BEFORE THE ENVIRONMENT COURT

AT CHRISTCHURCH

I MUA I TE KŌTI TAIAO O AOTEAROA
KI ŌTAUTAHI

IN THE MATTER	of the Resource Management Act 1991
AND	of a notice of motion under section 149T(2) to decide proposed Plan Change 8: Water for Otago (referred to the Environment Court by the Minister for the Environment under section 142(2)(b) of the Act)
	OTAGO REGIONAL COUNCIL
	(ENV-2020-CHC-128)
	Applicant

Memorandum of Friends of Lake Hayes Society Inc

PLAN CHANGE 8

(22 February 2022)

May it please the Court

1. In accordance with the Court's directions issued on 14 December 2021,

Friends of Lake Hayes Society Inc wishes to provide the lay evidence that Society members Richard Bowman and/or Mike Hanff will present to support the proposed plan change 8 - Urban Issues – Sedimentation at the hearing scheduled for 21 March 2022.

Dated this 22nd day of February 2022

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Richard Bowman

Secretary

Frends of Lake Hayes Society Inc.

Otago Region Water Plan Appeals - PC 8 Sedimentation

Evidence presented by Friends of Lake Hayes Society Inc.

for the Hearing scheduled for 21 March 2022

1. Summary

Friends of Lake Hayes Society Inc. wishes to support proposed changes to the Otago Region Water Plan under Change 8. Extensive scientific work over the last 70 years at Lake Hayes confirms that sediment pollution is the main driver behind the continued degradation of lake's health. Thus, we are using Lake Hayes to illustrate why we consider proposed changes are essential to assist with the improvement of the water quality both here and elsewhere in Otago Region.

We believe that the new measures outlined below will help achieve this:

- New Policy 7.D.10 which prioritises avoiding discharges or, where this is not achievable, best practice guidelines for minimising sediment loss are implemented.
- New Rule 14.5.1.1 permits the use of land and associated discharge of sediment for earthworks or residential development subject to conditions, including that the area of exposed earth is no more than 2,500m2 in any 12-month period, there are setbacks from water bodies, and basic onsite management practices are implemented to prevent accidental discharges.
- Any activities which do not comply with the conditions of Rule 14.5.1.1 are a restricted discretionary activity under Rule 14.5.2.1. The matters which ORC's discretion are restricted to are:
    - o Erosion, land stability, sedimentation or property damage resulting from the activities.
    - o Effectiveness of proposed erosion and sediment control measures.
    - o Compliance with the Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region 2016.
    - o Adverse effects on water quality and natural or human use values, including Kāi Tahu values.

Accordingly, as parties to the appeal we strongly oppose any attempt to delete or otherwise impair the effectiveness of the proposed changes.

In our evidence we will show:

Lake Hayes as a nationally and internationally renowned water body has an ongoing problem with water quality which has significantly impacted on the lake ecosystem as well as its social and cultural values.

The principal cause of the degraded water quality is human activities in the catchment – particularly those releasing sediment and nutrients into the lake where urban development is a prime cause.

The most effective long-term solution to degraded water quality in Lake Hayes is to reduce rate of input of sediment and nutrients generated from the catchment into the lake.

The current policies and regulatory tools employed by the District Council and Regional Council are clearly not reducing the inputs of sediment and nutrients into the lake sufficiently to allow improvement in water quality over time.

It is inevitable in the next decade there will be widespread, large-scale urban development in the Lake Hayes catchment which will promote and exacerbate continuing water quality problems.

It is critically important that policy and regulatory tools are upgraded and monitored rigorously in use to ensure they minimise the adverse impacts of future urban development in the Lake Hayes catchment.

The Regional Water Plan changes (PC8) will not only provide a consistent regional standard for sediment management across Otago but by directly involving ORC in the management process will also provide additional regulatory control over development activities which we contend have not been effectively managed by District Councils in the past.

2. Friends of Lake Hayes Society Inc.

Friends of Lake Hayes Society was incorporated in October 2008. Its charitable purpose is to do whatever is reasonably necessary to enhance and maintain the quality of water in the lake for the benefit of use and enjoyment of everybody residing in the vicinity of Lake Hayes and all visitors and users of the lake. It currently has a membership of around 200 and executive committee of 10.

The Society was formed because residents were concerned about the deteriorating water quality in the lake. This was triggered by persistent blooms of an endemic algae (*Ceratium hirundinella*) which began in 2006 and gave the lake an unattractive brown colour (Figure 2.). They also caused fish kills in the lake initially and have significantly reduced the size of trout fishery as indicated by reduced angler use of the lake. (Figure 4.) They are thought to cause allergic (hay fever-like) reactions in some people who spend extended periods in the water, i.e., long distance swimmers. We are aware of highly visible blooms of cyanobacteria which from time to time (Figure 3.). Human health and safety risks posed by these potentially toxic cyanobacteria blooms and high concentrations of E.coli bacteria have caused the lake to be closed for significant periods over the last few years.

Since 2008 the Society has gathered information about the state of water quality in the lake and has investigated a range of actions to improve water quality. It is quite clear that nutrient inputs to the lake over the last 100 or more years have caused the lake to move from oligotrophic (clean pristine) to a eutrophic (algal dominated) state.

3. Scientific Investigations

The state of the water in Lake Hayes has been studied comprehensively since the 1950s.

Much of the scientific investigation done on Lake Hayes water quality is summarised in a substantial report titled “Lake Hayes Restoration and Monitoring Plan”. It was commissioned by the Society and prepared by Dr Marc Schallenberg and Lena Schallenberg of Hydrosphere Research Ltd and can be accessed at:

https://www.savelakehayes.org.nz/_files/ugd/c1b10b_d2993ed023cd4bdbac7eef71a89c2de7.pdf

The degraded state of water quality in the lake is demonstrated in Figure 1. Based on the Trophic Level Index (TLI)

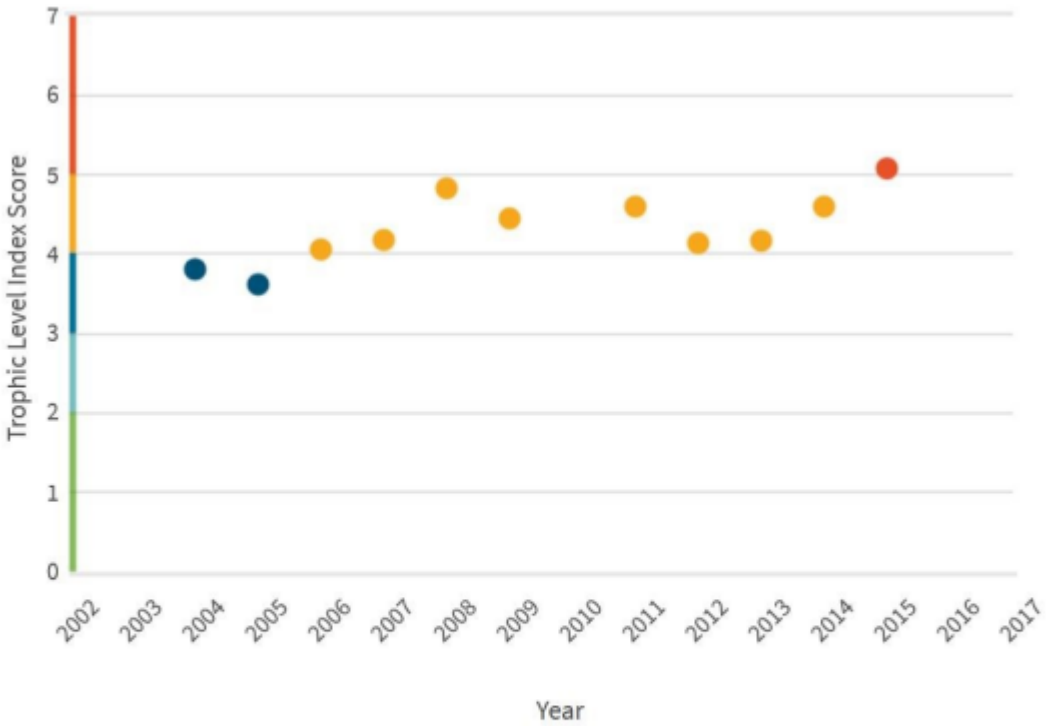

Figure 4. The trophic level index (TLI) score for Lake Hayes from 2004 to 2015. The TLI aggregates total phosphorus, total nitrogen, chlorophyll *a* (an indicator of phytoplankton biomass) and Secchi disk depth (a measure of water clarity) data. TLI between 3 and 4 is mesotrophic (good water quality). TLI between 4 and 5 is eutrophic (poor water quality). TLI between 5 and 6 is supertrophic (very poor water quality). Data and graph are from the LAWA website.

Figure 1. The Trophic Level Index for Lake Hayes (from Schallenberg and Schallenberg 2017)

Four key recommendations are made:

> *This report evaluates the potential for many various restoration activities to accelerate the recovery of the lake. Four of these strategies have been selected to be the most promising and cost-effective. These are: (1) food web bio-manipulation, (2) enhanced flushing by using surplus irrigation water from the Arrow River, (3) alum dosing to flocculate and bind phosphorus in the lake bed, and (4) a focus on land use activities in the catchment to further reduce nutrient and sediment losses from land to water.*

It is recommendation (4) relating to the input of nutrient and sediment inputs to Lake Hayes from the catchment that forms the rationale for our strong support for the proposed changes to the Otago Region Water Plan.

4. Impacts of Algal Blooms on Lake Hayes

4.1 Ceratium Algae

Ceratium algae blooms which have occurred in Lake Hayes since 2006 have given the lake an unattractive 'brown appearance' as shown in Figure 2.

Lakes Hayes Summer1960 December 2015

Figure 2. The photos above compare the lake in a clean state in 1960 to that during an intense bloom in 2015. (Photos – Richard Bowman)

These have also caused intense and prolonged stratification of the lake which has resulted in a significant reduction in the trout population. Long distance swimmers in the lake have experienced 'hay fever-like' symptoms since its arrival.

Figure 3. A photo above shows a dead, emaciated trout found on the southern shores of Lake Hayes in March 2008. Fish kills were reported in Lake Hayes in March and April 2007 and trout around that time were noted to be in poor condition. (Photo Richard Bowman)

4.2 Cyanobacteria

Blooms of cyanobacteria (blue green algae) have been reported in Lake Hayes since 1969 but have become more prevalent and pronounced recently. (Figure 4.)

Figure 4. The photo above was taken in the NW corner of Lake Hayes 9 February 2018 and shows a dense accumulation of cyanobacteria along the shoreline. (Photo from Otago Daily Times)

Cyanobacteria can be toxic to both humans and animals and at times when blooms are present over the summer it has been necessary for the authorities to close the lake for contact recreation for periods of several weeks. Figure 5.

Figure 5. On 15 February Otago Regional Council erected signs at Lake Hayes warning that toxic algae may be present.

5. Ongoing Risks to Lake Hayes from its Catchment

It is known that the excessive algal blooms in Lake Hayes relate directly to the abundance of nutrients, chiefly phosphorus and nitrogen compounds, which are sourced from within the catchment.

The release of these nutrients from the catchment is often exacerbated by human activity, and they carried down the waterways into the lake. They are then trapped there in a 'sink' where they are held for a considerable period. Here they act as a 'fertilizer' for the algae and cyanobacteria in the lake and when conditions are favourable this results in excessive growth which disrupts the normal function of ecosystems in the lake and reduces water quality.

Nutrient inputs are generally low during normal flow but increase dramatically during intense, short-lived rainfall events. These flush soil and dissolved material containing phosphorus and nitrogen compounds as well as other contaminants, e.g., *E coli* bacteria, down to the lake. It is known that the vast majority of nutrient and contaminant input to the lake occurs in these periodic events.

Figure 6. High levels of sediment input are recorded in the photo above taken on 1 February 2018 during a heavy rain event where 60-90mm of rain fell in the catchment in a day. It shows the heavy sediment load coming down Mill Stream into Lake Hayes. (Photograph taken by Richard Bowman)

A sample of water was taken from Mill Stream during the event shown in Figure 6. and analysed by Hills Laboratories. Comparing to the data on the LAWA site it showed that Nitrate+Nitrite was around 3x higher than is typical for Mill Stream at this time of year. It also showed that Total Phosphorus (TP) was around 18x higher than is typical for both Mill Stream and for the lake surface waters at this time of year.

6. Recent Analysis of Sediment and Nutrient Inputs

In 2021 Friends of Lake Hayes analysed 2018-2020 water inflow data to Lake Hayes and compared this to 1983/84 data from Robertson. The analysis was done by Prof Brian J. Boyle FAA, FRAS and Mike Hanff. The principal findings were that using data obtained over the period March 2018 – December 2020 by FoLH and the ORC monitoring station on Mill Creek at the entrance to Lake Hayes, it was

possible to establish a strong correlation between water flow rates, turbidity , solid particle and total phosphorus (TP) levels. The report can be accessed at:

https://www.savelakehayes.org.nz/_files/ugd/742908_829fec819e28424697547fa108b3097d.pdf

These relations were used to estimate that, in 2020, 2.1tonnes of phosphorous and 1.76 kilotonnes of solids flowed into to Lake Hayes via Mill Creek. Comparison with Robertson (1984) reveals that the mean phosphorous concentration in the Mill Creek water has increased by 42% from 0.096mg/L in Robertson (1984) to 0.136mg/L in 2020. Over the same period the solid concentration in the Mill Creek water has increased by 250%; from 45.7mg/L in 1983/84 to 115mg/L in 2020.

These findings confirm not only that there are large volumes of sediment and nutrients are entering the lake from Mill Creek but they also appear to have increased significantly between 1984 and 2020. Since agricultural production in the catchment has been steadily declining in recent decades it is therefore logical that the rapid expansion of land development for both residential and commercial purposes is the cause.

7. The Impacts of Urban Development

In December 2020 a report was prepared for Friends of Lake Hayes by The Nature Conservancy Aotearoa New Zealand authored by policy consultant Jackie Dingfelder, PhD, entitled "Approaches for Minimising Water Quality Impacts from Urban Development in Lake Hayes/Wai Whakaata Catchment, New Zealand." This can be found at:
https://www.savelakehayes.org.nz/_files/ugd/742908_2ab36d174c83485f8d55befcbf28f871.pdf

The report highlights the effects of urban development on catchments and water quality. It focusses on Lake Hayes and its catchment and examines its current state in terms the existing policy and regulatory environment. Recommendations are made to improve the situation and reference is made to several relevant case studies of similar problems in other parts of the world.

The changes that are occurring now in the Lake Hayes catchment are exemplified in this extract from the report below:

"A report prepared for the Ministry for the Environment by Morphum Environmental Ltd. (2019) details research conducted on the impacts of urbanisation on sediment discharges. The report describes that catchment sediment yields increase as land use changes from forestry to pasture, and then sharply increase during urban development (Morphum, 2019). It also underscores that "in an urban environment, the greatest source of sediment occurs during development, when the land is stripped of vegetation" (Morphum, 2019, p. 5). During development, the land is stripped of vegetation, exposing bare earth which is susceptible to erosion. Sediment control measures can be effective at reducing sediment, but the effectiveness is reduced during storms.

Environmental impacts from sediment pollution are often cumulative and the ultimate results and costs may not be evident until years later. Example effects include:

- Eroded soil can contain nitrogen, phosphorus, and other nutrients. When carried into water bodies, these nutrients can trigger algal blooms that reduce water clarity, deplete oxygen, and create odours.

- Erosion of streambanks and adjacent areas can destroy streamside vegetation that provide shade and aquatic habitats.

- Excessive deposition of sediments into water bodies can smother bottom fauna and destroy fish habitat.

- Turbidity can increase the amount of sunlight absorbed in water, raising lake or stream water temperatures.
- Suspended sediment can abrade and coat aquatic organisms.
- Erosion removes the smaller and less dense constituents of topsoil, including clays, fine silt particles and organic materials that hold nutrients that plants require for healthy establishment

The report presents seven recommended actions for reducing sediment transport into Lake Hayes from new urban development during the three development phases:

Phase 1: Planning and Design of New Development

1. Strengthen erosion and sediment control policy language in the District Plan
2. Promote low impact development approaches

Phase 2: Construction Management for New Development

3. Strengthen erosion control plans for all development in Lake Hayes catchment focusing on use of Best Management Practices
4. Ensure a robust compliance and enforcement programme

Phase 3: Ongoing Occupancy of New Development

5. Strengthen BMP monitoring and maintenance programme (ongoing)
6. Work with the building industry (throughout all phases)
7. Expand strategic partnerships to leverage scarce resources (throughout all phases)

The proposed Plan Changes (PC8) would support and underpin all these recommendations and particularly recommendation 3.

8. Increasing Urban Development in the Lake Hayes Catchment

Changes to Rural Subdivision Zones in the current review of the Queenstown Lakes District Plan will greatly increase the amount of urban and peri-urban development in the Lake Hayes Catchment. A proposed Rural Amenity Zone (4,672 ha) will limit subdivision to 80 hectares and the proposed Rural Lifestyle Zone (2,198 ha) will limit subdivision to 6000 square metres.

The maps of the extent of these zones show the majority of the new Rural Lifestyle Zone (estimated at 70%) falls within the catchment area of Lake Hayes. This means there is potential to develop up to 2,500 new residential properties within the catchment area. It is noted that most of the RLZ within the catchment lies within the flat land flanking Mill Stream.

This level of new development along with existing ones (e.g., Millbrook, Waterfall Park) will place a significantly increased risk of nutrient loss from earthworks, urban storm water runoff, septic tank seepage, as well as from the impacts of landscaping and landscape maintenance (i.e., mowing, use of fertilizer and associated irrigation). The new high density Special Housing Area proposed for the Ladies Mile, with potential for several thousand new residential dwellings, may also have a significant impact on Lake Hayes water quality.

9. Efficacy of Current Policy and Regulatory Measures to Limit Sediment Loss

Over the last few years, deficiencies in the current sediment management regime for urban development have been apparent. This has been evident from many media reports of excessive sediment discharges in urban developments in various parts of the District and particularly at Wanaka. These clearly involve breaches of conditions set in resource consents and in some cases have resulted in prosecution. Unfortunately, this situation appears to be ongoing, and reports of serious sediment loss problems continue. (Examples of this were presented to a QLDC Resource Consent Hearing in a submission from Friends of Lake Hayes – see Appendix 1.)

QLDC itself has acknowledged the general ineffectiveness of current earthworks controls in the in a Section 32 report (Appendix 2) as part of the current review of the District Plan. Here their consultant stated: "As was observed during the site visit the implementation of erosion and sediment control practices does not currently meet best practice. An expectation in implementing the rule chapter (and a key driver for seeking to regulate bulk earthwork activities with area thresholds) is that erosion and sediment control practices will be applied through both permitted activity and consented earthworks."

At Lake Hayes the Society is aware that there are many earthworks currently underway in the catchment and that the controls for managing sediment loss do not appear to be effective. This is demonstrated by the high sediment load in Mill Creek observed entering the lake during rainfall events such as that on 1 February 2018. (Figure 7.) We also see evidence of this in our recent analysis of sediment and nutrient inputs discussed above. It is also reflected in the continued occurrence of algal blooms and high E.coli readings and the resulting closures of the lake for contact recreation for extended periods.

Our concerns about the efficacy of the current policy and regulatory controls of sediment loss are heightened by observations made of stormwater infrastructure around the lake during rainfall events. An example of this was on 6th July 2021 when a rainfall event occurred and 36mm of rain fell in a six-hour period. Richard Bowman and Mike Hanff carried out an inspection of two recently constructed stormwater outfalls into the lake at midday just as the rainfall was easing. A series of photographs below illustrate several important points.

Figure 7. Stormwater entering Lake Hayes at the Wakatipu Rowing Club. (Photograph taken by Richard Bowman)

Figure 8. Recently constructed stormwater channel feeding into the lake next to the public toilets at the Wakatipu Rowing Club. (Photograph taken by Richard Bowman)

Figures 7. and 8. Show that a stormwater system, recently constructed on public land at the Lake Hayes Showgrounds next to the Wakatipu Rowing Club is allowing significant amounts of sediment to enter the lake during a moderate rainfall event.

Figures 9. and 10. show the major stormwater culvert constructed in the last few years below the lower Threapwood subdivision at the western end of Lake Hayes. This demonstrates that the structures are failing to contain sediment in stormwater during a moderate rainfall event. (Figure 10.)

Figure 9. Recently constructed stormwater culvert and channel next to Threapwood at the western end of Lake Hayes. (Photograph taken by Richard Bowman)

Figure 10. Stormwater overflowing protection barriers below the Threapwood culvert. (Photograph taken by Richard Bowman)

Figure 11. Overland flow across sloping land after rainfall of 36mm fell in 6 hours north of the lower Threapwood subdivision. (Photograph taken by Richard Bowman)

Figure 11. shows the effects of a moderate rainfall event on sloping land around Lake Hayes where water flowing overland can pick up sediment from any bare ground and carry it into water courses and down to the lake.

In mid-2019 QLDC updated its rules for earthworks and produced its Guidelines for Environmental Management Plans. These were aimed at addressing many of the previously recognised shortfalls in sediment management. It is concerning then that we are still seeing significant sediment loss problems relating to urban development at Lake Hayes and elsewhere in the District.

A common response from those involved with earthworks when queried about this issue is that 'you can't design every development for a 100-year event'. Taking this approach is not the answer to the problem. First it is clear that significant sediment loss is still happening in consented urban development projects where supposedly best practice measures were implemented. This is happening in even moderate rainfall events which may occur several times a year. Second with changing climate trends it is likely in future that there will be more frequent high rainfall events. Given this evidence it would seem that even more stringent measures are needed to meet the required environmental standards. It has also been suggested by some that it is unfair to impose additional costs on developers to implement environmental safeguards to reduce sediment loss and downstream impacts. However, it could also be argued that it is even more unfair that the many public users of Lake Hayes should have to suffer the impacts and costs of poorly managed activities in the catchment caused by those profiting from development.

10. Recent initiatives to improve water quality in Lake Hayes

In the Schallenberg and Schallenberg (2017) report it states there is evidence that nutrient levels (phosphorus and nitrates) in the lake may be showing a decreasing trend and that if this is correct the lake water quality should improve. If this is the case, then it is critical that sediment and nutrient inputs into the lake from the catchment area are not allowed to increase and should in fact be made to decrease.

This critical factor was recognised in the review of the QLDC District Plan where a new policy (24.2.4.2) has been included. It requires the restricting of subdivision, development and use of land in the Lake Hayes catchment, unless it can contribute to water quality improvement in the catchment commensurate with the nature, scale and location of the proposal.

We believe that the proposed PC 8 changes will support the outcomes sought by the new policy 24.2.4.2.

In 2020 a locally based iwi trust called Mana Tahuna adopted a 'vision plan', developed by Friends of Lake Hayes, to restore the Lake Hayes Catchment involving the planting of riparian buffers on every waterway, the installation and maintenance of sediment traps and the recreation of wetlands. This project has funding of $4.5M over the next four years and is expected to make a major contribution to reducing sediment loss from the catchment.

The proposed PC 8 changes will greatly assist this project by raising the regulatory standards for urban developments and by reinforcing the importance of reducing the adverse effects caused by sediment loss.

13. Concluding Remarks

Given the information we have provided above we believe it is essential that the proposed changes to the Regional Water Plan are implemented as proposed. Deleting them or 'watering them down' will only allow the present very unsatisfactory situation to continue and this will have long-lasting if not permanent adverse impacts on Lake Hayes.

The proposed changes means that ORC will become directly involved with the consenting and regulatory management of urban development activities which have the potential to seriously affect water quality in sensitive waterbodies in the region. It also means that the Territorial Authorities

which have been able to operate in suboptimal ways in the past will be bound by a consistent set of region-wide standards to limit sediment loss. These will not only raise the standards for design and operation of measures to prevent sediment loss but will also increase and the level of accountability for the management of urban development projects.

While these changes are unlikely to provide the complete solution to sediment pollution from urban development in Otago, they are nonetheless a substantial step forward. They will hopefully lead to better protection and improvement of water quality in small, vulnerable water bodies and thereby contribute toward to meeting national water quality goals.

Appendix 1.

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Sediment control and urban pollution issues relating to construction sites in the Lakes District in 2018
Evidence presented to the Waterfall Park Hearing by Friends of Lake Hayes Society Inc – 23/1/19

Wanaka Sun - 31/5/18 Flooding on Aubrey Road at the entrance to Northlake 22/5/18 Photo: Nikki Heath -

Crux -10/10 18 - The stormwater channel carrying runoff from the Northlake subdivision through the Hikuwai development.-

Wanaka Sun 31/5/18 - Water flowing out of the Alpha Series subdivision retention pond and into Bullock Creek 22/5/18

Wanaka Sun – 10/10/18 -Subdivision runoff flowing into the DOC Hikuwai reserve on September 30th this year

The News – 12/10/18 - Water damage . . . Anna Simmonds of Wanaka inspects stormwater damage at Rockabilly Gully in the Hikuwai Reserve.

Stormwater entering the Clutha below Hikuwai Reserve - 30/09/18
https://www.youtube.com/watch?v=VrCt2yzk2cY&t=20s