
To: NZSki
Cc: Mitchell Daysh
From: e3Scientific
Date: 21/8/2026
Subject: Remarkables Ski Area Upgrade and Doolans Expansion Freshwater Ecological Impact Assessment Report - Tarns, Weir and Watertake: Otago Regional Council Feedback Response (Torlesse 26/5/2026, 29/4/2026, Morphem 4/5/2026 and DOC 4/5/2026)

1 Introduction

The Remarkables Ski Area Upgrade and Doolans Expansion Freshwater Ecological Impact Assessment – Tarns, Weir and Watertake (FEcIA-Tarns, Weir and Watertake) (e3Scientific, 2026d) was submitted by NZSki as part of the NZSki Remarkables Upgrade and Doolans Expansion substantive fast-track application. The FEcIA assesses the freshwater ecological impacts of the construction of a new weir, water storage reservoir, and an associated water take.

Otago Regional Council has provided feedback on matters relating to the FEcIA-Tarns, Weir and Watertake via the following documents (in chronological timeline):

- 29/04/2026 - Torlesse Environmental Ltd – Pre-lodgement review of aquatic ecology report;
- 4/05/2026 – Morphem – Specialist Response
- 26/05/2026 – Torlesse Environmental Ltd – Pre-lodgement review of second tranche of technical documents.
- 6/08/2026 – Torlesse Environmental Ltd –Water Quality and Freshwater Ecology
- 12/08/2026 – Morphem – Response Table

The Department of Conservation (DOC) has provided feedback on matters relating to the FEcIA-Tarns, Weir and Watertake via the following document:

- 4/05/2026 – Department of Conservation

The key issues raised by each review, along with a response, are listed below.

2 Torlesse Freshwater Ecology Reviews

The following matters relating to the FEClA-Tarns, Weir and Watertake were raised by Torlesse in reviews dated 29 April 2026, 26 May 2026 and 6 August 2026. Our responses to the matters raised are provided below.

1. *Please provide an estimation of residual flow and allocation relative to MALF at multiple downstream locations, including reaches supporting fish populations. and*

Effects of the water take: The current effects assessment does not include sufficient evidence to support the conclusion that there will be no effects on resident macroinvertebrate communities. A clearly articulated line of reasoning is needed to justify this conclusion. Dr Allibone was able to outline the key elements of this argument during the workshop, and I suggest the authors start by expanding on the points he raised there (6/8/2026 Torlesse review comments).

Response: This information is provided in the hydrological watertake feedback response memorandum (e3s Response to DOC questions regarding B-08 Water Take). Dr Richard Allibone has prepared a further memo to address the ecological implications of the water take in relation to MALF (Appendix A). Various reductions from MALF are assessed and reductions to 30% of MALF are considered significant and maintaining 45% of MALF should retain 80% of the stream width, maintaining a residual flow of 30 L/s is also considered beneficial. The residual flow now proposed is 50% of MALF, 33.5 L/s. The FEClA-Tarns, Weir and Watertake report (e3Scientific 2026a) has been updated to reflect a change in activity relating to the maintenance of a residual flow of 33.5 L/s within Doolans Creek. Based on this amendment, Sections 2.2, 2.2.2, 6.2.2 and Table 13 of the FEClA-Tarns, Weir and Watertake report has been updated to reflect the proposed increase in residual flow from 20 L/s to 33.5 L/s.

2. *Comparison of these values (from point 1 above) with relevant regional guidance, particularly in fish-bearing reaches (e.g. Hayes et al., 2021).*
3. *Identification of the downstream point at which the abstraction is unlikely to have a meaningful effect on flows, and consideration of the significance of the affected stream length in the wider catchment context.*

4. *Additional information supporting the conclusion that downstream waterfalls and gorge features prevent fish passage would also be beneficial;*

Response: 2, 3 & 4 are addressed in Section 4.4 and 6.2.2 of the updated FEClA-Tarns, Weir and Watertake report dated 21/8/2026. Also see comment from Department of Conservation (DOC) Q3.1 in Section 4 below for further response. Dr Richard Allibone has supplied a separate memo dated 21/8/2026 to address the water take aspects. This is included as Appendix B of this memo.

5. *An assessment of whether the backwash discharge has the potential to result in a conspicuous change in visual clarity, and the likely duration of any such effect, is required.*

A further question was raised on 26 May 2026:

6. *Clearly describe when and how sediment will be returned to Doolans Creek (during the proposed backwash discharge) and the potential for this to generate conspicuous changes in visual clarity.*

Response to 5 & 6: The Doolans Creek Weir Site, DC 3 (located a short distance upstream) had streambeds that comprised of 5% sand, and DC 1 located in the headwaters comprised of 10% sand and no stream sites had silt present during the instream habitat assessment within Doolans Creek (Doolans Creek Right Branch) (Table 5; e3Scientific, 2026d). Given the low sediment volumes observed in the stream and the coarse-grained nature, the majority of sediment contained in the backwash discharge is expected to be larger sand particles which settle quickly out of suspension (Davies-Colley, *et al.*, 2024).

Stantec have outlined that backflushing will be required after significant storm events. No information is available on volume or frequency of sediment transport within Doolans Creek; however, it is expected that backflushing will be required at start up and every two months during the snow making season and end of season flushing may be required (Chinn, 2026). The intake will be operated intermittently during the off-season (i.e. outside of the snow making season), following reservoir maintenance or inspection activities and backwashing of the intake during May may be required to ensure that the intake operates satisfactorily. For comparison, in the Rastus Burn Catchment the intake requires cleaning annually or biannually (Chinn, 2026).

The duration of flushing is dependent on the volume of material which has precipitated out in the structure, but approximately one to three minutes duration of flushing is anticipated to be sufficient to clear the inlet chamber (Chinn, 2026).

As primarily sand and gravels are present, it is likely sand and gravels will comprise the material to be flushed from the pump inlet chamber. Any localised stream visual clarity reduction due to pump backwashing will be limited to the 1-3 minute duration of the pipe backflushing, with any sand present then rapidly settling (within 10 - 20 m, e.g. Thompson, 2001; Blueprint Ecology, 2023) to the stream bed in slower flowing edge habitats.

The frequency and duration of backwashing operations, and potential alterations to water clarity, will be further addressed in a separate feedback response memorandum prepared by e3Scientific relating specifically to feedback raised regarding the Doolans Creek water take. This is provided to ORC in a separate memorandum regarding the Doolans Creek water take.

3 Morphum Reviews

The following freshwater ecology questions were raised by Morphum on 4 May 2026. It is understood Morphum was engaged to provide the wetland ecology review; however, they also provided feedback relating to the proposed Doolans water reservoir tarn conversion and proposed stream crossings.

1. *The use of the Taxon-Independent Community Index (TICI) for the tarn samples is not considered appropriate as the method is based on past samples (and associated ecological analysis) and it is likely that tarns are poorly (if at all) represented in the TICI database.*

Response: I agree that tarns are poorly represented within the TICI database, hence the TICI information was only utilised as supplementary information within the FEClA-Tarns, Weir and Watertake report and was not utilised to establish the freshwater ecological value assignments. The main assessments used to establish the ecological values is based on benthic macroinvertebrates and tarn zooplankton which is considered to be an acceptable method because;

- a) Benthic macroinvertebrates are widely used as bioindicators because many taxa are sensitive to changes in water chemistry, habitat structure and sedimentation, they complete life cycles in predictable timeframes, and they are largely sedentary, so their presence reflects local conditions rather than transient events (Fureder, *et al.*, 2006).
- b) Zooplankton respond quickly to changes in water column conditions such as nutrient enrichment, primary production, and fish predation pressure; shifts in zooplankton

community composition, size structure, and abundance are sensitive early-warning signals of trophic change and altered food-web dynamics (Dehingia, et al., 2026).

c) Combining zooplankton with benthic data captures both benthic and pelagic pathways of ecosystem change (Arias, et al., 2022).

2. *The avoidance and other options to the reclamation of the tarn have not been presented.*

Response: When considering alternatives to the tarn habitat reclamation, the avoidance options are provided in Section 6.2.3 (e3Scientific, 2026d) and in the Substantive Application Assessment of Environmental Effects (Mitchell Daysh, 2026), also see further details in Table 2 of the DOC Hydrology Review response memo (e3scientific, 2026f). The selection by NZSki of Tarn 3 as the reservoir location is an avoidance strategy to avoid other habitats assessed to have higher ecological values than Tarn 3, such as the "Very High" ecological values identified within the surrounding terrestrial habitat (e3Scientific, 2026c) and the other tarns in the immediate area (e.g. Tarn 1 and 2) (Table 10; e3Scientific, 2026d). However, as discussed in Section 6.2.3 Tarn 3 still represents a "High" ecological value habitat and an overall "High" level of effect is identified based on the modification of this tarn. It was assessed that no further avoidance, mitigation, remediation or offset options were available to reduce these identified effects (e3Scientific, 2026d). Further options are outside the scope of this FECLA-Tarns, Weir and Watertake report and are being addressed by NZSki directly.

3. *How has the area (4,450m²) of the tarn been assessed? Given that the water level has fluctuated between the two site visits, is this the maximum likely flooded area?*

Response: Yes, the maximum floodable area has been used to determine the size of the tarn. The area of bare rock and the absence of tussocks was used to determine the maximum floodable area using aerial imagery and GIS.

4. *The resulting reservoir is reported to be lined. There is little information on this or assessment of the effects of a reservoir being in the location of the tarn. It is considered if a lining is to be utilized, the water take will need to occur throughout the year as the reservoir will need to remain full to protect the lining. This may affect the water take assessments.*

Response: Yes, the reservoir is to be lined. It is planned that the reservoir will be filled at the end of the snow making season to ensure there is water within the reservoir to

remove the risk of wind uplift. It is not intended that further water abstraction will be required to top up the reservoir other than for reservoir refilling after maintenance or inspection activities (Chinn, 2026). It is not considered necessary to adjust the water take volume and timings to accommodate summer reservoir filling to protect the liner.

5. *The EclA classed all wetland features as having a very high ecological value. Please explain why tarns, an uncommon wetland feature, are considered only to have a high ecological value?*

Response: Wetlands (excluding tarns) within the EclA all had high rarity values assigned due to the presence of a number of Threatened or At Risk plants within them (e3Scientific, 2026c). Whereas, Tarn 2 had high rarity values due to the detection of a data deficient stonefly in the eDNA sampling indicating it is present in the tarn or an upstream water course. The high rarity score is also a precautionary approach in terms of rarity and the use of the Tarn 2 as habitat. McLellan (2006) reports that the stonefly *Z. macburneyi* is widespread and reported from North and South Island areas (Taranaki, Wellington, Canterbury, and Otago). Allibone (2024) detected *Z. macburneyi* eDNA in a series of high altitude small first order streams near Tekapo indicating the Tarn 2 detection may be due to the stonefly occupying upstream inflow habitat. Tarns 1 and 3 had moderate values assigned as they did not have Threatened plants or macroinvertebrates present (e3Scientific, 2026d). This led to the 'Very High' overall ecological rating for the wetland features and Tarn 2, and the 'High' overall ecological rating for Tarn 1 and 3 in the FEclA-Tarns, Weir and Watertake.

In Section 5.2 of the FEclA-Tarns, Weir and Watertake, Tarn 2 was assigned an overall ecological value of '**High**'. This has been updated to '**Very High**' based on the assessment undertaken in Table 10 when following EIANZ Table 6 (Roper-Lindsay, *et al.*, 2018), due to the presence of the data deficient stonefly. The diversity and pattern score for Tarn 3 was assessed as low due to low (1 to 2) zooplankton taxa richness (Table 6; e3Scientific, 2026d). However, following feedback from DOC (See Q3.3 in Section 4 below), it was agreed that the low diversity is likely due to ephemeral traits of the tarn and not a measure of biodiversity loss. Therefore, the Diversity and Pattern matter for Tarn 3 has been adjusted to moderate to reflect the water level fluctuations, and incorporating this change the overall ecological value remains "High" (Table 1).

Table 1: Ecological value summary for the tarns assessed (e3Scientific, 2026d).

Matter	Tarn 1	Tarn 2	Tarn 3
Representativeness	High	High	High
Rarity/distinctiveness	Moderate	High	Moderate
Diversity and pattern	Moderate	Moderate	Moderate
Ecological context	High	High	High
Overall	High	Very High	High

6. *I consider the reclamation of the tarn to be a significant residual effect (no avoidance, minimisation or mitigation proposed).*

Response: This is addressed above in response to Question 2, in Table 2 of the DOC Hydrology Review response memo (e3scientific, 2026f) and in the updated version of the FECLA-Tarns, Weir and Watertake (dated 21/8/2026).

7. *There are at least 4 locations where the proposed works (earthworked access way tracks) crosses a permanent or intermittent stream. There is no assessment of potential adverse effects for these locations. It's not clear how these streams will be crossed, what the streamworks methodology will apply and how the potential adverse effects will be managed. This is considered a significant gap.*
8. *Stream impacts are not addressed specifically and therefore should be set out in the residual adverse effects table.*

Response to 7 & 8: Stream impacts from proposed stream crossings/tracks have been assessed separately in the Tracks, Stream Crossings and Stormwater Freshwater and Hydrological Impact Assessment report (e3Scientific, 2026b) submitted with the substantive fast-track application. Please refer to this report for a full assessment of these stream crossing aspects.

3.1 Morphem Review Response Tracking Table

The following freshwater ecology questions and assessment of notes/close out were provided by Morphem on 12 August 2026. Comments were also provided on the updated reports. New topics not previously covered in section 3 are addressed in the following points.

- a) *The report contains a definition of wetlands and a tarn (pg 2). Is this definition from a known source? I do not see it in the NPS:FM, RMA or other*

legislative documents and it affects how the tarn is captured in policy terms. It is also not in the exclusions of a wetland in the NPS:FM. Johnson and Gerbeaux (2004), the DOC national wetland classification guide, considers lakes to have a major dimension of 500m or more and treats a lacustrine hydrosystem as one of the wetland hydrosystems. Caselaw for wetland focuses on the requirement to contain animals (and plants) adapted to wet conditions. Please provide the source of this definition and the reason to exclude a tarn, which has demonstrated large volume changes in a year and has therefore an intermittently wet margin. Departure from statutory definitions will require justification.

Response: As stated in the in Section 1.1 of the FEClA - Tarns, Weir and Watertake, these definitions were intended as a “working definition” for this report to support clarity regarding what features were discussed in the terrestrial ecological assessment (i.e. wetlands which primarily have terrestrial plant habitat values) and which were included in the freshwater ecological assessment (i.e. tarns which primarily have freshwater habitat values). We understand this differentiation may not be ideal; however, in this instance it was primarily targeted at accurately assessing and characterising the freshwater ecological values of Tarn 3 as it was identified by the wetland experts that this tarn did not have any adjoining wetland (terrestrial) values within its littoral margin. Meaning when the water level of Tarn 3 naturally recedes, the littoral edge is composed of exposed schist rock only and does not contain animals or plants adapted to wet conditions; therefore, this tarn should not be considered a wetland. Tarn 1 and 2 were assessed to have wetland characteristics within their littoral margins; however, no impacts are anticipated within these habitats, and therefore their legislative definition was not discussed further.

However, the reviewer's suggestion that another approach would be to use the RMA wetland definition unmodified and provide clarity around Tarn 3 not meeting the wetland definition is noted. The text in the report has been altered to reflect this by removing the exclusion in Section 1.1. Further text is then added to Section 2.1.2 and 6.2.3 to explain why, in this instance, Tarn 3 does not meet the criteria to be classified as a wetland.

b) A point to note: The Doolans Basin is Crown land administered by the Department of Conservation, and clause 3.23(2) of the NPS-FM expressly relieves regional councils of the duty to map natural inland wetlands on public conservation land. The absence of these tarns from ORC mapping,

and their "not yet listed" status in ORC's 2022 regional wetland assessment, is explained by the exemption. This therefore does not support an inference that they are not natural inland wetlands.

Response: This is noted with regard to the characterised Tarn 1 and 2. However, it remains that Tarn 3 does not meet the definition of a wetland, regardless of mapping effort.

- c) *Check Tarn extents – on page 7: Tarn 1 is large (13,750 m²). Tarn 2 is small (910 m²). Tarn 3 is of moderate size (4,450 m²). Section 6.2.4 and Table 13 represents this as a 13.5% of tarn habitat loss in the Doolans Basin. The evidence is only of the 3 tarns and therefore is 23% of the tarns noted by area and 33% by feature. This alone, on applicant's scale, would push it to very high level of effect.*

Response: Four tarns are identified within Doolans Basin, three of which were surveyed due to their proximity to the proposed activity area. Tarn 4 is 7,940 m² and was beyond the surveyed extent, but forms part of the tarn habitat within the Doolans Basin, therefore is appropriately considered within the overall tarn habitat calculations. Tarn 4 is visible in Figure 1 and Figure 5 of the FEClA (Tarns, Weir and Watertake) as an unlabelled tarn at the bottom of the figures. Text has been added to Section 2.1.2 of the FEClA (Tarns, Weir and Watertake) report to alert the reader about this tarn. The total tarn area within the Doolans Basin is 27,050 m². The maximum wetted area has been used to assess the extent lost for Tarn 3 as part of a precautionary approach to the tarn size. However, as demonstrated in Figure 1 below, the water level and wetted area of this tarn changes through time with April 2022, April 2023 and January 2026 illustrating wetted areas of 1,210 m², 2,090 m² and 4,450 m², respectively (Figure 1). This is calculated off aerial imagery. The wetted area does not alter for the other three tarns within Doolans Basin (Figures 2, 3 and 4). Tarn 4 has not been included in the assessment to date as the area was originally out of scope, but the tarn does form part of the tarn habitat within the basin and is therefore included within this calculation. Using these areas the calculated tarn area loss ranges from 4.5% to 16.5% at its recorded maximum, rather than the 13.5% originally stated in the FEClA (Tarns, Weir and Watertake) report due to an initial over measurement of Tarn 4. It does not equate to a 23% loss by area, suggested by the reviewer. This edit has been made to the executive summary, Section 6.2.3 and Table 13 of the FEClA (Tarns, Weir and Watertake) report. Based on this, the level of magnitude applied is considered appropriate and the loss of Tarn 3 is assessed as resulting in a 'High' overall level of effect.



Figure 1: Tarn 3 (left to right) January 2026; April 2023; April 2022 (Google earth historical images).



Figure 2: Tarn 1 (left to right) January 2026; April 2023; April 2022 (Google earth historical images).



Figure 3: Tarn 2 (left to right) January 2026; April 2023; April 2022 (Google earth historical images).



Figure 4: Tarn 4 (left to right) January 2026; April 2023; April 2022 (Google earth historical images)

4 DOC Wetland and Freshwater Review (Freshwater Only)

The following freshwater ecology questions were raised by DOC on 4 May 2026. DOC's review covered the wetland, freshwater ecology and hydrological aspects of the project. Only responses to freshwater questions are provided within the following section.

- Wetland questions (2.1, 2.2, 2.3, 2.4, 5.1, 5.2, 5.3 and 5.4) are covered in the Terrestrial Ecology DOC response memo (e3Scientific, 2026e).
- Hydrology questions (2.3, 2.7, 3.5 in part, 4.1, 4.2, 4.3 and 4.4) are covered in the DOC Review response memo (e3scientific, 2026f).

2.5 Cumulative effects assessment is inadequate at basin and conservation-area scale. Each report addresses a slice of the project. None address the project as a whole at basin scale, and none integrate effects on the local ecology from the existing Remarkables ski area. The Wildlands (2011) survey of the existing Remarkables ski area found that ski-area wetlands are ecologically significant under QLDC criteria and that the greatest potential adverse effects on those wetlands arise from earth-moving activities that destroy or modify wetlands or their hydrology. The Doolans expansion is precisely that activity. A basin-scale cumulative effects assessment integrating the Doolans expansion and the existing ski-area infrastructure is required.

Response: The Part A substantive application document addresses the project as a whole and provides the overall assessment of environmental effects, based on the findings of each discipline.

2.6 Survey effort is insufficient for the values being characterised

The FEClA fieldwork comprised two visits in shoulder seasons (April 2025 and January 2026). For an alpine system at 1,380–1,750 m a.s.l., where many invertebrate taxa have short adult flight periods and where the boundary at the upland transition shifts seasonally, this baseline is likely to under-represent the values being characterised. The detection of the Data Deficient stonefly *Zelandobius macburneyi* in eDNA at multiple sites in the FEClA is consistent with that risk. At least one additional summer macroinvertebrate and zooplankton sampling event across all three basin tarns and Doolans Creek will strengthen the baseline data for taxa likely inhabiting freshwater habitats

Response: The survey effort completed to date characterises the freshwater habitats throughout the basin have high to very high ecological values (e3Scientific, 2026d; e3Scientific, 2026b). This characterisation is based on a precautionary approach based on the level of sampling effort. Further sampling may refine distribution, abundance and diversity knowledge. However, the classification of the freshwater habitats as high or very high ecological value would be unlikely to change. An ecological value of 'Very High' is the highest currently allocated under the EIANZ guidelines.

With regard to the tarns, Tarn 1 and 2 appear to be relatively stable ecologically, based on wetland margins and there are no impacts from the activity expected. Tarn 3, due to its fluctuating water levels is likely to be less stable ecologically with an area, depth and thermal regime that will alter over summer/autumn as the water volume diminishes (See Figure 1). However, Tarn 3 has been assigned High ecological values and as such the loss of this High value habitat is considered a High overall effect. E3scientific consider the stonefly *Zelandobius macburneyi* to be reasonably widespread through alpine conditions with its range described as found in the North Island (Taranaki and Wellington regions) and in the South Island in Central Canterbury, Central Otago, Otago lakes and Dunedin (McLellan, 2006). Its data deficient ranking is due to a lack of data to conduct the ranking process, and does not indicate it is threatened. The lack of data is probably due to its high altitude, possibly trout free, habitat that is rarely sampled. Its detection in the surveys simply indicates that the upper Doolans catchment is part of its geographic range and appropriate sampling has been applied to detect it.

The eDNA, macroinvertebrate and zooplankton sampling completed in January and April are a robust combination of methods that complement each other in their various detection abilities for characterising freshwater ecological values. We acknowledge that there could be further freshwater invertebrate species not found at the site during those specific survey times; however, desktop assessment of alpine species is also

utilised to cover any potential gaps. The terrestrial ecology survey completed light trapping and identified Tipulidae taxa with adult flying stages as the main aquatic/semiaquatic taxa present.

3.1 Sampling and methods

The combination of Surber/kicknet macroinvertebrate sampling, zooplankton tows, eDNA and rapid habitat assessment is consistent with current freshwater ecological practice. The author's reasoning that the fishless status of upper Doolans Creek can be confirmed by eDNA alone is acceptable in this case, given the natural waterfall and gorge barriers 2.5–6 km downstream, the elevation (1,380 m a.s.l.) above the typical altitudinal range of Nevis galaxias (Galaxias 'nevis') in this catchment, and the absence of historical NZFFD records. My experience of Nevis galaxias distributions align with the author's findings and I agree with the conclusion that the stream where the water take is proposed is fishless.

However, two field visits in shoulder seasons are unlikely to capture the full alpine macroinvertebrate community given the strongly seasonal emergence and short adult flight periods of many alpine taxa. The 2026 sampling is the first available characterisation of Tarn 3 specifically and the limitations section should state this more directly and assess whether further sampling is required.

Response: e3Scientific appreciates the agreement with regard to the fish assessment and this description by DOC demonstrates alignment between the e3Scientific report findings and DOC's local knowledge of the area. This conclusively addresses Q4 of the Torlesse Review in our opinion.

The strong seasonal climatic drivers can restrict the appearance of the adult terrestrial forms of a macroinvertebrate community to a short summer/autumn window. Therefore, it is more likely that the whole community was present and able to be sampled at the time of the field visits rather than less likely. Furthermore, the nymph and larval forms are longer lived life history stages and these stages over-winter in their aquatic habitats, and some species also exist as multiple generations. Therefore, the Surber samples and freshwater eDNA samples can be expected to detect the freshwater resident life history stages all year round. The Limitations Section of the report has been updated to outline that Tarn 3 aspects of zooplankton and eDNA were sampled directly in January 2026 and macroinvertebrates in April 2026. Sampling effort is discussed in more detail in the previous response.

3.2 TICl and tarn assessment

The Taxon Independent Community Index (Wilkinson et al. 2024) was developed primarily for lotic systems and its calibration to lentic systems such as alpine tarns is not yet well established. The "Excellent" TICI scores for Tarns 1, 2 and 3 should be treated as indicative rather than diagnostic, and the assessment of tarn ecological condition should give greater weight to the macroinvertebrate, zooplankton and habitat-structure evidence. Irrespective of the biological communities and hydrological regimes of the tarns, they are already protected due to their location on Public Conservation Land. This also needs to be considered when assessing ecological value.

Response: Yes, e3s agrees with the reviewers comments in relation to the TICI use. Please also see response to Q1 in Section 3 (Morphum Review) with regard to the TICI Metric use. The Representativeness and Ecological context aspects of ecological values assessment take into account the conservation status of the alpine tarns. This is provided in Table 10 of the FECLA-Water Take and Tarns report.

3.3 Ecological values

I broadly agree with the High ecological value assigned to both the Doolans Creek weir reach and the basin tarns. I disagree with the Low score given to Tarn 3 on Diversity and Pattern. The absence of EPT taxa and the reduced aquatic plant cover at Tarn 3 reflect a different hydrological regime (fluctuating water levels, no surface outflow, intermittent inflow) rather than degradation, and that distinctive regime is itself a feature of value within the basin tarn complex. Tarn 3 should be assessed as Moderate on Diversity and Pattern, consistent with Tarns 1 and 2. The report's own observation that water levels fluctuated markedly between April 2025 and January 2026 supports this interpretation.

Response: E3s agree with DOC that although the ephemeral nature of the tarn and the absence of identified ecological rarity and diversity values would typically indicate a Low score for this aspect, in this instance the unique environmental characteristics could also contribute to a Moderate score and does not represent degradation. This has subsequently been changed in the FECLA-Water Take and Tarn report (Table 10) and associated text. This alteration to the Diversity and Pattern matter specifies that the overall assessment of "High" ecological value for Tarn 3 remains the same.

3.4 Weir Construction and water abstraction

The proposed Tyrolean weir design, the use of prefabricated components to minimise in-stream concrete works, the timing of works to dry/low-flow periods, dewatering and isolation of cement, ESC best practice, and the back-flushing

controls in the EMP are appropriate. I agree the residual level of effect on Doolans Creek can be managed to Low. The proposed take regime (≤ 30 L/s for 16 days, May–October, with at least 20 L/s residual flow) is conservative against the modelled MALF and the affected reach is short (~600 m to the next significant tributary input). I agree with the Low level of effect conclusion for the take in isolation, conditional on monitoring of residual flow at the take site during operation and on the back-flushing protocol specifying timing relative to natural flow events to avoid coinciding with low-flow periods.

Response: Thank you for clarifying that the reviewer agrees with the assessment of a low level of effect for the water take. Further to this, a residual flow of 33.5 L/s is proposed as a consent condition currently.

The suggestion to time 'back flushing' with elevated flow events is a good idea, and e3scientific supports trials of this this being included in the management plan to occur as far as practicable (i.e. at season start up it may not be possible to time with an elevated flow event). However, this would have to be confirmed by NZSki and Stantec prior to committing to this.

3.5 Reservoir Construction

This is my principal point of disagreement with the report. Three issues warrant detailed engagement:

Magnitude: The report assigns Moderate magnitude on the basis that 13.5% of basin tarn habitat is lost by applying a basin-scale denominator. Applying the EIANZ (Roper-Lindsay et al. 2018) magnitude criteria to the affected feature (Tarn 3 itself), the activity is unambiguously a total loss with a Very High magnitude of effect. Combined with the High ecological value already assigned, the EIANZ matrix gives a Very High level of effect (Roper-Lindsay et al. 2018, Table 6).

Avoidance: The report states that an alternative depression ~200 m north was discounted on pumping-distance and terrestrial-ecology grounds, but does not document a structured options assessment. Among the alternatives that should be explicitly considered could include:

- an engineered tank reservoir not requiring an existing depression
- supplying snowmaking water from existing Remarkables base-area infrastructure
- and a smaller reservoir lined within only part of Tarn 3's footprint, retaining a portion of the tarn margin and littoral habitat.

Each should be assessed against the mitigation hierarchy before offsetting/compensation is invoked.

Compensation: *The report flags a biodiversity project as the proposed compensatory package but provides no detail on type, location, scale, ecological equivalence, security of tenure, timing or monitoring. The example given (Nevis galaxias habitat restoration in a nearby catchment) is not equivalent to the loss of an alpine tarn ecosystem and is poorly matched on a like-for-like basis. Any compensation proposal should be set against established principles (e.g. Baber et al. 2021 Biodiversity Compensation Model already cited in the reference list) and should demonstrate at least no-net-loss for the specific ecosystem type lost. Although, I acknowledge a different approach may be required given that alpine tarns are an uncommon ecosystem (Holdaway et al. 2012) that are mostly of high-naturalness and not readily restorable.*

Response: Magnitude: As described in response to 3.3 (above) and response to Q5 in Section 3 Morphum Review (above) the assigned ecological value assigned to Tarn 3 remains assessed as High. Within the FEClA-Water Take and Tarn the loss of Tarn 3 is assessed in relation to the total tarn habitat in the Doolans Basin. This equated to 13.5% of the tarn habitat of Doolans Basin by area. As such we consider the magnitude of effect meets the "moderate" definition of "Loss of a moderate proportion of the known population or range of the element/feature" (Table 8; Roper-Lindsay, et al., 2018) and results in an overall "High" level of effect.

e3scientific have discussed further options to reduce and mitigate the effects with the engineering team through the design process; however, these have not been considered viable to meet the requirements of the infrastructure required, which is outside our expertise. A structured options assessment of alternative engineering designs for the reservoir is beyond the scope of the FEClA and is best provided by the engineering design team or planning team as part of the application.

E3scientific agree that the loss of Tarn 3 will require redress and that compensation should only be recommended when all other hierarchical management options are unavailable. It is our understanding (based on advice from outside our areas of expertise) and assessment that in this instance further avoidance, mitigation, remediation and offset options are unavailable with regards to the loss of Tarn 3.

Avoidance: Please see Table 2 of the DOC Review response memo (e3scientific, 2026f) for a more thorough assessment of avoidance options that were considered prior to the selection of the reservoir site. This is also provided in the Part A substantive application document.

Compensation: It is out of our scope to provide compensation options or to assess the appropriateness of this loss of tarn habitat. However, our finding remains that the loss of Tarn 3 represents a “high” overall level of effect.

3.6 Didymo

Didymo was detected at the weir site in January 2026 but not in April 2025 upstream. Construction and operational vehicle and equipment vectors increase risk of upstream and inter-tarn spread. The EMP should include explicit Check-Clean-Dry protocols for both construction and ongoing operational use. Avoiding the upstream spread of didymo should be a priority.

Response: Agreed, the Tracking and Stormwater report (e3Scientific, 2026b) outlines the requirement for this within the EMP.

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Appendices

Appendix A: Doolans DC3 flow physical habitat relationships

To: [REDACTED] Mitchell Daysh Ltd
 Cc: [REDACTED], NZski; [REDACTED], Mitchell Daysh Ltd
 From: Richard Allibone, Water Ways Consulting Ltd
 Date: 21 August 2026

Subject: Doolans DC3 flow physical habitat relationships

[REDACTED]

In the memo below I have assessed the Doolans Creek water abstraction and made a minimum flow recommendation based on the information available for habitat modelling as discussed with and requested by Micheal Greer.

Background

NZski has proposed to use Doolans Creek to provide water for snow making for the Doolans ski field development. The proposed water take includes a proposed maximum water take rate of 30 L/s for 16 days in autumn. E3 Scientific have estimated the MALF at the proposed intake site is 67 L/s and this will occur during in autumn after snow melt has finished. Therefore, the water abstraction is expected to occur during a low flow period in Doolans Creek. The Otago Regional Council review of the Doolans water abstraction (Michael Greer, Torlesse Environmental i) queried the effect of the water take on instream habitat due to the proposed take being a high percentage of the MALF potentially leading to significant loss of habitat.

Physical habitat modelling can be used to assess the change in habitat with change in flow. The System for Environmental Assessment (SEFA) is a physical habitat modelling software than can be used to undertake this assessment. A standard approached to this is to have a number of cross sections (generally 15) placed cross different habitat types (pools, riffles and runs) along the stream reach in question. For Doolans Creek Site there are one site available from the E3 Scientific ecological and hydrological assessment work where these is data to construct a model.

ⁱ Greer, M April 2026. NZski Remarkables Fast-Track approvals application: Pre-lodgement review of aquatic ecology report. Memo to Otago regional Council.

Physical habitat model

Doolans Creek has been gauged on four occasions to develop a rating curve for the stream and to assess the water resource available. These gauging provide the flow and water height data for the SEFA model (Table 1). This gauging location is a run habitat (Figure 1) and riffle habitat occurs upstream of the location (Figure 2) and as such any physical habitat model developed from the data is useful for similar run habitat reaches but not for riffles and pools when considering individual species' habitat change with respect to flow.

Table 1: E3 Scientific gauging data for Doolans Creek Site DC3

Date	Flow (L/s)	Stage
19 Nov 2025	1042	0.464
11 Feb 2026	98	0.247
25 Feb 2026	65	0.207
29 May 2026	71	0.215

For the SEFA model water depth, water velocity, stream cross section and measurement locations and streambed substrate at the cross sections are required. The water depth, water velocity measurements and stream cross-section measured on the 19 Nov 2025 by e3 Scientific staff are used as the model cross section. The cross section measured on this day is well above the low flow range of concern. Therefore, the SEFA model does not have to extrapolate the bank profiles for flows higher than the data available has measured. Substrate data for the model was taken from the habitat assessment in the stream habitat assessment (E3 Scientific 2026ⁱⁱ). This substrate assessment was done as percentages for whole site (boulder 5%, cobble 80%, gravel 10% sand 5%) and these percentages were used at all points on the cross-section in the model.

ⁱⁱ E3 Scientific 2026. Remarkables Ski Area upgrade and Doolans expansion freshwater ecological impact assessment. Report prepared for Nzski Limited



Figure 1: Downstream view at Doolans Creek at DC3 gauging site.

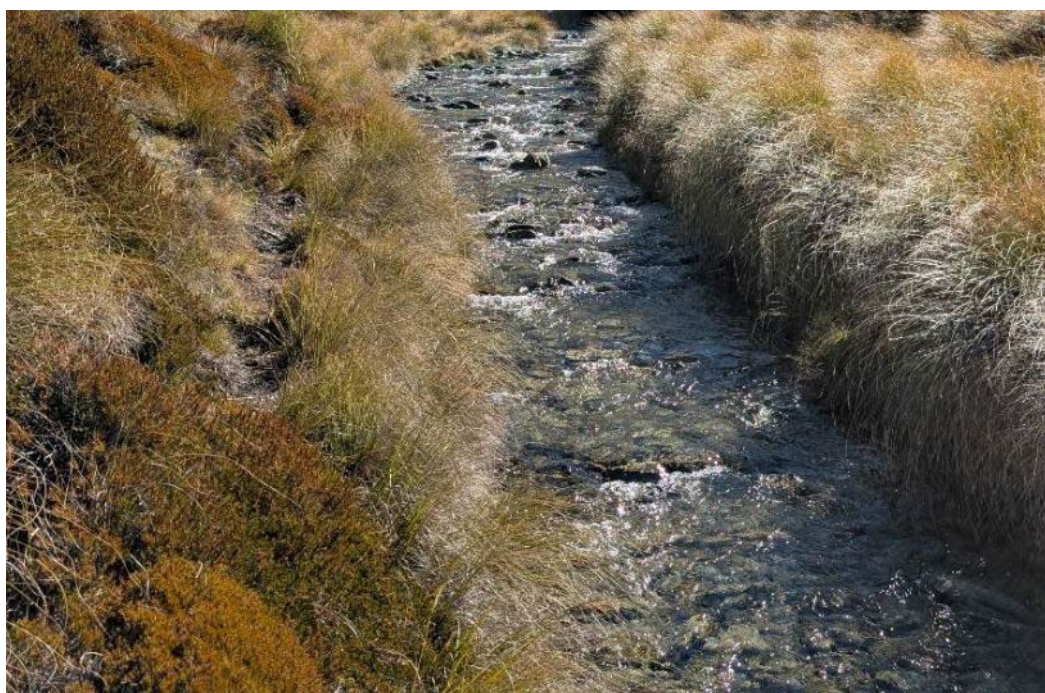


Figure 2: Upstream view at Doolans Creek site D3.

SEFA model outputs

The SEFA model shows the gauging data is well fitted to a rating curve (Figure 2).

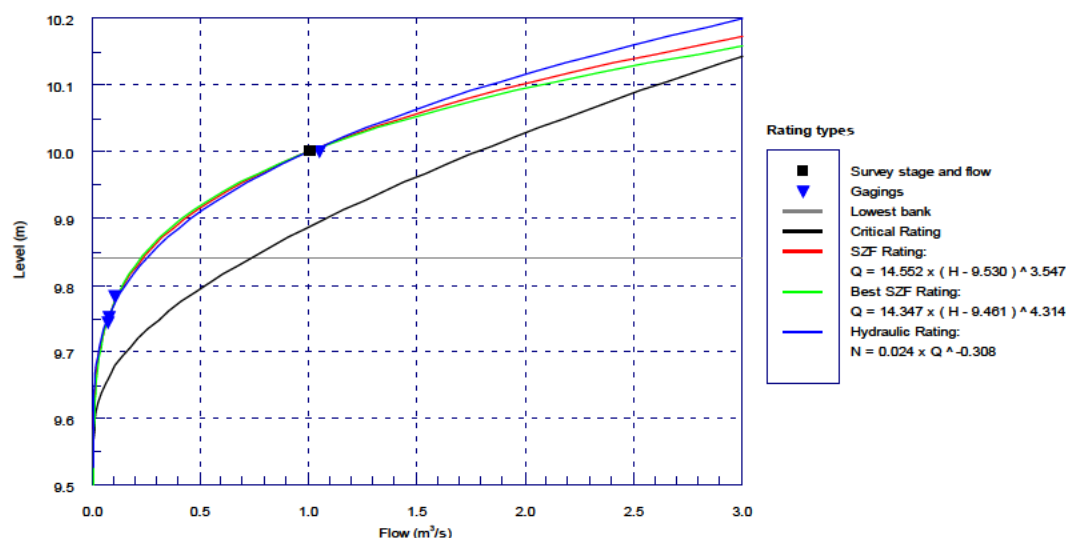


Figure 2: Rating curve for the DC3 site on Doolans Creek.

To model changes in the habitat of individual species as flow changes habitat suitability curves (HSCs) are required. The macroinvertebrate data collected by E3 Scientific (2026) provides a very useful assessment of the macroinvertebrates present in Doolans Creek at the take location. The most abundant species collected was the mayfly *Deleatidium* and there are four sets of HSCs available for *Deleatidium*. Two sets of HSCs have been used for the assessment, a small stream HSC and HSC based on generalised *Deleatidium* habitat use. Two large river HSC sets were not used. None of the other species collected at DC3 are abundant, but the mayfly *Nesameletus* and the stonefly *Zealandoperla* are common at the weir site, and there are HSCs available for both taxa.

The DC3 cross section model shows there is no habitat for *Zealandoperla*, and this stonefly was not collected in the Surber samples at DC3 (Figure 3). For the two mayflies and the three HSCs selected there are very similar habitat change trends. Habitat declines throughout the range modelled as flow declines, and this decline becomes very steep decline in below 10 L/s.

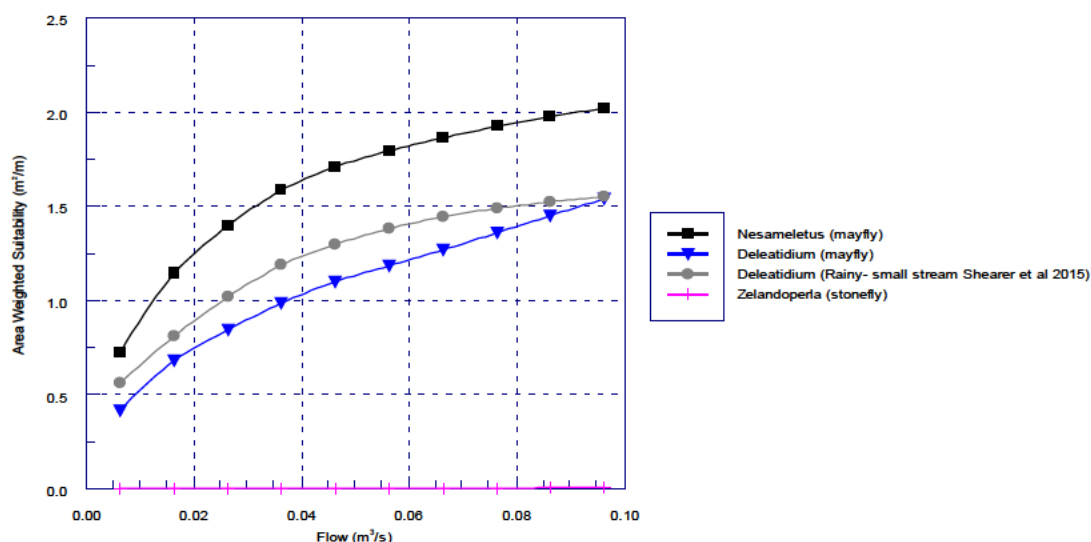


Figure 3: Predicted habitat for *Deleatidium*, *Nesameletus*, and *Zelandoperla* at Site DC3 with changing flow.

The model also provides two width outputs, wetted perimeter and width. Both show the same trend and steep decline in the width occurs below 30 L/s (Figure 4, Table 2). The slow change in stream width above 30 L/s is due to the stream channel that has steep banks and requires a substantial drop in flow and water level before the streambed is exposed. The site photo shows this channel form appears to continue downstream of the site for approximately 250-300 m (Google Earth images). The next 300-350 m downstream to the first tributary confluence appears to be a cascade section where this physical habitat model output is not appropriate.

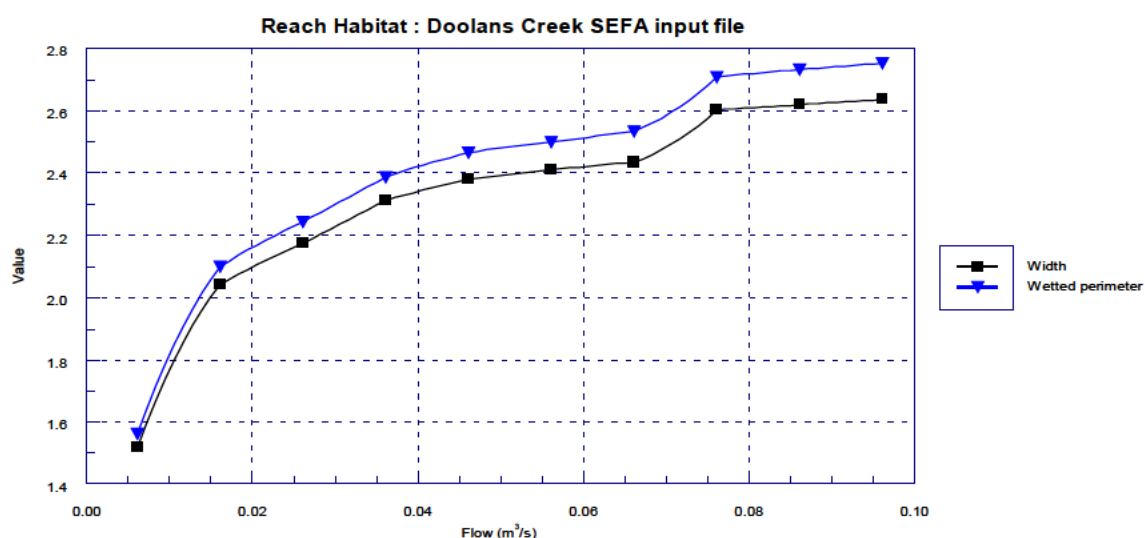


Figure 4: Predicted width and wetted perimeter for at Site DC3 with changing flow.

Given the lack of HSCs for the majority of the taxa present in the Doolans Creek Surber samples an assessment of the wetted width available at various percentages of MALF has been conducted to determine the likely change in stream width as flow decreases. The wetted width is modelled to drop below 80% of that present at MALF when the flow is reduced to between 40% and 50 % of MALF (Table 2). At flows between 30% and 20% of MALF the loss of wetted width increases to over 50%.

Table 2: Change in wetted width at Site DC3 with changing flow below MALF.

Percentage of MALF	Flow remaining (L/s)	Predicted wetted width (m)	Width change from MALF	Percentage width loss
100%	67	2.535	0	100
70 %	47	2.468	0.067	94.714
60%	40	2.437	0.098	92.26824
50%	33.5	2.353	0.182	85.64103
40%	26.5	2.250	0.285	77.51479
30%	20	2.163	0.372	70.65089
20%	13	1.744	0.791	37.59369
10%	6	1.560	0.975	23.07692

Habitat type considerations

The analysis at Doolans Site DC3 is based on run habitat and the channel form present at the site. As the channel deviates from this model cross-section the utility of the model declines. For this reason, modelling is usually undertaken using a number of cross-sections in each habitat type to capture the habitat variation present in the reach of interest. Therefore, the outputs presented above do not account for any habitat variation. A general rule of thumb can be applied to the output. Riffle habitat is the most sensitive to flow reduction, and species that require high water velocities will also lose more habitat as flow reductions occurs. These high-water velocity species are generally riffle dwellers.

Given the run habitat loses habitat rapidly when the flow declines below 30% of MALF (20 L/s) it can be expected that riffle habitat undergoes a noticeable reduction in habitat at a higher flow. Setting a minimum flow to protect riffle habitat could then require it being set between at 40% to 50% of MALF or around 30 L/s.

Physical habitat verses habitat required

The SEFA physical habitat modelling is a method to assess how available habitat changes with changing flow. However, the output is only of significance if the

abundance of taxa being assessed are at or close to the carrying capacity of the habitat in the stream. When the taxa of interest are in low abundance compared to the habitat available or food is limiting rather than habitat then a reduction in habitat available can have no effect on the taxa of interest as there is still uncrowded habitat available. The macroinvertebrate collections in Doolans Creek have a total abundance range of 38 to 357 individuals. Scarsbrook et al (2010)ⁱⁱⁱ analysis of macroinvertebrate samples in the National Water Quality Monitoring Network found Surber sample abundance ranged from 11 to 33,027 individuals indicating the macroinvertebrate community of Doolans Creek is of very low abundance, and habitat is probably not a limiting factor.

Duration and timing of low flow.

A second factor to consider in this assessment is the duration of the low flow period. In this case abstraction is limited to 16 days. This is a much shorter duration than irrigation abstractions that operate from September to May that are subject to minimum flow constraints as they can create long duration low flows in the summer when algae can proliferate and water quality conditions can be poor. For the Doolans water take there are no water quality, duration of low flow or risk of nuisance algae growths associated with the abstraction.

Conclusions

Significant stream habitat loss, assessed from stream width modelling, occurs at site DC3 when the flow is reduced below 30% of MALF. In riffle habitat the reduction in stream width is expected to occur at a higher flow between 40% and 50% of MALF. To restrict potential habitat loss in riffle habitat a minimum flow of 30 L/s (45 % of MALF). When considering factors other than habitat availability; such as macroinvertebrate abundance, duration of the abstraction and the potential effects on water quality, the risk of a water abstraction affect over a short abstraction period is very low and the 45 % MALF minimum flow is expected to provide for the instream community for the short duration of the water take.

Regards

ⁱⁱⁱ Scarsbrook, MR., Boothroyd, IKG., & Quinn, JM. 2010. New Zealand's national River Water Quality Network long-term trends in macroinvertebrate communities. New Zealand Journal of Marine and Freshwater Research 34(2) 289-302.



Richard Allibone

Appendix B: Email from Derek Chinn 15/6/2026.

Frequency of Backwashing of the Doolans Creek Right Branch raw water intake ...

Summarize



Reply

Reply All

Forward



Mon 15/06/2026 11:02 am

Follow up. Start by Monday, 15 June 2026. Due by Monday, 15 June 2026.
You forwarded this message on 30/06/2026 9:36 am.

All,

I have been asked to respond regarding the frequency of backwashing of the Doolans Creek Right Branch raw water intake structure. It is not appropriate to revise the intake concept report to address this question and I respond as follows.

It is likely that back washing will be required after significant storm events when sediment becomes mobilised and precipitates out within the structure. The intake structure incorporates a grill and larger rocks which transported as bed load within the creek to be carried over the intake. Smaller fractions, and suspended sediment, will be able to enter the structure through the grill. The creek bed is both steep and erodible and has steep over steepened banks. thus, we anticipate that storm events will mobilise sediment. Sediment mobilisation is more likely to occur in spring during snow melt and during unsettled spring weather than during winter. In winter the creek is covered by snow and flow is attenuated by the presence of this snow.

No information is available on either the frequency or volume of sediment transport within the creek. However, it is reasonable to expect that backflushing of the intake may be required every two months approximately during the snow making season. Outside of the snow making season the intake will be required to refill the reservoir following maintenance or inspection activities. It is desirable to maintain the reservoir with at least 1m to 2m of water to minimise wind uplift on the liner thus the reservoir will be left nominally full at the end of winter and will be refilled after any inspection or maintenance activities during the off season. In addition, there will be a reduced off-season requirement for potable water at the Doolans Gondola return station facilities. End of season flushing of the wastewater pumping main from the Gondola Return Station facilities may be required to prevent the wastewater within the rising main becoming anoxic. Consequently, the intake will be operated intermittent during the off-season, and backwashing of the intake during the off-season may be required to ensure that the intake operates satisfactorily. For comparison, in the Rastus Burn Catchment the upstream most of the two intakes (which is used for potable water intake) requires cleaning annually or biannually.

The duration of flushing is dependent on the volume of material which has precipitated out in the structure, but approximately one to three minutes duration of flushing is anticipated to be sufficient to clear the inlet chamber.

Regards

Derek Chinn, BE (Civil), CPEng, IntPE, CMEngNZ, FEngNZ
Senior Principal Structures Engineer