

Remarkables Ski Area Expansion Project

Wastewater Treatment and Disposal Feasibility Report

Prepared for:
NZSki Limited

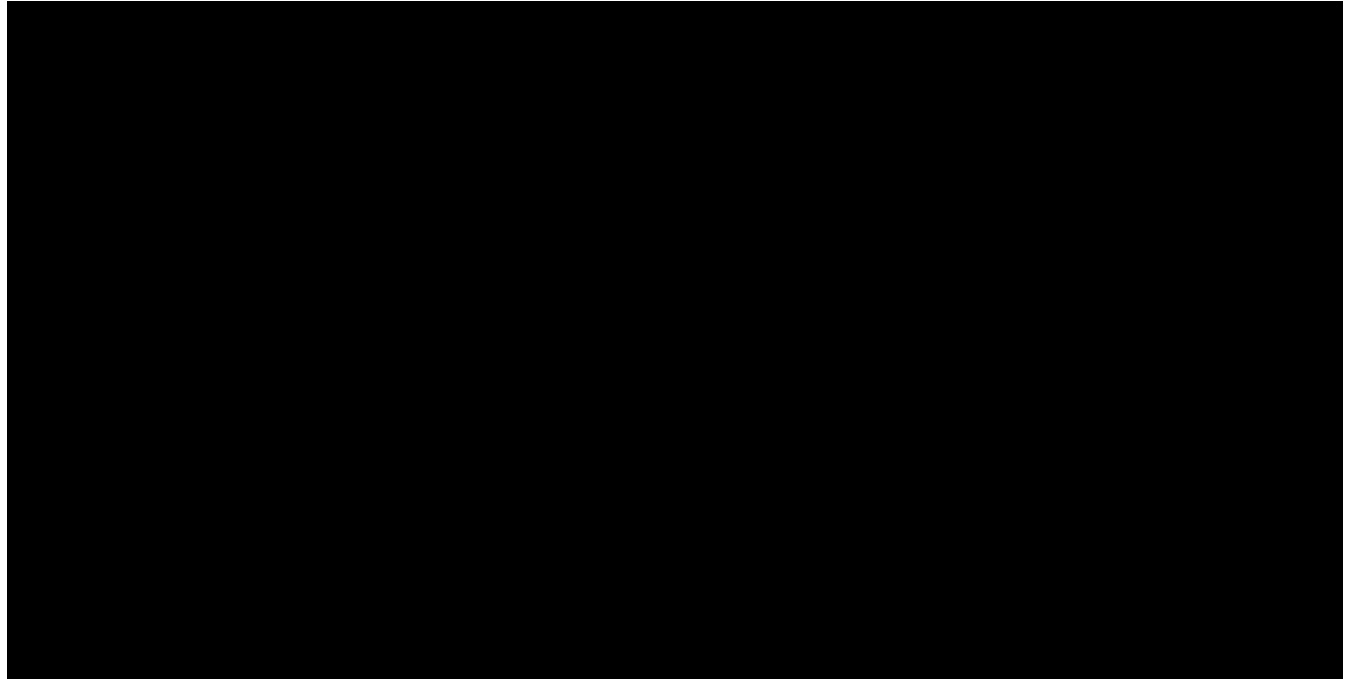
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Remarkables Ski Area - Rastus Burn Wastewater Feasibility

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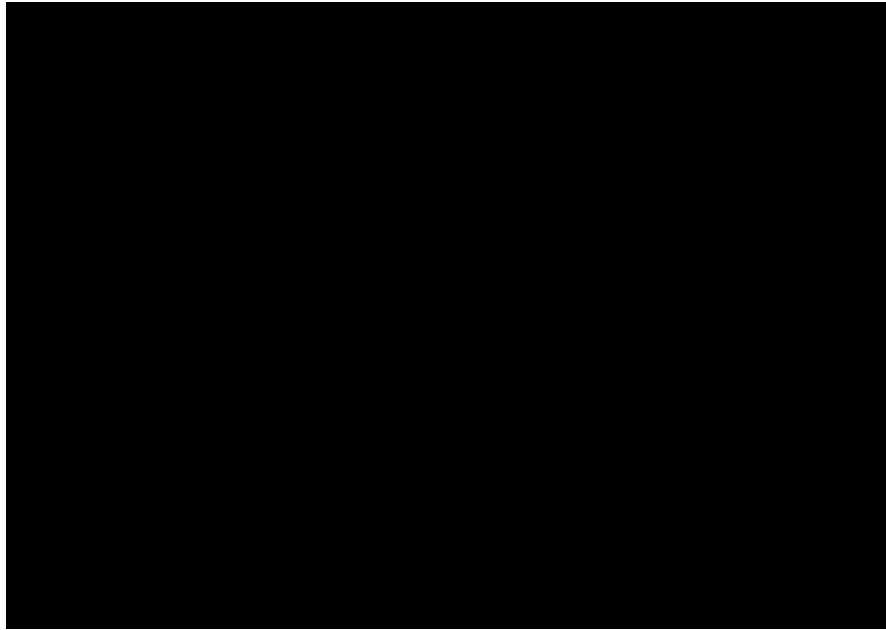


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Executive Summary

This feasibility study evaluates wastewater treatment and disposal options to support existing operations at the Remarkables Ski Area and future growth associated with the Doolans Basin Expansion. The existing Rastus Burn wastewater system has performed adequately under historic conditions but cannot reliably support future expansion without upgrades. Increased wastewater flows, higher nutrient loads, and the challenges of alpine operation create clear capacity, performance, and consent risks.

A first principles assessment of wastewater flows and nutrient loads indicates that historical nitrogen and phosphorus loads may be higher than historic sampling alone suggests. Based on multiple assessment methods, Stantec is satisfied that the most likely 2022 baseline loads are approximately 900 kg/year total nitrogen and 155 kg/year total phosphorus.

Independent assessment of the existing rapid infiltration basins confirms they have proven hydraulic performance and significant capacity. Indicative soil permeability testing completed in 2026 indicates hydraulic conductivity in the range of 1.9-4.8 m/day, well above earlier conservative assumptions. On this basis, the existing basins are proposed to be retained and reused with a conservative loading rate of 50 mm/day, providing sufficient land disposal area for the increased flows, redundancy and operational resilience without reliance on undeveloped reserve areas.

A wide range of wastewater treatment and disposal options were assessed. Primary treatment options were found to be unsuitable, as they do not manage increased flows or nutrient loads and would result in declining environmental outcomes. Secondary treatment options improve effluent quality and reduce loading on the infiltration basins but do not significantly reduce nitrogen or phosphorus and may exceed baseline nutrient loads. Options incorporating nutrient reduction provide improved environmental outcomes by specifically targeting nutrient baselines, but involve higher capital cost, increased energy demand, and greater operational complexity. Off-mountain conveyance options offer scalability and remove nutrient loading from the immediate catchment, but introduce significant construction, consenting, and operational risks.

The existing wastewater discharge via the rapid infiltration basins in the Rastus Burn catchment is a proven and well-understood system with demonstrated hydraulic performance and available capacity. Reuse of this established discharge pathway enables wastewater generated from the Doolans Creek Right Branch expansion to be managed without creating a new discharge location or introducing contaminants into an unmodified catchment. This approach contains effects within a known and previously modified receiving environment.

Overall, treatment upgrade pathways located at the ski field, combined with reuse of the existing rapid infiltration basins, represent the most feasible approach to support future demand while managing environmental and operational risks. However, key uncertainties remain, including final nutrient baselines, treatment performance under alpine winter conditions, and consent requirements. These matters will require further monitoring, testing, and refinement during subsequent design stages.



Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
LAS	Land application system
LASE	Land application system envelope
RIBs	Rapid infiltration basins
DIR	Design irrigation rate
WWTP	Wastewater treatment plant
PS	Pump station
P.e.	Population equivalent
L	Litres
CBOD5	Carbonaceous Biochemical Oxygen Demand over 5 days
TSS	Total suspended solids
TN	Total nitrogen
D R Phosphorus	Dissolved reactive phosphorus
BGL	Below ground level
ARV	Air release valves
PN	Nominal pressure rating
DI	Ductile iron
MDPE	Medium density polyethylene
GAC	Granular activated carbon



1 Introduction

1.1 Background and Context

The Remarkables Ski Area operates an onsite wastewater system under ORC consent RM14.336.01, which permits up to 127.44 m³/day of treated effluent discharge. The capacity of the existing ski field is approximately 4,000 skiers. The current wastewater discharge permit expires in April 2030, and a new consent with increased discharge capacity will be essential to support continued ski field operations and future growth.

NZSki are proposing upgrades to the ski field with a maximum capacity of 6,000 skiers, that would result in an increase in daily wastewater flows beyond the consented limits.

This report explains why the current wastewater system needs upgrading and how different options were assessed.

1.1 Objectives of this Report

This report's objective is to identify feasible wastewater treatment and disposal options for current operations and future growth.

The initial concept report evaluated wastewater management approaches for the Remarkables Ski Area and identified the need for additional investigation into the Rastus Burn wastewater system. Further detailed analysis was required to identify a practical, economical, and consentable wastewater system that would be compatible with the requirements of the planning and environmental assessments. This feasibility study evaluates a range of options to confirm there are credible, technically feasible options, and gain a high-level understanding of their associated CapEx and OpEx costs.

The key areas of consideration are:

- The ability of the system to treat wastewater to an appropriate level in winter.
- The ability of the plant to cope with significant seasonal fluctuations in climatic conditions and wastewater quality and quantity, while continuing to function satisfactorily.
- The hydraulic capacity of the disposal fields or disposal route.
- The capacity to be upgraded or extended to match the predicted increase in visitor numbers.
- The suitability of the receiving environment to accept the treated wastewater.
- CapEx cost.
- Practicality of operation and associated OpEx costs.
- Minimising the footprint of the plant, particularly where it is located on valuable land.



2 Existing Wastewater System Overview

2.1 System Components

The existing wastewater system components include:

- Storage and Pre-treatment (refer to Figure 1)
 - One 35 m³ pre-settlement tank located beneath Carpark 1.
 - Two 75 m³ septic tanks located beneath Carpark 1, fitted with outlet filters.
 - One additional 31 m³ pre-settlement tank located near the infiltration basins (not shown on Figure 1).
 - Total tank volume approximately 216 m³.
- Effluent Disposal
 - Effluent is piped to three infiltration/disposal ponds where it infiltrates naturally through soil substrates, providing some passive treatment via filtration through the ground.
- Solids Management
 - Solids are periodically removed from septic tanks by specialist contractors.
- Monitoring
 - A magflow meter is installed on the gravity main to monitor flows into the effluent disposal system.
- Five groundwater monitoring bores are installed near the disposal ponds to monitor potential discharge effects and compliance with consent conditions.

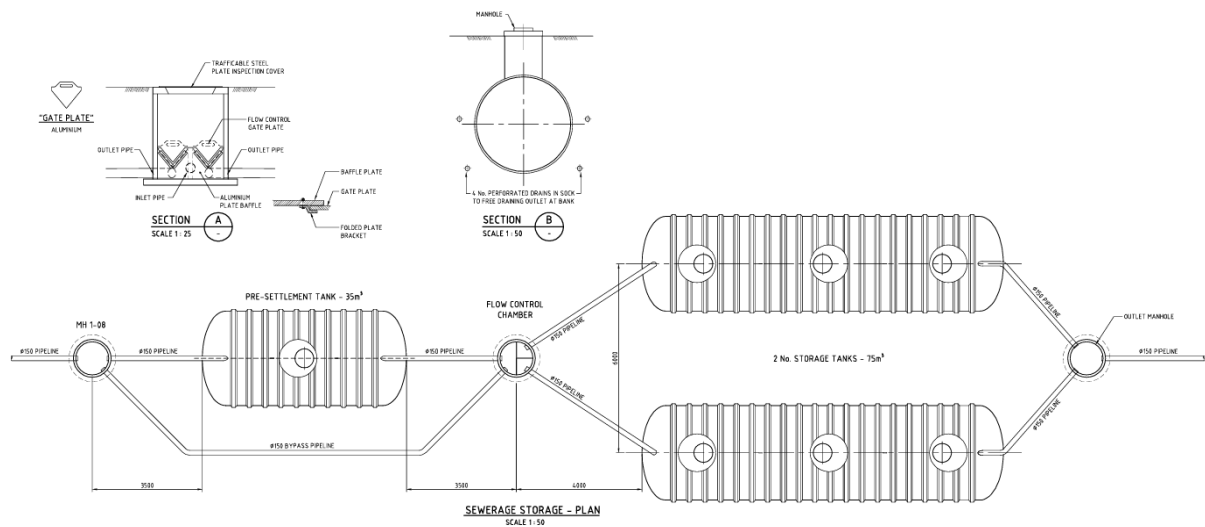


Figure 1. Plan view of existing sewerage storage general arrangement at Carpark 1 (MWH New Zealand Limited, 2014).

2.2 Rapid Infiltration Basins

1985 Oxidation ponds

The existing wastewater disposal system at the Remarkables Ski Area was originally constructed in 1985 and comprised a below-ground sedimentation tank discharging to three oxidation ponds operating in parallel, with disposal to land via infiltration through unsealed pond bases.



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2 Existing Wastewater System Overview

2014 Upgrade works – what exists now

The original design included a decanting and overflow system to the Rastus Burn, however, the 2014 investigations confirmed there was no evidence that this system had operated as intended, and the lower-level overflow pipes discovered during refurbishment were removed. The oxidation ponds were assessed and repurposed during 2014 to function as rapid infiltration basins (RIBs), involving reconditioning of the pond floors to remove accumulated fines and break up any developing impermeable layers that could restrict infiltration. Rapid infiltration basins (RIBs) are shallow basins where treated wastewater soaks into the ground, they are usually dry and the water level may increase if the inflow exceeds the soakage capacity of the soils.

Refer to Figure 2 for photos of the soils testing and renovation works completed in 2014.



Figure 3-2 : Test pit profile showing dry graded colluvium in Pond 1



Figure 3-1 : Test pit excavation in pond 2.



Figure 3-5 : Pond 1 during renovation operation

Figure 2. Oxidation pond reconditioning (MWH New Zealand Limited, 2014)

Ponds 1, 2 and 3 were designed with a combined base area of approximately 6,100 m², with operational storage depths typically 2–3 m deep. Based on conservative soil assumptions consistent with AS/NZS



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2 Existing Wastewater System Overview

1547 (Category 2 sandy loam), the 2014 assessment adopted an infiltration rate of 20 mm/day, equating to an acceptable discharge capacity of approximately 127.44 m³/day across the three ponds.

Renovation works undertaken on Ponds 1, 2 and 3 involved excavation and replacement of up to 2 m depth of material to improve permeability and remove visible fine material accumulation. Monitoring during and after the 2014 ski season confirmed that Ponds 1 and 2 remained dry, with only limited standing water observed in Pond 3, demonstrating effective infiltration and no evidence of pond overtopping (MWH New Zealand Limited, 2014).

What was tested

The RIBs have been measured using LiDAR in 2026 and the Ponds 1, 2 and 3 have base areas of approximately 2,240 m², 1,140 m² and 1,870 m² respectively. With approximately 300mm of freeboard, the total area available for discharge (including side walls) is approximately 6,970 m².

Operation of the system has demonstrated ongoing performance, with NZ Ski advising that the infiltration basins have not overtopped. This operational history is supported by April 2026 soil permeability testing completed by an independent contractor, following a period of heavy rain and snow, which indicates hydraulic conductivity within the existing RIBs ranging between 1.9-4.8 m/day (indicative preliminary results), significantly exceeding the conservative assumptions adopted in 2014.



Figure 3. Independent contractors testing permeability in RIB 3 in April 2026 after bad weather

What this means

Recognising the proven performance and substantial unsaturated soil profile beneath the ponds, it is proposed that the existing rapid infiltration basins be retained and reused. A maximum loading rate for secondary treated effluent of 50 mm/day is deemed conservative as this leaves sufficient head room for future blockages and blinding of the surface of the RIBs.

Reserve area

Following infiltration testing, the basins can be conservatively loaded at 50 mm/day for secondary treated effluent in accordance with AS/NZS 1547:2012, Table L1 for Category 1 and 2 soils.



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2 Existing Wastewater System Overview

At this design loading rate (DLR), two basins are sufficient to accommodate the daily inflow, with testing indicating that a single basin would be hydraulically capable of accommodating the secondary treated effluent discharge (in an emergency). This provides inherent redundancy within the system layout.

Clause 5.5.3.4 of AS/NZS 1547:2012 states that a 100% reserve area should be considered as part of a risk-management process, or alternatively other equivalent mitigation measures may be provided to enable resting, expansion, or duplication of the land application system. In this case, the intent of the clause is met through the provision of three basins, enabling one basin to act as a reserve at any time. Basins can be alternated in operation, or taken offline for resting or reconditioning, while maintaining full operational capacity.

This approach provides effective operational resilience without the need for a separate 100% undeveloped reserve area and excludes reliance on the approximately 13,000 m³ of storage capacity within the basins, which provides additional contingency.

2.3 By-wash

By-wash is clean water that is run through the wastewater pipe network to prevent both potable and wastewater pipework from freezing to keep a minimum flow in pipes and including when the ski field is not operating. The ski field maintains this flow outside the ski season to protect pipework from frost damage. Although potable water is used, because it enters the wastewater network it is therefore classified as wastewater. This off-season flow dominated by-wash can be problematic for biological treatment systems, as it contains little to no nutrients. In the absence of nutrients, the microorganisms responsible for biological treatment gradually die off during the off-season. As a result, the biological population must re-establish at the start of each ski season before effective treatment can be achieved.

The options discussed in this report consider bywash and the effects on each system.

2.4 System Performance and Constraints

- The original system was designed to service current visitor flows and has limited treatment capacity to support future growth or expansion of the ski field.
- The system is unlikely to meet future effluent quality standards, particularly under more stringent regional or national requirements.
- Historical flow data shows occasional breaches of the consented daily discharge limit (127.44 m³/day), primarily outside the ski season likely due to by-wash, stormwater ingress through manhole risers, or metering errors rather than representative ski field wastewater flows.
- The alpine climate poses risks:
 - Freezing pipework
 - Reduced biological treatment performance at low temperatures
 - Need for heating or winterisation strategies in any future system
- The site is located within steep alpine terrain, restricting the land available for new or expanded disposal areas (although the existing RIBs have been confirmed to be suitable for reuse).

Existing system takeaway

The existing system has worked to date but does not have enough treatment capacity or treatment performance to support future use. Hydraulic disposal capacity is easily sufficient.



3 Flows and Loads

This section describes the wastewater flow rates and volumes, and the associated contaminant loadings. A flows and loads report has been provided in Appendix A which defines the following aspects of the Remarkables wastewater treatment scheme:

- Peak and seasonal occupancy totals,
 - Historical skier numbers,
 - Forecast skier numbers with 6,000 capacity limit,
- Nitrogen and phosphorus loading calculations,
- The key risks that arise from these assumptions.

This information was reviewed and agreed by NZ Ski. The flows and loads report will be updated in future design stages and systems, processes, and limits discussed in this report will be updated.

3.1 Historical and Projected Flows

Rastus Burn’s existing wastewater system was originally sized based on a design flow of 40 L/person/day. The existing discharge from Rastus Burn is authorised under Otago Regional Council Discharge Permit RM14.336.01, allows a maximum daily discharge of 127.44 m³/day. For the current assessment, Stantec has adopted a design flow of 34 L/person/day for the reasons set out below.

While the original consent was based on 40 L/person/day, metered flows for most previous seasons range between 60 and 100 m³/day, indicating that the original 40 L/person/day flow allowance was conservative for the Remarkables Ski Field.

Data from multiple New Zealand ski fields was reviewed to inform the adopted design flows and loads, with relevant reports available in Appendix A. A comparison of these values are summarised in Table 1.

Table 1. Comparison of average influent flows and loads between different NZ ski fields and the proposed design flows and loads where available.

Ski Fields	Average flows (L/person/day)	Influent total nitrogen (TN mg/L)	Influent total phosphorus (TP mg/L)
Coronet Peak	25 - 34	130–145	-
Mt Hutt	30	-	- (5g/m ³ Effluent)
Mt Ruapehu	~30	-	-
Porters Ski Field	45	-	-
Original Remarkables consent limit	40	-	-

Benje Patterson’s economic report skier numbers and NZ Ski’s estimated skier count (max. capacity of 6,000 skiers) are presented in Table 2. To accommodate NZ Ski’s projected total occupancy, the projected average number of monthly skiers increases to a maximum of 6,000 skiers per day and a season total of 372,712.



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3 Flows and Loads

Table 2. Historical and forecast design years.

Month totals	2019	2020	2021	2022	2023	2024	2025	Forecast Design Skiers (6,000 Cap.)
June	48,577	No data	10,547	18,987	29,051	23,076	28,223	30,983
July	101,135	41,388	84,059	87,899	108,773	87,255	103,313	147,004
August	75,641	22,712	30,149	87,228	87,654	83,073	91,708	115,319
September	47,722	25,401	31,882	65,707	65,049	57,686	55,869	67,412
October	12,952	10,678	20,731	21,831	9,099	19,736	15,622	11,994
Grand Total	286,027	100,179	177,368	281,652	299,626	270,826	294,735	372,712

Historical data equates to a flow rate of approximately 32.5 L/person/day, which has been used in historic flows and contaminant loads calculations. Adopting a slightly conservative design approach, future wastewater flows and contaminant loads in this feasibility report have been calculated using a design allowance of 34 L/person/day.

3.1.1 Design flows

The following table summarises the historical and forecast skier count and the design daily flow.

Table 3. Design assumptions.

Parameter	Historical	Forecast (design year)	Notes
Annual skiers	100,179 to 294,735	372,712	Excludes out of season occupancy
Ski field capacity	4,000	6,000	
Wastewater generation	40 L/person/day	34 L/person/day	Actual wastewater generation per person was less than the original design of 40 L/person/day
Design daily flow	127,440 L/day	204,000 L/day	Includes by-wash allowance
Season duration	120 days	120 days	

3.2 Effects of Existing Treated Wastewater Discharges to the Rastus Burn Catchment

NZSki conducts ongoing monitoring at four sites within the Rastus Burn Catchment: upstream, 50m downstream, 200m downstream, and 1,500m downstream. Aquatic ecology is monitored at the end of every ski season once snow melt has occurred.

A clear on-season and off-season pattern exists, with significantly higher nutrient concentrations and loadings during the on-season and lower nutrient concentrations during the off-season due to a higher proportion of clean by-wash water entering the system. Although the existing treated wastewater discharge quality entering the RIBs exhibits large variations in quality, ongoing monitoring completed by NZSki and E3 Scientific highlights minimal adverse impacts to the catchment (E3 Scientific, 2026).



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3 Flows and Loads

E3 Scientific have assessed the existing discharge monitoring data to the Rastus Burn. Monitoring and water quality results have indicated the aquatic ecosystem remains in good to excellent condition (E3 Scientific, 2026).

To maintain the existing good to excellent water quality and aquatic ecosystem conditions of the Rastus Burn Catchment, a baseline effluent load is quantified in the following sections.

3.3 No New Discharge to the Doolans Creek Right Branch Catchment

The proposed management of wastewater associated with the Doolans Creek Right Branch expansion does not introduce a new treated wastewater discharge to the Doolans Creek Right Branch catchment. The Doolans Creek Right Branch is currently an unmodified environment with no existing wastewater treatment or disposal systems, and this status would be maintained under the proposed approach.

Wastewater generated within the Doolans Creek Right Branch would be conveyed to the existing Rastus Burn wastewater treatment and disposal system for treatment and land application via the established RIBs. This approach utilises a discharge pathway with a demonstrated operational history, known performance characteristics, and an existing monitoring framework. No new land application areas, discharge points, or receiving environments are proposed within the Doolans Creek Right Branch catchment.

By retaining wastewater treatment and disposal within the Rastus Burn catchment, potential effects are contained within a receiving environment that is already modified and subject to ongoing monitoring and management. This avoids introducing contaminants into an unmodified catchment and reduces uncertainty associated with establishing new discharge locations in sensitive alpine environments.

Takeaway

The proposed approach manages additional wastewater using an existing, proven discharge system and avoids creating any new wastewater discharges in the Doolans Creek Right Branch catchment.

3.4 Baseline Nutrient Loads

3.4.1 Nitrogen Baseline

This section outlines a first principles assessment of the baseline total nitrogen nutrient loading to the Rastus Burn catchment for skier counts and flows from 2022 and compares it to Table 12 from (E3 Scientific, 2026).

Table 4. Total nitrogen baseline.

Parameter		E3 Scientific	Stantec
Total nitrogen (TN kg/annum)	Minimum	250	500
	Mean	499	900
	Maximum	916	1,200

- Stantec have assessed the likely actual 2022 loading using three different methods, giving a range of 500 – 1,200 kg/annum TN.
- Stantec believe the most likely figure for 2022 was 900 kg/annum TN.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

3 Flows and Loads

- On the basis of 'being no worse, as a minimum' Stantec proposes a consent limit of 750kg/year TN.

3.4.2 Phosphorus Baseline

Using the same methodology as section 3.4.1 above, this section outlines a first principles assessment of the baseline total phosphorus nutrient loading to the Rastus Burn catchment for skier counts and flows from 2022 and compares it to Table 13 from (E3 Scientific, 2026).

Table 5. Total phosphorus baseline.

Parameter		E3 Scientific	Stantec
Total phosphorus (TN kg/annum)	Minimum	38	60
	Mean	64	155
	Maximum	107	215

- Stantec have assessed the likely actual 2022 loading using three different methods, giving a range of 60 – 215 kg/annum TP.
- Stantec believe the most likely figure for 2022 was 155 kg/annum TP.
- On the basis of 'being no worse, as a minimum' Stantec proposes a consent limit of 100 kg/year TP.

Total phosphorus concentrations from literature reviews ranged from 7-91mg/L (Bronwyn Humphries (ESR), 2024) and 18-35mg/L (Abdel-Shafy, 2017). Due to the variability in TP concentration being impacted by phosphorus containing cleaning chemicals and detergents and the large range of likely concentration, Stantec proposes a higher consent limit than E3 Scientific.

3.5 Testing and validation

Significant variation of flows and nutrient loads are possible when by-wash is present. Based on this, the final agreed design effluent concentration (end of pipe) requires validation and testing to confirm. This is expected to be completed in the following season after the fast-track consent lodgement, with TN and TP baseline targets revisited where required.

For further information, refer to the flows and loads report in Appendix A.



4 Standards, Codes and Consent Framework

Both NZBC G13 and AS 3500 refer to AS/NZS 1547:2012 for the design of onsite wastewater systems. The concepts proposed in this report follow this standard regarding system design and flow rates.

- AS/NZS 1547:2012 – On-site wastewater system design.
- NZ Building Code G13 – Foul water drainage compliance.
- AS 3500 – Plumbing and drainage installation.

Building on the learnings from the Coronet Peak’s wastewater treatment system and consent, to reduce potential erroneous limit breaches (e.g. during routine maintenance when an effluent filter is serviced, some unfiltered waste can bypass the filter) effluent disposal discharge limits are proposed on a per annum basis rather than a per litre basis.

However, proprietary manufacturers design treatment systems on a per litre (i.e. flowrate) basis. As such, to confirm that practical solutions are available and to obtain CapEx estimates for Option 5a and 5b (introduced later), Table 6 values were provided to suppliers as performance design targets and are not intended to be used to inform consent limits.

Table 6. Potential WWTP design criteria

Estimated discharge limit	Value	Unit
cBOD ₅ <	20	mg/L
TSS <	30	mg/L
TN <	30	mg/L
TP <	15	mg/L
E. coli <	1,000	MPN/100 mL

Among these, total nitrogen (TN) is expected to be the limiting parameter influencing system design complexity and energy demand, particularly under cold conditions. These values have been provided by Innoflow and are based on comparable local developments and recent consent limits from Jack’s Point, Mt. Cardrona Station, Coronet Peak, and Gibbston Valley Winery.

The AEE produced by others is expected to cover the following, but not limited to:

- Conservation Act 1987
- Resource Management Act 1991 (RMA) – Section 15 compliance.
- ORC Regional Plan: Water for Otago.
- QLDC Three Waters Bylaw 2020 – Local compliance confirmed.
- Taumata Arowai Standards – If Required
- Cultural and stakeholder input.
- Others as determined by others.

A site assessment and walkover took place in January 2026 to assess the existing RIBs against regional plan requirements and confirmed compliance with:

- ≥ 20 m from surface water.
- ≥ 50 m from water abstraction bores.
- ≥ 1 m vertical separation to groundwater.
- Outside drinking water protection zones.



5 Design Basis and Methodology

The design basis for this feasibility assessment is based on available flow data, observed system performance, and treatment requirements. It also considers the preliminary options identified for further assessment. The methodology includes defining wastewater flows and loads, assessing peak flows and temperature effects, summarising treatment options, and identifying gaps that require further investigation.

Wastewater entering the treatment plant is highly seasonal. It occurs at low temperatures and with variable flow rates. Wastewater strength is relatively high due to low per-person water use. Peak loads occur during the ski season, with long periods of little or no occupancy outside the season.

Alpine weather conditions further affect system behaviour. During periods of heavy snow and high winds, the ski field may close, and wastewater flows reduce to background levels. Once the storm passes and conditions improve, the ski field can rapidly return to peak occupancy. As a result, the wastewater system experiences a drop in flows and loads, followed by clean potable water by-wash, and then a rapid increase in wastewater loads. These irregular flow patterns and shock load conditions can cause significant variation in treatment performance and effluent quality.

Wastewater quality is also influenced by potable water by-wash used to prevent freezing. This by-wash dilutes nutrient concentrations and introduces cold, low-nutrient water into the system. Together, these conditions limit biological treatment performance and increase sensitivity to operational changes. For this reason, wastewater treatment at alpine ski resorts is inherently complex and requires a robust and carefully designed treatment process.

Wastewater treatment at alpine ski fields is complex due to cold temperatures, seasonal use, and rapid changes in flow and load.

5.1 Treatment Summary

Two broad options exist for locations to treat the wastewater:

- Local treatment, in the vicinity of the base area of the ski field (Options 1-5).
- Low altitude treatment, after conveyance of the wastewater down the ski field road for treatment, then discharge (Options 6a, 6b, and 6c).

For a full description of options considered, refer to the Stantec Doolans Creek Right Branch wastewater report and Section 6 of this report.

5.1.1 Local Treatment

Treatment is being considered at a feasibility level only, to inform option comparisons and order-of-magnitude cost estimates.

For Options 4, 5a and 5b discussed later in this report, the treatment approaches considered are outlined in Table 7 below. Option 4 provides secondary treatment only and does not include nutrient reduction, while Options 5a and 5b incorporate nutrient reduction treatment scenarios. All treatment systems must operate reliably under cold influent temperatures and highly variable seasonal loading, with provision for process and tank heating as required.

The most practical site for the treatment plant is considered to be car park 3.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

5 Design Basis and Methodology

Table 7. Treatment options considered – local treatment.

Treatment Scenario	Description	Relative Complexity
Option 4 – Secondary treatment	Secondary treatment with no targeted reduction in TN and TP.	Moderate
Option 5a – No worse than existing nutrient discharge	Treatment such that annual nutrient discharge (kg/annum) is no worse than existing conditions, with some reduction in TN and TP.	Moderate to High
Option 5b – 30% more nutrient reduction than existing discharge	Treatment such that annual nutrient discharge (kg/annum) is 30% less than the existing primary discharge, this roughly equates to TN and TP discharge targets similar to the Jacks Point Discharge system with no UV disinfection.	High
Cold climate provision	Heating for tanks and biological processes.	Required for options 4, 5a and 5b

5.1.2 Low Altitude Treatment

This covers Options 6a, 6b, and 6c where the wastewater is conveyed to the bottom of the ski field access road, where it is discharged to ground or Council reticulation. The only treatment considered for these options is those that provide nutrient removal, as per Options 5a and 5b.

Low altitude treatment options do not require heating due to higher temperatures throughout the year.

The level of nutrient removal required has not yet been determined, noting:

- Option 6a assumes disposal of the treated wastewater via land application. Treatment and nutrient reduction targets would need to be developed once a land application site had been determined and parameters established by environmental science and planning assessments if this option is selected.
- Option 6b and 6c assumes disposal of the treated wastewater to the QLDC system. Treatment and nutrient reduction targets would need to be developed and agreed with QLDC if this option is selected.

5.2 Treated Effluent Disposal Summary

Two broad options exist for locations to discharge treated wastewater:

- Reusing the existing RIBs, in the vicinity of the base area of the ski field (Options 1-5). Both recent independent testing, and past performance of the ponds, demonstrates the suitability of the RIBs for disposal of the predicted flows. The rehabilitation works undertaken in 2104 also demonstrates that should the infiltration rate decrease, due the build-up of impermeable layers, then rehabilitation by excavation and screening of fines is a practical method available for rehabilitation the basins.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

5 Design Basis and Methodology

- Low altitude disposal, after conveyance of the wastewater down the ski field road for treatment, then discharge (Options 6a and 6b).

5.2.1 Low Altitude Discharge

Wastewater is conveyed to the bottom of the ski field access road, where it is treated before discharge.

- Option 6a assumes disposal of the treated wastewater via land application. The required area and method of treated wastewater application would need to be developed once a land application site had been determined and parameters established by environmental science and planning assessments.
- Option 6b and 6c assumes disposal of the treated wastewater to the QLDC system. Limitations on flow discharge parameters would need to be agreed with QLDC. This includes peak flow rates and their timing, along with maximum volumes. This will inform the extent of any attenuation storage.



6 Long List Options for Wastewater Upgrades

This is a feasibility assessment intended to inform the fast-track consenting process by identifying technically and environmentally feasible wastewater management pathways and does not pre-empt regulatory decisions regarding final consent limits, conditions, or compliance requirements, which will be determined through the consenting process and supporting application documentation.

This section discusses upgrade options that were considered, but several were ruled out due to cost, risk, or poor environmental outcomes. Selected options were progressed to the short list in section 7.

6.1 Option 1 – Do nothing

Under this option, nothing is done to upgrade the existing Rastus Burn wastewater system while acknowledging an increase to the flows and loads.

Option 1 is the baseline for treated wastewater disposal from the Remarkables Ski Field in the Rastus Burn Catchment. Monitoring and water quality results have indicated the aquatic ecosystem is currently in good to excellent condition (E3 Scientific, 2026), while noting a dip in 2022 and 2023.

If additional skiers used the existing systems, increasing the total to 6,000 skiers/day, this would result in an exceedance of the existing consented 127.44m³/day wastewater flow limit. The increase in wastewater flow to a peak value of 204m³/day would increase the loading rate to the rapid infiltration basins from the consented maximum 20mm/day to approximately 32mm/day. This would exceed the Category 2 soil maximum design loading rates for trenches and beds from Table L1 AS/NZS1547:2012 for primary treated effluent.

The increased load from additional skiers, food, and cleaning chemicals would increase the nutrient load in the catchment which is expected to result in a decline in the Rastus Burn water quality and increased odours.

In the wastewater optioneering workshop (11th February 2026), this option's impact to the environment and the ability to reliably treat wastewater to the expected standard under alpine conditions were assessed as significantly negative.

This option does not address future demand, the upcoming consent expiry, or long-term compliance risks. For these reasons, it was not considered feasible and was not assessed further.

6.2 Option 2 – Renewals and Operational Improvements

This option maintains the current level of performance by addressing routine wear, reliability issues, and general system resilience.

Under this option, pipework crossing the Rastus Burn is renewed and minor operational improvements are undertaken to maintain the functionality and compliance of the existing system, without increasing the level of treatment or the available disposal capacity.

This option does not increase the volume of the septic tanks to accommodate the additional flows or sludge handling capacity of the septic tanks to comply with the capacity requirements of AS/NZS1547:2012 section 5.4.2.2.1 Capacity requirements.

Without an increase in wastewater treatment performance, the increased flows and loads on the system would result in an increased load on the Rastus Burn catchment and this is expected to trigger a negative effect on the environmental outcomes, with subsequent reduction in ecological health.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

6 Long List Options for Wastewater Upgrades

Renewals only maintain day-to-day performance, they do not materially improve environmental outcomes or address the long-term risks associated with capacity constraints, consent expiry, or future compliance requirements. As a result, this option's impact scoring was assessed as significantly negative and has been ruled out as not feasible.

6.3 Option 3 – Make Existing Septic Tanks Bigger

Under this option, the existing septic tank volume is increased from 216m³ with an additional 125m³ to allow for the increased wastewater flows. This upgrade increases the waste storage, sludge retention and is expected to slightly improve the separation (primary treatment) performance. The rapid infiltration basins remain unchanged and as discussed for Option 1, the loading rate increases from 20mm/day to approximately 32mm/day.

The existing retention time within the septic tanks remains at 1.7 days during peak flows and results in:

- Negligible appreciable improvement in peak day treated wastewater concentrations.
- Slight improvement in sludge and floatable separation under average daily wastewater volumes.
- Increased load on the environment as larger settling volume does not provide conditions required for nutrient reduction.

This option still results in increased nutrient loads on the Rastus Burn catchment when the wastewater flow increases with the projected additional skiers. While technically feasible to add septic tank volume, increasing the settling capacity of the WW system doesn't provide conditions for Nitrobacter and other mechanisms to effectively reduce nutrients and the resultant load on the environment.

Like Options 1 and 2, this option received a significantly negative impact scoring and is not a feasible solution.

6.4 Option 4 – Existing System with Secondary Treatment Upgrade

This option moves away from a septic tank upgrade and introduces a new proprietary on-site secondary wastewater treatment system that provides secondary level effluent treatment. The rapid infiltration basins continue to receive treated effluent, however at a higher quality.

Secondary treatment reduces BOD₅ and TSS but is not engineered to reduce nitrogen or phosphorus which have been identified as two key nutrients requiring reduction to provide a "no more than existing" load profile for the Rastus Burn catchment (see Option 5a and 5b below for nutrient reduction systems).

To provide secondary treatment the following components are typically required for biological treatment:

- Primary sedimentation tanks with effluent filter
- Buffer storage
- Aeration chamber
- Clarifier
- Sludge return system from base of clarifier into primary tank
- Treated effluent pump station
- Effluent disc filters

Unlike primary systems, secondary treatment systems require power and are more complex with more stringent ongoing maintenance requirements.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

6 Long List Options for Wastewater Upgrades

Although the option introduces higher operational complexity, increased maintenance obligations, and additional energy demand, these challenges were considered manageable within the broader feasibility assessment.

Following testing by an independent contractor, the RIBs were assessed and the design loading rates for secondary treated effluent have been increased to 50 mm/day (AS/NZS1547:2012 Table L1).

Given its potential to improve treatment performance, support higher future flows, and strengthen long-term consentability, this option was taken forward for more detailed technical evaluation in Section 7.2.

6.5 Option 5a – Option 4 + No More Nutrients to Environment

Option 5a builds on the secondary wastewater treatment plant and potential land disposal system upgrade in Option 4 by adding a tertiary treatment step with nutrient removal sufficient to match the existing total nitrogen and phosphorus loads from the septic tank discussed in Option 1.

With the increase in skiers up to 6,000/day, this system provides tertiary treatment to have a no worse than existing load profile to the Rastus Burn catchment.

To provide tertiary treatment the following components are typically required (for an aerated system):

- Primary sedimentation tanks with effluent filter
- Buffer storage
- Nitrification chambers
- Aeration chamber
- Clarifier
- Sludge return system from base of clarifier into primary tank
- Anoxic tanks
- Treated effluent pump station
- Effluent disc filters
- Carbon dosing system
- Alkalinity dosing system
- Other proprietary components

The end result of this system is the environment sees no fundamental change in the cumulative loading to the environment (kg/year) when compared to the existing primary effluent discharge which has maintained good to excellent aquatic health.

The size and performance of this system is directly related to the design year and nutrient baseline information to be provided by others. Components discussed above are based on an aerated system and will be different if a textile solution is selected or an alternative supplier is engaged.

This option was taken forward into the short list evaluation.

6.6 Option 5b – Option 4 + Less Nutrients to Environment

Option 5b increases the treatment provided by Option 5a by an arbitrary percentage, initially set at 30%.

This increase in effluent treatment and nutrient removal, accommodates the increase in skiers and the environment sees a lower cumulative load (kg/year) of Nitrogen and Phosphorus. TSS and BOD also reduce when compared to Option 4.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

6 Long List Options for Wastewater Upgrades

To provide an increase in the tertiary treatment over Option 5a the following additional components are required:

- Additional Nitrification chambers
- Aeration chamber with modified aeration controls
- Clarifier
- Larger sludge return system from base of clarifier into primary tank
- Additional Anoxic tanks
- Larger Carbon dosing system
- Larger Alkalinity dosing system
- Larger heating systems
- Monitoring systems
- Other proprietary components

The size and performance of this system is directly related to the design year and nutrient baseline information to be provided by others. Components discussed above are subject to further assessment and will be updated.

This option was taken forward into the short list evaluation.

6.6.1 Example System

As an example of the required onsite wastewater components to treat effluent from up to 7,000 people, the following arrangement was proposed by Innoflow:

Pre-settlement

- Existing 31m³ settlement tanks
- Existing 2 x 75m³ septic tanks with effluent filters (<3mm screen)

Secondary and tertiary wastewater treatment

- 1 x 28m³ organic removal stage 1 tank with 20% media fill
- 1 x 28m³ organic removal stage 2 tank with 14% media fill
- 3 x 28m³ nitrification stage 1 tank with 47% media fill
- 1 x 28m³ nitrification stage 2 tank with 18% media fill
- 1 x lamella clarifier with minimum of 25 sqm plate area
- 1 x 28m³ post anoxic/ denitrification tank with 64% media fill
- Polishing AdvanTex recirculating packed bed reactor including
- 9 x 21.5m³ recirculation tank with dosing pumps
- 5 x AdvanTex AX100 packed bed reactor pods
- 9 x 21.5m³ treated effluent tank with irrigation pumps
- Pulse effluent flow meter
- 1 x carbon dosing system
- 1 x alkalinity dosing system
- 1 x TCOM
- 1 x Thermal or solar heat exchange
- Control building to include blowers, chemical storage, panels etc



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6 Long List Options for Wastewater Upgrades

Land Treatment System

- Treated effluent rising main
- Sequencing valves, venting and flushing components

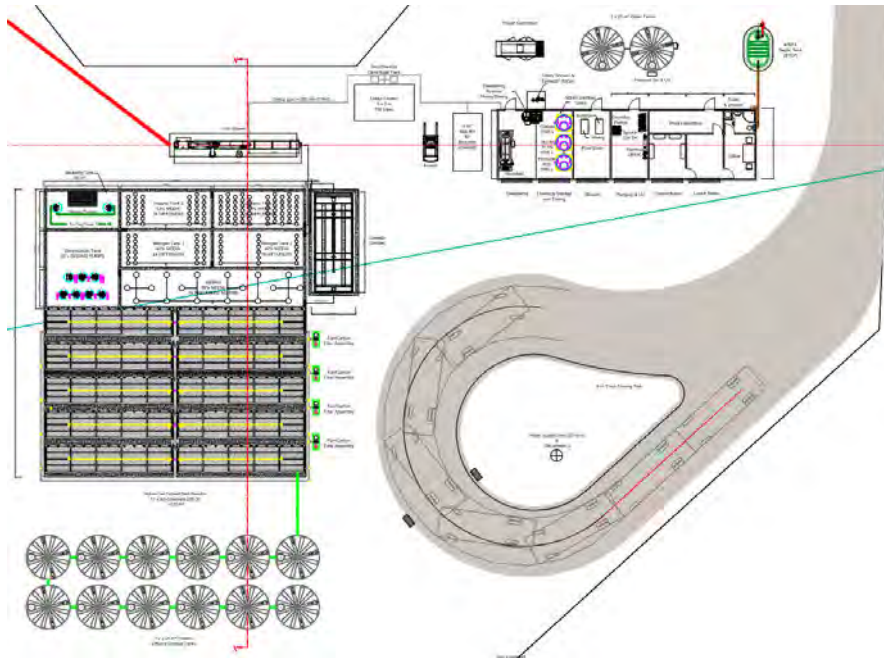


Figure 4. Onsite wastewater (Innoflow system) for Mt Cardrona Station.

6.7 Option 6 – Falling Main to New Treatment Plant

Option 6 involves conveying primary-treated wastewater from the ski field down to the base of the mountain for further treatment. This option removes the need to heat wastewater infrastructure at altitude, improves access for operations and maintenance, and reduces the demand for carpark space to accommodate treatment infrastructure.

A new treatment plant located on Trojan-owned land, with a nearby disposal area, could address the challenges associated with treating effluent in low-temperature environments. Given the high energy requirements and increased likelihood of freeze related failures at altitude, treatment at lower elevations would generally provide more stable, reliable, and resilient performance compared with systems located on the mountain.

However, conveying wastewater down the mountain would require a combination of gravity and rising mains over a long distance. Long conveyance times and warmer temperatures at lower elevations increase the risk of wastewater becoming septic, leading to odour generation and potential corrosion issues.

The proposed pipeline alignment (refer Figure 5) traverses steep and potentially unstable terrain, presenting significant construction and operational challenges. These include risks of damage due to landslides, erosion, and ground movement, which would result in high capital costs and ongoing maintenance requirements.

Additional constraints include the need for new power supplies, landowner approvals, and the potential for effluent to daylight on third-party land. This is considered the least feasible treatment and disposal option.



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6 Long List Options for Wastewater Upgrades

Options 6a, 6b, and 6c were investigated further and are discussed in the following sections. Overall, due to the high costs and risks associated with wastewater conveyance, it is considered more feasible to provide upgraded treatment systems at the ski field.

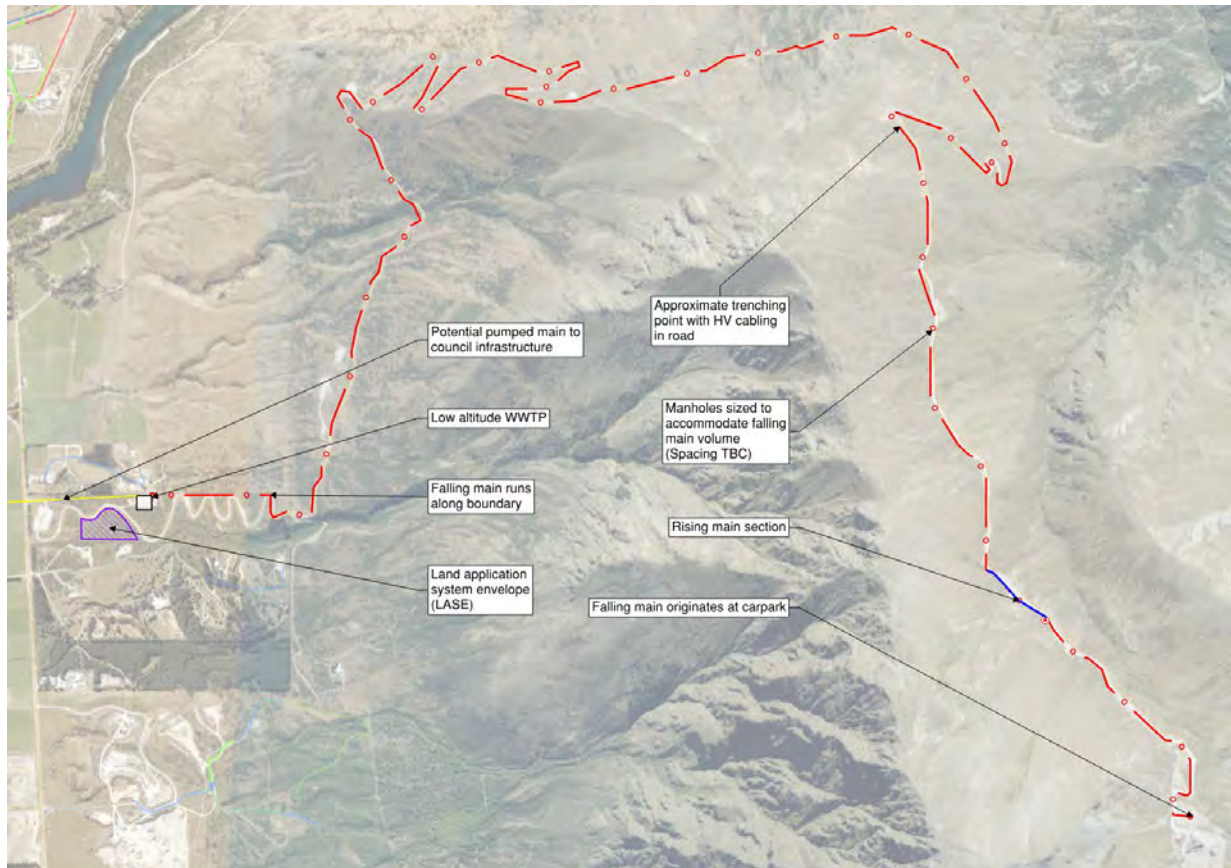


Figure 5. Falling main to Trojan owned land.

6.8 Option 6a – Pipe down road to new treatment plant and disposal field

If the decision is that onsite disposal at the ski field is to be avoided, and to accommodate future design flows with future head room, a potential option is that a downhill pipeline is used with a new treatment plant constructed in the Trojan owned land. The Option 6 a/b/c downhill pipeline allows long term future upgrade capacity and expansion.

A key benefit of the downhill pipeline options is the reduced risk related to regional plan changes or resource consenting stipulating nitrogen and phosphorus reduction as this is more consistent at lower elevations and doesn't rely on a heating system.

A key risk of this option is that the characteristics of the proposed disposal field are unknown, including if/where treated wastewater might subsequently daylight, and its effect on stakeholders and the receiving environment. These matters would need to be properly understood, and stakeholders consulted before its feasibility could be confirmed.

Initial assessments for this option rule out this as feasible with CapEx estimates at 150%-200% of the Option 5 costs once installed.



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6 Long List Options for Wastewater Upgrades



Figure 6. Treatment and disposal system in Trojan owned land.

6.9 Option 6b – Pipe down road to new holding tank and connect to Hanleys Farm PS

Similar to Option 6a, wastewater is piped down the hill to Trojan owned land. Wastewater enters storage tanks sized to accommodate 24-48hrs of peak daily flow and is pumped into the Hanleys Farm pump station.

Approximately 800-1,000m³ of storage (or more) is required with a duty assist standby pump station.

Due to raw effluent being retained for in excess of 24hours, septicity and anaerobic conditions are expected, leading to the effluent souring and significant odour risks.

An odour control unit (likely a bark bed or activated carbon system) with condensate pump station is required.

Effluent from this disposal would enter the QLDC Shotover WWTP.

With regard to acceptance into the QLDC system, discussion with Simon Mason (QLDC Infrastructure Operations Manager) highlighted:

- Wastewater characteristics: high nitrogen, no carbon, peaky flows which is considered an undesirable scenario.
- Multiple developers (including Homestead Bay) are seeking connections; NZSki would need to join the queue.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

6 Long List Options for Wastewater Upgrades

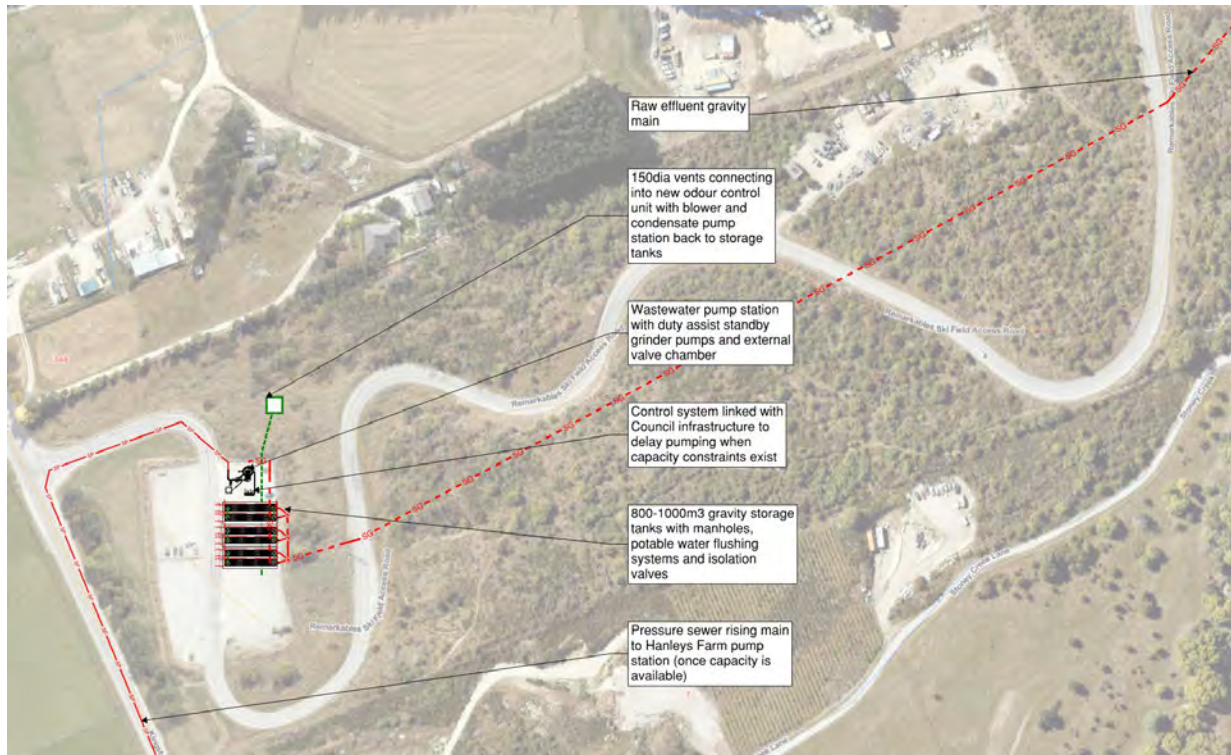


Figure 7. Holding tanks and pump station in bottom carpark.

Input from Iain Banks (Stantec, Queenstown) indicates:

- The Hanleys Farm pump station is nearing capacity, with existing services almost oversubscribed.
- The new connection may require upgrading existing services and discharging into a manhole further upstream. This is technically feasible but complex.

The risks associated with this system and the undesirable scenario of storing effluent during peak wet weather events for long durations further reduce the feasibility of this option.



Figure 8. Approximate route to convey to Hanleys Farm Pump Station.



6.10 Option 6c – Pipe down road to new treatment plant and pumped main discharging into Council network downstream of Hanleys Farm system

An alternative to discharging effluent onsite within Trojan owned land, is to run a pressure main under State Highway 6 under the farmland, river and connect into the OD450 PE pipeline conveying wastewater from Hanleys Farm to the Council treatment plant.

This option has been discounted due to the increased complexity of the pressure main connection being unknown, potential capacity constraints of the council infrastructure, easements, covenants and stream crossings.

Effluent from this disposal would enter the QLDC Shotover WWTP downstream of the Hanleys Farm pump station.



Figure 9. Treatment plant and treated effluent main crossing SH6.

For the fast-track consent process, this option likely has the largest number of affected parties that would require consultation and is unlikely to be achieved within a reasonable timeframe. This includes additional landowners and neighbours, approvals and negotiations associated with crossing SH6, and engagement with QLDC Wastewater Management regarding connection capacity and operational impacts.

The cost of this connection is expected to be similar to onsite disposal within Trojan owned land and as such has not been considered as a potential option.

Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

6 Long List Options for Wastewater Upgrades



Figure 10. Approximate connection to the OD450 PN16 Wastewater Pressure Main.



7 Short List Options for Wastewater Upgrades

The following section discusses the feasibility of the short list options identified in the wastewater options technical workshop of 11th February 2026. The size and performance of systems discussed are directly related to the design year and nutrient baseline information to be provided by others. Further updates and design changes are expected in future design stages.

The short-listed options are 4, 5a and 5b.

7.1 Adopted Requirements and Constraints

To assist with identifying the short list options, minimum requirements and constraints were agreed at the technical workshop of 11 February 2026, as below.

7.1.1 Adopted Minimum Treatment Requirements

Advice from environmental science and planning assessments concluded that:

- A minimum of secondary treatment would be required (Options 4 – 6a, 6c).
- For discharge to the Rastus Burn, observed environmental effects could support a consent application where the total discharge of contaminants was no worse than present (Option 5a).
- For discharge to the Rastus Burn, consentability would be improved if the total discharge of contaminants were clearly less than at present. A specific percentage reduction was not advised at the workshop (Option 5b).

7.1.2 Adopted Disposal Location

The 11th February workshop, the design team concluded that there were considerable cost and uncertainty on many aspects of low altitude disposal, particularly associated with pipeline failure risk. Further, it was considered that feasible Rastus Burn options existed.

Therefore, the low altitude options presented by Options 6a-c were excluded from the Short List.

7.1.3 Volumes to Rastus Burn Land Application System

For all discharge options considered below, the existing Rastus Burn rapid infiltration basins are proposed to be utilised up to and beyond the existing consented limit.

Independent hydraulic and infiltration assessments have been undertaken of these rapid infiltration basins and verified the long-term capacity of the existing disposal system to receive wastewater is comfortably more than 50mm/day. Refer to Appendix A for further information.

7.2 Option 4 – Existing System with Secondary Treatment Upgrade

7.2.1 Summary

Option 4 involves upgrading the existing Rastus Burn wastewater system by introducing a new onsite secondary wastewater treatment process.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

7 Short List Options for Wastewater Upgrades

For disposal, the upgraded system would continue to utilise the existing rapid infiltration basins for land application, with improved effluent quality reducing solids loading and supporting more reliable long-term operation.

Secondary treatment systems for this option require heating of the influent and/or treatment tanks to maintain biological activity (typically above 10°C at all times). The extent and necessity of heating will need to be confirmed during preliminary and detailed design stages should this option be progressed. The likely heating requirement is approximately 220-240kW.

Feedback from suppliers confirmed that a secondary treatment plant can be expected to achieve the following level of treatment:

- Negligible additional reduction of nitrogen and phosphorus
- BOD₅: < 20 g/m³ for at least 90% of samples
- TSS: < 30 g/m³ for at least 90% of samples
- No single sample exceeding:
 - BOD₅ > 30 g/m³
 - TSS > 45 g/m³

Achieving these performance targets will improve effluent clarity compared with the current primary-treated discharge, however, subject to E3 Scientific's assessment, may not reduce the overall nutrient footprint in line with the baseline with 6,000 skiers/day.

This solution was not issued to suppliers to obtain CapEx and OpEx estimates as it does not meet the baseline requirements of E3 with 6,000 skiers per day.

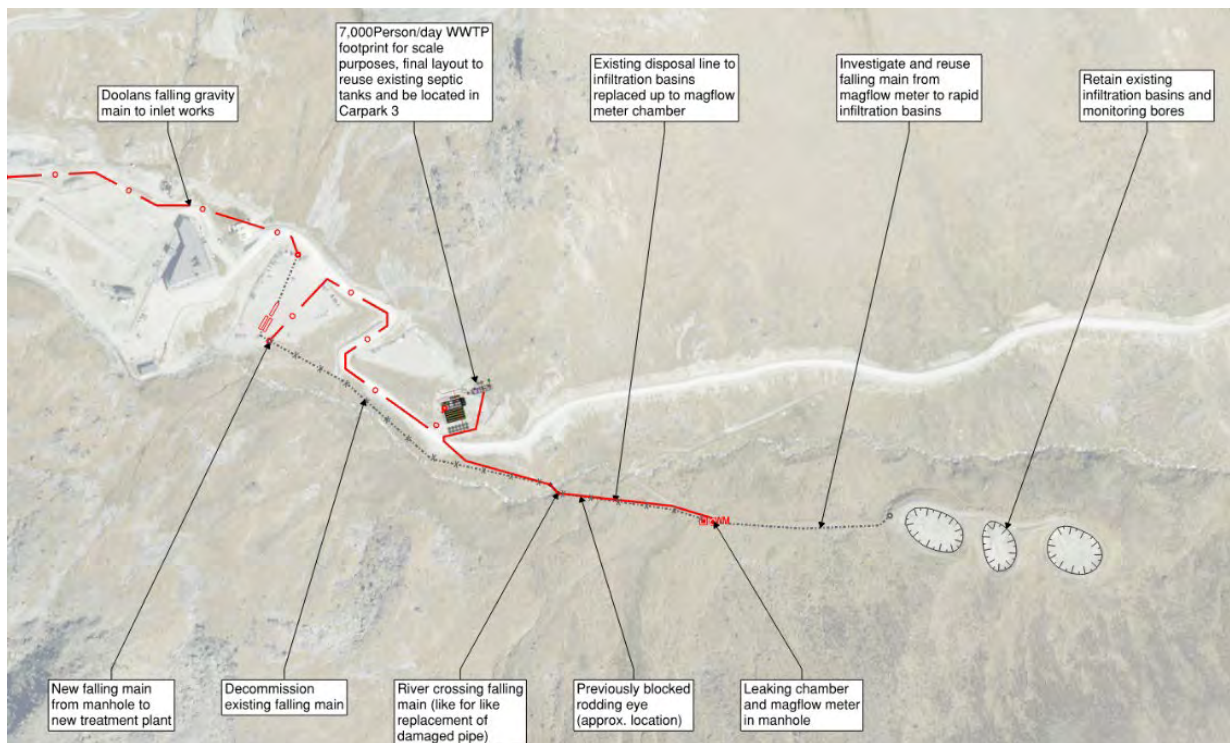


Figure 11. Option 4 site plan.



7.2.2 Pros/cons

Pros:

- Provides improved effluent quality compared with septic tanks.
- Reuses the existing RIBs.
- Reduces contaminant loading on the existing RIBs, supporting reuse at 50 mm/day.
- Scalable to accommodate variable flows with modular options available.

Cons:

- Higher operational and maintenance requirements compared to septic tanks.
- Insufficient nutrient reduction and treatment to maintain existing baseline nutrient loading with 6,000 skiers/day.

Unknowns:

- Consentability for a new discharge at altitude remains uncertain and will depend on soils, groundwater, and receiving-environment findings.
- Extent of operational oversight, heating demand, and energy consumption required to maintain stable winter performance.
- Long-term treatment reliability under variable seasonal loading, including impacts of low-strength by-wash flows, requires further assessment.

7.3 Option 5a – Option 4 + No More Nutrients to Environment

7.3.1 Summary

Option 5a builds on the upgrades proposed in Option 4, adding further treatment processes to ensure that total annual load of nitrogen (TN) and total phosphorus (TP) discharged to the environment remains no greater than current levels, even with increased flows from the Doolans expansion. This option therefore aims to achieve a nutrient-neutral discharge profile, matching the existing nutrient load produced by the primary treatment system.

To achieve this level of nutrient reduction, additional system components are required, including:

- Nutrient removal stages
- Recirculation
- Heating (approximately 240kW required)
- Dosing systems
- Sludge handling and removal systems
- Monitoring systems

These elements support nitrification, denitrification, and phosphorus-reduction processes that would not reliably function at cold influent temperatures without thermal and process control upgrades. Onsite secondary or tertiary treatment systems require heating of influent and/or treatment tanks to maintain biological activity and prevent freezing of pipework.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

7 Short List Options for Wastewater Upgrades

Potential heating strategies to maintain effluent temperatures of 10°C include:

- Ground source heat pumps with heat exchangers, coils and immersion loops.
- Solar thermodynamic panels connected to heat pumps with heat exchangers, coils and immersion loops .
- Heat recovery from treated effluent stream back into the influent stream to reduce heating loads.

Heated wastewater treatment systems in alpine environments present several challenges. They are costly, can be noisy, and require a high level of operational oversight to ensure reliable and continuous performance. For these reasons, avoiding the need for heating at altitude is preferable wherever possible. However, installing and maintaining a treatment system with 240kW of heating at the ski field is considered more feasible overall than conveying wastewater down the mountain.

E3 Scientific has confirmed additional E. coli treatment is not required. Monitoring of the Rastus Burn within the last 10 years show that E. coli levels remain within acceptable limits without additional disinfection, due to effective natural UV die-off in the rapid infiltration basins, natural rapid die off underground, and natural UV die-off again within the Rastus Burn during downstream exposure. As such, no disinfection measures such as UV, chlorine, or ozone are proposed for this option.

7.3.2 Pros/cons

Pros:

- Builds on the improved secondary treatment performance of Option 4, with additional heating and recirculation to stabilise treatment under cold alpine conditions.
- Can maintain nutrient discharge levels at or below existing measured conditions, helping support a longer-term consent where “no additional nutrient load” is required.
- Allows continued use of existing rapid infiltration basins for part of the flow, reducing additional disposal footprint requirements.

Cons:

- Requires heating systems and more complex recirculation processes, significantly increasing energy demand and operational cost.
- Increased energy consumption and more complex treatment trains introduce reliability, noise, and operability risks.
- Likely to require a larger operational footprint and more intensive process control.
- More sensitive to alpine operational challenges, including freezing risk, power outages, and variable load conditions.
- Increased complexity and system operator skill reliance compared with standard secondary treatment; higher operator attendance and maintenance required.

Unknowns:

- For a given technology, actual nutrient removal performance in alpine winter conditions is uncertain and would require supplier specific testing or modelling.
- Increased phosphorus removal is complex given low temperatures and lack of reliability for alum dosing in these conditions.
- Extent of heating required to reliably meet performance targets during severe weather events is uncertain.
- Temperature of wastewater from Doolans falling main and impact to the treatment process.



- Long-term performance reliability under highly variable seasonal loading (particularly low-strength by-wash flows) requires validation.

7.4 Option 5b – Option 4 + Less Nutrients to Environment

7.4.1 Summary

Option 5b expands on the treatment upgrades included in Option 4, like Option 5a, but an arbitrary 30% increase in nutrient-reduction processes to achieve a further decrease in TN and TP discharged to the environment. Whereas Option 5a aims to match the existing nutrient load, Option 5b aims to reduce nutrient loads.

This option requires more extensive and complex nutrient reduction infrastructure than Option 5a, including increased heating, recirculation, and treatment. Additional components may include:

- Expanded nitrification and denitrification tanks with more media surface area
- Additional tanks and controller upgrades
- Increased peak heating system capacity and response time to ensure consistent temperature throughout the treatment system
- Increased aeration capacity and longer residence times
- Higher internal recirculation flows to stabilise nitrogen removal
- Additional servicing, dosing and testing components to manage ongoing treatment

The feasibility of upgrading from Option 5A to Option 5B would be dependent on the installer and the supplier of the final treatment system, which would be confirmed during subsequent design stages. While additional tanks could potentially be incorporated as part of an upgrade, there is a risk that components of the initial system could become redundant if this approach were pursued. This report has been prepared on the basis that a single option would be selected for implementation, rather than allowing for staged upgrades between options.

As with Options 4 and 5a, Option 5b relies on natural E. coli die-off. While Option 5b does not have confirmed nutrient load targets, it is expected to deliver greater reductions than Option 5a.

7.4.2 Pros/cons

Pros:

- Reduces nutrient discharge concentrations to the receiving environment.
- Enhanced recirculation and treatment stages provide more consistent effluent quality across seasons.

Cons:

- Requires higher levels of heating, recirculation, and process control than Option 5a, resulting in substantially higher CapEx and OPEX.
- Increased energy consumption and more complex treatment trains introduce reliability, noise, and operability risks.
- Likely to require an even larger operational footprint and more intensive process control.
- May require more chemical dosing processes that are difficult to manage in cold, remote environments.
- Higher likelihood of spills and unintentional operational and maintenance issues.



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7 Short List Options for Wastewater Upgrades

Unknowns:

- For a given technology, actual nutrient-removal performance in alpine winter conditions are uncertain and would require supplier-specific testing or modelling.
- Increased phosphorus removal is complex given low temperatures and lack of reliability for alum dosing and sludge removal systems in subzero conditions were not well proven for NZ conditions at the time of writing.
- 30% reduction may be too high without a significant change in technology.
- Aiming to achieve a higher reduction may cause more common system failures and consent exceedances.

7.5 CapEx and OpEx Estimates

Energy demand summary (heating): This report estimates heating based on 200,000 L/day and an 8°C temperature increase. This gives an estimated heating demand of about 240 kW (including system inefficiencies).

The cost estimates in Figure 12, Table 8, and Table 9 are presented on a Rough Order-of-Magnitude (ROM) basis and should be treated as indicative only. These estimates have been developed at an early feasibility stage and therefore carry a high degree of uncertainty. ROM estimates at this stage may vary significantly reflecting the limited design definition, uncertainties in wastewater flows, by-wash behaviour, disposal field suitability, vendor scope, and treatment performance requirements. These ranges do not allow for civil works, upgraded electrical supplies, P+G, contingencies, winterisation, and operational assumptions.

Given these uncertainties, the ROM values should be used only for option comparison and feasibility-level decision-making, and will require refinement once flow data, vendor performance requirements, and planning inputs are confirmed.

The following CapEx and OpEx estimates are rough order-of-magnitude and are intended as a starting point for discussion only.

There are few key assumptions here, that would be clarified in detailed design stage (and a site visit, actually). In summary, the cost to supply, deliver and install the system is

- 250m³/day MBBR wastewater treatment plant: \$ 2.4 million
- Solar heat exchange with conventional back up heat exchange unit: \$300,000, (TBC, waiting on confirmed pricing)
- 12,500 basal square meter land application system using 0.86m wide H-20 sub surface chambers. Using a provisional sum of \$175/sqm = \$2.19 million

Figure 12. Innoflow proposal, noting additional 12,500m² basal area option was not progressed.

Table 8 is a placeholder in this report issue. Final CapEx values are not confirmed.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

7 Short List Options for Wastewater Upgrades

Table 8. Rough Order-of-magnitude (ROM) CapEx cost estimates for feasible options.

CAPEX Estimate		160m3/day MBR Reuse	250m3/day Hynds	210m3/day InnoFlow MBBR
		Option 5b	Option 5a	Option 5a
Base Construction Estimate				
Quotations Received: Treatment + Reuse of RIBs + Heating System		\$ 10,710,000	\$ 3,940,000	\$ 2,700,000
P&G		\$ 2,140,000	\$ 2,140,000	\$ 2,140,000
Total Base Construction Estimate		\$ 12,850,000	\$ 6,080,000	\$ 4,840,000
Professional Fees				
Design Development (Prelim and Detailed Design)		\$ 510,000	\$ 240,000	\$ 190,000
Construction Monitoring & Contract Management		\$ 320,000	\$ 150,000	\$ 120,000
Total Professional Fees		\$ 830,000	\$ 390,000	\$ 310,000
Allowances				
Geotechnical site investigations		\$ 50,000	\$ 50,000	\$ 50,000
Telemetry & Operational Enhancements		\$ 1,290,000	\$ 610,000	\$ 480,000
Trafficable structural slab + enhancements for underground treatment		\$ 1,290,000	\$ 610,000	\$ 480,000
Additional scope requirements not identifiable prior to design		\$ 1,930,000	\$ 910,000	\$ 730,000
Client project costs		\$ 320,000	\$ 150,000	\$ 120,000
Contingency		\$ 2,570,000	\$ 1,220,000	\$ 970,000
Escalation		\$ 1,930,000	\$ 910,000	\$ 730,000
Total Allowances		\$ 9,380,000	\$ 4,460,000	\$ 3,560,000
Total Estimate		\$ 23,060,000	\$ 10,930,000	\$ 8,710,000

Note, the above table is a placeholder only and is subject to change.

Table 9. Annual OpEx rough estimate.

Option	Labour Cost	Heating Cost	Dosing Cost	OPEX
Option 4	\$10,200	\$181,440	\$0	\$191,640
Option 5a	\$35,400	\$241,920	\$4,930	\$282,250
Option 5b	\$73,200	\$362,880	\$7,395	\$443,475

Assumptions & Exclusions

The cost estimates have been prepared on the basis of high-level concepts only. They are based on outline assumptions with no supporting design. They are order-of-magnitude estimates intended for option comparison and strategic planning. Actual costs may vary significantly as the project progresses through preliminary and detailed design, and once site conditions, consenting requirements, and market factors are confirmed.

These cost estimates should not be relied upon for tendering, contract negotiation, or funding approval without further design development. Any reliance placed on the estimates beyond their intended purpose is at the client's discretion.

The following assumptions were used in preparing the OpEx calculations:

- Operator labour cost is assumed at \$150 per hour.
- A one-month pre-heating period is required prior to the start of each ski season.



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

7 Short List Options for Wastewater Upgrades

- Heating requirements are based on 200,000 L/day of effluent entering the treatment plant over a 24-hour period, with an 8°C temperature increase. This equates to an estimated heating demand of approximately 240 kW (including system inefficiencies).
- Chemical dosing costs include alkalinity (30% sodium hydroxide in 200 L drums) and carbon dosing (80% acetic acid solution), totalling \$4,930 per year, based on the 2020 Coronet Peak Wastewater Treatment Plant Upgrade – Submission Evaluation Report.
- Estimates exclude mileage and delivery costs.
- Option 4 incorporates fewer tanks; therefore, its heating demand is assumed to be approximately 75% of the heating requirement for Option 5a.
- Option 5b is assumed to require 150% of the heating input and chemical dosing consumption of Option 5a, reflecting its increased level of treatment.
- All options assume the existing RIBs are reused.

7.6 Limitation on Treatment Technologies and Estimates

Stantec have relied on the submissions by providers and at this stage have made no technical assessment of their suitability, accuracy or completeness. This assessment will be essential and will need to follow the selection of the preferred option. Ultimately a different treatment technology may be selected that will achieve the end of pipe treatment outcomes. The work done to date is intended to demonstrate that reputable suppliers believe that viable options exist. As a preferred option is developed it is expected that additional scope of work to make it complete and resilient would be identified.



8 Staging, Scalability and Implementation Pathway

Staging of the physical upgrade’s implementation is required due to alpine construction constraints, limited summer/autumn work windows, and the need to maintain compliance and ski field operations during upgrades. Scalability refers to the ability to provide more (i.e. duplicate) process elements in the future to increase or improve treatment performance.

Each option has different construction complexity, scalability, and operational implications for design flows and loads, as outlined in Table 10.

Table 10. Staging, scalability, and implementation pathway for feasible options.

Option	Staging Requirements	Scalability	Implementation Considerations
4 – Existing System with Secondary Treatment Upgrade	<p>Construction staged around ski season.</p> <p>Maintain operation of existing system while integrating new secondary treatment.</p>	<p>Moderate scalability.</p> <p>Limited by footprint at ski field and disposal field constraints.</p> <p>Long-term flow capacity constrained.</p>	<p>Higher complexity at altitude (heating, winterisation).</p> <p>Requires careful integration with existing tanks and piping.</p> <p>Seasonality of works may extend delivery timeframe.</p> <p>Supplier lead times are anticipated to be 4-6 months, subject to when ordered.</p>
5a – Option 4 + No More Nutrients to environment	<p>Staged construction similar to Option 4 but with additional commissioning steps for heating/recirculation.</p> <p>Must maintain existing discharge until new system stable.</p>	<p>Moderate scalability.</p> <p>Heating/recirculation improves winter resilience, but disposal field capacity remains a limiting factor.</p>	<p>More complex installation due to heating systems and controls.</p> <p>Higher commissioning effort to confirm nutrient-neutral performance.</p> <p>Alpine operational risks require robust winterisation.</p> <p>Supplier lead times are anticipated to be 6-8 months, subject to when ordered.</p>



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

8 Staging, Scalability and Implementation Pathway

5b – Option 4 + Less Nutrients to Environment

Largest staging requirement of the three options.

Highest theoretical scalability in treatment performance.

Most complex option to construct and operate.

Additional process stages require incremental commissioning.

Chemical systems and additional reactors require more space, power, and operator training.

Construction and commissioning likely extend over multiple off-seasons.

Winter performance validation is essential before full transition.

Lead times are expected to extend over multiple ski seasons from order to construction being completed.

Supplier lead times are anticipated to be 6-12 months, subject to when ordered.



9 Risk Assessment

Table 11. Rastus Burn key risks.

All Options – Design year, baseline and process dependencies

- The size, configuration, and performance of the wastewater system are dependent on the adopted design year (refer to mem WW V01 Design WW Flows and Loads in Appendix A) and nutrient baseline assumptions, which are not yet fully confirmed.
- Differences exist between design years assumed across disciplines and option assessments, creating potential inconsistencies in flow, load, and treatment performance expectations.
- Nutrient baseline inputs (including reliance on third-party data) have not yet been fully reconciled with first-principles mass balance and process calculations.
- Process engineering input is still required to confirm achievable TN and TP performance under alpine, cold-weather operating conditions.
- Several treatment components, operating parameters, and performance criteria remain TBC.
- Changes to confirmed design year or baseline assumptions may require re-sizing of infrastructure, modification of treatment processes, or reassessment of option viability.
- The options assessment and preferred concept will require review and update once outstanding inputs are resolved.
- The soils testing completed in the RIBs may be neither representative nor static. This risk can be appropriately addressed by independent infiltration testing at 5 year intervals to confirm that the infiltration rate exceeds the required rate. Should this not be the case, the basins can be rehabilitated using the methodology undertaken in 2014. This involved excavation and screening to remove fines, and break up and remove any impermeable layers which may have formed.

Option 1 – Do nothing

- Very unlikely to be consentable as it does not address long-term compliance.
- Poor environmental and cultural outcomes with a likely a decline in the Rastus Burn water quality, increased odours, potential loss of amenity values and reduced skier sentiment.
- Public/ stakeholder opposition likely.

Option 2 – Renewals and Operational Improvements

- Very unlikely to be consentable as it does not address long-term compliance.
- Poor environmental and cultural outcomes, worsening as flows increase with the Doolans expansion.
- Public/ stakeholder opposition likely.

Option 3 – Make Existing Septic Tanks Bigger



- Unlikely to be consentable.
 - New legislation and discharge standards actively discourage primary treatment and disposal.
 - Aged effluent arriving into the septic tank (from Doolans) may have soured or become septic resulting in bad odours and septicity at vents and basins.
 - Increased flow through septic tanks may result in fats oils and grease bypass and fouling of the infiltration basins.
-

Option 4 – Existing System with Secondary Treatment Upgrade

- Proprietary treatment systems may not be suitable or achieve rated performance.
 - Indicative costs provided by suppliers only include their scope and may not provide the full picture.
 - Heating of wastewater system and pipework requires ongoing energy input.
 - System complexity and sensitivity may necessitate daily monitoring of system.
 - Under increased occupant loads, level of treatment may be insufficient and require an upgrade within a short timeframe of installation.
-

Option 5a – Option 4 + No More Nutrients to Environment

- Reliant on E3 Scientific baseline data.
 - High process complexity, footprint, and energy demand.
 - Reliability risk due to extensive heating, chemical dosing, and recirculation.
 - Alpine climate may limit achievable TN/TP reductions.
 - Potential chemical handling/ storage risks (alkalinity, carbon, alum if used).
 - Greater operational oversight is needed as system is more sensitive to load changes.
 - Difficulty commissioning across short alpine work seasons.
 - More planning and expertise needed at ski season start-up.
-

Option 5b – Option 4 + Less Nutrients to Environment

- Option 5b treatment targets unknown.
 - Highest process complexity, footprint, and energy demand.
 - Reliability risk due to extensive heating, chemical dosing, and recirculation.
 - Alpine climate may limit achievable TN/TP reductions.
 - Potential chemical handling/storage risks (alkalinity, carbon, alum if used).
 - Difficulty commissioning across short alpine work seasons.
 - Greater operational oversight is needed as system is more sensitive to load changes.
 - More planning and expertise needed at ski season start-up.
-

Option 6a – Pipe down road to new treatment plant and disposal field

- Unknown ground conditions may require remediation and result in delays.
 - Shallow rock below road may make trenching impractical.
-



Remarkables Ski Area Expansion Project - Wastewater Treatment and Disposal Feasibility Report

9 Risk Assessment

- Water flowing down slope in bedding material may undercut resulting in road instability.
- Road may become unstable due to open trench and excavation for manholes and pump stations.
- Odour risk could be exacerbated through aeration and stirring up of solids due to high velocity flows.
- Siphons may work improperly and require pump stations.
- New disposal field may not be available or suitable in Trojan owned land.
- Nearby neighbour may oppose effluent disposal.

Option 6b – Pipe down road to new holding tank and connect to Hanleys Farm PS

- Council may reject connection to their system.
- Multiple other parties and subdivisions are in queue to connect to council infrastructure.
- Council indicated high strength wastewater may be problematic for their system.
- Unknown ground conditions may require remediation and result in delays.
- Shallow rock below road may make trenching impractical.
- Water flowing down slope in bedding material may undercut resulting in road instability.
- Road may become unstable due to open trench and excavation for manholes and pump stations.
- Odour risk could be exacerbated through aeration and stirring up of solids due to high velocity flows.
- Siphons may work improperly and require pump stations.

Option 6c – Pipe down road to new treatment plant and pumped main discharging into Council network downstream of Hanleys Farm system

- Council may reject connection to their system.
- Unknown ground conditions may require remediation and result in delays.
- Shallow rock below road may make trenching impractical.
- High installation complexity (under SH6, farmland, watercourses).
- Water flowing down slope in bedding material may undercut resulting in road instability.
- Road may become unstable due to open trench and excavation for manholes and pump stations.
- Odour risk could be exacerbated through aeration and stirring up of solids due to high velocity flows.
- Siphons may work improperly and require pump stations.

Note, this section is for discussion, refer to the Risk Register in Appendix D for additional risks, mitigations, and further information.



10 Conclusion

This feasibility assessment has demonstrated that the existing Rastus Burn wastewater system cannot reliably support future ski field use without upgrades. While the system has performed adequately under historic conditions, increased wastewater flows, higher nutrient loads, and the challenges of alpine operation create clear capacity, performance, and consent risks.

A first principles assessment of flows and nutrient loads indicates that historical nitrogen and phosphorus loads may be higher than historic sampling indicates. Based on multiple assessment methods, Stantec is satisfied that the most likely 2022 baseline loads are approximately 900 kg/year total nitrogen and 155 kg/year total phosphorus.

Assessment of the existing rapid infiltration basins confirms they have proven hydraulic performance and significant capacity. Independent testing completed in 2026 demonstrates infiltration rates well above earlier conservative assumptions. Retaining and reusing the existing basins at a conservative loading rate of 50 mm/day provides sufficient capacity, redundancy, and operational resilience without reliance on undeveloped reserve areas.

A wide range of wastewater treatment and disposal options were considered. Primary treatment options were found to be unsuitable, as they do not manage increased flows or nutrient loads. Secondary treatment options improve effluent quality but do not reduce nutrients and may not provide long-term consent certainty. Options incorporating nutrient reduction provide improved environmental outcomes but involve higher capital cost, energy demand, and operational complexity. Off-mountain conveyance options offer scalability but introduce significant construction, consenting, and operational risks.

At this stage, treatment upgrades located at the ski field, combined with reuse of the existing infiltration basins, provide the most feasible pathway forward. However, key uncertainties remain, including final nutrient baselines, treatment performance under alpine winter conditions, and consent requirements. These matters will require further monitoring, testing, and refinement during subsequent design stages.



11 References

Abdel-Shafy, H. (2017). *Pilot residential blackwater, Table 3*. Egypt.

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E3 Scientific, S. B. (2026, April 5). Remarkables Wastewater Discharge Impact Assessment, Document ID: 25047.4A .

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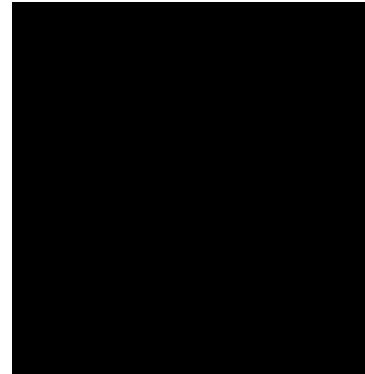
Appendix A – Memos and Correspondence



To:



From:



Project/File: 310104671

Date:

Reference: Doolans' Expansion Wastewater – Confirming Wastewater Design Year V3

1 Purpose

The purpose of this memo is to define, and seek NZ Ski's agreement to, the following aspects of the Remarkables wastewater treatment scheme.

- Peak and seasonal occupancy totals,
 - Historical skier numbers,
 - Forecast skier numbers with 6,000 capacity limit,
- Nitrogen and phosphorus loading calculations,
- The key risks that arise from these assumptions.

Written confirmation of acceptance from NZSki is required to provide Stantec with confidence to progress the V01 Feasibility Reporting and developed design.

The reason for this request is that there are potentially significant consent condition implications and cost implications for construction and operation of the plant which are dependent on these assumptions.

2 Design Year Framework

Wastewater infrastructure performance at the ski field is driven by highly variable seasonal occupancy. For design purposes, Stantec proposes that the consent requirements are based around annual nitrogen and phosphorus mass discharged to the receiving environment plus maximum end of pipe (at the point of discharge to the infiltration basins) concentrations of these elements.

The treatment process will require reduction in nitrogen and phosphorous in the wastewater before the treated flow enters the infiltration basins. The current primary treatment does not achieve a reduction of

Reference: **Doolans' Expansion Wastewater** – Confirming Wastewater Design Year

these determinants. If guest numbers are to increase for the design horizon, and the requirement is no increase in load then reduction is required.

The treatment process will need to be designed for seasonal variation in visitor numbers and the resulting varying flow rate and the concentration of the wastewater. The varying flow rate will require that the plant capacity for nutrient removal is suitable for increases over the season. Increase in treatment capacity requires an increase in the number of bacteria within the process, and this takes time to achieve. Thus, initially nutrient removal will be less effective than once the bacterial concentration has stabilised to match the wastewater concentration and flow rate.

Consequently, consent conditions that;

- Measures the annual mass of nutrients entering the receiving environment from the process,
- Plus a maximum value for the instantaneous nutrient concentration

Best reflects the nature of the process and the likely effect on the environment.

The treatment process will be defined using the following components:

- Peak day guest numbers
- Peak week guest numbers
- Peak month guest numbers
- Total guest numbers per season
- Number of guests in the season beginning and season end shoulder seasons
- The wastewater concentration of nutrients, i.e. how diluted or otherwise is the wastewater flow (we need to know the effectiveness of by-wash minimisation and any toxic or other nutrient rich chemicals that may enter the wastewater stream) so that we can determine total seasonal nitrogen and phosphorus load and concentration.

This approach to consent conditions recognises that the treatment process sizing is driven by short-duration peaks, while nutrient discharge limits are governed by seasonal and annual loads.

2.1 Proposed Design Year Assumptions (for Agreement)

For the purposes of the V01 Rastus Burn WW Feasibility Report, Stantec have collated the Benje Patterson's economic report historical skier numbers (2019-2025) and NZ Ski's forecast skier count (max. capacity of 6,000 skiers) into one figure for discussion. The historical numbers have been used to estimate flows and loads which have been applied to the forecast numbers to determine future flows and loads. This is shown overleaf.

Reference: Doolans' Expansion Wastewater – Confirming Wastewater Design Year

Economic Report Skier Numbers

Month	Location 2026	The Remarkables							Design Skiers (6,000 Cap.)
		2019	2020	2021	2022	2023	2024	2025	
June Total		48,577		10,547	18,987	29,051	23,076	28,223	30,983
July Total		101,135	41,388	84,059	87,899	108,773	87,255	103,313	147,004
August Total		75,641	22,712	30,149	87,228	87,654	83,073	91,708	115,319
September Total		47,722	25,401	31,882	65,707	65,049	57,686	55,869	67,412
October Total		12,952	10,678	20,731	21,831	9,099	19,736	15,622	11,994
Grand Total		286,027	100,179	177,368	281,652	299,626	270,826	294,735	372,712

Figure 1. Benje Patterson historical (2019-2025) and NZ Ski forecast design skiers (6,000 capacity) for discussion.

Design years are based on the following assumptions:

1. Historical skier numbers have been updated to align Benje Patterson’s economic report (April 2026).
2. NZ Ski provided forecast design skier numbers have a max of 6,000 skiers per day and a season total of 372,712.
3. The 2019 and 2022-2025 occupancy numbers are to be used to estimate the historical total nitrogen discussed in Section 2.2 below.
 - a. Skier numbers affected by COVID-19 have been excluded from L/person/day flow estimates.

Please can NZSki confirm that this assumption matches NZSki’s expectation of historical and forecast occupancy.

2.2 Nitrogen Load Estimation (Historical vs Proposed Design Year)

Due to the uncertainties in effluent sampling, bywash impacts and seasonal wastewater constituents, the following assumptions have been made. Table 1 demonstrates that with the increase in visitor numbers there is a significant increase in the annual mass of nutrients entering discharged to the treatment plant.

Table 1. Design assumptions

Parameter	Historical	Forecast (design year)	Notes
Annual skiers	270,826 to 294,735	372,712	Excludes out of season occupancy
Ski field capacity	Approx 4,000	6,000	
Wastewater generation	40 L/person/day	34 L/person/day	Actual wastewater generation per person was less than the original design of 40L/person/day

Reference: Doolans' Expansion Wastewater – Confirming Wastewater Design Year

Max consented design daily flow	127,440 L/day	204,000 L/day	Includes by-wash
Wastewater generated per annum (m3/year)	10,217	13,000	Historical estimate from MWH 2014, Table 5-2: estimated maximum future water volume entering the ponds
Influent total nitrogen (TN mg/L)	51-153	51-180	Reference: Coronet 130-145mg/L, Public toilet 50-180mg/L,
Season duration	120 days	120 days	
Generated Annual Total Nitrogen (kg/year)	~ 500-1,200	~ 620-2,200	Total nitrogen entering the treatment plant
Discharged Annual Total Nitrogen (kg/year)	~ 500-1,200	~ 500-1,200	Total nitrogen entering the Rastus Burn catchment, with treatment to reduce to current baseline levels

The historical effluent concentration estimated by E3Scientific ranges between 51-153mg/L from (E3 Scientific, 2026). Stantec has judged at the outlet of the existing septic tanks, the influent entering the wastewater treatment plant will range in concentration from 51-180mg/L TN with a concentration of 100mg/L TN. Coronet average influent of 135mg/L TN has been included to graphed in Figure 2 when applied to the revised occupancy numbers.

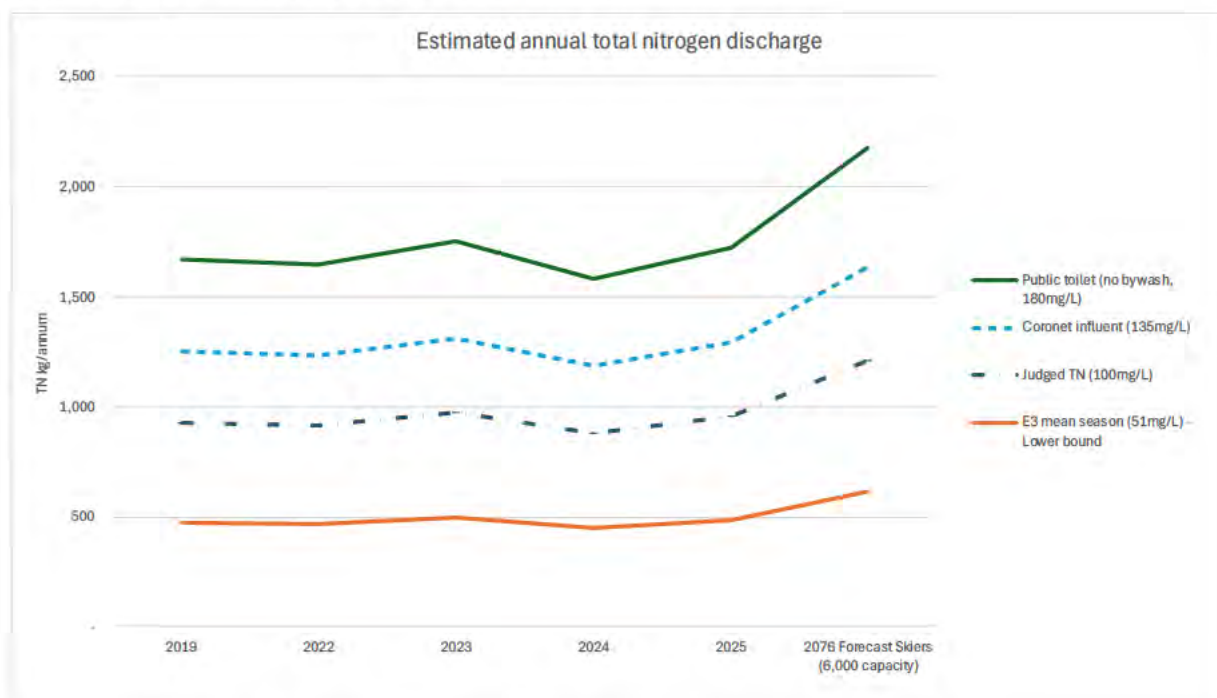


Figure 2. Estimated historical and forecast total nitrogen discharge per annum

Reference: **Doolans' Expansion Wastewater** – Confirming Wastewater Design Year

Note, due to the update of skier numbers, and the ski season being assessed over 120 days rather than the full June and October months, these values differ from E3 Scientific's values and the estimated baseline load. Further refinement of these figures will be completed following magflow meter upgrades and completion of additional testing as required as part of detailed design.

The following table's values were used to create Figure 2 and emphasise variability caused by seasonal effluent quality and bywash volumes. Public toilet values were included to create an upper bound and highlight a theoretical maximum annual load if bywash was eliminated.

Table 2. Annual total nitrogen estimates (kg/year)

Influent Concentration (mg/L TN)	2019	2022	2023	2024	2025	Forecast Design Skiers (6,000 capacity)
E3 Mean season (51mg/L)	474	466	496	448	488	617
Judged (100mg/L)	929	915	973	879	957	1,210
Coronet influent (135mg/L)	1,254	1,235	1,313	1,187	1,292	1,634
Public toilet (no bywash, 180mg/L)	1,672	1,646	1,751	1,583	1,723	2,178

2.3 Phosphorus Load Estimation (Historical vs Proposed Design Year)

Using the same methodology as the section above, this section outlines a first principles assessment of the baseline total phosphorus nutrient loading to the Rastus Burn catchment for skier counts and flows from 2022 and compares it to Table 13 from (E3 Scientific, 2026).

Table 3. Annual total phosphorus estimates (kg/year)

Influent Concentration (mg/L TP)	2019	2022	2023	2024	2025	Forecast Design Skiers (6,000 capacity)
E3 mean season (6.9mg/L)	64	63	67	61	66	84
2022 TP (9.3mg/L)	86	85	90	81	89	112
ESR primary mean (17mg/L)	158	155	165	149	163	206
USEPA typical domestic (18-29mg/L, 23.5mg/L Avg)	218	215	229	207	225	284
Public toilet (no bywash, 18-35mg/L, 26.5mg/L Avg)	246	242	258	233	254	321

Reference: Doolans' Expansion Wastewater – Confirming Wastewater Design Year

Total phosphorus concentrations from literature reviews ranged from 7-91mg/L (Bronwyn Humphries (ESR), 2024) and 18-35mg/L (Abdel-Shafy, 2017). Due to the variability in TP concentration being impacted by phosphorus containing cleaning chemicals and detergents and the large range of likely concentration, Stantec proposes a higher consent limit than E3 Scientific.

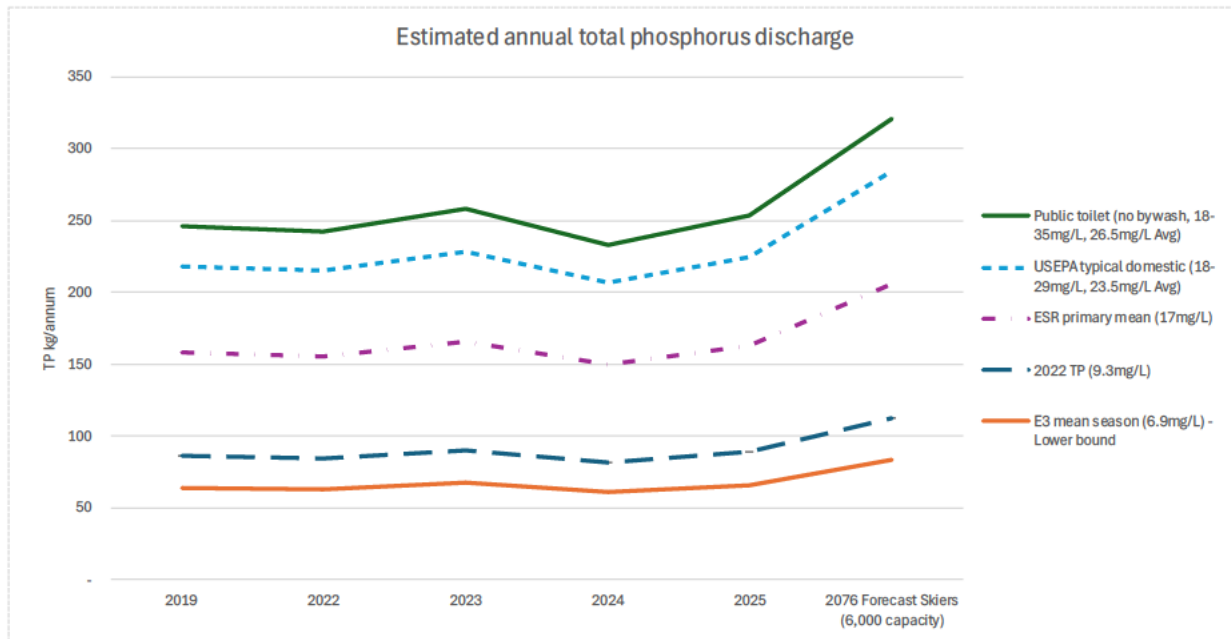


Figure 3. Estimated historical and forecast total phosphorus discharge per annum

2.4 Future Performance Uncertainty, By-wash Reduction

Current influent data for nutrient concentration includes significant dilution from by-wash.

As by-wash is progressively reduced and influent concentrations begin to resemble those observed at comparable ski fields, the following outcomes are expected:

- Lower overall flows
- Correspondingly higher influent nutrient concentrations as bywash is reduced
- Variable impact to treatment processes

This transition introduces uncertainty and risks, hydraulic loading and process performance.

Therefore, it will be necessary to identify the design level of by-wash and the resulting concentration of the wastewater flow. Physically smaller plant options are much more susceptible to high flow as the residence time in the plant is reduced. Thus, a good understanding of the flow rate and concentration is necessary. A process designer will seek to define both the maximum plant flow rate and the wastewater concentration. To make a supplier responsible for the performance of a plant, the flow rate and wastewater concentrations must be as defined at the time of design.

3 Key Risks Requiring NZ Ski Acceptance

The following risks are inherent in proceeding on the current assumptions and must be accepted by NZ Ski:

1. Occupancy forecast risk - Actual skier numbers may exceed assumed design values during peak periods or future “dream seasons”.
2. Influent quality uncertainty - Limited representative influent data, particularly under reduced by-wash conditions, creates uncertainty in nutrient loading assumptions. E3 estimate 51-153mg/L total nitrogen while the Coronet Peak data indicates that the wastewater in 2019 was 130-145 mg/L. Consequently, the treatment process will be dependent on the influent concentration and there is a potential significant variation in wastewater concentration resulting from the base infrastructure.
3. For design purposes a median total nitrogen concentration of the influent of 100mg/L has been assumed.
4. Uncertainty about the wastewater flow rate and its concentration presents a cost and performance risk.
5. Regulatory risk - Resource consent conditions may require treatment upgrades if influent characteristics or loading exceed assumptions.

4 Proposed Monitoring and Validation Programme (Next 12 Months)

To reduce uncertainty and validate assumptions, Stantec recommends the following monitoring programme:

- Influent sampling across the season and in summer (assuming that by-wash is minimal in summer)
- Hourly sampling during plant start-up
- Intensive sampling during opening week
- Hourly sampling during peak week
- End-of-season sampling

Data from this programme can then be used to refine the baseline loading to the Rastus Burn Catchment, wastewater concentration and inform future staging decisions.

5 Modularity and Future Staging

Once the baseline loading is understood, and a proprietary treatment supplier has been engaged, the developed design could consider supplier specific modular treatment solutions to allow staged upgrades as occupancy, influent quality, and regulatory requirements evolve.

Reference: Doolans' Expansion Wastewater – Confirming Wastewater Design Year

6 Level of Accuracy

At this stage, the design basis carries a wide level of uncertainty and is subject to further investigation, monitoring, and review. Assumptions presented in this memo will require further refinement throughout the monitoring, validation and design periods with the intent to confirm prior to detailed design and construction.

7 Required NZ Ski Confirmation

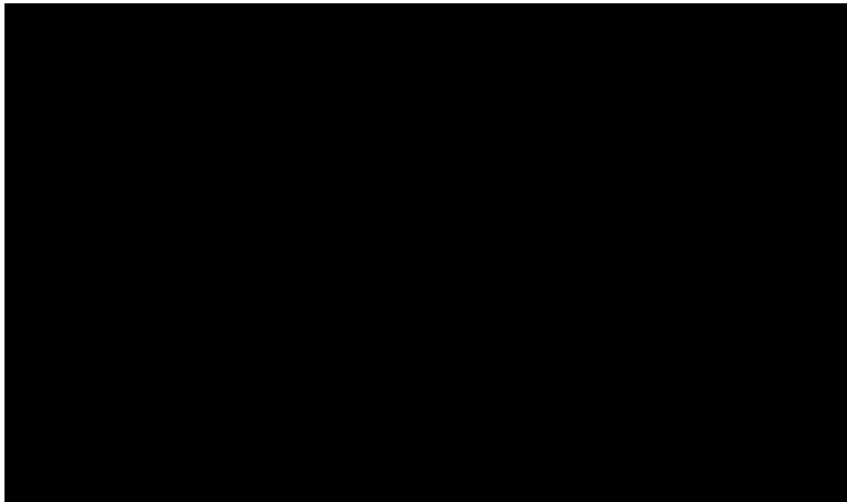
NZ Ski is requested to confirm in writing that it:

- Agrees with the proposed updated wastewater design year definition
- Accepts the occupancy and nitrogen loading assumptions
- Accepts the identified risks and their potential cost implications
- Agrees that the wastewater treatment plant and land disposal system design may require modification as additional data becomes available

This confirmation will provide Stantec with the necessary confidence to proceed.

Yours sincerely

Stantec New Zealand



To: NZSki Ltd

From: 

Project/File: File 12.1

Date: 10 February 2026

Reference: Summary of Coronet Peak Learnings

The following CoPilot generated summary draws directly from Coronet Peak wastewater documents and presents design lessons useful for planning a new WWTP at The Remarkables.

View original content here for full context: [Coronet Peak](#)

1. Resource consent framework – what it actually requires and why it has been hard**Key consent settings**

The Coronet Peak WWTP operates under [Appendix A Consent No 2009.458.pdf](#) (Otago Regional Council). The key conditions are:

- **Discharge limits**
 - Max 65 m³/day to land.
 - Max 12,000 m³/year total volume.
 - Land application rate max 4 mm/day in any part of the field, and max 150 kg N/ha/yr.
- **Effluent quality limits – per sample**
 - BOD₅ ≤ 20 mg/L
 - TSS ≤ 20 mg/L
 - Total N ≤ 30 mg/L
 - E. coli ≤ 200 cfu/100 mL
- **Sampling regime**
 - From 30 April 2011 onward, one treated wastewater sample in the second week of June–October plus the following February (i.e. 5–6 samples per year) from a tap at the WWTP outlet.
 - Monthly upstream and downstream surface-water samples in a nearby watercourse during the same months.
- **Monitoring & reporting**
 - Daily discharge volumes recorded with a flow meter and reported annually.
 - An annual report must summarise all analytical and flow results, comment on compliance, include visitor numbers, complaints, malfunctions and corrective actions.
- **Operations & freezing**
 - An Operations and Management Manual is mandatory, covering weekly/monthly checks, monitoring, contingency plans, complaints, emergency contacts, and water conservation.
 - Between 15 May and 31 October, the system must be checked weekly for freezing-related underperformance or pipe failures, with incidents reported within two days.

“Every single sample” – no rolling averages

In multiple places, the Coronet Peak work highlights that **compliance is based on each individual sample**, not on a rolling or annual average:

- [AGrant Alpine Challenge.pptx](#) explicitly states for the consent:

“Every single sample needs to comply (3 sample/year). No rolling average.”

- [Paper NZ Water 2020-Annika Grant \(002\).doc](#) reinforces that the project underscored the importance of fully understanding consent conditions, “i.e. in this case compliance of every single sample rather than rolling average.”

Design implication: the plant must be robust enough that **every compliance sample** (which may be taken at or near worst-case winter loading) is within limits – there is no statistical smoothing. This has clearly been **problematic** when:

- Influent loads were higher than assumed.
- The biological process was destabilised by shock loads or equipment faults (see Section 3).

Consent point of compliance vs treatment reality

In [Coronet Peak Waste Water Management.pdf](#), the 2015 results show that “**Outlet**” concentrations at the WWTP often exceeded consented limits, while the “**Land Bottom**” samples (effectively the end of the treatment train, after land application) were very low. The document notes:

“The 2015 results are significantly higher than the consented ‘Outlet’ limits... We would like to investigate if the ORC discharge consent limits can be measured from the ‘Land Bottom’ results instead of the ‘Outlet’ results?”

That is a direct indication that the *location and basis* of compliance in the consent has been challenging for the existing plant.

2. Influent characteristics – where the original design went wrong

Design basis vs measured wastewater strength

- The original request for tender (2010) assumed **total nitrogen (TN) \approx 80 mg/L**, based on a limited number of grab samples.
- Later composite sampling and analysis in 2019 showed actual **TN around 140–145 mg/L in peak season**, with $BOD_5 \approx 525$ mg/L and $COD \approx 1,020$ mg/L.
- BioWin modelling concluded that the existing plant was **overloaded with nitrogen** under actual conditions, even though it could have met consent limits under the original (incorrect) design influent.

Operational changes that increased strength

< File>Paper_NZ Water 2020-Annika Grant (002).doc documents a key operational change:

- Club huts had historically left taps running 24/7 in winter to prevent pipes freezing, leading to **high flows but diluted wastewater**.
- After this practice was changed, **flows reduced** but the **wastewater strength increased**, pushing the contaminant load **above the design load** of the WWTP.

Flow patterns, visitor numbers and temperature

From [WWTP Graphs & Statistics 2020.pptx](#) and the sampling letter:

- Coronet Peak is a **predominantly day-use facility** (plus night skiing), with very pronounced diurnal peaks. Instantaneous hourly peaks up to ~ 8.5 m³/h were observed.
- Composite sampling confirmed **higher strength at higher daily flows**, especially during busy days and night ski periods.
- Typical **minimum wastewater temperatures** in winter were around **8 °C**, lower than the >10 °C assumed for design.

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

- Club huts contribute only about **4% of total flow but ~8% of TN load** on average at the sampling hour – important for nitrogen design even though hydraulically modest.

Lesson: the original design significantly underestimated both **TN concentration** and the effects of **daily/seasonal peaks** and **cold temperatures**, directly leading to non-compliance risks.

3. What has not worked – causes of problems and non-compliance

Under-sized and temperature-vulnerable nitrogen removal

The 2019 sampling/modelling findings and Annika Grant's paper summarise the situation:

- The system was “**overloaded with nitrogen**” under measured TN \approx 140–145 mg/L.
- WWTP temperatures dropped to \sim 8 °C, making nitrification difficult.
- To achieve consent compliance, major modifications were required (balancing, pre-anoxic, extra aeration, dosing – see Section 4).

Pre-treatment failures and solids carry-over

In [Coronet Peak Waste Water Management.pdf](#):

- The base building separation tanks originally used **weeping walls**, which:
 - had high maintenance requirements,
 - low durability, and
 - eventually disintegrated, causing solids to flow through into the pond for an unknown period between 2010–2014.
- Even after a retrofit, the overall system was still “**not satisfactory**”, and the plant struggled with **high nitrogen**, with **TSS and BOD more than double consent limits during winter**.

Non-compliance in 2020–2021 and process upsets

The 2021 annual report and the non-compliance presentation document issues during and prior to the plant upgrade:

- **2020 season:** “Compliance of water quality parameters was not met during the peak season of 2020.” All samples failed the TN specification.
- **2021 upgraded plant:**
 - Commissioning results in May 2021 showed excellent performance at full design flow.
 - As soon as the season started and the plant went from buffered lagoon flows to direct, highly variable inflows from the field, performance deteriorated.
 - Voltage fluctuations caused faults in the variable speed drives (VSDs), stopping aeration blowers for an extended period, severely damaging the nitrifying biomass.
 - The next samples (July and August 2021) were non-compliant for all parameters; subsequent troubleshooting took several weeks before September results approached compliance.

Final filtration / UV pre-treatment issue

CP WWTP July August 2021 - Non-Compliance.pdf identifies a very specific cause:

- The final filter before UV was being cleaned via an automatic spray jet using treated wastewater as the cleaning water.
- This led to a clogged, slimy filter, which is suspected to have caused the non-compliant effluent quality (solids and associated *E. coli* shading the UV).
- The corrective action was to change the spray jet to use clean potable water.

Instrumentation and data gaps

The 2021 annual report notes:

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

- The previous HYNDS data monitoring system failed in 2020, so no flow data was available that year.
- This was accepted by ORC for the 2020 report, but it's a clear risk for demonstrating consent compliance.

Operational & access constraints

Annika Grant's paper and presentation emphasise operational challenges:

- WWTP is at ~1,050 m elevation, with **steep, rutted access road, 4WD-only in summer and no vehicle access in winter**.
- The owner (NZ Ski Ltd) is a ski field operator first, not a water utility:
 - WWTP operation competes with core business priorities.
 - Operator input does not justify a full-time WWTP operator.
 - Frequent staff changes make knowledge retention difficult.
- Setting up and running influent autosamplers in August/September required multiple "trial and error" approaches because equipment froze at $-10\text{ }^{\circ}\text{C}$.

4. What has worked – effective solutions and improvements

Pre-treatment retrofit

Although the original weeping walls failed, the **retrofitted separation tank configuration** has been positive:

- Running the two chambers in parallel with decant via tee outlets has:
 - Proven more reliable;
 - Reduced maintenance.
- However, this alone did **not** solve the nutrient/consent issues.

Additionally, monitoring has shown that the **septic tank below the base building** is "an essential part of the current (and future) wastewater treatment scheme" because of its good solids removal and year-round pump-out access.

Storage pond and flow control

The consent and subsequent modelling/design recognise the importance of the **3,000 m³ buffer pond** and associated flow logic:

- Inflow to the WWTP is limited to **65 m³/day**; anything above this is automatically diverted to the storage lagoon.
- Upgraded PLC/SCADA now ensures:
 - Daily discharge limit is rarely reached (only one day in 2021).
 - Any exceedance would alarm and halt discharge.
- Recommended operating strategy:
 - During off-season, feed all fresh wastewater to the plant, but keep enough volume in the pond to allow a gradual ramp-up before the ski season.
 - At season start, temporarily feed entirely from the buffer pond to avoid shock loads and maintain consistent temperature and strength.

Upgrade concept – mixed attached/suspended growth with heating

The sampling/modelling letter and the Water NZ conference paper outline the upgrade concept that was ultimately procured:

Minimum modifications identified as necessary:

- **24-hour balancing tank** with wastewater heating to about $15\text{ }^{\circ}\text{C}$.
- Pre-anoxic tank for denitrification.

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

- Additional aeration volume (or conversion from purely attached growth to mixed attached/suspended growth).
- pH and carbon dosing capability.
- Tertiary treatment such as sand filtration to improve N and solids removal and protect drip irrigation.

The selected supplier (per [Stantec Final Summary of Supplier Tenders.pdf](#) and [Paper NZ Water 2020-Annika Grant \(002\).doc](#)) proposed:

- Converting the existing WWTP to a **mixed attached and suspended growth system**, with:
 - Pre-anoxic volume,
 - Enhanced aeration,
 - Shell and tube heat exchanger using treated effluent to pre-heat influent (plus electrical heater) – a sustainable heating approach.

The 2021 annual report lists the actual upgrade elements implemented:

- Hourly feed diversion to smooth inflows.
- New mixing in both anoxic tanks and a large recycle stream from aeration to 1st anoxic tank (with heating).
- Larger blowers for aeration.
- Caustic dosing for pH correction; facility for carbon dosing.
- Two WAS tanks for sludge management.
- New auto-cleaning filter and UV reactor.
- New automation system with data logging.

Commissioning and late-season results demonstrate that, under stable operation, the upgraded plant can meet **all consent limits** for BOD₅, TN, TSS and *E. coli*.

DBO procurement & vendor selection

The Coronet Peak project deliberately used a **design–build–operate (DBO)** approach:

- [Paper NZ Water 2020-Annika Grant \(002\).doc](#) describes how including operation in the RFQ was considered essential due to NZ Ski's limited WWTP expertise and staff turnover.
- [Stantec Final Summary of Supplier Tenders.pdf](#) summarises evaluation criteria, including:
 - robustness of process,
 - experience (especially in cold climates),
 - service package for commissioning and operation,
 - HSEQ management and personnel.
- The chosen supplier was self-performing (design, supply, operation in one organisation), and offered a comprehensive service package and heating innovation, which were decisive factors.

Monitoring, troubleshooting and operational strategies

The 2021 annual report and non-compliance documents outline effective operational responses:

- During the 2021 upset, corrective actions included:
 - Stopping acetic acid dosing (to avoid competition with nitrifiers).
 - Temporarily reducing flow by ~30% to relieve load and increase temperature.
 - Dosing freeze-dried nitrifying and denitrifying seed bacteria.
 - Daily colourimetric testing by NZ Ski staff to track recovery.
- For future seasons, a detailed **operational plan** has been set out:
 - Use buffer pond strategically before opening.
 - Maintain adequate heating.
 - Keep spare colourimetric kits to avoid degraded reagents.
 - Add seed bacteria at season start and after major events.
 - Rapidly address blower or heating failures.

Specific consent / rolling-average issues that have been problematic

From the perspective of planning a new WWTP (such as at The Remarkables), the Coronet Peak case shows the following **consent-related pain points**:

1. **Stringent single-sample limits, no rolling averaging**
 - Explicitly “no rolling average” and “every single sample” must comply.
 - In a system with:
 - high variability in flows and loads (night skiing, events), and
 - strong temperature swings,it is easy for a few samples (e.g. mid-winter) to sit above TN or TSS limits even if average performance is acceptable – and this has occurred repeatedly.
1. **Compliance point at WWTP outlet vs end of land treatment**
 - The 2015 slide set explicitly questions whether compliance could be measured at “Land Bottom” instead of “Outlet”, because outlet samples were over the limit while land-discharge samples were well below.
 - This suggests that the chosen consent point has forced the plant to be designed and operated to a tighter standard than the receiving environment strictly requires.
2. **Temperature & nitrogen constraints not recognised at consent stage**
 - The consent requires $TN \leq 30$ mg/L for every sample but assumed >10 °C wastewater; measured temperatures of 8 °C in winter significantly increase the process complexity to meet that TN limit.

Design takeaway for Remarkables: it would be prudent, when negotiating or interpreting a new consent, to ensure:

- The **compliance metric** (per-sample vs percentile vs rolling average) is aligned with realistic alpine variability.
- The **compliance point** (WWTP outlet vs end of land treatment) reflects where environmental risk actually lies.
- Temperature effects and realistic TN levels are built into both consent conditions and design.

All three of those points are directly flagged in your Coronet Peak documents; they aren’t speculative.

6. Lessons to apply directly to a new WWTP at The Remarkables

Everything below is still drawn from Coronet Peak docs – this is essentially their own “lessons learned” list, framed as design considerations for another alpine ski field.

Understand all “puzzle pieces” before choosing the process

In [AGrant Alpine Challenge.pptx](#), Annika Grant describes a “puzzle piece” model:

- Puzzle piece **influent** – actual flows, loads, diurnal and seasonal variation.
- Puzzle piece **treated effluent** – consent or environmental quality requirements.
- Puzzle piece **site conditions** – climate, access, construction constraints.
- Puzzle piece **client requirements** – operator capabilities, resourcing, appetite for DBO.

Only when those are well understood should the WWTP “black box” be defined. This is explicitly presented as a **lesson learned** from Coronet Peak.

For The Remarkables, the same methodology would apply: thorough influent monitoring (including summer gondola/MTB operations if relevant), clarity on consent metrics, careful consideration of alpine access, and frank assessment of NZ Ski’s long-term operational model.

Influent characterisation must be robust

The documents repeatedly stress the importance of:

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

- Multiple 24-hour composite samples at different load conditions (including night skiing equivalents).
- Grab samples at key upstream locations (e.g. base building pre- and post-septic tank, club huts).
- Linking flows to visitor numbers and operating patterns (daily & seasonal).
- Capturing temperature and COD:BOD:TN ratios to assess carbon availability and nutrient removal options.

Failure to do this at Coronet Peak led directly to an under-designed nitrogen process.

Alpine-specific design features

From the modelling letter, Water NZ paper, upgrade tender and the 2021 annual report, key alpine design features that have been shown to be necessary are:

- **Balancing and storage**
 - 24-h balancing with heating to lift wastewater temperature.
 - Large seasonal storage pond with automated diversion at consented daily limit.
- **Robust nitrogen removal at low temperature**
 - Pre-anoxic and aeration tanks sized for higher-than-domestic TN at -8 – 12 °C.
 - Provision for pH and external carbon dosing.
 - Option for tertiary filtration (e.g. sand filter) to polish solids and protect drip fields.
- **Heating and energy recovery**
 - Integration of a shell-and-tube heat exchanger to recover heat from treated effluent and pre-heat influent.
 - Supplemental electric heater for very cold periods.
- **Pre-treatment and solids management**
 - Durable septic tanks / separation tanks with proven internal hardware (the failed weeping walls are a clear negative example).
 - Accessibility for desludging even in winter.
- **Automation and remote monitoring**
 - Full PLC/SCADA, integrated with the building management system.
 - Automated irrigations zones that respect 4 mm/day and even distribution to land.

Operational support and contract structure

The Coronet Peak project concluded that, for a private ski-field operator:

- Incorporating operation (DBO) in the procurement was critical to:
 - Ensure the plant is designed with realistic operator input.
 - Provide long-term process support and training.
- Evaluation of suppliers considered not only price, but:
 - clarity of scope and contract terms,
 - process design details and modelling,
 - HSEQ systems and personnel,
 - experience with **similar** scale WWTPs, even noting a lack of directly comparable cold-climate references for some bidders.

For The Remarkables, the same DBO model (or at least long-term O&M support) appears strongly justified by these documents.

Practical operational strategies

Finally, the 2021 annual report lays out specific operational advice that would be directly transferable to any upgraded or new alpine plant:

- Use the buffer pond to avoid shock loads at the start of each season.

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

- Maintain heating and rapidly address any failures.
- Use seed bacteria (nitrifiers/denitrifiers) when starting up.
- Continue regular colourimetric testing alongside formal lab compliance monitoring to detect trends early.
- Adjust VSD fault settings to be resilient to supply voltage fluctuations.

7. Short summary: What this means for a new WWTP at The Remarkables

Based solely on the Coronet Peak material, the critical design takeaways that should inform a new WWTP at The Remarkables are:

1. **Do not under-estimate TN or ignore cold temperatures** – Coronet Peak’s original 80 mg/L TN and >10 °C assumptions proved wrong; actual TN ≈ 140–145 mg/L and ~8 °C temperatures demanded a much more robust process.
2. **Design for single-sample compliance (no rolling average)** if your consent is similar – the CP experience shows that “every sample must comply” is hard in an alpine environment, and this should be reflected in both process sizing and negotiations about compliance metrics and points.
3. **Provide heated balancing and ample storage** – both diurnal and seasonal buffering have been crucial for CP, especially combined with influent heating and an automatic diversion logic at 65 m³/d.
4. **Take pre-treatment seriously** – the failure of weeping walls and the importance of the base-building septic tank show that robust, maintainable solids separation upstream is non-negotiable.
5. **Expect and design for operational constraints** – limited winter access, power quality issues, staff turnover and competing ski-field priorities all argue strongly for DBO or at least long-term O&M contracts, high automation and clear operating manuals.
6. **Avoid known design pitfalls** – e.g. using treated effluent to backwash final filters, which has directly caused non-compliance at CP.

Yours sincerely

Stantec New Zealand

To: NZSki Ltd

From: 

Project/File: File 12.1

Date: 03 March 2026

Reference: VO1 – Wastewater Consenting – Briefing Note**1. The Issue**

The wastewater consent for the Remarkables requires nutrient-related conditions that are environmentally defensible and able to be defined with sufficient certainty for the April 2026 consent application.

Two potential approaches to nutrient controls are being considered:

- End-of-pipe concentration limits for treated wastewater (e.g. nitrogen and phosphorus), and
- Mass-based nutrient limits, expressed as the mass of nitrogen and phosphorus entering the ground via the infiltration basins over defined time periods.

There is significant uncertainty in both current and future wastewater flows, primarily due to unresolved by-wash volumes. As a result, future treated wastewater concentrations cannot be reliably predicted. This makes concentration-based consent limits difficult to justify. Nor is the concentration at the end of the pipe at the infiltration basin a reliable measure of the effects on the Rastus Burn creek.

Existing estimates of annual nitrogen discharge range from approximately 500 to 750 kg/four-month season, but monitoring indicates that the receiving environment has experienced minimal adverse effects under existing conditions. There is currently no further guidance from environmental scientists on the long-term assimilative capacity of the receiving environment.

The core issue is therefore –

- a) how to frame consent conditions that manage environmental effects without relying on uncertain flow and concentration assumptions, and
- b) how to achieve the short timeframe for compiling and lodging a consent application.

2. Suggested Approach

Stantec suggest that the proposed consent conditions cover the following:

- A maximum four-month seasonal discharge of nitrogen mass in kg. This condition is likely to lie between 500 and 750 kg/four-month season.
- A maximum peak period discharge of nitrogen in kg. We anticipate that this peak period would coincide with the fourteen days of Australian School holidays (June 27 – July 12 Queensland and Northern Territory holidays). This would require frequent testing of the treated wastewater concentration at the infiltration basins multiplied by the flow rate over this time.

3. What Stantec Have Done / Can Do to Help

Stantec have:

- Reviewed available wastewater flow and nutrient data and identified key uncertainties, particularly around by-wash
- Assessed existing estimates of annual nitrogen discharge and their relationship to observed environmental effects
- Identified that nutrient mass reaching the Rastus Burn over peak season, rather than end of pipe concentration, is the key driver of effects on the receiving environment
- Developed a consent strategy that aligns with the demonstrated performance of the existing system and the available evidence

Stantec can also:

- Support development of mass-based consent conditions that are technically robust and consentable
- Assist with translating agreed nutrient limits into design criteria for the treatment system
- Work with environmental scientists to refine short-term (e.g. weekly) nitrogen mass limits once permeability testing results are available

4. Information Required from Other Parties

To finalise the consent approach, input is required from others on the following:

- Environmental scientists:
 - Advice on the appropriate time period (daily, weekly, monthly) over which nitrogen mass should be controlled, based on attenuation between the infiltration basins and Rastus Burn.
 - Interpretation of bore permeability testing results to inform short-term mass limits.
 - Confirmation of the four-month mass of nitrogen being discharged to the infiltration basis currently vs the initial estimate of 750 kg from Stantec
- NZSki:
 - Best available advice on the likely extent of by-wash reduction achievable in the short to medium term.
- Project team:
 - Agreement on an appropriate level of conservatism to apply in setting nitrogen mass limits given current uncertainties.

5. Decisions Required

To progress the wastewater design and an April 2026 consent application, decisions are required on the following:

1. Adopt a mass-based nutrient consent framework, rather than end-of-pipe concentration limits.
2. Confirm the target annual nitrogen discharge limit to be carried forward into the consent application (e.g. ~600 kg/year, or alternatively ~750 kg/year).
3. Agree in principle a short-term nitrogen mass limit (likely two weekly), with final values to be informed by permeability testing and environmental science advice.

Reference: Rastus Burn Wastewater Pipeline Creek Crossing Inspection Results

These decisions will provide a clear and defensible consenting position and allow the wastewater treatment design to proceed with confidence.

Yours sincerely

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

Direct: [REDACTED]

Mobile: [REDACTED]

Stantec New Zealand

Appendix B – Drawings



Appendix C – Risk Register



Remarkables Doolans Expansion

Risk Register

Date: 30/04/26



Risk ID	Risk Title	Description/Cause/Consequence	Risk Owner	Risk Owner Organisation	Date Raised	Risk Status	Project Phase	Primary Discipline	Consequence	Likelihood	Pre-mitigation Score	Mitigation and Treatment	Post Mitigation Consequence	Post Mitigation Likelihood	Post-mitigation Score	Comments
1	Selection of Wastewater Treatment for Rastus Burn	There is a risk that the Rastus Burn wastewater system must treat flows equivalent to a medium-sized town within a small, cold alpine site that is unsuitable for efficient nitrogen removal. The very limited timeframe prevents full feasibility studies or plant trials, increasing uncertainty in technology selection. The consequence of the risk is that rushed decision-making could result in consenting delays, impractical design, poor treatment performance, or non-compliance with discharge standards – potentially requiring costly redesign or off-site treatment solutions.	NZski	NZski	20-Feb-26	Live - Threat	Design	Planning	Very High - 5	Very High - 5	25	Immediate roundtable review with NZski and Stantec to assess feasible treatment options; adopt proven designs (e.g. Coronet Peak model) or reliable off-site treatment alternatives.	Very High - 5	Low - 2	10	
2	Robustness of Snowmaking Pond Layout	There is a risk that no geotechnical investigation data is currently available for proposed snowmaking water storage sites, meaning design assumptions on rock depth, groundwater, and moraine conditions may later prove incorrect, affecting design feasibility and cost. The consequence of the risk is that unexpected ground conditions could lead to design changes, higher construction costs, or delays in pond delivery. Uncertainty around the consentability of the preferred reservoir site may require relocation and redesign.	NZski	NZski	20-Feb-26	Live - Threat	Design	Geotechnical	High - 4	High - 4	16	Adopt multiple layout options (A-D) with contingency allowances; confirm assumptions through early site testing; retain risk-based cost allowance and alternate site option.	Med - 3	High - 4	12	
3	Snowmaking Pond Consentability	There is a risk that uncertainty remains about the consentability of the preferred snowmaking pond location. The consequence of the risk is that design changes, cost overruns, or schedule delays may occur if consent is not granted.	NZski	NZski	20-Feb-26	Live - Threat	Consenting	Planning	High - 4	High - 4	16	'Option 2' is an alternative if consent is denied for the current site. Both sites are at comparable altitudes, and we expect similar intake pumping arrangements for each.	Med - 3	High - 4	12	
4	Function of Doolans Wastewater Treatment Plant	There is a risk that wastewater treatment in cold alpine environments proves technically challenging due to variable flows, low temperatures, and difficult discharge conditions such as steep slopes, permeable scree, and proximity to rock. The consequence of the risk is that poor treatment performance or effluent breakout could result in environmental contamination or consent non-compliance, requiring additional treatment infrastructure or remedial works.	NZski	NZski	20-Feb-26	Live - Parked	Operation	Civil	Very High - 5	High - 4	20	Engage specialist wastewater designers; include pre-heating and effluent discharge controls; incorporate monitoring and contingency treatment provisions in design.	High - 4	Med - 3	12	
5	Environmental and Regulatory Risk	There is a risk that, because the project spans multiple jurisdictions (QLDC, CODC, and DOC Conservation Land) and involves significant environmental interfaces such as alpine terrain, wetlands, and waterways, multiple consents and approvals will be required for earthworks, vegetation clearance, snowmaking, wastewater discharge, and access roads. The consequence of the risk is that delays or additional mitigation requirements could substantially affect the programme, cost, and scope.	NZski	NZski	20-Feb-26	Mitigated	Consenting	Planning	Med - 3	High - 4	12	Early engagement with DOC, QLDC, CODC, and ORC; comprehensive environmental assessments; staged and robust consenting strategy.	Very Low - 1	High - 4	4	
6	Power Supply and Infrastructure Risk	There is a risk that the project's dependence on a major upgrade to the mains power line (from 11kV to 22/33kV) and installation of new substations, transformers, and backup generation could be affected by design, capacity, or ownership delays with Aurora Energy or network transfer. The consequence of the risk is that such delays could impact the commissioning of the gondola and base building expansion.	NZski	NZski	20-Feb-26	Live - Parked	Construction	Project Management	Med - 3	High - 4	12	Early coordination with utility providers; confirm design and loading requirements early; incorporate temporary power contingencies.	Low - 2	Med - 3	6	
7	Geotechnical and Constructability Risk	There is a risk that the alpine topography, including steep slopes, schist rock, avalanche-prone areas, and access constraints, will make construction of lifts, trails, and access roads complex. The consequence of the risk is that unforeseen ground conditions may cause design changes, cost overruns, or schedule delays.	NZski	NZski	20-Feb-26	Mitigated	Construction	Geotechnical	Med - 3	High - 4	12	Conduct detailed geotechnical investigations; use flexible design and early contractor involvement to resolve constructability challenges.	Med - 3	Low - 2	6	
8	Access Road	There is a risk that the access road may be damaged and/or disabled from a landslide. There are already signs that areas of the road are unstable. The consequence of the risk is that the ski field will not be able to operate due to the lack of an access road.	NZski	NZski	20-Feb-26	Mitigated	Operation	Geotechnical	High - 4	Med - 3	12	Geotechnical investigations and development of slope stability measures where possible.	High - 4	Low - 2	8	
9	Stakeholder, Cultural, and Community Risk	There is a risk that the project's location on conservation land and its proximity to nearby communities will attract scrutiny from environmental groups, iwi, and residents. The consequence of the risk is that objections or appeals could delay the fast-track approval or require redesign, affecting delivery schedule and reputation.	NZski	NZski	20-Feb-26	Live - Threat	Consenting	Planning	Med - 3	Med - 3	9	Proactive iwi and community engagement; transparent consultation; integrate cultural and environmental interpretation into design.	Low - 2	Med - 3	6	
10	Seasonal Construction Windows / Programme Risk	There is a risk that short alpine off-season work windows extend delivery timelines and complicate staging. The consequence of the risk is a multi-season construction timeline, schedule delay, and increased delivery risk.	NZski	NZski	24-Feb-26	Live - Parked	Construction	Project Management	Med - 3	Low - 2	6	Realistic construction staging, extensive planning and preparation in design and tender stages with all relevant stakeholders.	Med - 3	Very Low - 1	3	
11	Land and Footprint Constraints	There is a risk that limited land area and competing uses (e.g., carparks) constrain expansion of disposal fields and treatment footprint. The consequence of the risk is limited scalability, complex staging, and potential operational disruption.	NZski	NZski	24-Feb-26	Live - Threat	Operation	Civil	High - 4	Med - 3	12	Engagement with client to design and plan around space constraints, considering short term and long term.	High - 4	Very Low - 1	4	
12	Carpark Loading Over WW Infrastructure	There is a risk that trafficable disposal systems in carparks could be damaged by heavy vehicles if not adequately protected. The consequence of the risk is the loss of disposal performance, repairs, and service disruption.	NZski	NZski	24-Feb-26	Live - Parked	Construction	Civil	Med - 3	Med - 3	9	Design for protection of WW infrastructure during both construction and operation	Med - 3	Very Low - 1	3	
13	Discharge Requirements Uncertainty	Discharge limits have not yet been set, creating uncertainty around required effluent quality. Changing nutrient or hydraulic requirements may alter treatment configuration, heating needs, disposal design, and CAPEX/OPEX, potentially causing redesign, delays, or increased costs.	NZski	NZski	25-Feb-26	Live - Threat	Design	Civil	High - 4	High - 4	12	Engage early with Mitchel Daysh and ORC, apply conservative nutrient and flow assumptions, coordinate with E3 Scientific, and design treatment systems with modularity to accommodate evolving discharge requirements.	High - 4	Low - 2	8	

14	Reliance on Proprietary Treatment Systems	Vendor-supplied systems may not achieve performance claims under alpine conditions or variable seasonal loadings.	NZski	NZski	25-Feb-26	Live - Threat	Operation	Civil	Med - 3	High - 4	12	Further design to be completed in later design phases. Awareness that achieving performance is more challenging in site conditions at high altitude.	Med - 3	Med - 3	9	
15	High Variability in Vendor CAPEX/OPEX Estimates	ROM costs for feasibility stage Options 5a/5b range widely, reflecting significant uncertainty that may result in budget overruns.	NZski	NZski	25-Feb-26	Live - Threat	Design	Civil	Med - 3	Med - 3	9	Further design to be completed in later design phases, which will reduce uncertainty for systems required and their CAPEX/OPEX costs.	Med - 3	Low - 2	6	
16	Energy Demand Uncertainty	Heating and aeration requirements may exceed early assumptions, increasing long-term operational expenditure.	NZski	NZski	25-Feb-26	Mitigated	Operation	Civil	Med - 3	Med - 3	9	Conservative estimates have been made and uncertainties communicated. Cost estimates should not be relied upon for tendering, contract negotiation, or funding approval without further design development. Any reliance placed on the estimates beyond their intended purpose is at the client's discretion.	Med - 3	Low - 2	6	



Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

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