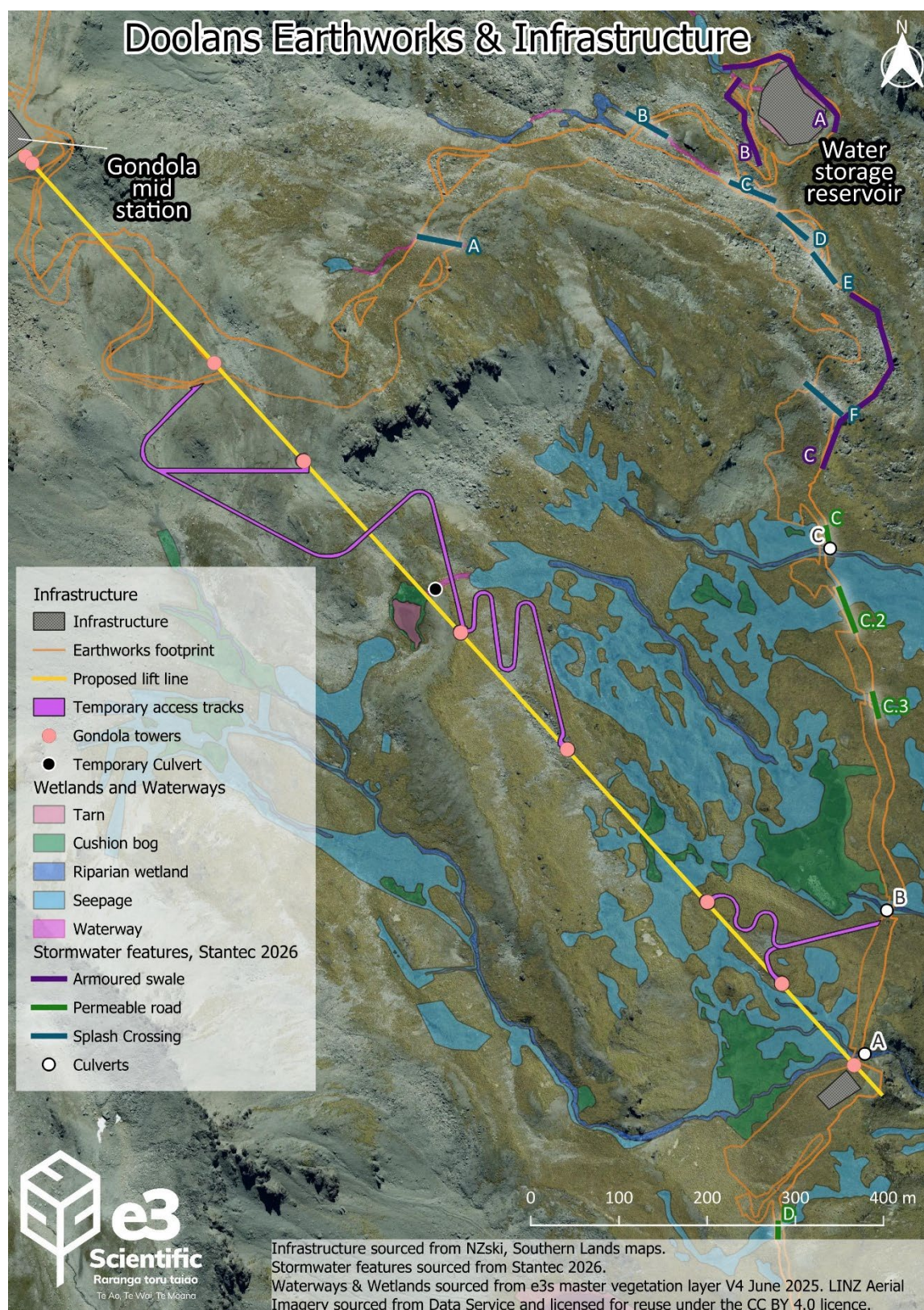


Figure 4: Doolans Basin proposed access track and stormwater management



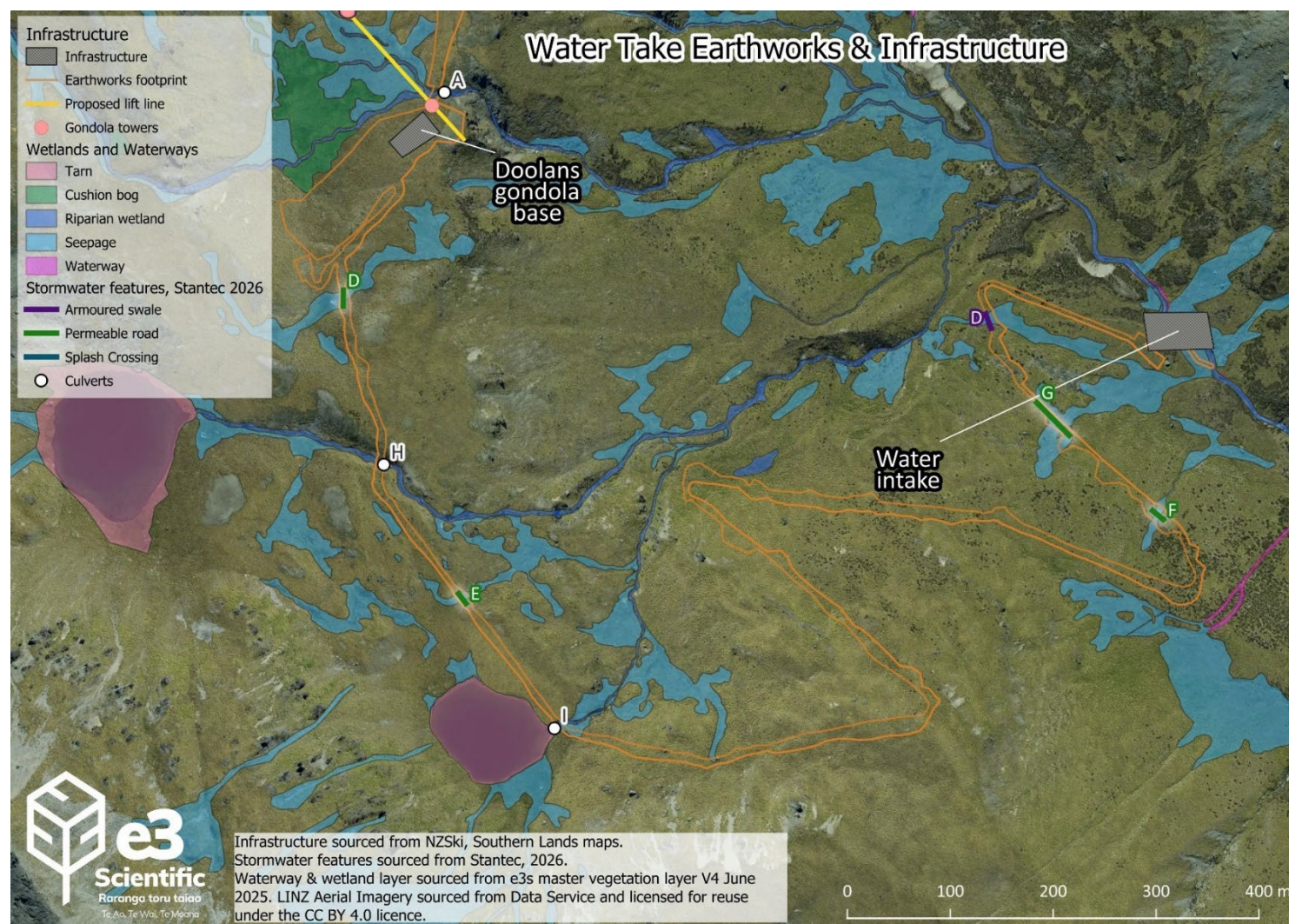


Figure 5: Doolans Basin proposed water take access track and stormwater management



2.2.1 Tracking Earthworks and Trenching

A new gravel track will be established from the Remarkables Ski Field Base (from the top of the existing Sugar Bowl and Curvey Basin trails) to the Doolans Basin Base Building, which will then continue on to the water take location at Doolans Creek (see Figure 1 and Figure 3 - Figure 5). In general, the tracking is designed to be slightly lower on the downslope than the upslope to enable water to sheet off naturally and minimise hydrological changes and sediment mobilisation.

Trenching is proposed below this new track to lay wastewater, water and utility cables. Trenching is also proposed below the existing track from the Remarkables Gondola Base to the top of the existing Curvey Road, this will involve trenching utilities through two existing stream crossings (1 culvert 1 splash crossing) in the upper Rastus Burn Stream. It is understood that by laying utilities beneath the track, the total disturbance footprint is reduced. Where stream crossings are required, the 1 m wide by 2 m deep trenching will be dug across the waterway. It is proposed that the watercourses will be sand bagged (or similar) and water pumped around the works area to enable the trenching to occur largely in the dry. If water is likely to be diverted down the trench, concrete bulkheads will be used to ensure water continues to flow in the original flow path post works and no concrete is to be poured in flowing water.

2.2.2 Stream Crossings

To give an indication of the works area associated with stream crossings it has been assumed that stream width of the tributaries in the Doolans Basin on average is 1 m wide and the track crossing will be 8 m in length (noting that the actual formation width is likely to be in the order of 4 m to 6 m for splash crossings and 8 m for culverts). If 12 crossings were to be established this would equate to an instream works footprint of 96 m² within the Doolans Basin.

The Rastus Burn is wider (~3 m) at the existing splash crossing to be trenched with the existing track culvert needing to be removed and trenching undertaken underneath and then the culvert replaced. These two actions will result in the disturbance of approximately 16 m in length (splash crossing 8 m and culvert 8 m long).

Stantec, (2026b), outlines three methods to be used where the track crosses streams:



1. Culverts are proposed at larger or incised stream crossings (Figure 6).
2. Splash crossings (fords) are proposed at permanent or intermittent stream crossings with low gradient and low approach angles (Figure 7).
3. Engineered permeable track crossings are proposed at smaller ephemeral or seepage wetlands crossings. These are designed to enable hydrologic connectivity to remain intact between upstream and downstream wetland areas (Figure 8).



Figure 6: Culvert example (Stantec, 2026b).





Figure 7: Splash crossing (ford) example (Stantec, 2026b).

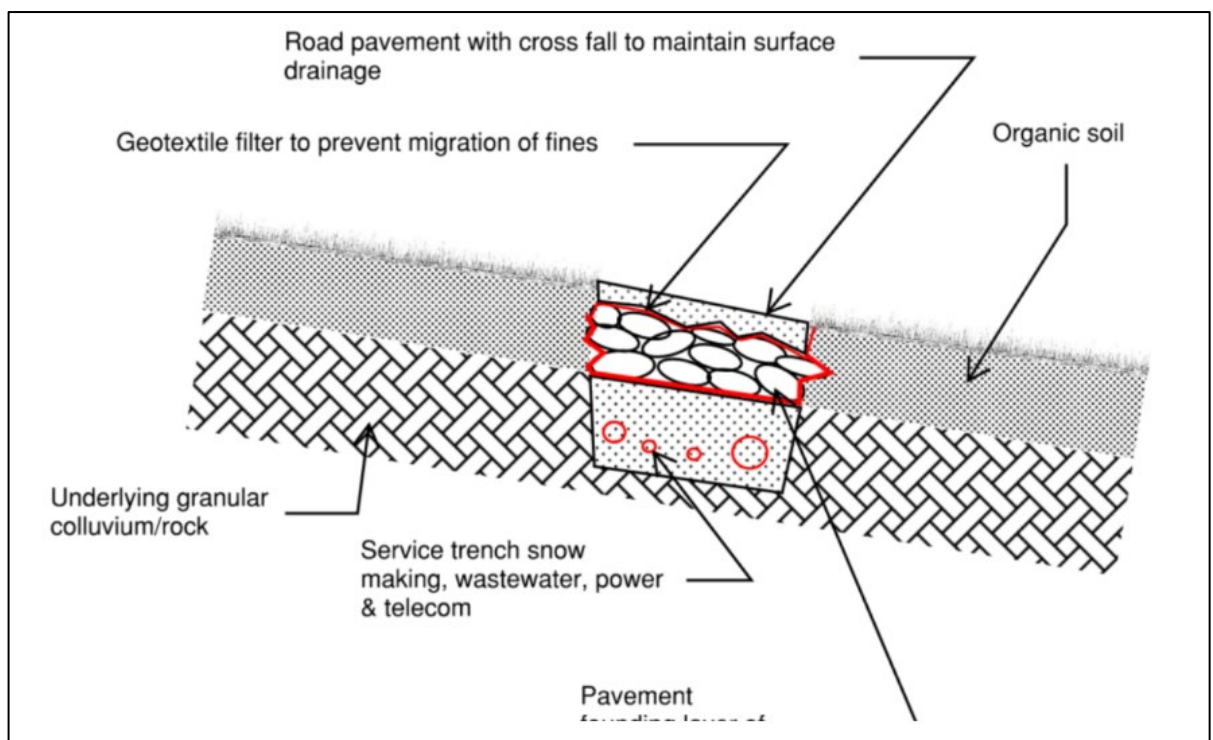


Figure 8: Engineered permeable track crossing design (Stantec, 2026b).



The locations of the proposed stream crossings are outlined in Figures 9-11 in Section 3 below. Note that there are some minor discrepancies between the Stantec report (2026b) and the draft Enviroscope CEMP report (Enviroscope, 2026). The Enviroscope CEMP and ESCP are draft reports, and they will be updated to respond to any changes to project design, resource consent conditions and detailed design completed prior to works commencing. Following this process the detailed design, CEMP and ESCP will be subject to certification processes. When assessing stream crossings, e3s have only assessed the crossings proposed in the Stantec report (Stantec, 2026b).

This inconsistency is not considered material to this assessment, as the CEMP and the ESCP are "draft" and will be updated to respond to any changes to the Project design, resource consent conditions and detailed design completed prior to works commencing. Both the detailed design and the CEMP and ESCP will be subject to later certification processes.

2.2.3 Reservoir Inflow Diversion

The intermittent inflow to the proposed water storage reservoir is to be redirected around the north and south in two armoured swales. The intermittent inflow channel has been mapped as 210 m long. The armoured swales will divert water away to the northern swale 55 m upstream of the reservoir and to the southern swale 32 m upstream of the reservoir. The southern swale is proposed to be 111 m long and the northern swale 177 m long. Snowmelt and rainwater will now be diverted around the reservoir and discharged into terminal armoured soakage fields (Stantec, 2026b). The loose bouldery landform will enable rapid soakage to groundwater along the swale length and at the terminal soakage field.

2.2.4 Base Building and Stormwater Run-off

Roof runoff from the base buildings and gondola stations will be collected in recessed guttering, conveyed to ground-level catch pits, and discharged via pipework to nearby streams (Stantec, 2026b). Smaller secondary buildings are not proposed to include guttering or dedicated stormwater infrastructure. Roofing is expected to comprise Colorsteel®, which typically leaches low concentrations of contaminants such as zinc and copper (Charters FJ, 2020).



3 Hydrological Assessment

The hydrology review of the SP, ESCP and CEMP assesses the following:

- Hydrological effects of the proposed crossings on streams and wetland.
- Hydrological effects of the proposed earthworks and associated discharges within 10 or 100 m of a wetland,
- Any loss of river or wetland extent and value,
- Effects of stormwater discharges.

3.1 Methodology

- Review of the Stantec SP (Stantec, 2026b) and Enviroscope ESCP and CEMP (Enviroscope, 2026).
- Mapping of the controls suggested in both reports.
- Field visit 30th April to photograph and briefly assess each crossing.
- Desktop assessment of hydrological effects of the proposed stream and wetland crossings and the effects of earthworks and discharges within 10 m or 100 m of a wetland.
- Desktop assessment of the effect of stormwater discharges and associated contaminants.

3.2 Wetland Assessment Context

3.2.1 Regulatory Context

Under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-FM), the ski field is considered specified infrastructure and the construction of this infrastructure is considered a discretionary activity (45) if:

(a) earthworks are within or within 10m of a natural inland wetland;

(b) Earthworks are between 10m and 100m of a natural inland wetland and results in, or are likely to result in, the complete or partial drainage of all or part of the natural inland wetland;

(c) the taking, use, damming or diversion of water is within 100m of a natural inland wetland, there is a hydrological connection between the taking, use,



damming and diversion and it will change, or is likely to change the water level range or hydrological functioning of the wetland.

The proposed activities are summarised with respect to the NES-FM (45):

- Earthworks for the construction of specified infrastructure are proposed to occur within a 10 m setback from a natural inland wetland, as such this activity is classed as a discretionary activity.
- Earthworks and land disturbance for the construction of specified infrastructure are proposed to occur between 10m and 100 m of natural inland wetlands. These earthworks are to be managed so they do not cause the complete or partial drainage of all or part of the natural inland wetlands present and therefore do not meet the discretionary activity criteria.
- Temporary diversion of water is proposed to occur within a 100 m setback of natural inland wetlands in locations where there is a hydrological connection between the water diverted and the wetland. The activity will be managed to ensure any diversion of water within 100 m of a natural inland wetland will not change the water level range or hydrological function of the wetland and therefore would not meet the discretionary activity criteria.

3.2.2 Terrestrial Ecological Wetland Assessment

Wetland delineation across the site is documented in the terrestrial ecological impact assessment for the project (e3Scientific, 2026c). Three types of wetland communities were identified – Riparian, Seepage and Cushion Bog. The key points with respect to the effects on wetlands made in that report are as follows:

- The direct **loss of vegetation** was assessed within the earthworks footprint, and via edge effects for two metres either side –“affecting less than 50% of the vegetation cover within this two-metre area. This vegetation alteration has been accounted for within the overall magnitude of effect relating to vegetation loss”.
- **Fragmentation and infrastructure impediment** losses were expected to have a Very High level of effect within wetland communities due to the importance of hydrological movement throughout the landscape being widely dispersed and interconnected, forming continuous tracts of vegetative cover and pathways for dispersal for a range of species. If



recommendations are followed, the residual effects are expected to be Moderate.

- **Sedimentation** of wetland communities is assigned a Moderate level of effect even when erosion and sediment controls are implemented.

The terrestrial ecological impact assessment did not include a review of the proposed stormwater plan (Stantec, 2026b) or the Erosion and Sediment Control Plan (Enviroscope, 2026). This section further reviews the activities proposed with respect to their hydrological impacts on wetland and streams based on the stormwater and erosion and sediment controls proposed.

3.3 Assessment of Hydrological Effects

3.3.1 Principles of Assessment

3.3.1.1 *Risks to Waterbodies from Stormwater & Erosion and Sediment Controls*

Key risks to waterway and wetland hydrology and water quality arising from the proposed stormwater management are assessed as:

- Sediment discharges into wetlands due to earthworks disturbance and access track runoff.
- Cut/fill activities diverting and concentrating flows from natural hydrology.
- Standard erosion and sediment control principles which divert clean water around earthworks and concentrate dirty water for treatment.
- The services trench underlying the access track could act as a conduit of bypass flow for seepage water from wetlands (especially a risk when trench into competent rock).

3.3.1.2 *Design Principles*

e3s recommends the following design principles in addition to the methodology described in the reviewed reports.

- Where stream crossings have steep sides, likely for Culverts A and H but subject to detailed design, services will not be trenched under stream crossings at culvert locations but will instead be placed within the access road as the access road is built up above culverts to cross the stream (D. Chinn, personal communication, 6 May 2026).
- Where the services trench passes through a wetland and where the trench is on a gradient and could divert wetland seepage water away from the natural flow path, a concrete collar (bulkhead) is recommended on the



trench up and downgradient of the wetland crossing. The concrete collar will ensure seepage water from the wetland does not flow along the trench away from the downslope wetland but instead water may fill the constrained trench and then continue to seep through to the downgradient wetland area over the top of the trench, maintaining wetland hydrology.

- Earthworks through wetlands shall be carried out in sections which take one day to complete to ensure water flow to the downgradient wetland is maintained, avoiding loss of wetland extent downgradient.

3.3.1.3 Assumptions & Limitations

- Due to some minor discrepancies between the Stantec report (2026b) and the draft Enviroscope CEMP and ESCP (Enviroscope, 2026) this review has focused on the crossings proposed in the Stantec report (Stantec, 2026b) acknowledging that the CEMP and the ESCP are "draft", subject to changes, followed by certification.
- Mobilisation of sediment will peak directly after the construction of the access track, and will stabilise soon afterwards.
- Concentration and diversion of stormwater flows may negatively impact on wetland hydrology and should be avoided where possible in permanent designs.
- The access tracks into the Doolans Basin will be most heavily trafficked during construction, after which time the road use will be limited to periodic maintenance activities in summer. The access track to the intake location will have the lowest use of all of the planned access tracks.
- Detailed design will assess exact locations of stormwater controls, provide in depth detail on erosion and sediment control measures as well as how these measures will transition to the permanent infrastructure. Reports reviewed and therefore our commentary reflect that detailed design has not been undertaken.

3.3.2 Temporary Access Tracks & Crossing

Where current and proposed access tracks do not intersect with the gondola towers a temporary access track will lead from the access track to the gondola towers for the purpose of installing the gondola itself (these tracks are shown in purple in Figure 9 and Figure 10). These tracks do not directly intersect wetlands however four of the temporary access tracks will be located within 10 m of a wetland. The methodology in the ESCP and CEMP recommends minimising



earthworks on these tracks as much as possible and the use of rubber matting near critical source areas (Enviroscope, 2026). The combination of these two measures and the temporary nature of the tracks will ensure there is no complete or partial drainage of wetlands between 10 m and 100 m and no change in water level of wetlands within 100 m of the earthworks.

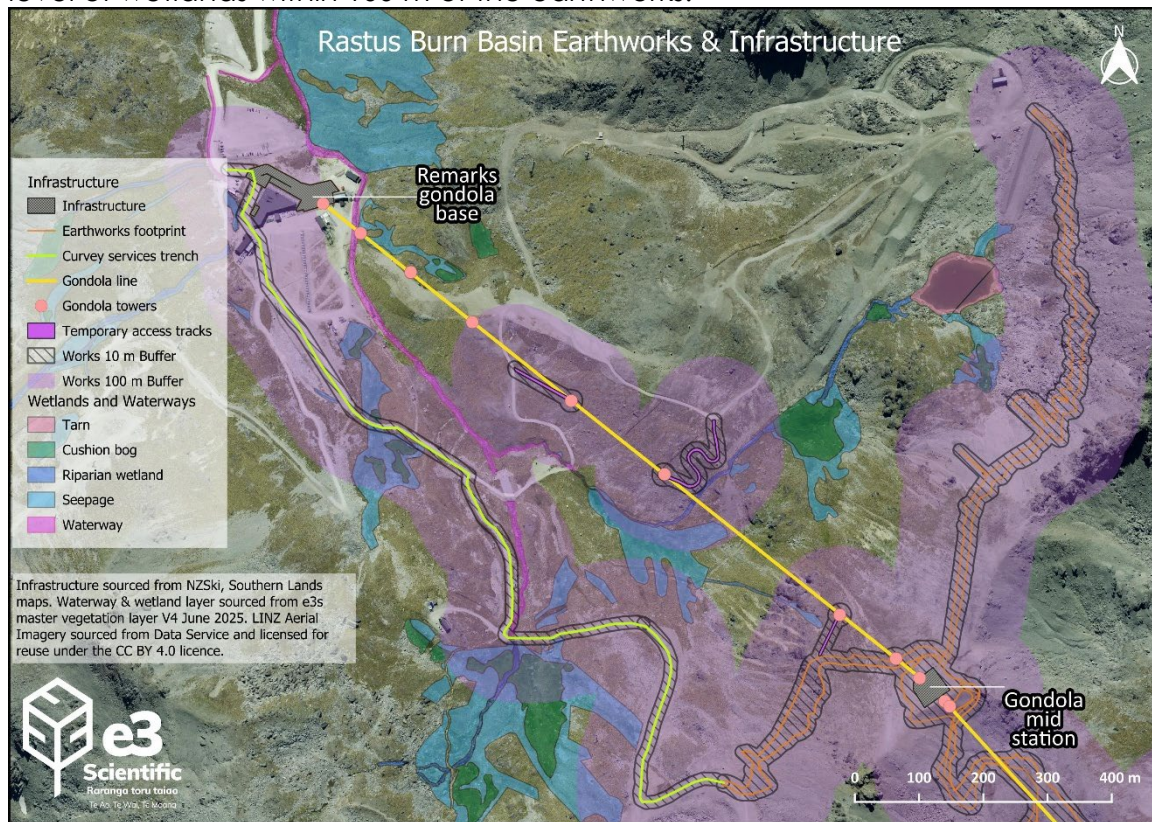


Figure 9: Wetlands within 10 or 100 m of earthworks for proposed access tracks in the Rastus Burn Basin.



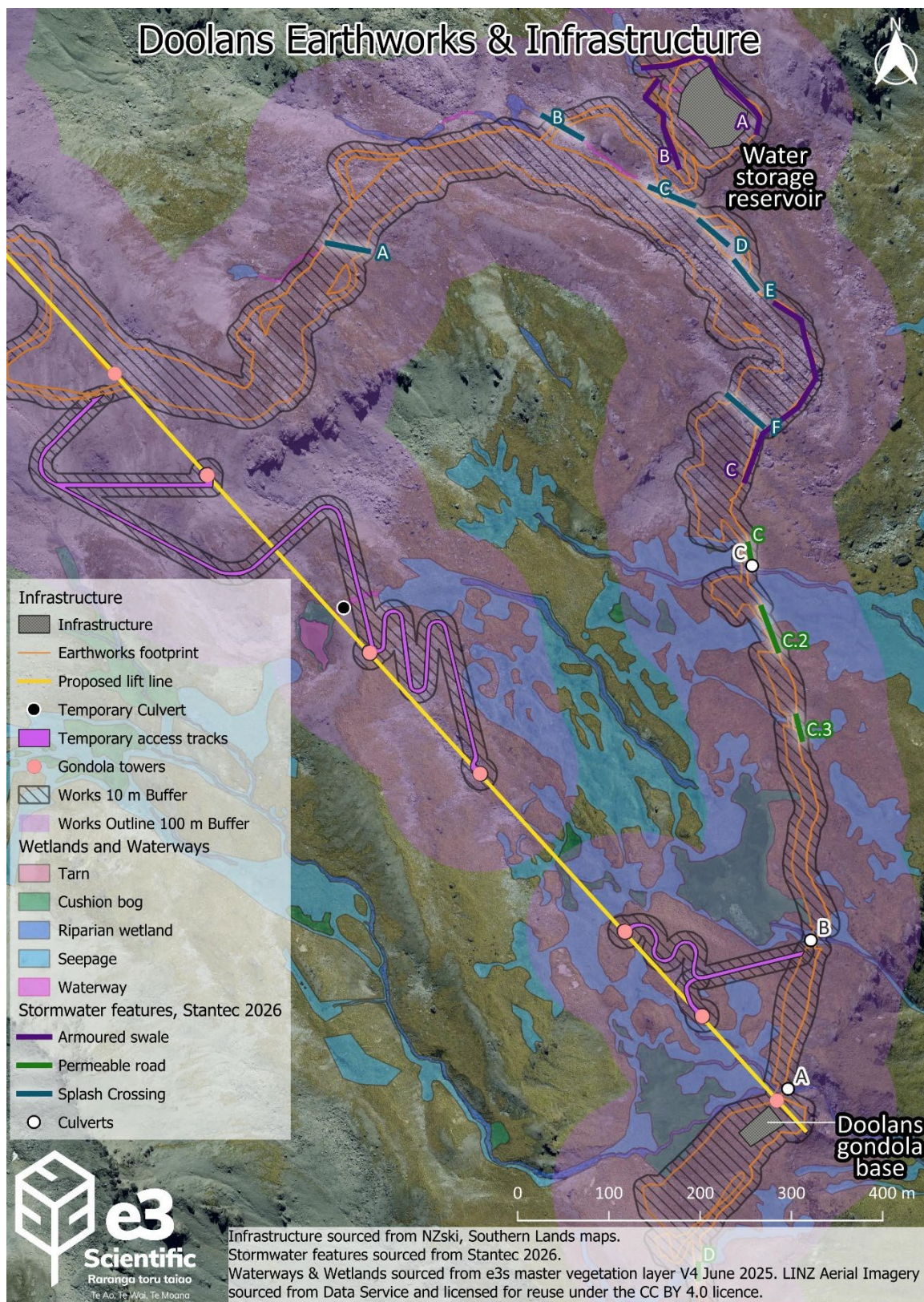


Figure 10: Wetlands within 10 or 100 m of earthworks for proposed access tracks in the Doolans Basin.





Figure 11: Example of temporary access track (left), rubber matting for use near critical source areas (right).

The temporary access track from the Gondola Mid Station to access the gondola towers in the Doolans crosses over a waterway at point T (pale red) on Figure 5. The ESCP (Enviroscope, 2026) recommends a temporary culvert over this crossing. Overall, a temporary culvert will have a lower long-term impact on stream hydrology than installing a splash crossing. We recommend even if the temporary access track is required for more than one construction season, that the temporary culvert be removed at the end of the construction season to ensure it does not restrict flow and induce scouring during spring high flows.

Due to the temporary nature of the culvert (and as long as it is removed at the end of the construction season), there will be no effects on stream or wetland hydrology, loss of river or wetland extent and the placement of the culvert itself will not result in discharges to the downgradient wetlands.

3.3.3 Gondola Towers

Gondola Towers are marked by pink dots in Figure 9 and Figure 10. All towers are located outside of wetlands and waterways however two are located within 10 m of wetlands. Towers will either be accessed along the access track or via temporary access tracks. The ESCP and CEMP (Enviroscope, 2026) recommend general mitigations and those specific to the installation of gondola towers such as marking the work zone extent by personal, including the site ecologist, and reinstating vegetation and rock evenly around the tower footing after construction. If during construction of tower footing dewatering is required then the methodology in the CEMP is to be followed and any water diversions in place,



as part of dewatering, are to maintain the hydrological connectivity of surrounding wetlands. These measures will ensure there is no complete or partial drainage of wetlands between 10 m and 100 m and no change of water level to wetlands within 100 m.

3.3.4 Rastus Burn Basin

The assessment of hydrological effects in the Rastus Burn Basin addresses the effects of earthworks and discharges from access track works, temporary access tracks (Section 3.3.2), Gondola towers (Section 3.3.3) and the expansion of the Remarkables base building on the hydrology of wetlands within 10 m and 100 m.

3.3.4.1 *Curvey Services Trench*

The proposed Curvey services trench is highlighted green in Figure 9. The trench is to be placed under the existing Curvey access track and is located within 10 m of wetlands already intersected by the track. There has been no proposal and therefore no subsequent assessment that the installation of this trench and associated earthworks extend outside of the existing Curvey access track and as such it must be kept within this area. The CEMP specifically recommends controls and mitigations to occur during service trench excavations, for example that the trench should only be extended as far as it can be backfilled and restabilised within 24 hours of a forecast significant rainfall event (Enviroscope, 2026). If additional water is observed in the trench and the trench is thought to be a conduit of water away from wetlands then, as per Section 3.3.1.2, a concrete collar is to be installed up and downgradient in the trench.

Where the trench crosses the Rastus Burn or intersects wetland hydrology it is important that the existing hydrology is maintained after trench installation. For the crossing of the Rastus Burn this would mean that the crossing gradient would maintain flow rates to avoid changing the water level in the upgradient wetlands. If wetland hydrology is intersected, flow must be enabled to pass through the trench to the downgradient wetlands, as described above. Trench installation through these areas will require appropriate controls to divert clean water around the trench during installation and mitigate sediment mobilisation. Where this relates to wetlands, diversions shall occur only for a length which can be completed in one day to ensure water flow to the downgradient wetland is maintained (Section 3.3.1.2).



Given the footprint of activities related to the trench installation is contained to the existing Curvey access track, the design principles (Section 3.3.4.1) and controls outlined in the finalised versions of the ESCP and CEMP (Enviroscope, 2026) are implemented, we consider that there would be no complete or partial drainage of wetlands between 10m and 100 m and no change in water level of wetlands within 100 m.

3.3.4.2 Remarkables Base Building

The expansion of the Remarkables Base Building to house the Gondola terminal will not be located within 10 m of a wetland. Earthworks will be carried out within 100 m of wetlands, however the footprint is contained by a large carpark area around which erosion and sediment controls can be setup to mitigate discharges. Stormwater from the additional roof area is proposed to be discharged to ground and then diverted to the existing piped stormwater system. This stormwater would previously have been diverted from the carpark area via stormwater channels to the Rastus Burn and is not considered to have contributed to wetland hydrology.

Given stormwater is discharged via the existing piped network we consider that there would be no complete or partial drainage of wetlands between 10m and 100 m and no change in water level of wetlands within 100 m.

3.3.4.3 General Access Track Works

Figure 9 shows proposed access tracks for the new Gondola mid station with 10 m and 100 m buffers to identify wetlands within these setbacks of the earthworks. Whilst there are no wetlands within 10 m of the track, there are wetlands within 100 m of the proposed earthworks.

The proposed access track section from the top of the Sugar chairlift to Helicopter Ridge cuts across a very steep face and will require some large cuts and fills to create a platform. Part of the fill is suggested to be gabion baskets which will create a permeable surface and encourage infiltration of stormwater. Additionally, the area between the access track and the wetlands is comprised of large rocks and boulders and is highly permeable.

Stantec (2026) propose that, as much as possible, flow is maintained across the track as existing sheet flow and through ephemeral flow paths. Given that maintaining an even grade along the track will be difficult, flow continuity may



be provided by side water channels across the track to catch flow from the track and surrounding slopes and move it across the track at discharge points. This will result in numerous very small discharges off the track rather than a lesser number of concentrated flows that require culverting. This approach has been proven to be successful in the Rastus Burn catchment (see Figure 12). While the placement of stormwater channels is subject to detailed design, in general this approach is considered the best way to avoid concentrating flows which may then result in scour and movement of material into the downgradient wetlands, or diversion of flows away from wetlands.



Figure 12: Stormwater channels to maintain surface sheet flow as much as possible (Stantec New Zealand, 2026).

In areas of steep slope, the use of gabion baskets to support the required fill will assist in capture of sediment that passes through sediment controls. If flow concentration is avoided, runoff will infiltrate into the highly permeable rocky substrates prior to reaching the downgradient wetlands. Additionally, the finalised CEMP and ESCP, alongside detailed design, will contain specific measures to mitigate discharges from the track.

If these controls are followed, wetland hydrology will not be affected by the works, and sedimentation of wetlands will be avoided.

3.3.5 Doolans Basin

The assessment of hydrological effects in the Doolans Basin focuses on effects to stream and wetland hydrology from the proposed wetland and waterway



crossings and stormwater controls, effects of earthworks and discharges within 10 or 100 m of wetlands and the loss of waterway or wetland extent. The effects of general access works, are discussed in the following section, prior to assessment of the effects track crossing streams and wetlands and crossings within 10 m or 100 m of wetlands.

3.3.5.1 General Access Track Works

Figure 10 shows the proposed access track from the Gondola mid station to Doolans Gondola base building with 10 m and 100 m buffers to identify wetlands within these setbacks of the earthworks. This section addresses effects from the access tracks that are not within wetlands but within these buffers. This map demonstrates that there are extensive areas of wetlands within these areas; the complete or partial drainage of wetlands between 10 m and 100 m would be a discretionary activity.

Where areas of wetland are upgradient of the road works (i.e. generally west), the access works will not result in any sedimentation. Given the geology of the area (thin soils over bedrock, with accumulations of peat in wetland areas), road works greater than 10 m away of wetlands are unlikely to cause any drainage or changes to hydrology within the wetlands, if sheet flow is maintained across the track. However, it is recommended that:

- Wetlands within 10 m of works are clearly demarcated prior to any construction works,
- Earthworks are paused for further assessment if there is significant water make within any cuts. Additional sections of Permeable Road may be required to maintain hydrological connectivity in these locations and they should be assessed accordingly.

This is particularly important for the large area of seepage and cushion bog wetland which is located to the west of the Doolans Gondola base building and mostly south of the proposed lift line. The track is generally located on a small rise adjacent to the wetland area, however cuts do extend right up to wetland boundaries. The contour of the track generally means wetland seepage will not be impacted by the access track, other than in areas that are recommended for permeable tracks (see the next section).

Figure 13 shows proposed access track from the Doolans Gondola base building to the water intake in the Doolans Creek with 10 m and 100 m buffers to identify



wetlands within these setbacks of the earthworks. Areas within 10 m are mostly addressed with crossing solutions to maintain hydrological connectivity, however there are some areas with downgradient wetlands that could be sustained by flows above the proposed track. If management measures are followed, expect there will be no complete or partial drainage of wetlands between 10 m and 100 m and no change in the water level of wetlands within 100 m of the earthworks

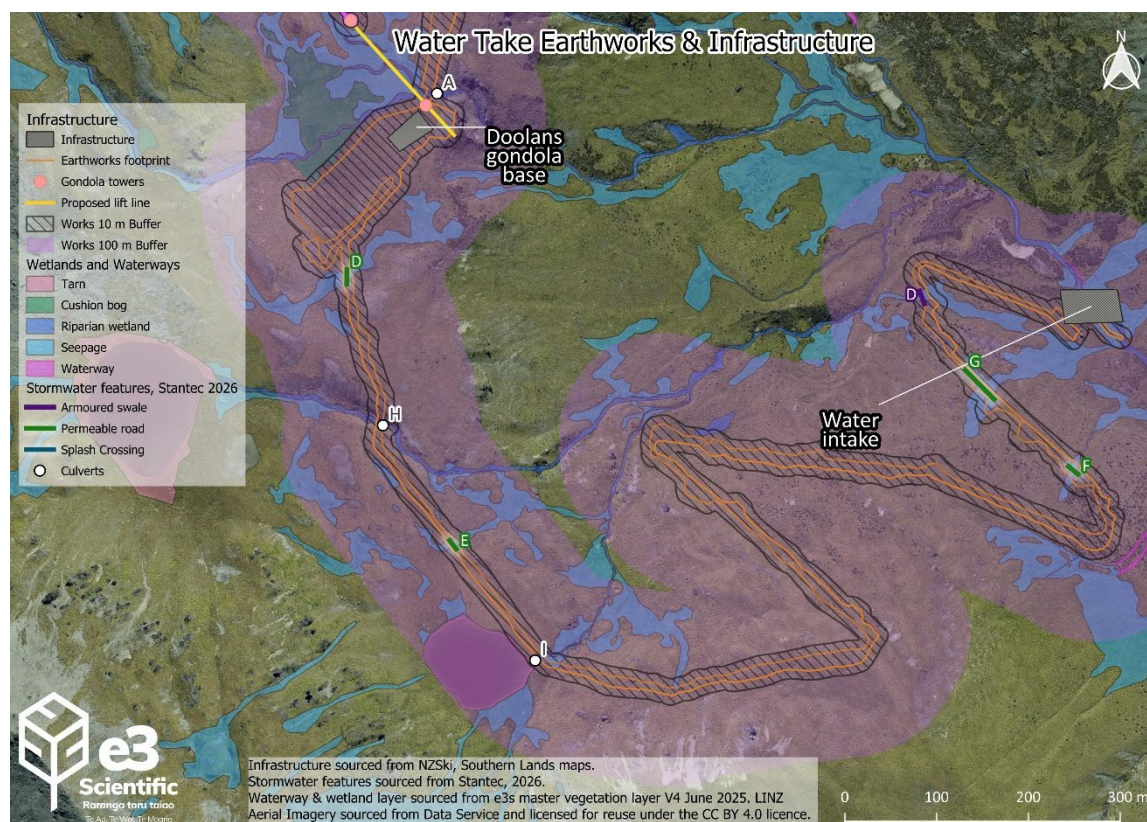


Figure 13: Wetlands within 10 or 100 m of earthworks along the Doolans Creek water take access road.

During construction, discharges will be managed through dirty water diversions, these will be outlined in the finalised ESCP and CEMP developed during detailed design. Long term, sediment discharges in this environment are expected to be very low and track contouring to immediately discharge stormwater off the track is considered the best approach to avoid concentrating flow.

3.3.5.2 Doolans Base Building & Learners Slopes

The proposed Doolans base building and learners slopes will require cut and fill earthworks to occur within 10 m of wetlands. The wetland area around the Doolans base building and learners slopes drains through a stream which is proposed to pass through Culvert A. As part of sizing Culvert A Stantec have



undertaken an analysis of the catchment feeding the stream and therefore wetland (2026b). The catchment is 61.45 ha and includes only a small part of the learners slope area Figure 14. From the analysis undertaken the proposed Doolans base building and learners slopes are not within the catchment for the wetland and we have assessed that their construction will not result in complete or partial drainage of wetlands between 10 m and 100 m. This is subject to the review of wetland hydrology in this area during detailed design site investigations. If any changes to the catchment are noted or impact on wetland hydrology assessed, then changes to the size or construction of the learners slope will be required to ensure wetland hydrology is maintained.

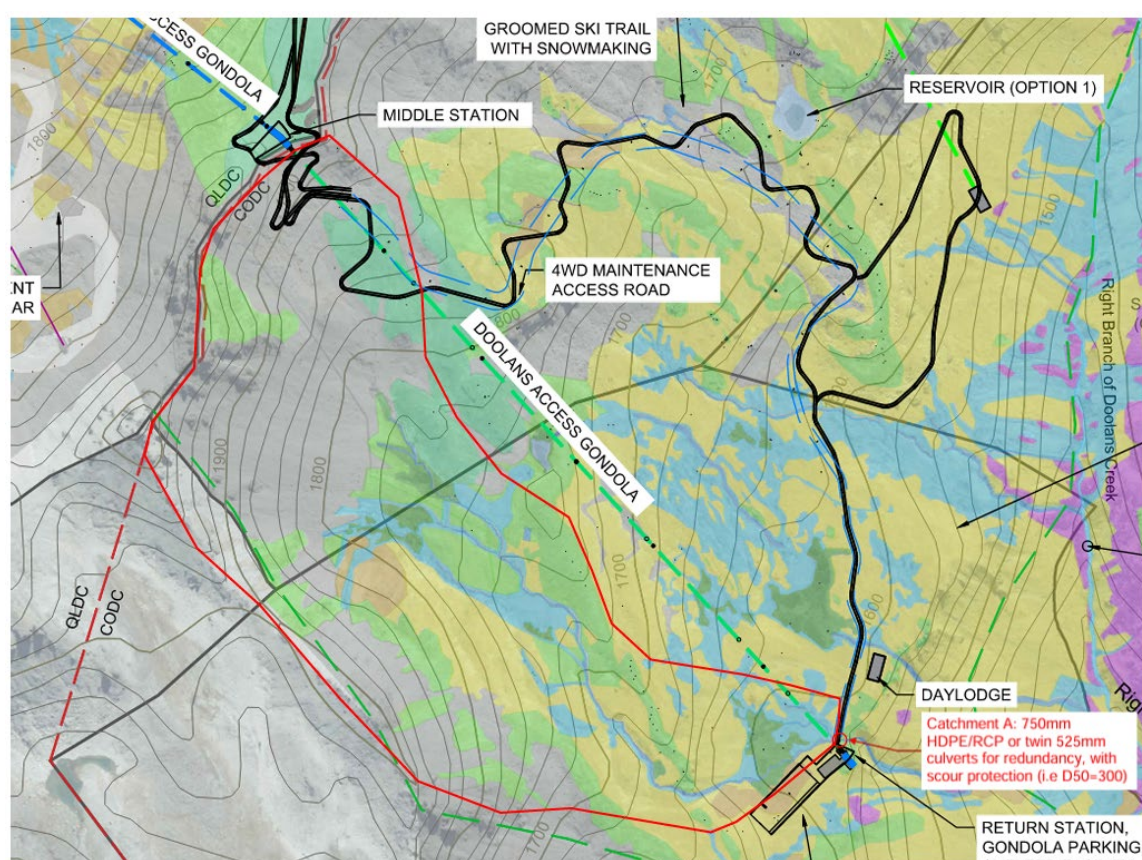


Figure 14: Catchment A (Stantec, 2026b).

3.3.5.3 Assessment of Crossings

The locations of each of the crossings are shown in Figure 4 and Figure 5 in Section 2.2. Crossings are grouped into the following main categories and the effects of these crossings or controls, associated earthworks and discharges on wetland and waterway hydrology and any loss of wetland or waterway extent are assessed in Table 1 to Table 4:



- Splash Crossings A – F marked in blue in Figure 5 are assessed in Table 1,
- Culverts A – I marked by white dots in Figure 5 and Figure 12 are assessed in Table 2,
- Permeable Tracks C – G marked in green in Figure 5 and Figure 12 are assessed in Table 3,
- The Proposed Temporary Crossing marked by a black dot in Figure 5 is assessed in Section 3.3.2.

In Table 1 the effect of Splash Crossing A – F (marked blue in Figure 5), associated earthworks and discharges on stream and wetland hydrology are assessed alongside any loss of river or wetland extent. Loss of wetland value has been assessed by e3s (2026) and loss of river value has been assessed in Section 5.

Table 1: General Assessment of Splash Crossings

Assessment	Splash Crossing A - F
Hydrological effects of Splash Crossings on stream & wetland hydrology	Splash Crossings are commented on individually below however in general stream hydrology is maintained and there are no splash crossings over wetlands.
Hydrological effect of earthworks and discharges associated with Splash Crossings within 10 or 100 m of wetlands	There are no Splash Crossings over wetlands. Splash Crossings are located within 10 m or 100 m of a wetland however these crossings are either downgradient or cross gradient of the wetland therefore not impacting the hydrology of the wetlands which are sustained by their upgradient catchments.
Loss of river or wetland extent	There is no loss of wetland extent from Splash Crossings. Splash Crossings will maintain stream extent. Rip rap will be used for the bed of the splash crossing. We recommend clean rip rap is used to reduce sediment load on streams and additional rip rap is added when required to reduce damage to stream bed and suspension of sediment.
Technical details	All splash crossings assume a 2% bed grade, a side slope of 1V:3H and a depth of 200-250 mm (300 mm maximum).

A photo of each of the crossings with supporting commentary is provided in Figure 15. All photos were taken on 30th April, 2026 during dry, sunny conditions with significant runoff due to snowmelt. Orange arrows show the approximate crossing location and direction of track. Blue arrows show the direction of water flow.



Figure 15: Review of Individual Splash Crossings.



Splash Crossing A: Crosses outflow from a small tarn. There are no nearby wetlands, and the stream goes to ground soon after this location



Splash Crossing B: There is a wetland immediately upgradient of this crossing. It is important that the crossing is placed, as mapped, where the gradient increases and the wetland becomes a intermittent stream. During the site visit the waterway was not observed on the surface but was instead heard running underneath the boulders.





Splash Crossing C: This is downgradient on the same channel as Splash Crossing B. At the site visit water was heard passing underneath ground through the large boulders visible.





Splash Crossing D: downstream on the same channel as B and C. At the site visit no stream was visible, and no water was heard underground. Likely the stream had infiltrated to ground upgradient.



Splashing Crossing E: Final crossing downgradient of D. At the site visit no water was seen on the surface or heard moving through the boulders at this location.





Splash Crossing F: Detailed design required to address how this will terminate in Armoured Swale C. At the site visit no water was observed on the surface or heard running through boulders.

Table 2 summarises the effect of Culvert Crossings A – I (marked by white dots in Figure 5 and Figure 12) and associated earthworks and discharges on stream and wetland hydrology alongside any loss of river or wetland extent. Loss of wetland value has been assessed by e3s (2026) and loss of river value has been assessed in Section 5.



Table 2: Assessment of Culvert Crossings

Assessment	Culvert Crossing A – I
Hydrological effects of Culvert Crossings on stream & wetland hydrology	<p>Culverts will have a localised effect on stream hydrology by introducing changes to the natural channel profile, bed and therefore flow dynamics. Culverts are sized for 1 in 50-year return storm events and inlet and outlet protection is provided to avoid overtopping and scouring. Clean material should be used for inlet and outlet protection, maintenance of this protection is required and the culvert must be kept clear of debris.</p> <p>Wetlands are often present on the approach or exit from Culvert Crossings across waterways. Where the seepage path is downgradient, running parallel to the stream, a Permeable Access Track should be considered in detailed design; these are assessed in Table 3. Where the direction of the seepage path is uncertain we have included recommendations (Section 3.4) to assess wetland flow paths during detailed design to determine if a Permeable Access Track is required.</p>
Hydrological effect of earthworks and discharges associated with Culvert Crossings within 10 or 100 m of wetlands	<p>Where the approach to and exit of the access track over a culvert passes through a wetland there will be disruption to wetland hydrology; this is assessed in Table 3 - Permeable Access Tracks. As suggested in Section 3.3.1.2 Design Principles, earthworks over wetlands must be completed within a day to maintain the hydrology and therefore integrity of the down gradient wetland. The ESCP suggests that during work in a waterbody the waterbody will be temporarily diverted by utilising a pipe drop structure to avoid clean water flowing over exposed earth. Detailed methodology has not been provided at this stage. Any diversion of clean water during installation of culverts must ensure that flow of water to a wetland is not cut off for more than a day. Controls to manage the earthworks associated with culverts on surrounding wetlands are also subject to detailed design. We recommend an appropriate sediment control is implemented on the downgradient access road edge to reduce discharges into wetlands.</p>
Loss of river or wetland extent	<p>Loss of stream extent will occur around culverts:</p> <ul style="list-style-type: none"> • Upgradient of the culvert, due to local changes to flow as water enters the culvert • For the length of the culvert. • Downgradient where scour protection has been installed at the pipe outlet until it returns to natural stream bed. <p>Loss of stream value has been assessed in Section 5. As discussed above loss of wetland extent has been assessed in Table 3 and loss of wetland value by e3s (2026).</p>
Culvert technical details	<p>Runoff coefficient of 0.25, based on catchment slope and material present. Representative Concentration Pathway 8.5 (RCP 8.5) to provide potential flow rates for 2100.</p> <p>Culvert length 8 m (access road width 4-5 m)</p> <p>Culvert longitudinal slope 1-1.5%</p>

A photo of each of the crossings with supporting commentary is provided in Figure 16. All photos were taken on 30th April, 2026 during dry, sunny conditions with significant runoff due to snowmelt. Orange arrows show the approximate culvert location and direction of track. Blue arrows show the direction of water flow.



Figure 16: Review of Individual Culvert Crossings



Culvert C: Yellow highlighted areas suggest approximate location of seepage wetlands relevant to Culvert Crossing (orange). A Permeable Track has been recommended by Stantec and is assessed in Table 3.

For RCP 8.5 $Q = 700 \text{ L/s}$.

Inlet & outlet scour protection size $D_{50} = 300\text{mm}$.

Culvert sizing 750 mm HDPE/RCP or twin 450 mm for redundancy and to reduce height

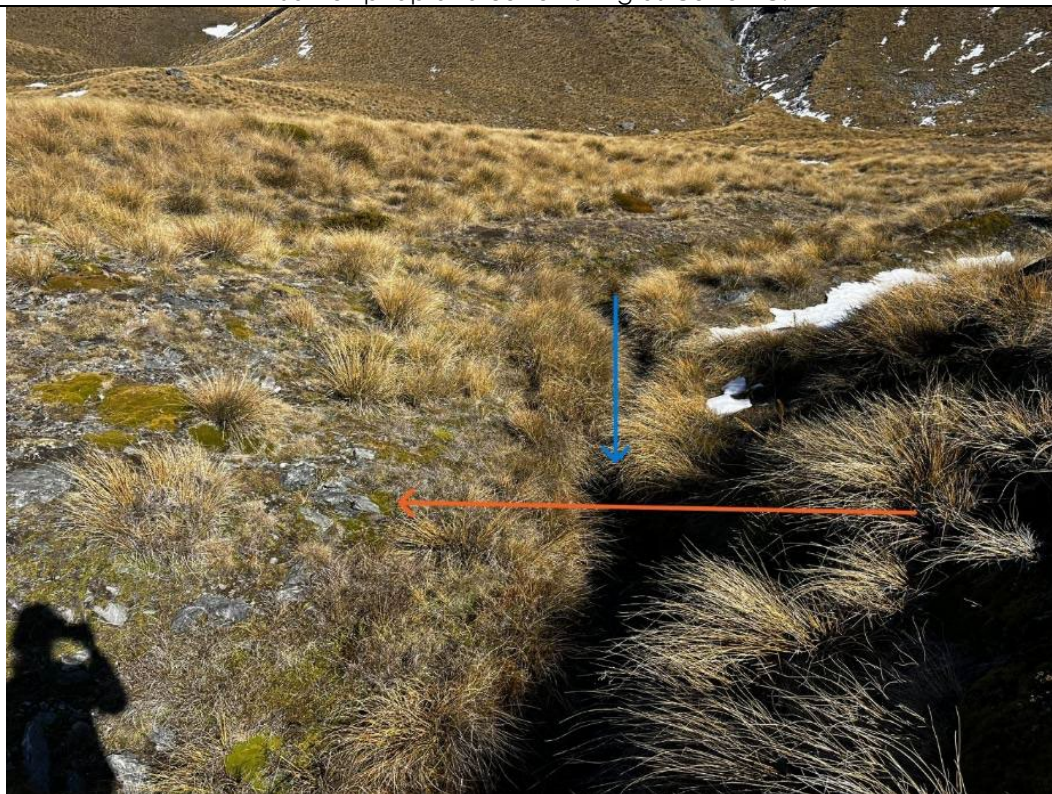




Culvert B: Yellow area represents approximate location of seepage wetlands relative to the culvert crossing (orange). Although the stream at Culvert B is less incised than the stream at Culvert C it is expected to convey significant flow from the catchment in spring and therefore is suited to a culvert. Two culverts are recommended here to reduce stream constriction and maintain hydrology.

For RCP 8.5 $Q = 710 \text{ L/s}$.

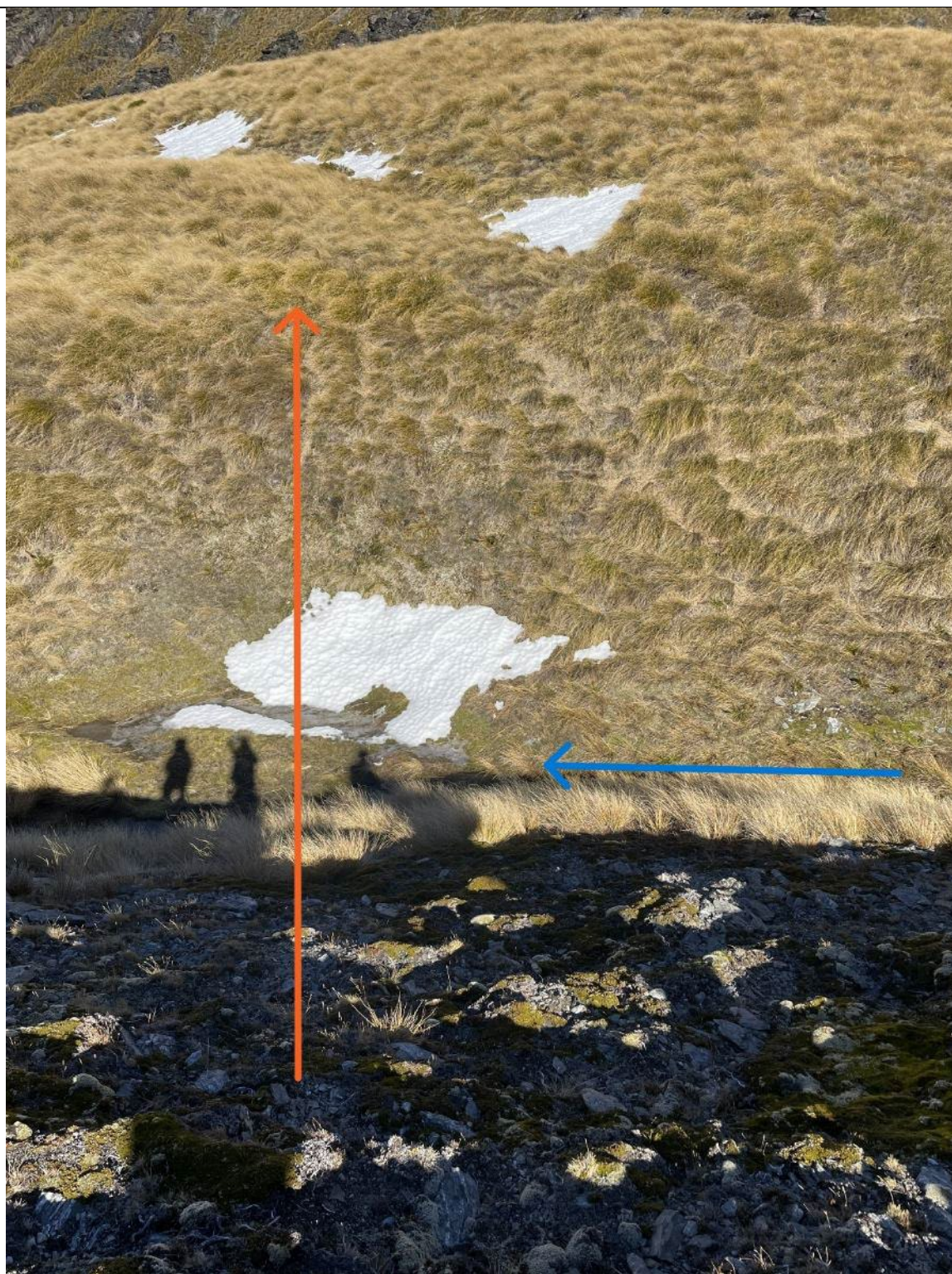
Same rip rap and culvert sizing as Culvert C.



Culvert A: Culvert A is again incised and has a high modelled flow rate for RCP 8.5 of $Q = 1800 \text{ L/s}$, it is the outlet for a large area of cushion bog and seepage wetland.

Culvert sizing 900 mm or two 600 mm pipes.





Culvert H: This stream sits in a gully and will require significant earthworks to build up the access track. A larger footprint, subject to detailed design, will likely be required here to support the access road therefore the loss of stream extent will be larger than for other crossings. There is no wetland present immediately surrounding this crossing. It is located on the water take access road below the outlet of a tarn.

For RCP 8.5 $Q = 730 \text{ l/s}$

Approximate culvert sizing of 900 mm has been provided at this stage.





Culvert I: Yellow area represents approximate location of surrounding seepage wetland area. Culvert I is directly downstream of a tarn on the water take access track. Installation of a Permeable Access track is recommended if water flow is thought to be parallel to the stream rather than seeping out from the stream during detailed design,

For RCP 8.5 $Q = 700 \text{ L/s}$.

Approximate culvert sizing of 900 mm has been provided at this stage.



In Table 3 the effect of Permeable Access Tracks C – G (marked green in Figure 5 and Figure 12) and associated earthworks and discharges on stream and wetland hydrology are assessed alongside any loss of river or wetland extent. Loss of wetland value has been assessed by e3s (2026) and loss of river value has been assessed in Section 5.

Table 3: Assessment of Permeable Access Tracks

Assessment	Permeable Access roads C – G
Hydrological effects of Permeable Access Tracks on stream & wetland hydrology	Where the access tracks crosses wetlands only the 4WD access track will be developed, the ski trail will be formed each winter from snow to reduce the area of earthworks within wetlands. Wetland hydrology will be maintained either side of the access track through the installation of Permeable Access Tracks Figure 8 and following the design principles (Section 3.3.1.2). We recommend assessing wetlands downgradient of the Permeable Access Tracks within one week of works completion, and one year later to ensure hydrology has been maintained and for any issues to be addressed if required. There are no Permeable Access Tracks over streams and they are not expected to affect stream hydrology.
Hydrological effect of earthworks and discharges associated with Permeable Access tracks within 10 or 100 m of wetlands	Erosion and sediment controls around Permeable Crossings are not currently addressed in the ESCP. However, in general the ESCP recommends undertaking works when water levels in wetlands are low which will reduce sediment mobilisation to the surrounding wetland environment. Completing earthworks in wetlands in daily sections (design principles, Section 3.3.1.2) will also reduce sediment mobilisation. We recommend an appropriate sediment control is implemented on the downgradient access track edge to reduce discharges into wetlands.
Loss of river or wetland extent	There are no Permeable Access Tracks over streams therefore no loss in stream value. The extent of wetland loss has been assessed to be the width of the access track with no more than a 50% loss in wetland vegetation up to 2 m either side (e3Scientific Ltd, 2026). We have assessed that as long as our design principles, recommendations and the Permeable Access Tracks are implemented wetland loss will not be extend beyond this. Loss of wetland value has been assessed by e3s (2026).

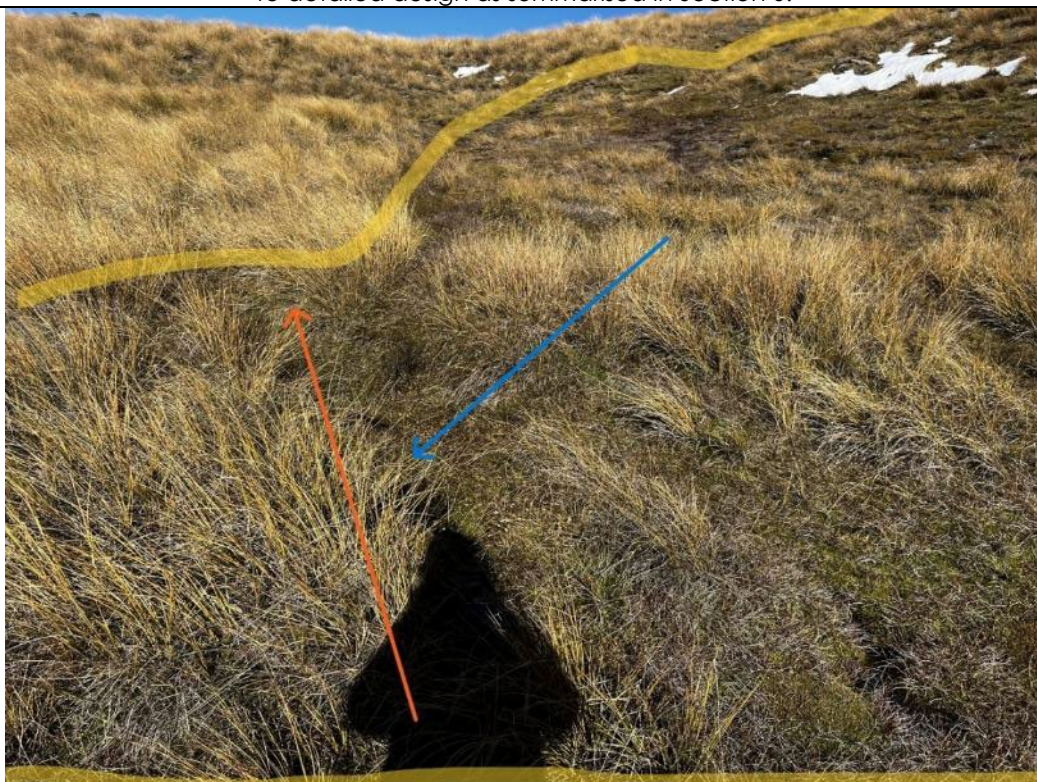
A photo of each of the crossings with supporting commentary is provided in Figure 17. All photos were taken on 30th April, 2026 during dry, sunny conditions with significant runoff due to snowmelt. Orange arrows show the approximate culvert location and direction of track. Blue arrows show the direction of water flow.



Figure 17: Review of Individual Permeable Track crossings



Permeable Track C: Wetland areas are highlighted in yellow. A Permeable Track has been recommended (Stantec New Zealand, 2026) with the placement adjacent to culvert C subject to detailed design as summarised in Section 0.



Permeable Track C-2: Blue line indicates general direction of flow. There is no waterway present, a Permeable Track of approximately 20 m will be required over the seepage wetland.





Permeable Track C-3: No waterway is present, a wetland crossing of approximately 10 m between the yellow lines will be required over the seepage wetland.



Permeable Track D: No waterway is present, a wetland crossing of approximately 15 m between the yellow lines will be required over the seepage wetland.





Permeable Track E: No waterway is present, a wetland crossing of approximately 10 m between the yellow lines will be required over the seepage wetland.



Proposed Permeable Track I: Review of Culvert I (Section 0) recommends a Permeable Track here, subject to detailed design.





Permeable Track F: No waterway is present, a wetland crossing of approximately 5 m between the yellow lines will be required over the seepage wetland.





Permeable Track G (foreground), Proposed Permeable Track H (background): No waterways are present, however a wetland crossing of approximately 20 m will be required over the seepage wetland at Permeable Track G. Due to the contour of the access t upgradient of Proposed Permeable Track H there will also be an Armoured Swale (Table 4) that will carry stormwater past this wetland area.



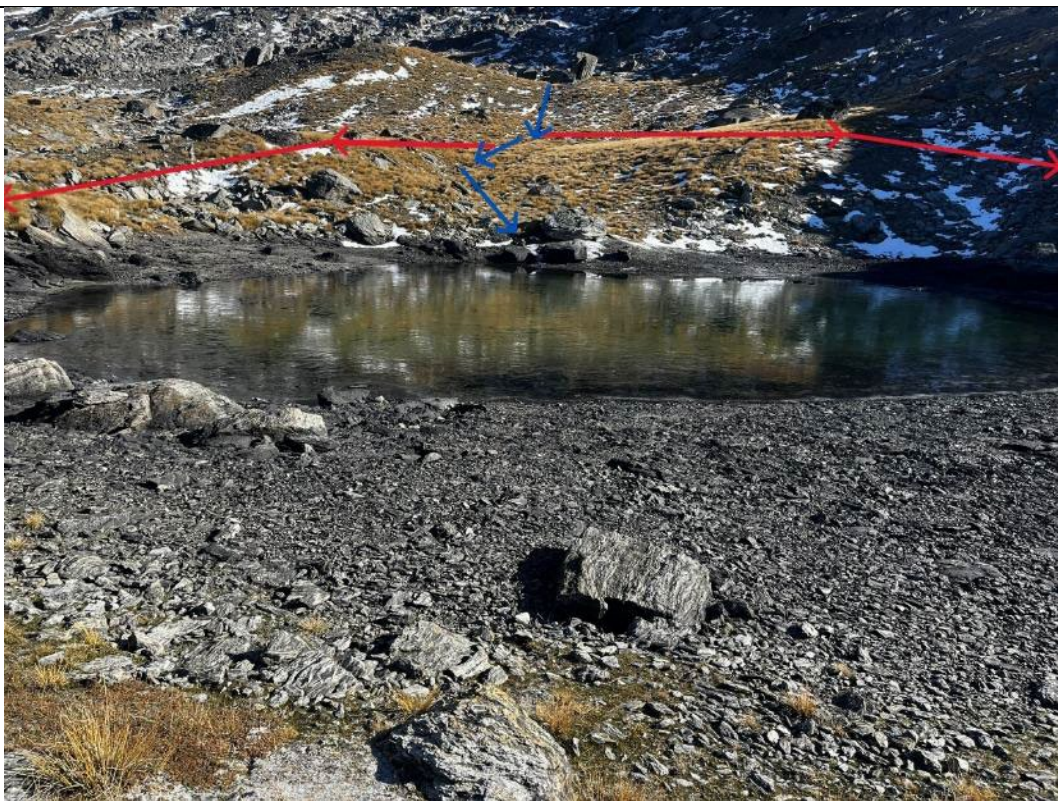
3.3.5.4 Armoured Swales

In Table 4 - Table 6 the effect of Armoured Swales A – D (marked purple in Figure 5 and Figure 12) and associated earthworks and discharges on stream and wetland hydrology are assessed alongside any loss of river or wetland extent. Loss of wetland value has been assessed by e3s (2026) and loss of river value has been assessed in Section 5.

Table 4: Assessment of Armoured Swales A & B

Assessment	Armoured Swales A & B
Hydrological effects of Armoured Swales A&B on stream & wetland hydrology	<p>Armoured Swales A & B have been recommended by Stantec to prevent stormwater and snowmelt from entering the Water Storage Reservoir, hence avoiding sedimentation. Water will be redirected around the reservoir and discharged to armoured soakage swales. The small stream that intermittently carries flow into the proposed reservoir will be diverted into these swales therefore stream hydrology will be affected for this section. However, discharge points for the swales are proposed to be where paths from natural overtopping of the tarn would occur and will maintain contribution to shallow groundwater which would likely have been occurring from the tarn.</p> <p>There is a riparian wetland area upgradient which feeds the intermittent stream and we recommend that the Armoured Swale A intersects downgradient of the transition to a stream to avoid any impacts on wetland hydrology. There is no impact expected to the hydrology of downgradient wetlands. This is also discussed in (e3Scientific Ltd, 2026a).</p>
Hydrological effect of earthworks and discharges associated with Armoured Swales A&B within 10 or 100 m of wetlands	The wetland that is within 10 m and 100 m of Armoured Swale A&B is upgradient of the Swale and therefore there will be no hydrological effects or discharges from earthworks to it
Loss of river or wetland extent	There will be loss of stream extent between the point Armoured Swale A intersects it and where it terminates at the proposed reservoir. Loss of stream value has been assessed in Section 5. There will be no loss of wetland extent if the armoured swale diverts the stream downgradient of the wetland.





Armoured Swale A & B: Approximate location of Armoured Swales (red) and waterway (blue).
Location of the riparian wetland has not been denoted, placement of the swale during detailed design will be subject to wetland location.



Table 5: Assessment of Armoured Swale C

Armoured Swale C	
Hydrological effects of Armoured Swale C on stream & wetland hydrology	<p>Where the access track runs up against an old moraine it will not be possible for stormwater to be discharged off the access track. Armoured Swale C has been recommended by Stantec to collect stormwater and carry it along the outside of the moraine before discharging it.</p> <p>Splash Crossing F occurs within the area of Armoured Swale C and the integration of these two stormwater controls needs further development during detailed design. Water from the swale is proposed for discharge into an existing small gully to the side of the access road. We recommend that this water is appropriately dispersed to avoid scouring and channelisation.</p>
Hydrological effect of earthworks and discharges associated with Armoured Swale C within 10 or 100 m of wetlands	<p>There are two locations where Armoured Swale C is within 100 m of a wetland. The seepage pathway for the upgradient wetland is likely from the intermittent stream over which Splash Crossings B – E pass. Armoured Swale C is downgradient of this and is unlikely to impact the hydrology of this seepage. The downgradient wetland within 100 m is associated with Culvert C. Water discharged from Armoured Swale C could result in extra water in this catchment and potential scouring. To avoid this discharge impacting the wetland hydrology water from the swale must be dispersed.</p>
Loss of river or wetland extent	<p>Given the path of Armoured Swale C and recommendation for dispersal of the discharge water there should not be a loss of stream or wetland extent.</p>
 <p>Armoured Swale C: Approximate location of Armoured Swale C (red) to convey stormwater from the access track past the extent of the moraine wall before discharging it.</p>	



Table 6: Assessment of Armoured Swale D

Armoured Swale D	
Hydrological effects of Armoured Swale D on stream & wetland hydrology	Where the contour of the access track results in concentration of stormwater Armoured Swale D is proposed to convey stormwater past the wetland before discharging it. Given our recommendation for Proposed Permeable Access track H, wetland hydrology should be maintained. There are no hydrological effects on streams from Armoured Swale D.
Hydrological effect of earthworks and discharges associated with Armoured Swale D within 10 or 100 m of wetlands	Stormwater captured by Armoured Swale D will need to be dispersed outside of the wetland area to avoid a concentrated flow which could result in scouring and release of sediment and in a location which does not result in water moving back into the wetland.
Loss of river or wetland extent	If the recommendations are followed there would be no loss of stream or wetland extent from Armoured Swale D.

Armoured Swale D will be situated downgradient and along side Permeable Track H. A photo of that location was provided in Figure 17.

3.4 Recommendations

To mitigate effects on terrestrial ecology within wetlands, recommendations were made e3Scientific, (2026c) that are reproduced here for clarity. The numbering system has been carried through for ease of reference.

1. A Vegetation, Weed, Invertebrate, and Wetland Management Plan will be prepared and implemented. The plan will ensure mitigatory actions are completed to achieve high plant survival rates, no weed introduction, retention of hydrological function, and preservation of invertebrate biodiversity. To accomplish this, the plan will clearly define the actions, methodology, and targets required to implement and achieve the actions set out in recommendations 2-22.
2. All hydrological function and connectivity of all wetlands and streams will be maintained by using appropriate crossings.
3. Designs and methodology will be provided for each stream/wetland crossing. Designs shall include, proposed drawings, methodology, materials, equipment, lengths, hydrological assessment/flow, and rehabilitation required.



4. All wetland and stream crossing designs will be reviewed by a Hydrologist and Ecologist and approved prior to any works commencing and be inspected once complete to ensure the design is implemented correctly and is functioning as anticipated. Checks will ensure ecological and hydrological function is maintained; checks will be undertaken immediately after completion and again 12 months later by a Hydrologist and Ecologist.
5. All earthworks are to be managed to mitigate the risk of runoff and sedimentation into adjacent watercourses, wetlands and vegetation. A specific sediment and erosion control management plan to mitigate the risk of runoff into wetlands, watercourses, and onto neighbouring vegetation is to be prepared by suitably qualified and experienced expert and approved by a Hydrologist and Ecologist prior to works commencing. This management plan is to include a drainage plan, which will ensure that as the topography is altered, long term sediment runoff is also managed.

Controls provided within the ESCP and Stormwater plan help to meet the above recommendations. In addition, based on our assessment of the effects of the crossings on stream and wetland hydrology and the hydrological effect of earthworks and discharges within 10 or 100 m of wetlands we make the following general recommendations:

- Prior to construction, the boundaries of wetlands within 10 m of the planned track should be marked out by a scientist experienced in wetland delineation to ensure that all contractors are aware of the location of wetlands and to ensure they are not damaged.
- If there is significant water (resulting in pooling or runoff) revealed within any cuts that are not already designated for crossings, work should be paused to assess the need for further mitigations to maintain hydrological connectivity in these locations, e.g. such as Permeable Track. This assessment should be completed by a suitably qualified scientist skilled in wetland assessment.
- Photo points should be established adjacent to tracks for wetlands within 10 m of track works. Photographs should be taken of the wetlands prior to works commencing, within one week of works completion, and once per year for two years. If effects to wetlands (i.e loss of wetland vegetation, or extent of wetted areas) appear to be extending beyond the area of direct loss assessed by e3s (2026c) then action must be taken to ensure



hydrological connectivity of the wetland and that earthworks and discharges are not impacting wetland vegetation beyond this assessed direct loss. This action may include upgrade of the crossing to ensure hydrological connectivity is maintained.

- Clean material should be used for splash crossings and for inlet and outlet protection at culverts.
- Maintenance of culvert protection is required and culverts must be kept clear of debris.
- Appropriate sediment control is implemented on the downgradient side of Permeable Access tracks to reduce discharges into wetlands.
- The footprint of earthworks for the Curvey trench installation shall not exceed that of the existing Curvey access track. Where the trench crosses a stream or wetland the original hydrology must be maintained.

Crossing specific recommendations:

- Splash Crossing B; installed downgradient of where the wetland turns into a waterway to minimise wetland disturbance.
- Review integration of Armoured Swale C with Splash Crossing F.
- Culvert B and I; assess direction of water flow to the wetland to determine if a Permeable Access track is required to maintain wetland hydrology.
- Culvert B; two culverts will likely better maintain stream hydrology than a single culvert.
- Armoured Swale D; a Permeable Access track is required to maintain wetland hydrology. Conveyed stormwater is to be dispersed past the wetland boundary so that it does not enter the wetland and to avoid generating scour and releasing sediment.
- Armoured Swale A; to intersect the stream downgradient of the transition from riparian wetland to a stream to avoid loss of wetland area.
- Armoured Swale C; dispersion of stormwater discharge using appropriate permanent measures to avoid scouring and channelisation of discharge water.

3.5 Hydrological Impact Assessment Summary

Implementing the design principles and recommendations covered in this review alongside the stormwater controls (Stantec New Zealand, 2026) and erosion and sediment controls (Enviroscope, 2026) we have concluded the following:

- There will be loss of stream extent at Culvert Crossings with changes to flow immediately upstream of the culvert, changes to stream bed over the



culvert extent (8 m) and at the discharge point where armouring is used to prevent scour. Over the entirety of the stream extent these losses are considered small.

- There will be loss of stream extent between the intersection of Armoured Swale A and the termination at the tarn.
- There will be loss of wetland extent and value at the access road footprint and up to 50% loss in vegetation 2 m either side, as assessed by e3s (2026c).
- Loss of wetland extent outside of this footprint and buffer will be avoided, this will be confirmed through the recommended wetland monitoring, if the monitoring identifies any wetland loss may occur then appropriate actions will be taken to remedy and avoid loss.

Beyond the immediate footprint of the track and crossings, changes in hydrological functioning and the loss of wetland and stream extent are likely to be minor if the proposed controls are followed.



4 Freshwater Ecology Assessment

This freshwater ecological assessment focusses on the Doolans Creek tributaries within the Doolans Basin. The assessment of the Rastus Burn ecological values has been undertaken previously (e3Scientific, 2026e) and includes the findings of a number of previous studies and monitoring surveys (Ludgate, *et al.*, 2014; Ludgate, 2017; SLR, 2023; SLR, 2026). These findings are summarised in Section 4.3, Table 14. The ecological impacts within both the Doolans Creek tributary streams and Rastus Burn are considered in Section 5.

This freshwater ecological assessment considers permanent and intermittent streams only. Wetland ecological habitat is addressed within the terrestrial EclA (e3Scientific, 2026c).

4.1 Methodology

This assessment includes a desktop review of existing *ecological* information and reports to determine ecological habitats and species likely present within the Doolans Basin tributaries. The following resources or databases were utilised:

- ORC Schedule 1A and Schedule 15 classifications (Otago Regional Council, 2025);
- Land and Water Aotearoa (LAWA) website for nearby water quality and macroinvertebrate records;
- The New Zealand Freshwater Fish Database (NZFFDB) and Wilderlab eDNA database to outline historic fish records; and
- The threat status freshwater species were determined via the Department of Conservations (DOC) New Zealand Threat Classifications (Grainger, *et al.*, 2018; de Lange, *et al.*, 2023; Dunn, *et al.*, 2025).
- Flow regimes and hydrology assessments are covered in e3Scientific (2026a).

Site visits to survey Doolans Creek tributaries where proposed activities may overlap were also completed on 12 and 13 April 2025, by e3s ecologists with a follow-up visit on 30 April 2026 by an e3s hydrologist. At the time of the 2025 site visits the stream crossing and earthworks locations had not been confirmed;



therefore, sites were selected based on proximity to potential works areas and representativeness of each stream reach.

The site surveys involved a visual assessment of habitat, aquatic plants, substrate and water flow at each accessed site. eDNA sample collection, water physio-chemical properties and macroinvertebrate sampling was completed within the three main tributaries. Stream survey site photos were taken on 12 and 13 April 2025 and are presented in Figure 19 and Appendix A of this report. By the site visit on 30 April 2026, stream crossing sites had been provided and representative photographs of each proposed stream crossing were taken and are included in the hydrology assessment in Section 3.

4.1.1 Sampling Strategy

The stream tributary survey locations were located across the Doolans Basin and sampled prior to the first snowfall of the year to allow for a robust characterisation of the freshwater habitats and ecological context within the basin.

Five tributaries that flow into the Doolans Creek mainstem were surveyed in April 2025 (Sites Trib A, Trib B, Trib C, Trib D, Trib E), and four of these were sampled (Trib D was found to be intermittent with no flow present in the upper catchment and a small flow in the lower catchment). A site at the headwater of Doolans Creek (DC1) was also sampled (Figure 18; Table 7). Each stream site varied in size generally in relation to their catchment size, although further sites assessed via desktop assessment were dry at the time of the site visit and excluded from the sampling regime. All tributaries were found to have both steep and flat streambed sections and all had riparian zones comprising primarily of tussockland (Appendix A).

Of the tributary streams assessed, Trib E and DC1 do not have proposed stream crossings, nor works near them. Other sites (except Trib D) were permanent streams sampled either directly downstream of the confirmed stream crossing locations or in the instance of Trib B, downstream near the confluence with Doolans Creek (Figure 18).



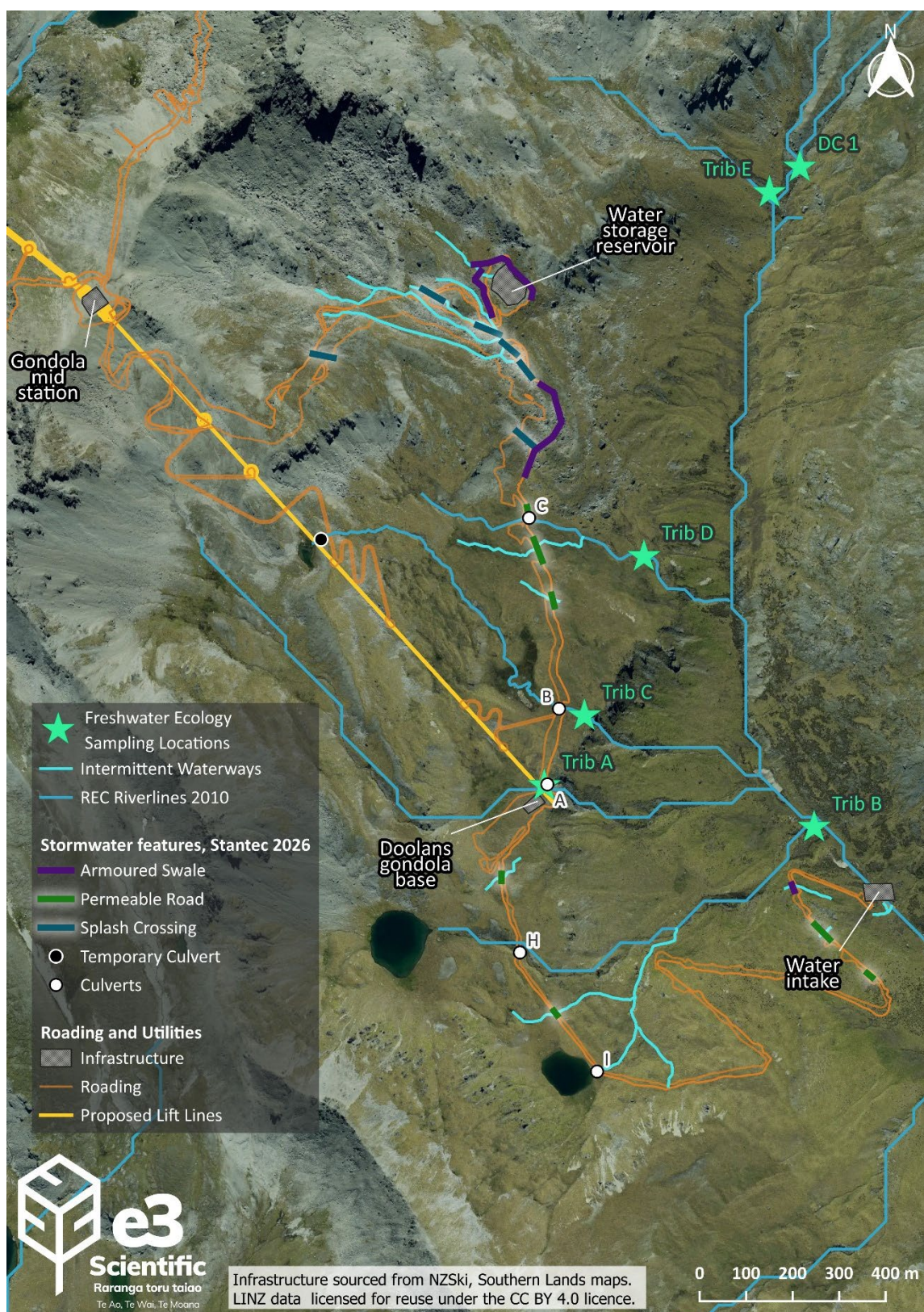


Figure 18: Stream sampling locations; note DC1 is located at the head of Doolans Creek.



Table 7: Freshwater ecological sampling locations and rationale (see Figure 19 for habitat photos).

Site name	Description	Rationale	Assessed
DC1	The headwaters of Doolans Creek immediately below the confluence of two tributaries. Steep, permanent.	Outside of proposed works footprint.	Flow, habitat, Macroinvertebrates & eDNA
Trib A	Tributary stream draining a reasonably large area. Narrow, incised, permanent.	Site near track crossing and the down slope end of the proposed Gondola lift line and base building.	Habitat, Macroinvertebrates & eDNA
Trib B	Tributary stream draining the two southern tarns. Site directly upstream of Doolans Creek confluence. Incised, permanent flow at this location.	Two stream crossings upstream of site. eDNA collected to capture upstream species present.	eDNA
Trib C	Tributary stream draining a wetland area, just upstream of a cliff and waterfall. Reasonable flat entry/exit, bedrock areas, permanent.	Directly downstream of proposed track ing.	Habitat, Macroinvertebrates & eDNA
Trib D	Intermittent upstream and very low permanent flow downstream. Defined steep incised channel.	Downstream of proposed track ing.	Not sampled
Trib E	Tributary stream near the head of the Doolans Basin, moderate flow present steep, incised, permanent.	Outside of proposed works footprint.	Flow only

4.1.2 Water Quality

4.1.2.1 Physico-Chemical Parameters

The properties of the water at each site were assessed by using a calibrated YSI ProDSS multiparameter meter that measured water temperature, dissolved oxygen, conductivity, pH and turbidity. The meter was deployed mid water and allowed to stabilise for 1 minute before the readings were recorded.

4.1.3 Habitat Assessment

The overall habitat was assessed by utilising a Rapid Habitat Assessment form (RHA) following Clapcott (2015). This habitat assessment includes assessment of



streambed and riparian conditions along with instream macroinvertebrate and fish habitat characteristics.

Algal cover was assessed at each site by visually assessing 5 transects across the width of the waterbody and averaging the total estimated cover (Biggs & Kilroy, 2000; Collier *et al.*, 2014).

Streambed substrate composition was visually assessed using the SAM1 method described in (Clapcott, *et al.*, 2011) and recording the full range of substrate size classes present across each assessed reach at DC1, Trib A and Trib C (Table 7).

4.1.4 Aquatic Fauna Sampling

4.1.4.1 Macroinvertebrate Sampling

The stream sampling methods utilised followed Stark *et al.* (2001) and NEMS (2022). At three tributary stream sites (DC1, Trib A and Trib C) three Surber samples were collected. Each sample was gathered by disturbing and scrubbing riffle riverbed stones within the 0.1 m² Surber sampler with a 500 micron mesh net. Each sample was labelled and then preserved in ethanol following Stark, *et al.* (2001) methods. The samples were then transported to the e3s laboratory for identification, enumeration and metric calculation.

The macroinvertebrate metrics were calculated following the methods outlined in Stark & Maxted, (2007) and Clapcott, *et al.*, (2017) for the Macroinvertebrate Community Index (MCI) and Quantitative Macroinvertebrate Community Index (QMCI), while the Average Score Per Metric (ASPM) was normalised using the method outlined in the NPS-FM 2020. The macroinvertebrate results from the field survey were then compared against the NPS-FM attribute bands (Ministry for the Environment, 2020) which are based on the MCI and QMCI bands of (Stark & Maxted, 2007) and ASPM method developed by (Collier, 2008; Clapcott, *et al.*, 2017) (Table 8). The proportion of mayflies, stoneflies and caddisflies (EPT) was used to outline the pollution sensitive taxa present and help differentiate tributary stream quality. Additionally, the Shannon-Weiner Diversity Index and Shannon Evenness Index are used to help explain macroinvertebrate community diversity.



Table 8: Macroinvertebrate metric attribute bands (NPS-FM, 2020).

MCI and QMCI band and description	MCI	QMCI	ASPM Band description	ASPM
A - Macroinvertebrate community, indicative of pristine conditions with almost no organic pollution or nutrient enrichment.	>130	≥ 6.5	A - Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions.	≥ 0.6
B - Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment.	≥ 110 and <130	≥ 5.5 and < 6.5	B - Macroinvertebrate communities have mild to moderate loss of ecological integrity.	< 0.6 and ≥ 0.4
C - Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.	≥ 90 and < 110	≥ 4.5 and < 5.5	C - Macroinvertebrate communities have moderate to severe loss of ecological integrity.	< 0.4 and ≥ 0.3
D - Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.	< 90	< 4.5	D - Macroinvertebrate communities have severe loss of ecological integrity.	< 0.3

4.1.4.2 Fish Sampling

eDNA samples were collected to ascertain if fish are likely to be present within the focal tributary reaches. However, it should be noted that the site elevation ranges between 1380-1750 m a.s.l.; 380 m above the natural altitude limit of 1000 m a.s.l. for local native fish species. At DC1, Trib A, Trib B and Trib C two replicate samples were collected for a total of 8 eDNA samples (Table 7). For each of the replicates 1 L of water was filtered, the filter then had preservative added to it, was labelled, and then was sent to Wilderlab Ltd for analysis. Wilderlab returned a taxa list of the eDNA found to be present in each sample.

Factors which influence eDNA sequence counts include the following: the distance of organisms from the sampling point, the presence of dead and decaying organisms, environmental factors which can speed up or slow down eDNA breakdown (e.g. temperature and light), and assay biases which can preferentially detect certain groups of organisms (Wilderlab, 2024). Therefore,



sequence counts do not directly relate to fish abundance (Wilderlab, 2024). In addition, a low sequence count is considered a “tentative detection” (Wilderlab, 2024). Run-off and animal faeces are two ways in which external DNA could be introduced to a site (Wilderlab, 2024). Therefore, the presence of eDNA cannot be converted to a relative abundance of fish or macroinvertebrate numbers present. It also means that eDNA of organisms not present at the site could be introduced to the site and detected in the samples (i.e., false positives).

eDNA results were also supplemented with results of the desktop assessment, which included the Wilderlab eDNA database and NZFFD records from the wider catchment.

4.2 Results

4.2.1 Water Quality

Water quality within the wider catchment is good and generally found to be within Band A of the NPSFM Attribute bands for water quality parameters downstream of this site (e3Scientific, 2026d).

The results of the site-specific water physico-chemical surveys completed in April 2025 show that all the locations across the study area have cool, clear, well oxygenated water (Table 9).

Table 9: Physico-chemical results.

	Water Temperature (°C)	DO (%)	DO (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)	Visual clarity
DC 1	2.5	103.7	11.95	60.7	7.55	0	clear
Trib A	6.6	100.2	10.38	12.9	7.3	0.03	clear
Trib B ¹	N/A						
Trib C	8.3	106.1	10.43	12.6	7.09	6.1	clear
Trib D ¹	N/A						
Trib E ¹	N/A						

¹ Trib B, D and E did not have physico-chemical parameters assessed.

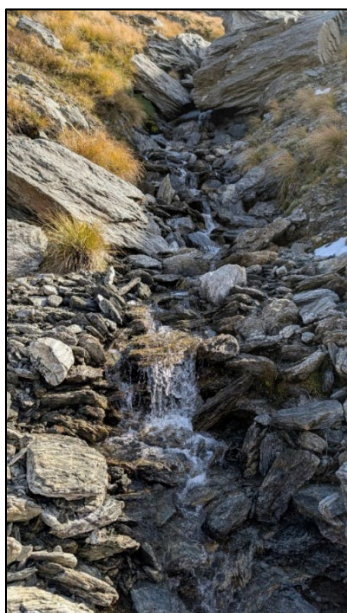
4.2.2 Habitat

The streambed characteristics of DC1, Trib A, Trib C and Trib E were consistent with an undeveloped alpine catchment with predominantly large substrates present



and exposed bedrock in steeper sections (Figure 19; Appendix A). Although the environment was open with no tree cover to shade the watercourses, algal cover was limited. This is most likely due to the cold, low nutrient water present. Submerged bryophytes (moss) were present at a number of locations; however, this habitat type was only within the Surber area sampled at Trib A and Trib C (Appendix A). The permanent tributary streams with proposed stream crossings (Trib A, C and upper reaches of Trib B) generally had high cobble and boulder proportions with low algal cover, moderate submerged bryophyte cover and the wetted width ranged from 0.8 m to 1 m (Table 10). The RHA habitat scores were good across the sites; however, the natural lack of shade led to reduced scores at all sites (Table 10).

Didymo was not observed nor identified via eDNA in any of the waterways sampled in the Doolan's Basin in April 2025. However, didymo was observed and identified in the eDNA results from downstream of these sites in the Doolans Creek in January 2026. Didymo is also present in the Rastus Burn catchment. Care should be taken with the track crossing design and installation activities in or near the waterways within the Doolans Basin to ensure didymo is not further spread across the tributary streams within this environment.



DC1



Trib A

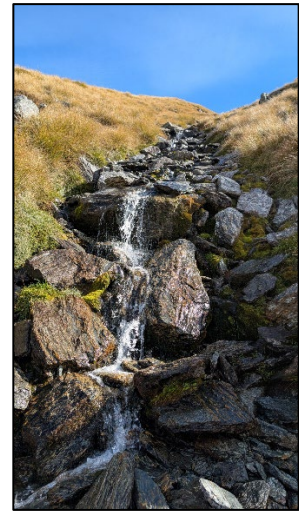




Trib B



Trib C



Trib E

Figure 19: Representative images of tributary stream habitat sites.

Table 10: Physical Habitat Results.

	DC1	Trib A	Trib C	Trib E
Substrate				
Bedrock	0	10	20	0
Boulder	20	10	5	60
Cobble	40	65	60	30
Gravel	30	10	13	10
Sand	10	5	2	0
Silt	0	0	0	0
Benthos cover				
Submerged moss cover	5	10	< 5	-
Total algal cover	0	< 5	< 5	-
Stream Width				
Mean wetted width (m)	-	0.8	0.1	-
Habitat Assessment				
Invertebrate habitat diversity (n/10)	7	9	9	-
Invertebrate habitat abundance (n/10)	10	10	10	-
Hydraulic heterogeneity (n/10)	9	10	8	-
Habitat Score (RHA) (n/100)	73	85	83	72

In addition to the permanently flowing stream reaches assessed above. There are also a number of intermittently flowing stream channels across the proposed track path. Intermittent streams are recognised as ecologically important components



of river networks, providing functions and biodiversity values that differ from but complement those of permanently flowing streams. Work in low altitude Hawke's Bay streams demonstrates that intermittent reaches maintain invertebrate communities, with many species surviving dry phases via eggs, pupae, or refuges below the water table, and recolonising rapidly when flow resumes (Storey & Quinn, 2007). Intermittent streams have lower species diversity than permanently flowing streams, but they do support viable communities of aquatic invertebrates and may contain some rare species (Storey & Quinn, 2007). SEV guidance emphasises that intermittent streams require tailored but robust ecological assessment, and that their values should be compared against intermittent reference conditions, not perennial systems, due to differences in temperature regimes, dissolved oxygen dynamics, and fauna composition (Neale, *et al.*, 2016). Collectively, the evidence shows that intermittent streams are integral freshwater habitats that maintain ecological integrity, catchment-scale processes, and indigenous biodiversity.

Intermittent streams are captured within the Otago Regional Plan: Water through the definition of "river", which includes *intermittently flowing* freshwater bodies. Although the operative plan does not explicitly list intermittent reaches, all rules relating to riverbed disturbance, discharges, and structures apply equally to them. National direction that ORC must give effect to particularly the NPS-FM 2020 and NES-Freshwater 2020 requires councils to avoid loss of river extent and values across the entire network, including intermittent headwaters. As a result, intermittent streams in Otago are regulated and managed as integral components of the freshwater system, reflecting their recognised ecological functions, hydrological connectivity, and contribution to downstream values.

4.2.3 Macroinvertebrates

As covered in more detail in the Tarn and Weir FEClA (e3Scientific, 2026d), the ORC Nevis River at Wentworth Station monitoring site demonstrates the macroinvertebrate community (MCI) state at the Nevis River in Band C indicative of moderate organic pollution or nutrient enrichment (101-106) based on the three samples collected to date (Table 11). The QMCI has the ecological state in Band A and B. The ASPM metric also ranges from Band A and B with values of 0.44 to 0.6, indicative of a macroinvertebrate community that has high ecological integrity to one with mild to moderate loss of ecological integrity.



Table 11: Ecology Results for the Nevis River at Wentworth Station (Source: LAWA website Accessed 26/2/2026).

Water Quality Parameter	5-Year median	NPS-FM 2020 Attribute Band	Trend Direction
Macroinvertebrate Community Index (MCI) 0 - 200	101-106 ¹	C	N/A
Quantitative Macroinvertebrate Community Index (QMCI) 0- 8	5.7-6.5 ¹	A/B	N/A
Average Score per Metric (ASPM) 0-1	0.44-0.6 ¹	A/B	N/A

¹ 2022-2024 result only

Results from the macroinvertebrate samples collected in April 2025 for this assessment are summarised in Table 12. Generally, there was low macroinvertebrate abundance, low diversity, low evenness and taxa richness across the samples. This led to lower MCI and ASPM scores than otherwise expected in cool clean water sites. This finding is characteristic of alpine environments with reduced dispersal (Barquin & Death, 2006) where low organic matter content limits fauna to a short food web of collector/browsers (Suren, 1991) and predators (Sherrin, *et al.*, 2025). The tributary sites had MCI values within attribute Band B and C indicative of mild to moderate pollution with a mix of sensitive and tolerant taxa (Ministry for the Environment, 2020) and were comparable to the Nevis River downstream. The QMCI scores were within attribute Band A and indicative of pristine conditions. The ASPM were all within attribute Band B indicative of a community with mild to moderate loss of ecological integrity (Collier, 2008; Ministry for the Environment, 2020). It should be noted low macroinvertebrate abundance found reduces confidence in the MCI, QMCI and ASPM metrics (Stark & Maxted, 2007). However, the proportions of EPT taxa present are high within the three flowing stream sites (DC1, Trib A and Trib C) indicating there is a high proportion of cool water adapted, pollution sensitive taxa present and a good quality macroinvertebrate fauna for this alpine environment within the streams. The MCI, QMCI and ASPM (in part) were designed to assess organic pollution rather than to assess high quality alpine communities specifically, therefore the EPT metrics are more representative and better indicators of the alpine macroinvertebrate community.

eDNA analysis demonstrated the presence of the stonefly *Zelandobius macburneyi* at the Trib C site. This species is considered data deficient in the New Zealand freshwater invertebrate threat classification (Grainger, *et al.*, 2018). Data deficient species are suspected to be rare but due to a lack of information are not assigned a threat category (Grainger, *et al.*, 2018). *Zelandobius* stonefly's



were found within the macroinvertebrate samples collected at DC1, Trib A and Trib C but were identified to genus level only (not species level).

Overall, the alpine tributary streams where the proposed stream crossings are to occur are relatively depauperate of macroinvertebrates but the macroinvertebrates that are present are typically indicative of good water quality and ecological integrity.

Table 12: Macroinvertebrate survey results.

Metric	DC1	Trib A	Trib C
Abundance	204	59	45
Taxa Richness	9	11	7
MCI	108	114	107
QMCI	6.9	6.5	6.5
ASPM	0.54	0.49	0.41
EPT % Abundance	99	70	59
EPT %Richness	57	57	46
EPT Richness	5	6	3
Shannon Diversity Index	1.04	1.69	1.20
Evenness	0.48	0.71	0.64

Average of three samples for DC1, Trib A, Trib C.

4.2.4 Fish

No fish records are present in the NZFFD or Wilderlab database for the Doolans Creek or its' tributaries in the Doolans Basin. This area is considered naturally fishless due to natural waterfall and gorge barriers 2.5 to 6 km downstream and the high altitude cold water conditions across the basin (e3Scientific, 2026d).

A review of the wider area outlined that the nearest known fish are brown trout (*Salmo trutta*) within the catchment approximately 7.5 km downstream on the Doolans Creek (e3Scientific, 2026d). The native non-migratory Nevis galaxias (*Galaxias nevis*) (Threatened - Nationally endangered; Dunn, *et al.*, 2025) was also recorded in the Nevis River approximately 20 km southeast of this study area (e3Scientific, 2026d).



Seven eDNA samples were collected across 4 stream sites. No fish eDNA was found in any of the samples. As discussed, the high altitude and steep catchment with multiple bedrock shoots, waterfalls and steep gorges limits access of fish to these sections of stream. The cold winter conditions limit the ability of many fish species to survive at this altitude with few records above 1000 m in the NZFFD.

4.3 Freshwater Ecological Value Summary

The ecological value findings are based on the Environment Institute of Australia and New Zealand (EIANZ) Guidelines, which set out evaluation criteria that can be used to determine the ecological values of a species or habitat. This approach and method are provided in Appendix C. Based on this methodology, Table 13 provides the ecological values for the Doolans Creek tributaries and Table 14 provides the Rastus Burn ecological value summary.

In summary, the Doolans Creek tributary streams are largely unmodified and retain high naturalness, with indigenous-dominated communities. They are naturally fishless due to altitude, distance inland, snow cover and downstream barriers. The cool, clear waters support EPT dominated macroinvertebrate assemblages indicative of pristine alpine reference conditions. Habitat is steep, high-gradient boulder/cobble channels driven by snowmelt hydrology, with naturally low productivity, low nutrient availability and correspondingly low taxon richness typical of alpine systems. No nationally rare or threatened macroinvertebrates were recorded, although the locally uncommon, data-deficient stonefly *Z. macburneyi* was found at Trib C. Overall, the tributaries support excellent ecological values. The intermittent streams within Doolans Basin have not been sampled expressly because they were dry. As such a precautionary approach is taken and they are assigned the same High ecological values as the permanently flowing tributary streams nearby within Doolans Basin.

The Rastus Burn supports cold, clear, well-oxygenated waters over stable rock substrates with low algal biomass, resulting in a limited food supply that sustains a macroinvertebrate community dominated by pollution-sensitive taxa. Monitoring has consistently rated this community good to excellent, indicating high ecological value and low tolerance for organic enrichment or fine-sediment deposition. The recent detection of didymo in the Lake Alta outlet represents a



key risk where future blooms could substantially alter benthic habitat and macroinvertebrate composition, reducing ecological resilience.



Table 13: Assessment of the Doolans Creek tributaries using the ecological criteria in the EIANZ Guidelines.

Matter	Criteria	Score
Representativeness	The tributary streams are unmodified by human activity currently other than a small amount of hunting and hiking and indigenous species dominate with few introduced species present and as such is representative of the ecological communities present in 1840. The tributary streams are naturally fishless due to the distance inland, high altitude, annual snow cover and barriers downstream. The tributary streams have cool clear water with macroinvertebrate EPT community's representative of pristine alpine reference conditions. The tributaries have high naturalness values.	High
Rarity/ distinctiveness	No rare or threatened native macroinvertebrates were recorded at the tributary sites, although a data deficient stonefly, <i>Z. macburneyi</i> , was present at the Trib C site. This is a locally uncommon species. The tributaries are naturally fishless due to the distance inland, high altitude, annual snow cover and barriers downstream.	Moderate
Diversity and pattern	The small alpine tributary streams and intermittent waterway sections have naturally low diversity due to the high altitude low nutrient and extreme conditions limiting the source pool of taxa. The alpine catchment is covered by snow in winter and is dry in summer. The habitat is steep, high gradient, boulder/cobble channels with snowmelt influenced hydrology. The stream sites have low productivity due to low nutrient levels and naturally low overall densities of macroinvertebrates.	Moderate
Ecological context	The high proportions of EPT (fragile taxa) demonstrated tributary streams are in excellent health and indicative of intact pristine alpine conditions. The Doolans Basin is part of a wider protected Kawarau / Remarkables conservation area which is intact, large and resilient to pest invasion.	Moderate

Combining these four matters using the method outlined in Table 6 of the EIANZ Guidelines (Roper-Lindsay, *et al.*, 2018), the overall freshwater ecological value of the Doolans Creek tributaries (permanent and intermittent) is considered **"High"**.



Table 14: Assessment of the Rastus Burn using the ecological criteria in the EIANZ Guidelines (Source: e3scientific 2026e).

Matter	Criteria	Score
Representativeness	The Rastus Burn is typical of an alpine stream in Otago with a steep rocky catchment. Permanent flow with a tarn in the headwaters. An algal and macroinvertebrate community representative of cool, clear water, where indigenous species dominate is present. Expected guilds and species assemblage present for this altitude. Reasonably low taxa richness due to the alpine cold conditions with snow covering the ground for at least 4 months of the year. Community likely to be very similar to 1840 baseline community.	High
Rarity/distinctiveness	The Rastus Burn does not support any rare or threatened fish. It does support a population of At Risk - Naturally uncommon caddisfly upstream of the wastewater discharge site. High macroinvertebrate predator numbers due to the lack of fish.	Moderate
Diversity and pattern	There is naturally low diversity in the algal and macroinvertebrate community present instream and an absence of fish. Alpine stream environments have lower diversity due to limited dispersal by adult (flying insect) macroinvertebrate life stages.	Low
Ecological context	The harsh alpine environment limits the community able to reach the upper Rastus Burn, and the growth rates and survivorship of those that do. This leads to low instream productivity with a low diversity and abundance of instream algae and macroinvertebrates and a community that is fishless. This is similar to other alpine streams in the region.	Moderate

Combining these four matters results in an overall **Moderate** ecological value for the Rastus Burn near the NZSki track crossings.



5 Freshwater Ecological Impact Assessment

The methods used follow EIANZ guidance to determine the level of ecological effects are outlined in Appendix D. This freshwater ecological impact assessment (FEcIA) considers permanent and intermittent streams only. Wetland habitat is addressed within the terrestrial EcIA (e3Scientific, 2026c).

Where there is variance between the Stantec stormwater design methodology (Stantec, 2026b) and Enviroscope CEMP (Enviroscope, 2026), this assessment has focused on the permanent installations within the Stantec design. It is assumed that the devices proposed within the CEMP/ESCP will be refined at detailed design stage and onsite as works are undertaken and actions required. The following paragraphs discussing effects and management actions are summarised in Table 16 (Section 5.9).

5.1 In-water Bed Disturbance

The Stantec stormwater concept report (Stantec, 2026b) is used as the basis for the assessment of the number and location of stream crossing areas to be disturbed. This outlines there are 11 permanent crossings and one temporary crossing proposed consisting of 5 permanent culverts (A, B, C, H, I), 1 temporary culvert (access track to tower 14), and 6 splash crossings (A, B, C, D, E, F) within the Doolans Basin (Figure 20)ⁱⁱ. Trenching for the services corridor will generally be installed beneath access tracks; and where the alignment crosses waterways for splash crossings and engineered permeable tracks, trenching will also occur through the watercourse. Where culverts are used, utilities are expected to be generally trenched and laid below the culvert (and streambed), but in suitable locations (~2 sites) they are to be laid above the culvert within the fill, avoiding instream trenching in those locations.

The average wetted channel width of the Doolan Creek tributaries crossings is approximately 1 m wide (see Section 4.2.2) and proposed culvert length is 8 m long (Stantec, 2026b). However, as recommended by the ORC reviewer the area of disturbance is represented in lineal stream length affected rather than area.

ⁱⁱ It should be noted that the CEMP (Enviroscope, 2026) map a number of other potential splash crossing locations within their report; however, these are across intermittent stream channels that are expected to be dry during works construction.



The disturbance from 12 stream crossings (and associated trenching), each averaging 8 m in length, results in approximately 96 m of permanent and intermittent instream disturbance within the Doolans Basin. Two existing crossings are present on the Rastus Burn (one culvert and one splash crossing), which will both require trenching for services and associated in-water bed disturbance. This will consist of a further 16 m of instream disturbance in the Rastus Burn relating to trenching through existing track crossings (Figure 21).

Based on the provided works description, the proposed physical instream earthworks will disturb approximately 96 m of Doolans Creek tributary and 16 m of Rastus Burn stream habitat, primarily affecting macroinvertebrates, algae and moss communities. The Rastus Burn and Doolans tributary streams are naturally fishless and fish have only been identified 6 km and >7.5 km downstream respectively, so direct impacts to fish are not anticipated. Instream earthworks are expected to mobilise a small amount of sediment from the total ~112 m footprint across both catchments. There is very little deposited fine sediment present within the streams to be mobilised; however, instream trenching of material 2 m deep and 1 m wide through the dewatered channel has the potential to contribute relatively more sediment to the watercourse.

The Doolans Basin tributaries comprise ~6.5 km of permanent stream and ~1.7 km of intermittent channel (8.2 km total); therefore, the proposed 96 m instream works equates to approximately 1% of the Doolans Basin streambed.

The Rastus Burn is approximately 7.5 km in length, therefore, the proposed 16 m of instream works equate to approximately 0.21% of the Rastus Burn streambed.

To minimise in-water disturbance, the methodology provided within the CEMP (Enviroscope, 2026) suggests that each stream crossing will be temporarily isolated using sandbags or equivalent barriers, with flows pumped around the work area or gravity-fed via pipe-drop structures so trenching can occur in drier conditions where practicable. Standard erosion and sediment controls will divert clean water around disturbed areas and direct sediment-laden runoff to treatment devices (See Section 5.4). Work in water best practice should be followed by ensuring the in-water works guidelines (MfE, 2021) such as working from the banks where possible and limiting the works area to the extent practical are incorporated to the CEMP/ESCP.



Despite these measures, some trenching and backfilling may occur with water present (Figure 22). Where there is a risk of water following the trench alignment, concrete bulkheads will be installed at the downgradient end to keep flows within the natural channel. This will involve placing fresh cement into the trench to set to create an impermeable barrier. Works will be dewatered prior to concrete placement to avoid contact between fresh concrete and flowing water. Unmanaged, there is a risk that fresh, uncured concrete, concrete slurry, cement and washings could release alkaline leachates that are toxic to aquatic life. Careful management of concrete handling, containment and washdown is therefore required to prevent high alkalinity water entering tributary streams and prevent the potential release of alkaline leachate an associated aquatic macroinvertebrate localised mortality (MfE, 2021).

In isolated locations where large boulders or shallow bedrock prevent mechanical excavation, limited blasting may be required. Given the absence of fish, any blasting effects are expected to be no greater than those from excavator trenching.

For the Doolans Creek tributaries, based on the above, in-water bed disturbance via trenching, splash crossing development and culvert installation works are assessed as having a **low** magnitude of effect, taking into consideration the short-duration of physical bed disturbance, small overall areas to be affected, and proposed sediment controls. Considering the high ecological value of the Doolans Creek tributary streams, the overall ecological effect is therefore **Low** (see Table 16).

For the Rastus Burn, in-water bed disturbance via trenching and then splash crossing re-establishment and culvert re-installation works are assessed as having a low magnitude of effect due to short-duration of physical bed disturbance, small overall areas to be affected, proposed sediment controls and unlikely use of cement within the existing crossings. Considering the moderate ecological value of the Rastus Burn, the overall ecological effect therefore results in **Low** (see Table 16). However, the in-water works within the Doolans Basin and Rastus Burn will require effective sediment management and should therefore still be included in the following management actions.

To effectively manage and reduce the potential level of effects regarding ~96 m of in-water bed disturbance within the Doolans Creek tributaries and ~16 m of



disturbance in the Rastus Burn, the following management and mitigation strategies are recommended:

- Earthworks should be undertaken during a dry period where stream flow is stable and low, and intermittent streams are dry, wherever possible.
- The Construction Environmental Management Plan (CEMP) and the Erosion and Sediment Control best practice approaches outlined in Enviroscope (2026) are to be followed.
- The CEMP will incorporate relevant in-water works guidelines (MfE, 2021) such as working from the banks where possible and limiting the works area to the extent practical.
- The works area should be dewatered with a short diversion in place to ensure the works area is isolated, and sediment laden water is pumped or drained to nearby sediment control devices e.g. sediment sump or turkey nest.
- Any disturbed streambanks shall be protected with geotextile matting and are to be replanted with dense plantings of eco-sourced native tussock grasses. This rehabilitation work will reduce the likelihood of bank erosion.
- Soil binding polymers are not to be used.
- The works area should be dewatered and ensure cement use is isolated, and any high alkalinity water pumped to a tanker and trucked offsite for disposal into a tradewaste system. This method should be included in the CEMP.
- The use of cement for bulkheads and how to minimise effects from its use is to be included in the CEMP.

Based on these management actions being implemented effectively, the residual effect is considered **Low**.



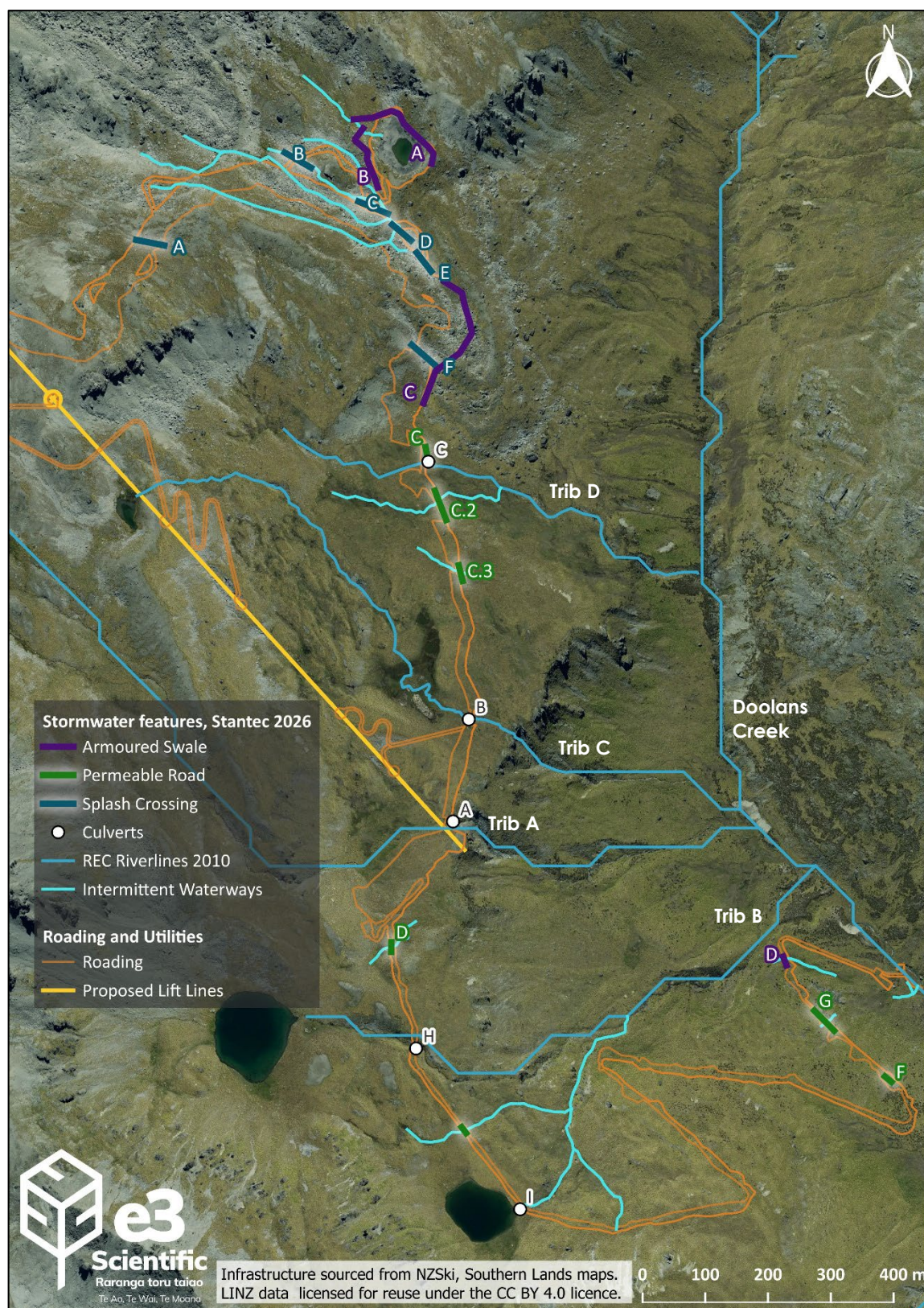


Figure 20: Location of instream works areas and crossings within Doolans Basin. Please note the identified trackside 'Armoured swale' on this map does not have any associated in-water works.



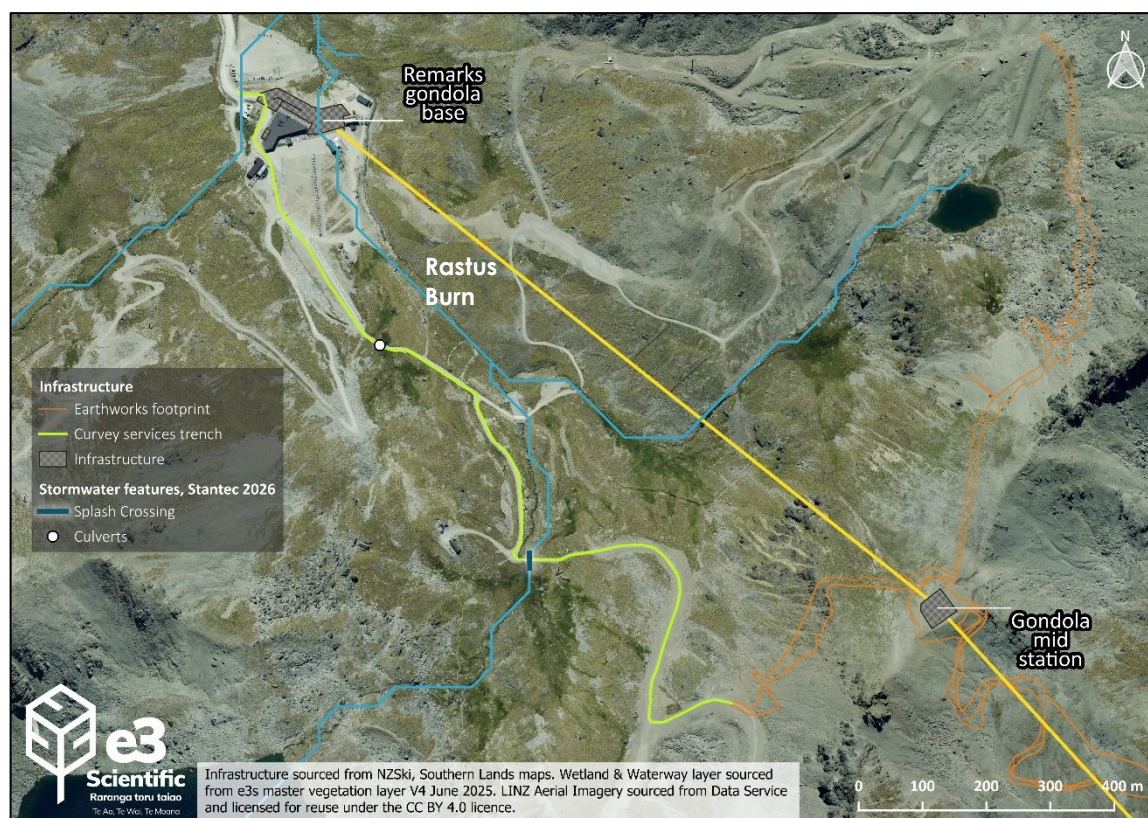


Figure 21: Location of instream works areas and crossings within the Rastus Burn catchment.



Figure 22: Example of a section of trenching (Source: Enviroscope, 2026).



5.2 Stream Habitat Modification

Culverts will maintain flow and hydrological connectivity with downstream watercourses; and because the tributary streams are naturally fishless, fish passage need not be considered in culvert design. Splash crossings (fords) will be formed on a ~2% bed grade with 1V:3H side slopes, a typical depth of 200–250 mm, and site-specific bottom width and flow depth. The crossing surface will be widened and armoured with riprap to provide an erosion-resistant surface suitable for low-speed 4WD access and to minimise long-term maintenance while still maintaining the existing stream bed level. Permanent habitat loss is limited to the footprint of the proposed 5 permanent culverts (5 x 8 m = 40 m) plus a temporary 8 m for the temporary culvert at Tower 14, with provision in the ESCP for additional culverts if required (Figure 23).

The tributaries comprise ~6.5 km of permanent stream and ~1.7 km of intermittent channel (8.2 km total); the proposed 40 m culvert footprint equates to approximately 0.5% of stream habitat. Biological communities are low in taxonomic richness and dominated by pollution sensitive mayflies; the data deficient stonefly *Z. macburneyi* was recorded in Tributary C near the proposed Culvert B.

Given the limited areal extent of disturbance, the low diversity of alpine adapted aquatic life affected, and the use of splash crossings to retain habitat post construction, the magnitude of effect is assessed as low. Considering the high ecological value of the streams but the small scale of modification to culvert habitat, the overall residual ecological effect is assessed as **Low**, and no further management actions are recommended.

The modification of 40 m of stream habitat due to the installation of 5 culverts has been assigned a low level of effect based on the small reach effected in relation to the 8.2 km of stream length within the basin. As the overall Project site has very high naturalness values, it is considered of greater ecological benefit to not disturb areas further by riparian planting or increasing stream lengths, which are common mitigating or remediation actions for these activities. Therefore, no further management actions other than that already included in the CEMP have been proposed.





Figure 23: Location of culverts and associated stream habitat loss.

5.3 Temporary Waterway Diversion and Dewatering

Track Crossing Diversion

A potential effect of the track crossing construction is the temporary reduced flow to the tributary streams and downstream aquatic habitats. Temporary coffer dams are proposed to be installed comprising of sandbags or hydro barriers and water will be pumped or drained via pipe-drop structures downstream past the open trenching and crossing construction area (Figure 24). The aim of the



temporary diversion is to minimise the amount of water present in the earthworks location and minimise sediment production while maintaining clean water flow to down gradient watercourses. Any sediment laden water will be pumped/diverted to the nearest sediment control device areas such as 'sediment sumps', 'turkey nests' or 'coconut coir logs' (Enviroscope, 2026). The flow removal effects on the hydrological regime of the catchment are considered very low due to the short-term nature of the damming before water is bypassed around the works area to the downstream channel (see Section 3). The overall flow is not expected to be impacted, and each crossing related works is expected to be completed within 2 days. The macroinvertebrate community is not expected to be adversely affected downstream of coffer dam and earthworks as macroinvertebrates can move to the hyporheic zone (beneath the streambed surface) for a period of time (Storey & Quinn, 2008). Low water temperature and high dissolved oxygen levels are the main drivers of the alpine macroinvertebrate community at this location, and these will remain cold and well oxygenated once the diversion is in place. As no fish are present, fish migration and spawning timings do not need to be avoided, and fish salvage will not be required.

Within the Rastus Burn, trenching within the existing tracking will be undertaken and dewatering required. Both crossings have wetlands upstream which are maintained by the existing crossing method, provided the culvert size or splash crossing are not altered from their current specifications (including culvert invert and bed level), no effects on the upstream wetland habitat are anticipated.

Based on the above, considering the short duration of the damming and diversion (i.e. maximum of two days) and the lack of fish in these waterways, a localised small reduction in macroinvertebrate communities, the magnitude of effect of the stream crossing related damming and diversion of water is considered low across both catchments, resulting in an overall **Low** level of effect (Table 16). No further management actions are therefore recommended.





Figure 24: Example of a hydro barrier (left) and sand bag coffer dam (right) ⁱⁱⁱ

5.4 Reservoir Inflow Diversion

The intermittent inflow to the proposed water storage reservoir is to be diverted around the reservoir (Figure 23). Snowmelt and rainwater feeding into this reservoir will now be discharged into terminal armoured soakage fields (Stantec, 2026a; 2026b). The pre-existing tarn was considered likely to have lost water to shallow groundwater along with evaporation (e3Scientific, 2026a). However, the diversions around the reservoir does represent a hydrological change to the intermittent inflow tributary stream (see Section 3). This equates to 55 m of intermittent inflow channel to be removed and replaced with water diverted into two separate 111 m and 177 m long swales (Figure 25). There is approximately 1700 m of intermittent stream habitat within Doolans Basin and the removal of 55 m of intermittent stream equates to 3% of the intermittent stream network within Doolans Basin. The intermittent stream was dry at the time of the first site visit and therefore no freshwater surveys could be undertaken, however it has been assessed to have High ecological value based on the values found within the permanently flowing streams throughout Doolans Basin. The swales, once established, will largely act ecologically as intermittent streams and represent a slight increase in this habitat type with 288 m of swale replacing the 55 m intermittent stream. There is potential for aquatic invertebrates to utilise these armoured swales (using racks sourced from this location) as habitat during the snow melt. However, due to the intermittent nature of the flow, low diversity of source macroinvertebrates at this altitude this cannot be guaranteed or relied on.

ⁱⁱⁱ image sources <https://www.hydroresponse.com/water-gate-barrier> and

https://www.neshire.co.nz/case-studies/stream-diversion/?utm_source=copilot.com

Tracks, Stream Crossings and Stormwater Freshwater Ecological and Hydrological Impact Assessment
Document ID:25047.5



The loss is assessed here as low magnitude of effect due to the small loss (3%) of Doolan Basin intermittent stream habitat. There is no hydrological or ecological change expected to the downgradient wetlands due to the diversion.

Based on this, the magnitude of effect of the intermittent stream diversion around the reservoir is considered low, resulting in an overall **Low** level of effect (Table 16). No further management actions are therefore recommended.

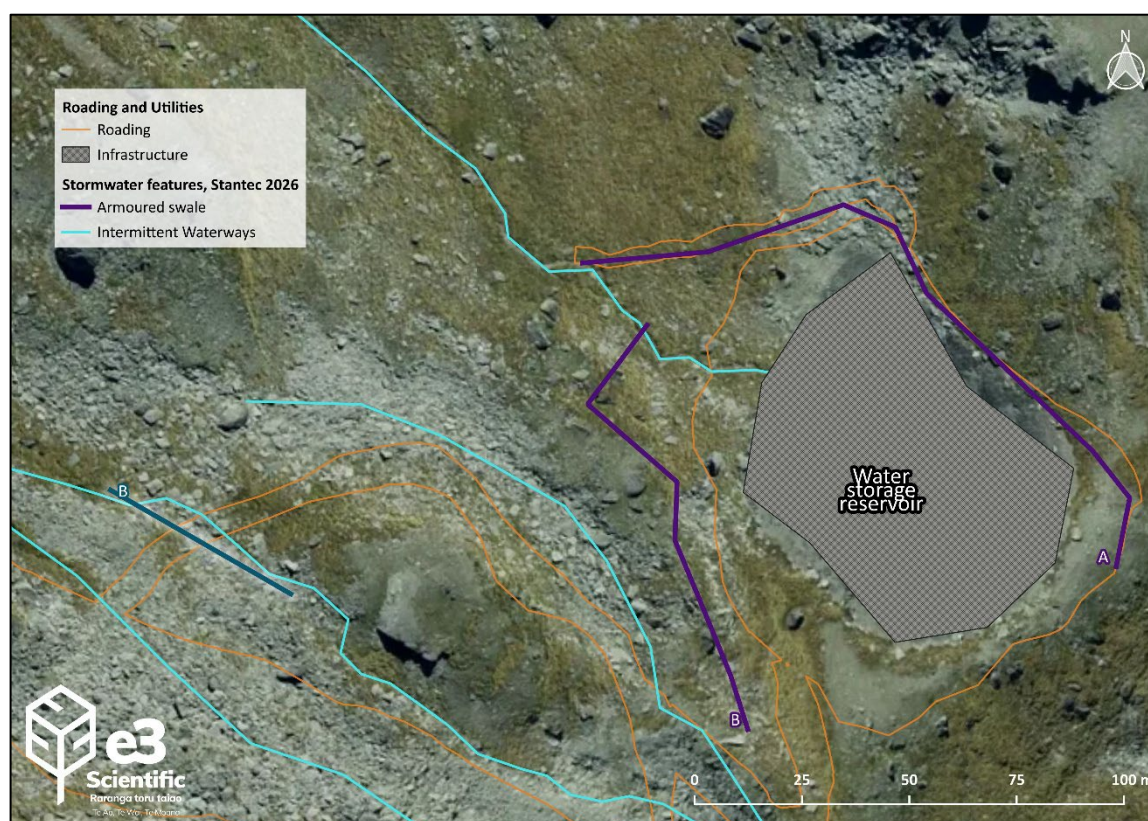


Figure 25: Armoured swale locations with terminal soakage areas (A & B).

5.5 Stormwater Run-off and Stream Sedimentation

Construction phase

Open tracking related earthworks areas are to be kept as small as practical and developed progressively (Enviroscope, 2026). Trench lengths will be limited to the distance that can be excavated and backfilled within a single day (approximately 150 m) to reduce exposure in the event of forecast significant rainfall (Enviroscope, 2026). Topsoil will be carefully stripped and vegetation retained for reinstatement.



Any rainfall during the construction phase will initially wash fine material off newly placed gravel track surfaces and freshly cut slopes. The Stantec stormwater design minimises culvert use and favours splash crossings to minimise earthworks, with culverts limited to the higher flow, more incised catchments north and south of the Gondola Return Station (Stantec, 2026b). Across the wider site, stormwater will generally remain as sheet flow following existing drainage paths across the track, with roadside channels or swales only introduced where flow must be redirected to prevent scour, overtopping, or sediment deposition (Enviroscope, 2026; Stantec, 2026b). It is proposed that erosion and sediment control devices are to be checked weekly to ensure they are in working condition (Enviroscope, 2026).

ESCP actions proposed to minimise effects include non-structural controls such as staging and timing works most appropriately and structural measures such as progressive rehabilitation and stabilisation, clean and dirty water diversions, contour drain/swales, check dams, drop-out pits, drop-pipe structures, level spreaders, material stockpiles, decanting earth bunds, sediment sumps, silt fences, turkey nests and coconut coir logs (Figure 26) (Enviroscope, 2026).

Ongoing (post construction) phase

There is potential for some sheet flow from tracking to contribute fine sediment to nearby waterways and wetlands, but in general sheet flow will drain to the downside of the track corridor to be filtered and retained in roadside tussocks. Armoured trackside swales have the potential to concentrate and redirect sediment to sensitive waterway receptors, therefore these have been designed to have check dams and other sediment protection devices to minimise the potential for sediment input to waterways. Several areas have been identified for further protection from scour (Stantec, 2026b). Regular (i.e. weekly when accessible November to May) assessment and maintenance is required for the permanent erosion and sediment control devices such as sediment sumps with sediment removal occurring at 20% capacity.





Figure 26: Examples of sediment control devices (Source Enviroscope, 2026).

Sedimentation

Earthworks associated with the track, trenching and stream crossing establishment has the potential to contribute sediment to the tributary streams that have high ecological values. Sediment inputs can smother instream habitat, fill interstitial spaces and clog aquatic macroinvertebrate gills, and can have flow-on effects downstream. Greater effects in alpine streams are expected where sediment occurs at naturally low levels. However, erosion and sediment control best practice will be followed as per the ESCP (Enviroscope, 2026) to ensure sediment contributions to the stream from bankside earthworks are minimised. Stormwater runoff is to be managed appropriately by limiting the works area to the extent practical and applying structural erosion and sediment control measures as outlined in the CEMP/ESCP. Thereby a low magnitude of effect of sedimentation on streams is expected.

Overall, due to the high quality but low density and low diversity macroinvertebrate community present, the lack of fish present and erosion minimisation actions, stormwater separation, sediment control, treatment and maintenance, the expected stormwater additions are considered to represent only a partial change in baseline conditions and the magnitude of effect is considered low (see Table 16). Given the assessed High ecological value of the Doolans Creek tributary streams, this results in an overall **Low** level of effect and no further management actions are recommended.

However, given the high value of the streams, verification monitoring is recommended to allow for feedback to the effectiveness of the measures used.



It is recommended that deposited sediment cover should be monitored using the SAM 2 method (Clapcott, et al., 2011) annually in summer to assess the deposited fine sediment levels within the stream bed. This monitoring is aimed to confirm the construction phase and ongoing sediment and erosion controls are appropriate and effective at ensuring no adverse ecological effects. Two stream locations are recommended, one site at Trib C site, downstream of culvert B, and a second site downstream of all works at the Doolans Creek weir site. The deposited fine sediment levels should remain within 10% of pre works levels.

5.6 Stormwater Discharge

5.6.1 Roofing Water Quality

Roof water from base buildings and gondola stations will generally be collected in recessed guttering and directed to ground level catch pits and piped to nearby streams (Stantec, 2026b). Smaller secondary buildings are not planned to have any guttering or stormwater infrastructure, instead discharging to land locally (Stantec, 2026b). However, the Gondola Base building complex stormwater is proposed to be discharged to Trib A. Copper and zinc concentrations in stormwater vary widely with roofing material type, age and local storm intensity (Gadd & Milne, 2019), but can be toxic to aquatic life at high levels. Copper levels have been reported to be as low as 0.04-0.5 µg/L in waterways in the South Island, New Zealand (ANZG 2023). Only one water quality sample has been collected within Doolans Creek for the purpose of assessing drinking water quality (e3Scientific, 2026d). At the time of sampling (27/05/2025), total zinc and total copper concentrations were below the default detection limit (<0.0011 g/m³ and < 0.00053 g/m³ respectively). Given the current lack of development in the catchment, it is reasonable to assume that this is representative of baseline conditions. However, provided the stormwater runoff to waterways is maintained below ANZG (2018) DGV levels for 99% species protection (1 µg/L for copper and 2.4 µg/L for zinc), assuming low dissolved carbon content, the ecological effects will remain low.

The primary roofing material for the Doolans Station Building is likely to be Colorsteel® as identified within the site Master Plans. The worst-case scenario for zinc and copper concentrations within roofing runoff would occur if the roofing materials were unpainted and untreated galvanised steel roofs. Charters, *et al.*, (2022) analysed runoff water quality from a new (<1 year old) and an older (22



years old) Colorsteel® roof in the Christchurch area over nine rainfall events. Of the steel roofs sampled, the Colorsteel® roof had the lowest zinc leaching rates, however it was noted that the the 22-year-old Colorsteel® 'old' roof had higher zinc concentrations than the new <1 year-old Colorsteel® roof.

Based on this sampling data, the MEDUSA^{iv} programme was developed to calculate load and concentrations of metals and total suspended sediments (TSS) during storm events. Within the model, the concentration of dissolved zinc for new Colorsteel® is 139 µg/L, but would be assumed to be 745 µg/L if the roof condition was poor. Using the concentration for new Colorsteel, Table 15 estimates concentrations of copper and zinc in Trib A based on the 1 in 50-yr return period flows calculated by Stantec (2026b) for the building runoff and flow through Trib A at Culvert A. Given that the main concern is intermittent discharges of stormwater, site-specific acute guideline values have been calculated based on the methods in Gadd, Hickey, & Snelder (2024). This indicates that during a stormwater event, whilst the ANZG (2018) 99th percentile default guidelines will be marginally exceeded, site-specific acute zinc guidelines values for the protection of 99% of species will not.

Should roofing materials not be maintained, and concentrations increase to those measured in the 22 year old Colorsteel as per the sampling completed by Charters, O'Sullivan, & Cochrane (2022), in stream concentrations could reach 16 µg/L zinc. This demonstrates the importance of roof maintenance over time.

5.6.2 Gondola Towers

Galvanised metal pylons will be used for gondola towers (locations shown in Figure 10 in Section 3.3.3. Towers 11-19 will be situated within the Doolans Catchment. It is possible that cleaning activities and rainwater runoff may cause contaminants to leach from the tower. Greatest concentrations are likely to occur within the first flush at the beginning of rainfall events and enter the soil at its base, prior to any incidence of sheet flow. Zinc is not highly mobile in the soil and contamination (if any) around structures is typically found in surface soils directly adjacent to the structure and declines rapidly with depth and distance, such that the levels are equivalent to background concentrations within 10 m of the pylons

^{iv} <https://www.urbanwaterways.org/>, accessed 29/06/2026



(Herms & Peterson, 1990). The presence of a pylon is not considered to be a HAIL activity.

Based on the mapping provided in the Stormwater Concept Report (Stantec, 2026b), towers 11, 12 and 13 will be located within upper Catchment A, more than 200 m from the water way itself. Towers 18 and 19 will be within the lower part of Catchment A. Should soil contamination occur within a ten-metre radius of these towers, this would be a total of 1570 m² within the 61.4 ha catchment above Culvert A, and would represent 0.2% of the sub-catchment. It is therefore unlikely that this would contribute significant loading of contaminants.

The remaining four towers are situated in Catchment B (24.1 ha catchment above Culvert B). A ten metre radius from these towers would represent 0.5% of the catchment above Culvert B, noting that these are small tributaries of Doolans Creek Right Branch. The catchment area of Doolans Creek Right Branch above the proposed water take is 568 ha.

5.6.3 Ecological Effects

The most abundant macroinvertebrates collected from the instream samples was the *Deleatidium* mayfly. Gadd *et al.*, (2024) reported copper (206 µg/L) and zinc (505 µg/L) sensitivities for *Deleatidium* based on the studies of Hickey & Vickers (1992) and normalised for water conditions of pH 7.5, hardness 30 mg/L and dissolved organic carbon (DOC) 0.5 mg/L. Therefore, the predicted zinc concentration (3 µg/L) as outlined in Table 15 is below that expected to directly affect *Deleatidium* mayflies.

Due to the low density and low diversity of sensitive macroinvertebrates present within Trib A, the lack of fish present and modern roofing materials to be used these stormwater additions are considered to represent only a partial change in baseline conditions that is restricted to rainfall events and Trib A. The magnitude of effect is considered low (see Table 16). Given the assessed High ecological value of the Doolans Basin tributary streams, this results in an overall **Low** level of effect.



5.6.4 Monitoring

However, to support a precautionary approach we propose monitoring for zinc, copper and dissolved carbon during the spring snow melt and two first flush rainfall events across summer and autumn for the first two years post building establishment. Firstly, sampling of the stormwater discharge outflow should occur to identify if roof runoff stormwater actually has elevated zinc or copper levels similar to the modelled data. If stormwater discharged from the roof stormwater system is elevated to near or above the DGV for 99% species protection then instream sampling upstream and downstream of the Trib A stormwater outlet is recommended. This is reflected in proposed conditions and management plan as appropriate. This monitoring is to provide an early warning system and if zinc or copper concentrations are elevated above ANZG (2018) 99% guidelines within the receiving waterway during this sampling, further roof stormwater capture, diversion and treatment will be proposed. Specifically, Trib A should be sampled upstream and downstream of the Doolans Return Station and Carrier Stacking building (labelled Gondola Base building in figures) stormwater input. In addition to water sampling (if elevated zinc/copper stormwater has triggered sampling), instream deposited fine sediment (if present) should be collected annually and tested for the presence of copper and zinc. Annual summer macroinvertebrate surveys should then also be undertaken upstream and downstream of the stormwater input to identify any measurable ecological response for the first two years. Provided at least 3 surber samples are collected at each site and habitats as similar as possible are sampled an average decrease of no more than 10% between upstream and downstream sites for %EPT abundance, %EPT taxa richness and %mayfly abundance would be a suitable trigger to identify ecological impacts. If monitoring indicates elevated levels of copper or zinc are present, or ecological impacts based on the macroinvertebrate community then management such as diverting first flushes to ground soakage or installing universal pollutant treatment (UPT) would need to be implemented to decrease concentrations.



Table 15: Potential concentrations of copper and zinc in Trib A after discharge of stormwater from the Doolans Return Station and Carrier Stacking Building based on Colorsteel® Roofing (red text denotes an exceedance of the DGV).

Building	Stormwater RCP 8.5 Q (L/s)	Discharge Concentration (µg/L)		Discharge Load (µg)		Stream + stormwater RCP 8.5 Q (L/s)	In-Stream Concentration (µg/L)	
		Copper	Zinc	Copper	Zinc		Copper	Zinc
Carrier Stacking building	24	5	139	120	3336	1840	0.1	3.0
Gondola Return Station	16			80	2224			
ANZG (2018) DGV 99% species protection							1	2.4
ANZG (2018) DGV 95% species protection							1.4	8.0
Acute GV 99% species protection*							0.9	14.6
Acute GV 95% species protection*							1.7	30.8

*Calculated based on pH = 7.4 and hardness (CaCO₃) = 24 mg/L in Doolans Creek from sampling completed 27/05/2025, and DOC = limit of reading



5.7 Biosecurity

Didymo is present in the Rastus Burn catchment and in the Doolans Creek at the basin floor but is not currently recorded in the tributary streams across the Doolans Basin. Introduction of didymo to tributary streams has potential to cause shifts in the periphyton and macroinvertebrate communities present. Didymo is known to proliferate in stable, low phosphorus streams (Bothwell, *et al.*, 2014) and alter the macroinvertebrate community present (Kilroy, *et al.*, 2009).

Didymo is easily spread and as a unwanted organism the whole of the South Island is a controlled area where it is recommended to clean and dry equipment before moving between waterways as you can transfer didymo in water and moist material without observing it (ORC, Accessed 13/5/2026; ECan, accessed 13/5/2026). ORC (2026) explicitly list vehicles and trailers among items that can carry didymo via mud, plant fragments and moist material trapped in wheel arches, undercarriage, or on trailers. Due to the relatively short distances and time between crossings it is likely transfer of didymo from Rastus Burn to Doolans Creek tributaries will occur, without management actions.

Strict biosecurity measures are required for vehicles and equipment used in Rastus Burn and should include that vehicle wheels (and undercarriages if immersed in water) are to be washed after the final Rastus Burn splash crossing. This may require a decontamination crossing to be set up for vehicles prior to entry into the Doolans Basin. Equipment used in Doolans Creek should also be decontaminated before returning through tributary streams and crossings, to minimise the risk of transferring didymo from Doolans Creek to the tributaries.

Post construction signage and decontamination stations should be established to minimise the risk of members of the public utilising the tracks spreading didymo to the Doolans Basin tributaries.

Overall, based on the above, movement across the basin utilising splash crossings without management actions would likely lead to the introduction of didymo to the tributary streams and an associated ecological community shift resulting in a moderate magnitude of effect. Considering the high ecological value of the tributary streams, the overall ecological effect is therefore **High** (see Table 16).

To effectively manage and reduce the potential level of effects regarding biosecurity and the spread of didymo, the following mitigation strategies are recommended:



- Biosecurity measures are in place after the last Rastus Burn stream crossing to ensure didymo is not transferred to Doolans Basin tributary streams and measures should be detailed in the CEMP.
- Biosecurity measures are in place for any equipment used within the Doolans Creek before it is used/driven back through the Doolans Basin tributary streams.
- Post construction signage and decontamination stations should be established to minimise the risk of members of the public utilising the tracks spreading didymo to the Doolans Basin tributaries.

Based on these management actions being implemented effectively, the residual effect is considered **Moderate** due to the residual risk of members of the public accessing the Doolans Basin due to the new infrastructure, which could inadvertently spread didymo.

5.8 Cumulative Effects

The cumulative effect of loss of vegetation and wetlands within Doolans Basin was considered to be low in the terrestrial EclA (e3Scientific, 2026c). The Doolans Creek and Tarns FEclA report identified the loss of a small (4,450 m²) alpine tarn and 20 m² of stream modification via the installation of a weir in Doolans Creek (e3Scientific, 2026d). Within this report there is an additional amount of permanent stream habitat loss (40 m), 55 m of intermittent stream length and in-water bed disturbance effects (112 m²) to be managed. This equates to a total freshwater habitat loss of 60 m² of permanent stream, 55 m of intermittent stream length and 4,450 m² of tarn habitat within the Doolans Basin. Within an ecological impact assessment, the area, length of time, foreseeable future actions and the complex interactions among them should be considered (Roper-Lindsay *et al.*, 2018). It is considered that the pristine, isolated and undisturbed character of Doolans Basin will be altered due to this project, but ecologically the combined cumulative effects on the freshwater streams overall remain **low** when considered across Doolans Basin.

Tarn 3 has been assigned as an overall 'High' level of effect based on the discussed descriptors. In-water bed disturbance in the Doolans basin and Rastus Burn has been assigned "Low" level of effects. The stream habitat modification due to tracks and crossings has been assigned "Low" level of effects. Temporary waterway dewatering and diversion has been assigned "Low" level of effect. Intermittent



streambed loss through reservoir inflow diversion has been assigned “Low” level of effect. The Stormwater run-off and sedimentation has been assigned a “Low” level of effect. The stormwater discharge has been assigned an overall level of “Low” level of effects. Didymo biosecurity has been assigned a moderate magnitude of effect and a “High” level of effect. Cumulative effects have been assigned a “**Low**” level of effects.

5.9 Summary

The freshwater ecological values assessment and associated impact assessment have been assessed at the Doolans Basin scale. This was assessed by e3Scientific to most accurately reflect the zone of influence of the project. Text within this Sections 5.8, 6 and Table 16 is provided to reflect the Doolans Basin scale that was used in this assessment for the freshwater attributes rather than ecological district scale (that was used within the Terrestrial wetland assessment).

The proposed tracking, stream crossing, reservoir inflow diversion, trenching and associated stormwater discharge will disturb small areas of streambed and wetland habitat, but effects are limited in scale and duration and are managed through established erosion, sediment, and in-water works controls. Instream works will disturb ~152m of habitat, through the establishment of fords and culverts. Doolans Creek tributary streams and Rastus Burn support low diversity, fishless alpine communities, and engineered permeable crossings, splash crossings, and minimal culvert use will maintain hydrological connectivity. Temporary diversions, dewatering, and trenching may mobilise sediment and involve cement use, but adherence to CEMP, ESC best practice, and MfE (2021) guidelines keeps effects low to moderate. Construction and operational stormwater will largely remain as sheet flow, with swales only where needed to prevent scour. Stormwater discharge from the painted and treated Gondola Base building roof will be discharged to a tributary stream; and monitoring is recommended to ensure no effects are evident. Overall, with mitigation implemented, residual effects on streams, and sedimentation remain Low, and freshwater cumulative ecological effects across Doolans Basin are assessed as Low. These effects and associated management actions are summarised in Table 16 below.



Table 16: Ecological Impact Assessment Summary for proposed tracking, crossings, diversions and associated earthworks.

Activity & Potential Effect		Ecological Value	Magnitude of Effect	Level of Effect	Recommended Impact Management Avoid/Mitigate/Remediate/Compensate	Residual Impact
Culvert and track Crossings	<u>In-water Bed Disturbance - Doolans</u> Trenching for the services installed beneath the access tracks is required to be 1m wide by 2m deep. Where trenching intersects small watercourses in-water works is required. Dewatering, bed disturbance, sediment mobilisation and blasting may affect streams. Cement use may be required but water will be isolated from flowing water. A total of 96 m of the 8.2 km streambed length is proposed to be disturbed for fords, with 40m length disturbed by culverting.	High (Doolans tribs)	Low	Low	<ul style="list-style-type: none"> No further actions are required, however the following standard ESCP actions are recommended . Earthworks should be undertaken during a dry period where stream flow is stable and low. The Construction Environmental Management Plan (CEMP) and the Erosion and Sediment Control best practice approaches outlined in Enviroscope (2026) are to be followed. The CEMP will incorporate relevant in-water works guidelines (MfE, 2021) such as working from the banks where possible and limiting the works area to the extent practical. The works area should be dewatered with a short diversion in place to ensure is the works area is isolated, and sediment laden water is pumped nearby sediment control devices e.g. sediment sump or turkey nest. Any disturbed streambanks shall be protected with geotextile matting and are to be replanted with dense plantings of eco-sourced native tussock grasses. This rehabilitation work will reduce the likelihood of bank erosion. Soil binding polymers are not to be used. The works area should be dewatered and ensure cement use is isolated, and any high alkalinity water pumped to a tanker and trucked offsite for disposal into a tradewaste system. This method should be included in the CEMP. The use of cement for bulkheads and its use is to be included in the CEMP. 	Low
	<u>In-water Bed Disturbance – Rastus Burn</u> No concrete required. A total of 16 m of streambed proposed to be disturbed across two crossings. The tracking is in place so disturbance are is limited to trench width and culvert replacement.	Moderate (Rastus Burn)	Low	Low		
	<u>Stream Habitat Modification</u> Permanent modification of 40 m of streambed habitat by placement 5 culverts.	High	Low	Low	<ul style="list-style-type: none"> No further actions recommended. 	Low



Activity & Potential Effect		Ecological Value	Magnitude of Effect	Level of Effect	Recommended Impact Management Avoid/Mitigate/Remediate/Compensate	Residual Impact
	Benthic macroinvertebrate communities at these sites are excellent. Represents a very small proportion of streambed within the tributaries of Doolans Basin. No fish present.					
	<u>Temporary Waterway Dewatering and Diversion</u> Short duration damming, dewatering of works area and diversion past the works area. Macroinvertebrates able to find refugia. Sediment laden water to treatment devices.	High	Low	Low	<ul style="list-style-type: none"> No further actions recommended. 	Low
Reservoir Diversion	<u>Reservoir Inflow Diversion</u> Water will be diverted around the reservoir in armoured swales and discharged into terminal armoured soakage fields. Local intermittent stream hydrology affected but downgradient wetlands not affected. Results in an overall loss of 3% of Doolans Basin intermittent stream habitat.	High	Low	Low	<ul style="list-style-type: none"> No further actions recommended. 	Low
Stormwater	<u>Stormwater Run-off & Sedimentation</u> Tracking construction phase will mobilise sediments and capture devices are established. Ongoing maintenance is required to ensure stormwater does not impact waterways. Potential for sediment associated with earthworks being mobilised and depositing in high value streambed downstream and smothering bed	High	Low	Low	<ul style="list-style-type: none"> No further management actions recommended. Validation monitoring recommended: Deposited fine sediment cover is to be assessed within 1 year of tracking earthworks completion downstream of Culvert B at Trib C site and at the Doolans Creek Weir using the SAM2 method and should remain within 10% of pre-works levels. 	Low



Activity & Potential Effect		Ecological Value	Magnitude of Effect	Level of Effect	Recommended Impact Management Avoid/Mitigate/Remediate/Compensate	Residual Impact
Stormwater	substrate and aquatic life or infilling wetlands. Appropriate methods and management actions proposed to avoid effects.					
	<p><u>Stormwater Discharge</u> New building roof water will be collected. There is potential for zinc and copper to be contributed to nearby receiving waterbodies at elevated levels.</p>	High	Low	Low	<ul style="list-style-type: none"> No further management actions recommended. Validation monitoring recommended - monitoring for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events at the stormwater outlet for the first two years post building establishment. If elevated zinc and/or copper above DGV 99% threshold is found within stormwater then further receiving water sampling is recommended: Monitoring for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events in Trib A for the first two years post building establishment. Deposited sediment (if present) is to be collected in Trib A and at the Doolans Creek weir site and zinc and copper levels characterised annually for first 2 years post-building establishment. Instream macroinvertebrate community to be assessed upstream and downstream of Gondola Base building stormwater outlet to Trib A during summer months annually for 2 years. Downstream %EPT abundance, %EPT Taxa richness, %mayfly abundance are to remain within 10% of upstream proportions. If monitoring indicates macroinvertebrate community change or elevated levels of copper or zinc are present in the water or sediment, then management such as diverting first flushes to ground soakage or installing universal pollutant treatment (UPT) would need to be implemented to decrease concentrations. 	Low



Activity & Potential Effect		Ecological Value	Magnitude of Effect	Level of Effect	Recommended Impact Management Avoid/Mitigate/Remediate/Compensate	Residual Impact
Biosecurity	<p><u>Didymo</u></p> <p>Potential for the spread of the invasive algae Didymo from Rastus Burn and Doolans Creek to the Doolans Basin tributary streams. Could cause an associated shift in freshwater community structure.</p>	High	Moderate	High	<ul style="list-style-type: none"> Biosecurity measures are in place after the last Rastus Burn stream crossing to ensure didymo is not transferred to Doolans Basin tributary streams. These measures should be detailed in the CEMP. Biosecurity measures are in place for any equipment used within the Doolans Creek before it is used/driven back through the Doolans Basin tributary streams. Post construction signage and decontamination stations should be established to minimise the risk of members of the public utilising the tracks spreading didymo to the Doolans Basin tributaries. 	Moderate
Project	<p><u>Cumulative Effects</u></p> <p>The local direct physical disturbance of 112 m and loss of 40 m of permanent and 55 m of intermittent watercourse. Indirect effects on hydrology in combination with other human actions are very limited at the Doolans Basin scale.</p>	High	Low	Low	<ul style="list-style-type: none"> No further actions recommended. 	Low



6 Conclusions and Recommendations

NZSki are proposing to upgrade the Remarkables Ski field and expand into the Doolans Basin located east of the existing ski field. The development of the ski field requires added infrastructure including an access track and utility services. This report provides a hydrology and freshwater ecology assessment of the proposed activities on the Doolans Creek tributaries and Rastus Burn and hydrological connectivity of the sites.

Section 3 assesses the effects of the proposed stormwater controls and mitigations on stream and wetland hydrology, earthworks and associated discharges within 10 or 100 m of wetlands and any loss of river or wetland extent. The review concludes that through implementing the design principles and recommendations proposed in the review alongside the stormwater controls (Stantec New Zealand, 2026) and erosion and sediment controls (Enviroscope, 2026) that the overall loss of river and wetland extent is considered to be minor. Specifically the following loss of stream and wetland extent is expected: a loss of stream extent at Culvert Crossings which will be limited to the area directly above, through and downstream of the crossing, a loss of stream extent downgradient of Armoured Swale A, a loss of wetland extent as assessed by e3s (2026). The loss of wetland extent outside of the area already assessed by e3s (2026) will be avoided through the recommended wetland monitoring and remedial actions, if required.

The tributary streams of the Doolans Basin retain very high naturalness, with no historical modification other than light recreational use, and their biota remains dominated by indigenous alpine species representative of 1840 reference conditions. These small, steep, high-altitude headwaters are naturally fishless due to distance inland, snow cover, cold temperatures, and downstream barriers. Macroinvertebrate communities are characterised by cool, clear water EPT assemblages typical of pristine alpine streams, with low productivity and naturally low diversity reflecting the extreme climate and low nutrient status. The ecological survey undertaken in April 2025, prior to winter snowfall, provides a robust representation of the perennial tributaries present. The wider Doolans Basin sits within the protected Kawarau / Remarkables conservation landscape, which is large, intact, and resilient to pest invasion, further reinforcing the naturalness and ecological integrity of the tributary streams. The Rastus Burn is a small, cold, low nutrient alpine stream draining steep cirque basins, with low baseflows, winter



freezing, and spring snowmelt peaks. With ski field development, the catchment supports intact alpine wetlands and the picturesque Lake Alta, and didymo has been confirmed within Rastus Burn.

Using the EIANZ (2018) method, the combination of high naturalness, indigenous dominance, intact alpine hydrology, sensitive EPT communities, and the presence of a regionally uncommon stonefly results in the Doolans Creek tributary streams being assigned a "High" ecological value. Wetlands within the basin, assessed separately within the terrestrial ecological assessment (e3Scientific, 2026c), hold "Very High" ecological value due to their extent, naturalness, and regional significance. Collectively, the Doolans Basin freshwater habitats represent a high-value alpine ecosystem with strong ecological resilience and minimal departure from natural baseline conditions. The Rastus Burn has been assessed as having Moderate ecological value given high representativeness, moderate rarity and ecological context and low diversity values.

Physical works for track construction, stream crossings, and trenching will disturb small areas of stream and wetland habitat within Doolans Basin, but the scale of disturbance is limited and largely temporary. Instream works will affect approximately 96 m of streambed, with only 40 m permanently modified by culverts, representing 1% disturbance and 0.5% of the 8.2 km tributary network impacted. 55 m of intermittent stream which equates to 3 % of the 1.7 km of intermittent stream present in the Basin, is to be replaced by 288 m of constructed armoured swale. In the Rastus Burn catchment approximately 16 m of streambed length will be disturbed via trenching activities and the recreation of the existing culvert and splash crossing. This equates to bed disturbance of approximately 0.21% of the Rastus Burn length. These alpine tributaries support naturally fishless, low diversity macroinvertebrate communities dominated by pollution sensitive mayflies, with very low fine sediment channels. Wetland disturbance totals 0.233 ha and is already accounted for within the e3Scientific Ltd, (2026) and engineered permeable track crossings are designed to maintain hydrological connectivity outside of these areas of direct disturbance. A Wetland Management Plan will be prepared as part of the Vegetation, Weed, Invertebrate, and Wetland Management Plan (e3Scientific, 2026c) to minimise loss of habitat. The effects of temporary diversions, and adherence to MfE (2021) in-water works guidelines, effects from dewatering, sediment mobilisation, stormwater, and cement use are assessed as low to moderate in magnitude with proposed erosion and sediment controls in place.



Overall, the proposed works occur within a high value alpine environment but are constrained in area, duration, and intensity, with robust mitigation measures applied. Hydrological effects from temporary diversions are short lived, and stormwater will largely remain as sheet flow filtered through tussock vegetation. Sediment generation is expected to be minimal due to naturally low fine sediment levels and the use of best-practice erosion and sediment controls. When combined with the small scale of habitat loss and the maintenance of stream and wetland connectivity, the residual effects on streams, hydrology, and sedimentation are assessed as Low, and cumulative ecological effects across the basin remain low at the Doolans Basin scale.

Management actions and validation monitoring are proposed regarding the in-water bed disturbance activities and wetland hydrological effects and are summarised below:

6.1 Recommendations to Maintain Ecological Stream Values

1. Earthworks should be undertaken during a dry period where stream flow is stable and low.
2. The Construction Environmental Management Plan (CEMP) and the Erosion and Sediment Control best practice approaches outlined in Enviroscope (2026) are to be followed.
3. The CEMP will incorporate relevant in-water works guidelines (MfE, 2021) such as working from the banks where possible and limiting the works area to the extent practical.
4. The works area should be dewatered with a short diversion in place to ensure the works area is isolated, and sediment laden water is pumped nearby sediment control devices e.g. sediment sump or turkey nest.
5. Any disturbed streambanks shall be protected with geotextile matting and are to be replanted with dense plantings of eco-sourced native tussock grasses. This rehabilitation work will reduce the likelihood of bank erosion.
6. Soil binding polymers are not to be used.
7. The works area should be dewatered and ensure cement use is isolated, and any high alkalinity water pumped to a tanker and trucked offsite for disposal into a tradewaste system. This method should be included in the CEMP.



8. The use of cement for bulkheads and how to minimise effects from its use is to be included in the CEMP.
9. Biosecurity measures are in place after the last Rastus Burn stream crossing to ensure didymo is not transferred to Doolans Basin tributary streams. These measures should be included in the CEMP.
10. Biosecurity measures are in place for any equipment used within the Doolans Creek before it is used/driven back through the Doolans Basin tributary streams.
11. Post construction signage and decontamination stations should be established to minimise the risk of members of the public utilising the tracks spreading didymo to the Doolans Basin tributaries.
12. Wetland Management Plan is to be prepared and implemented as per the Vegetation, Weed, Invertebrate, and Wetland Management Plan (e3Scientific, 2026c).

6.2 Monitoring of Stream Ecological Value

Stormwater Runoff

1. Deposited fine sediment cover is to be assessed within 2 months of tracking earthworks completion (if alpine conditions allow otherwise within 1 year) downstream of Culvert B at Trib C site and at the Doolans Creek Weir using the SAM 2 method and should remain within 10% of pre works levels.

Stormwater Discharge

1. Water quality monitoring recommended for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events in Trib A, for the first two years post building establishment.
2. Water quality monitoring recommended for zinc, copper and dissolved carbon during the spring snow melt and two first flush summer/autumn rainfall events at the stormwater outlet, for the first two years post building establishment.
3. If elevated zinc and/or copper above DGV 99% threshold is found within stormwater then further receiving water sampling is recommended.
4. Deposited sediment (if present) in Trib A and at the Doolans Creek weir site is to be collected, and zinc and copper levels characterised annually for first 2 years post building establishment.



5. Instream macroinvertebrate community to be assessed upstream and downstream of Gondola Base building stormwater outlet to Trib A during summer months annually for 2 years. Downstream %EPT abundance, %EPT Taxa richness, %mayfly abundance are to remain within 10% of upstream proportions.
6. If monitoring indicates macroinvertebrate community change or elevated levels of copper or zinc are present in the water or sediment, then management such as diverting first flushes to ground soakage or installing universal pollutant treatment (UPT) would need to be implemented to decrease concentrations.

6.3 Recommendations to Maintain Stream and Wetland Hydrology

1. Prior to construction, the boundaries of wetlands within 10 m of the planned track should be marked out by a scientist experienced in wetland delineation to ensure that all contractors are aware of the location of wetlands and to ensure they are not damaged.
2. If there is significant water (resulting in pooling or runoff) revealed within any cuts that are not already designated for crossings, work should be paused to assess the need for further mitigations to maintain hydrological connectivity in these locations, e.g. such as Permeable Track. This assessment should be completed by a suitably qualified scientist skilled in wetland assessment.
3. Photo points should be established adjacent to tracks for wetlands within 10 m of track works. Photographs should be taken of the wetlands prior to works commencing, within one week of works completion, and once per year for two years. If effects to wetlands (i.e loss of wetland vegetation, or extent of wetted areas) appear to be extending beyond the area of direct loss assessed by e3s (2026c) then action must be taken to ensure hydrological connectivity of the wetland and that earthworks and discharges are not impacting wetland vegetation beyond this assessed direct loss. This action may include upgrade of the crossing to ensure hydrological connectivity is maintained.
4. Clean material should be used for splash crossings and for inlet and outlet protection at culverts.



5. Maintenance of culvert protection is required and culverts must be kept clear of debris.
6. Appropriate sediment control is implemented on the downgradient side of Permeable Access tracks to reduce discharges into wetlands.
7. The footprint of earthworks for the Curvey trench installation shall not exceed that of the existing Curvey access track. Where the trench crosses a stream or wetland the original hydrology must be maintained.

Crossing specific recommendations to maintain stream and wetland hydrology:

1. Splash Crossing B; installed downgradient of where the wetland turns into a waterway to minimise wetland disturbance.
2. Review integration of Armoured Swale C with Splash Crossing F.
3. Culvert B and I; assess direction of water flow to the wetland to determine if an engineered Permeable Access track is required to maintain wetland hydrology.
4. Culvert B; two culverts will likely better maintain stream hydrology than a single culvert.
5. Armoured Swale D; a Permeable Access track is required to maintain wetland hydrology. Conveyed stormwater is to be dispersed past the wetland boundary so that it does not enter the wetland and to avoid generating scour and releasing sediment.
6. Armoured Swale A; to intersect the stream downgradient of the transition from riparian wetland to a stream to avoid loss of wetland area.
7. Armoured Swale C; dispersion of stormwater discharge using appropriate permanent measures to avoid scouring and channelisation of discharge water.



7 References

- ANZG. (2018). *Australian & New Zealand Guidelines for Fresh and Marine Water Quality*. Canberra: Australian Government.
- ANZG. (2023). *Toxicant default guideline values for aquatic ecosystem protection: Dissolved copper in freshwater. Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Canberra: Australian and New Zealand Governments and Australian state and territory governments.
- Auckland Council. (2016). *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region*. Auckland: Auckland Council.
- Barquin, J., & Death, R. G. (2006). Spatial patterns of macroinvertebrate diversity in New Zealand springbrooks and rhithral streams. *Journal of the North American Benthological Society*, 25(4): 768-786.
- Biggs, B. J., & Kilroy, C. (2000). *Stream Periphyton Monitoring Manual*. Christchurch: NIWA for the Ministry for the Environment.
- Bothwell, M. L., Taylor, B. W., & Kilroy, C. (2014). The Didymo story: the role of low dissolved phosphorus in the formation of *Didymosphenia geminata* blooms. *Diatom Research*, 29(3): 229-236.
- Charters FJ, C. T. (2020). The influence of urban surface type and characteristics on runoff water quality. . *Science of The Total Environment*. , 142470-142470.
- Charters, F. J., Cochrane, T. A., & O'Sullivan, A. D. (2016). *Untreated runoff quality from roof and road surfaces in a low intensity rainfall climate*. Christchurch: University of Canterbury .
- Charters, F. J., O'Sullivan, A. D., & Cochrane, T. A. (2022). Influences of zinc loads in urban catchment runoff: Roof type, land use type, climate and management strategies,. *Journal of Environmental Management*., 322.
- Clapcott, J. (2015). *National rapid habitat assessment protocol development for streams and rivers*. . Nelson: Prepared for Northland Regional Council. Cawthron Report No. 2649.
- Clapcott, J., Wagenhoff, A., Neale, M., Storey, R., Smith, B., Death, R. H., . . . Young, R. (2017). *Macroinvertebrate metrics for the National Policy Statement for Freshwater Managment*. Wellington: Prepared for the Ministry for the Environment. Cawthron Report No. 3073.
- Clapcott, J., Young, R. G., Harding, J. S., Matthaei, C. D., Quinn, J. M., & Death, R. G. (2011). *Sediment Assessment Methods: Protocols and guidelines for*



- assessing the effects of deposited fine sediment on in-stream values. Nelson: Prepared for the Ministry for the Environment, By Cawthron Institute.
- Collier, K. J. (2008). Average Score Per Metric: an alternative metric aggregation method for assessing Wadeable stream health. *New Zealand Journal of Marine and Freshwater Research*, 42: 367-378.
- Collier, K. J., Hamer, M. P., & Champion, P. (2014). *Regional guidelines for ecological assessments of freshwater environments: Aquatic plant cover in Wadeable streams - version 2*. Waikato Regional Council Technical Report 2014/03. Hamilton: Waikato Regional Council.
- de Lange, P., Gosden, J., Courtney, S. P., Fergus, A. J., Barkla, J. W., Beadel, S. M., . . . Michel, P. (2023). *Conservation status of vascular plants in Aotearoa New Zealand, 2023*. Wellington: Department of Conservation.
- Dunn, N., Closs, G., Crow, S., David, B., Goodman, J., Griffiths, M., . . . Makan, T. (2025). *Conservation status of New Zealand freshwater fishes, 2023*. Wellington: Department of Conservation. New Zealand Threat Classification Series 46.
- e3Scientific. (2026a). *Doolans Creek Water Take Assessment of Effects*. Arrowtown: Prepared for NZSki.
- e3Scientific. (2026b). *Doolans Basin Access Tracking Stormwater, earthworks and crossing FEClA*. Arrowtown: Prepared by e3Scientific for NZSki.
- e3Scientific. (2026c). *Remarkables Ski Area Upgrade and Doolans Expansion Terrestrial Ecological Impact Assessment*. Arrowtown: Prepared for NZSki.
- e3Scientific. (2026d). *Doolans Basin Tarns, Weir and Watertake Freshwater Ecological Impact Assessment*. Arrowtown: Prepared by e3Scientific for NZSki Limited.
- e3Scientific. (2026e). *Remarkables Ski Area Upgrade and Doolans Expansion - Rastus Burn Wastewater Freshwater Ecological Impact Assessment*. Arrowtown: Prepared for NZSki Ltd by e3Scientific.
- e3Scientific Ltd. (2026). *Remarkables Ski Area Upgrade and Doolans Expansion Terrestrial Ecological Impact Assessment*. Arrowtown: e3Scientific Ltd.
- e3Scientific Ltd. (2026a). *Remarkables Ski Area Upgrade and Doolans Expansion - Doolans Creek Water Take Assessment of Effects*. May 2026.
- ECan. (accessed 13/5/2026). *Didymo*. Retrieved from Environment Canterbury: https://www.ecan.govt.nz/pest-search/didymo?utm_source=copilot.com
- Enviroscope. (2026). *Construction Environmental Management Plan - Remarkables Ski Area Upgrade and Doolans Expansion Project*. Queenstown: Prepared by Enviroscope for SZSki Limited.



- Enviroscope. (2026). *Erosion and Sediment Control Assessment Remarkables Ski Area Upgrades and Doolans Expansion Project*. Wanaka: Enviroscope.
- Enviroscope. (2026). *Remarkables Ski Area Expansion - Construction Environmental Management Plan*. Hawea: Prepared by Enviroscope for NZSki Limited.
- Gadd, J., & Milne, J. (2019). *Monitoring water quality in urban streams and stormwater: Guidance for New Zealand practitioners*. Wellington: NIWA Client Report 2019168AK prepared for Envirolink. MBIE contract.
- Grainger, N., Harding, J., Drinan, T., Collier, K., Smith, B., Death, R., . . . Rolfe, J. (2018). *Conservation status of New Zealand freshwater invertebrates*. Wellington: Department of Conservation NZ Threat Classification Series 28.
- Kilroy, C., Larned, S. T., & Biggs, B. J. (2009). The non-indigenous diatom *Didymosphenia geminata* alters benthic communities in New Zealand rivers. *Freshwater Biology*, 54 (9):1990-2002.
- LAWA. (Accessed 2026, 24 06). Nevis River. Retrieved from LAWA: <https://www.lawa.org.nz/explore-data/otago-region/river-quality/dunstan-rohe/nevis-at-wentworth-station>
- Ludgate, B. (2017). *Remarkables Ski Area - Biological survey of the Rastus Burn*. Dunedin: Prepared for NZSki Ltd by Ryder Environmental Ltd.
- Ludgate, B., Arthur, J., & Ryder, G. (2014). *Remarkables Ski Area Wastewater System - Assessment of Environmental Effects November 2014*. Dunedin: Prepared for NZSki by Ryder Consulting Ltd.
- MfE. (2021). *National works in waterways guideline - Best practice guide for civil infrastructure works and maintainance*. Wellington: Ministry for the Environment.
- Ministry for the Environment. (2020). *National Policy Statement for Freshwater Management (December 2025 amendments)*. Wellington: Ministry for the Environment.
- Neale, M. W., Storey, R. G., & Quinn, J. L. (2016). *Stream Ecological Valuation: application to intermittent streams*. Auckland Council technical report, TR2016/023: Prepared by Golder Associates (NZ) Limited for Auckland Council. .
- NEMS. (2022). *National Environmental Monitoring Standards. Macroinvertebrates. Collection and Processing of Macroinvertebrate Samples from Rivers and Streams V1.0.0*. Wellington: Ministry for the Environment.
- NZFFDB. (2025, 02 18). New Zealand Freshwater Fish Database. Hamilton, New Zealand.
- ORC. (2016). *Regional Plan: Water for Otago*. Dunedin: Otago Regional Council.



- ORC. (Accessed 13/5/2026). *Didymo*. Retrieved from Otago Regional Council: https://www.orc.govt.nz/environment/biosecurity-and-pests/freshwater-pests/didymo/?utm_source=copilot.com
- Otago Regional Council. (2025). *Regional Plan: Water for Otago*. Dunedin: Otago Regional Council, Updated 21 August 2025.
- Pennington, S. L., & Webster-Brown, J. G. (2008). Stormwater runoff quality from copper roofing, Auckland, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 42: 99-108.
- Rance, B., & Boddy, N. (2020). *Kawarau/Remarkables Conservation Area ecological values*. Wellington: Department of Conservation.
- Robertson, H. A., Baird, K. A., Elliot, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. D., . . . Michel, P. (2021). *NEW ZEALAND THREAT CLASSIFICATION SERIES 36: Conservation status of birds in Aotearoa New Zealand, 2021*. Wellington: Department of Conservation.
- Roper-Lindsay, J., Fuller, S., Hooson, S., Sanders, M., & Ussher, G. (2018). *Ecological Impact Assessment (EclA): EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems*. Melbourne: EIANZ.
- Sherrin, S., Shcherbakova, Y., & Richardson, J. S. (2025). Macroinvertebrate Communities of Non-Glacial Alpine Streams in Western North America's Coast Mountains. *Limnological Review*, 25(3): 38.
- SLR. (2023). *Remarkables Ski Area - Biological survey of the Rastus Burn*. Dunedin: Prepared for NZSki Ltd by SLR Consulting New Zealand.
- SLR. (2026). *Remarkables Ski Area: Biological Survey of the Rastus Burn*. Dunedin: Prepared by SLR Consulting Ltd for NZSki Ltd.
- Snelder, T., Biggs, B., & Weatherhead, M. (2010). *New Zealand River Environment Classification User Guide*. Wellington: Ministry for the Environment.
- Stantec. (2025). *Remarkables Ski Area Doolans Expansion Water Intake Concept Report*. Queenstown: Prepared for NZSki Ltd by Stantec New Zealand.
- Stantec. (2026a). *Remarkables Ski Area Doolans Expansion Reservoir Concept Report*. Queenstown: Prepared for NZSki by Stantec New Zealand.
- Stantec. (2026b). *Remarkables Ski Expansion Project Stormwater Concept Report*. Queenstown: Prepared by Stantec New Zealand Limited for NZSki Limited.
- Stantec New Zealand. (2026). *Remarkables Ski Area Expansion Project Stormwater Concept Report*. Queenstown: Stantec New Zealand.
- Stark, J. D., & Maxted, J. R. (2007). *A user guide for the Macroinvertebrate Community Index*. Nelson: Prepared for the Ministry for the Environment. Cawthron Report No.1166.



- Stark, J. D., Boothroyd, I. K., Harding, J. S., & Scarsbrook, M. R. (2001). *Protocols for sampling macroinvertebrates in wadeable streams*. New Zealand macroinvertebrate working group (Report 1). Prepared for the Ministry for the Environment.
- Storey, R., & Quinn, J. (2007). When the rivers run dry. *Water & Atmosphere*, 15(2): 16-17.
- Storey, R., & Quinn, J. (2008). Composition and temporal changes in macroinvertebrate communities of intermittent streams in Hawkes Bay, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 42(1): 109-125.
- Suren, A. M. (1991). Bryophytes as invertebrate habitat in two New Zealand alpine streams. *Freshwater Biology*, 26: 399-418.



Appendices

Appendix A: Survey Site Location Photos



DC1 - Doolans Creek 1



Trib A – Tributary A



Trib B – Tributary B



Trib C – Tributary C



Trib E – Tributary E



Doolans Base Building location (left of image)

Appendix B: Macroinvertebrate raw data

Name	DC 1 (1)	DC 1 (2)	DC 1 (3)	DC1 mean
Ephemeroptera				
Deleatidium	219	159	59	
Nesameletus				
Plecoptera				
Zelandobius	36	27	12	
Austroperla				
Acroperla	8	1		
Zelandoperla				
Spaniocerca				
Trichoptera				
Tiphobiosis	1			
Hydrobiosis				
Hydrobiosella	2	15	1	
Psilochorema				
Hudsonema				
Confluens				
Oeconesus				
Periwinkla	6	9	4	
Philorheithrus				
Zelolessica				
Diptera				
Paralimnophila				
Tanypodinae	1	9		
Stictocladius	1			
Lobodiamesa				
Maoridiamesa				
Chironomus		1		
Orthoclaadiinae				
Ephydriidae				
Tabanidae				
Austrosimulium	4	9	3	
Aphrophila				
Eriopterini				
Limonia				
Neocurupira				
Muscidae				
Coleoptera				
Hydrophilidae				
Scirtidae				
Dytiscidae				
Antiporus				
Elmidae		1		
Tricladida				
Cura				
Neppia	14	9	1	

Name	DC 1 (1)	DC 1 (2)	DC 1 (3)	DC1 mean
Hemiptera				
Anisops				
Mecoptera				
Nannochorista				
Sphaeriidae				
Nematomorpha				
Nematoda				
Collembola	1			
Oligochaeta				
Abundance	293	240	80	204
Taxa Richness	11	10	6	9
MCI Taxa Richness	9	9	5	8
MCI	111	100	112	108
QMCI	7.03	6.89	6.91	6.94
ASPM	0.56	0.52	0.55	0.54
EPT % Abundance	93	88	95	92
EPT % Richness	55	50	67	57
EPT Richness	6	5	4	5
Shannon Diversity Index	0.97	1.25	0.89	1.04
Evenness	0.4	0.54	0.5	0.48
MCI Attribute Band	B	C	B	B
QMCI Attribute Band	A	A	A	A
ASPM Attribute Band	B	B	B	B

Name	Trib A (1)	Trib A (2)	Trib A (3)	Trib A Mean	Trib C (1)	Trib 2 (2)	Trib C (3)	Trib C Mean
Ephemeroptera								
Deleatidium	5	36	45		45		11	
Plecoptera								
Zelandobius		3	7		2			
Austroperla								
Acroperla	5	4	14					
Zelandoperla		3						
Trichoptera								
Tiphobiosis	2		1			4		
Hydrobiosis		1	1		2		21	
Hydrobiosella					1			
Psilochorema	1		1					
Hudsonema			2		1			
Confluens			1				1	
Oeconesus								
Periwinkla								
Philorheithrus								
Zelolessica	2							
Diptera								
Paralimnophila								
Tanypodinae								
Stictocladius							1	
Lobodiamesa			1					
Maoridiamesa	1		3					
Chironomus						1		
Orthoclaadiinae	1							
Ephydridae	8							
Tabanidae								
Austrosimulium		5	1		2		3	
Aphrophila	2							
Eriopterini	1							
Limonia	8					14	5	
Coleoptera								
Hydrophilidae						3		
Scirtidae	2					11	1	
Dytiscidae								
Antiporus								
Elmidae		4	4					
Tricladida								
Cura								
Neppia			1				4	
Hemiptera								
Anisops								
Mecoptera								
Nannochorista								
Sphaeriidae								

Name	Trib A (1)	Trib A (2)	Trib A (3)	Trib A Mean	Trib C (1)	Trib 2 (2)	Trib C (3)	Trib C Mean
Collembola								
Oligochaeta			1				1	
Abundance	38	56	83	59	53	33	48	45
Taxa Richness	12	7	14	11	6	5	9	7
MCI Taxa Richness	12	7	14	11	6	5	8	6
MCI	123	120	99	114	120	104	98	107
QMCI	5.92	7.09	6.58	6.53	7.57	6.42	5.38	6.46
ASPM	0.39	0.54	0.55	0.49	0.58	0.23	0.43	0.41
EPT % Abundance	39	84	87	70	96	12	69	59
EPT % Richness	42	71	57	57	83	20	33	46
EPT Richness	5	5	8	6	5	1	3	3
Shannon Diversity Index	2.19	1.26	1.62	1.69	0.66	1.31	1.64	1.20
Evenness	0.88	0.65	0.61	0.71	0.37	0.81	0.75	0.64
MCI Attribute Band	B	B	C	B	B	C	C	C
QMCI Attribute Band	B	A	A	A	A	B	C	B
ASPM Attribute Band	C	B	B	B	B	D	B	B

Appendix C: Ecological Value Assessment Methodology

Assessment of Ecological Value Methods

The Environment Institute of Australia and New Zealand (EIANZ) Guidelines set out evaluation criteria that can be used to determine the ecological values of a species or habitat. The assigned ecological value is then used along with the magnitude of the proposal to determine the ecological impact. The following sections use the EIANZ Guidelines to characterise the ecological value of the stream and tarn habitats and faunal species that may utilise the area.

Under the EIANZ guidelines (Roper-Lindsay, *et al.*, 2018) ecological value is assigned based on the following assessment matters:

- Representativeness
- Rarity and Distinctiveness
- Diversity and Pattern
- Ecological Context

The representative criteria is more difficult to utilise within the freshwater environment as it relies on a range of information to support the assessment. More easily incorporated into the EIANZ criteria are rarity, diversity and ecological context in the freshwater environment which is utilised to support an assessment of ecological value. These matters are each assessed on a five point scale from Negligible to Very High.

Representativeness

The representativeness value for the freshwater environment includes the extent to which the site is typical of the natural characteristics, catchment size, stream order, standing water characteristics and taxa present. Therefore, it is considered appropriate that sites classified as unmodified or representative are recognised with a higher value under the Representative criteria. An unmodified or more natural site or area is likely to be a better representative example than a more modified one; some people consider that representativeness is broadly equivalent to "naturalness".

Rarity / Distinctiveness

The New Zealand Threat Classification System (NZTCS) is used to assess the threat status of fish (Dunn, *et al.*, 2025), freshwater macroinvertebrates (Grainger, *et al.*, 2018), terrestrial and aquatic plants (de Lange, *et al.*, 2023) and birds (Robertson, *et al.*, 2021). This impact assessment has utilised these NZTCS reports to inform an

assessment of rarity. However, rare habitats, communities or ecosystem types should also be considered.

Diversity and Pattern

The desktop research undertaken within this report of the NZFFD, and Shannon Diversity Index provided within this report are the basis for an assessment of diversity at the proposed site. Diversity and pattern can include physical and biological diversity. Underlying physical patterns such as lower fish diversity at greater altitude or temporal gradients. Long-term trends and taxa density can also be considered.

Ecological Context

Ecological context describes an ecosystem's role in ecosystem functioning. Examples may include:

- freshwater and terrestrial habitat may provide an important food source for fish and/or birds.
- freshwater and terrestrial habitat may play an important part in the lifecycle of a species e.g. breeding or spawning locations for macroinvertebrate, bird or fish species.
- Macroinvertebrate metrics or TICI scores.

For the purpose of this assessment habitats that support Threatened and At - Risk species, are biologically diverse, provide an important food source or play a critical role in the lifecycle for a species are considered to have a high ecological value.

Appendix D: Ecological Impact Assessment Methodology

Freshwater Ecological Impact Assessment Methodology

This freshwater ecological impact assessment (FEcIA) follows the EIANZ Ecological Impact Assessment Guidelines for New Zealand. The guidelines are based on the assessment of the ecological values present within the disturbance area of the proposed tracking and associated stream crossings effects of reduced stream habitat and potential sedimentation and dewatering (see Section 2). The magnitude of the effect within the zone of influence and the wider context of species populations and extent of remaining freshwater habitat is then considered to establish the level of ecological effect.

The FEcIA guidelines provide a series of tables that assist with the assignment of value to the ecological features that will be disturbed and the magnitude of the activity. These tables are provided in Table D1 & D2 and referred to in the discussion below. A summary of the ecological effects and the measures employed to avoid and mitigate the ecological effects of the proposed works are presented in Table 15 in the report.

Assigning Magnitude of Effect

The EIANZ guidelines provide criteria for assigning the extent of the effects on the ecological values within the area that may be disturbed by the activity. This assessment adopts the criteria for describing magnitude of effect and is provided in Table D1 below.

Table D1: Criteria for describing magnitude of effect (Roper-Lindsay, *et al.*, 2018).

Magnitude	Description
Very High	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; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or 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/OR Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature

Magnitude	Description
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR having negligible effect on the known population or range of the element/feature

Assigning Level of Effect

The level of ecological effect is based on combining the ecological value of an environment that may be impacted by the proposed activities and the magnitude of the effect.

Table D2: Criteria for describing level of effect (Roper-Lindsay, *et al.*, 2018). is adapted from the EIANZ guidelines to provide a level of effect matrix. For the purpose of this assessment, where the level of effect is moderate or above, a management response is required to ensure potential environmental effects are managed appropriately. An effect level of Low or Very Low indicate the effect is ecologically less than minor.

Table D2: Criteria for describing level of effect (Roper-Lindsay, *et al.*, 2018).

		Ecological Value			
		Very High	High	Moderate	Low
Magnitude	Very High	Very High	Very High	High	Moderate
	High	Very High	Very High	Moderate	Low
	Moderate	High	High	Moderate	Low
	Low	Moderate	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low
	Positive	Net Gain	Net Gain	Net Gain	Net Gain

Residual Impact

The residual impact is the final impact level assigned to the proposed activity and potential effects once proposed mitigation/remediation options have been applied and is presented in Table 15 in the report.