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22 October 2026
Environmental Associates Ltd
Our Ref: EA00165

Attention Mr Greg Dewe

Parkburn Development Project - Subdivision adjacent to Lake Dunstan, Cromwell. Technical Assessment of Water Take and Use, and Lake Cove Nutrient Accumulation (water quality impact), for Fulton Hogan Land Development Limited

1.0 Introduction and Summary

The following report provides for Fulton Hogan Land Development Limited, technical assessment of the Parkburn Development Project comprising sub-division of land at Parkburn, adjacent to Lake Dunstan, Cromwell. This technical assessment covers the following items:

- Options assessment and potential effects for amenity irrigation water supply/use at the site, and
- Potential effects of possible nutrient accumulation (effect upon water quality), for the proposed (2) modestly sized lakeside amenity Coves for the sub-division.

The assessment of the above items (as below within this report), draws environmental and existing consents/activities information mainly from Otago Regional Council (ORC) monitoring and consents databases, which are available on-line at the Council's website. Additionally, this report is an updated version which reflects the revised scheme plan, and hydrology items raised in the ORC reviews of the Parkburn FTAA Substantive Application, with further response notes as contained within **Appendix A**.

There are three viable options for water supply (solely for irrigation of sub-division amenity areas totalling 11.47 ha), and they include:

- A groundwater take from a new riparian well located within 100 m of Lake Dunstan and adjacent to the sub-division site, or
- A surface water take from Lake Dunstan within a proposed amenity Cove, or
- A groundwater take from an existing authorised well(s)/take located within the sub-division site, which is currently used for materials processing and dust suppression/rehabilitation.

For the first two (above) water supply options, the irrigation water requirement is within the Permitted Activity take requirements of the Regional Plan: Water for Otago, and may be comfortably taken without the need for resource consent (for the take). The third option requires resource consent for the take (as it is not within 100 m of Lake Dunstan). However, the water requirement is comfortably within the rate and volume of the existing authorised consent, and would otherwise only require a simple variation to accommodate the "amenity" water use.

The proposed two lakeside Coves for the subdivision are a relatively modestly sized extension of two existing smaller Coves, which will maintain a direct hydraulic connection to the main lake. Such that with Lake Dunstan water level variability for hydroelectric power generation (at Clyde Dam), the two proposed Coves will be regularly and proportionately flushed by the main lake. Whilst there is most likely to be a slightly increased Nitrogen concentration within the Coves (from local groundwater through-flow), the resultant effect (concentration) is well within (below) that for protection of in-stream and lake values. Phosphorus concentrations are similar in both groundwater and Lake Dunstan, and will not be of any discernible effect within the Coves. There are no other potential environmental contaminant sources that would be of any resultant significance to the proposed Coves. Some ongoing Cove(s) nutrient water quality monitoring is proposed.

For (both) the assessed proposed options for amenity irrigation water take and assessment of resulting Cove(s) water quality, the environmental effects are determined to be either less than minor, within permitted baseline, or not-measureable.

My full name is Thomas Brendan Heller (the author of this report), and I hold the qualifications of New Zealand Certificate in Engineering (Civil) and a National Diploma of Science majoring in surface water and groundwater resources from the Otago Polytechnic, Central Institute of Technology, and the New Zealand Qualifications Authority. I also hold a Certificate in Management from the New Zealand Institute of Management and a Master's Degree in Environmental Science completed with first class honours from the University of Otago. I have over 40 years' experience working in surface water and groundwater resource evaluation, including hydro-geologic and water quality assessment relating to water allocation and land use issues. I have also been involved with technical aspects of groundwater and surface water policy development for several currently operative Regional Water Plans in the South Island.

2.0 Lake Dunstan and Local Groundwater Environments

The Parkburn Development sub-division is located adjacent to the Clutha River Mata-Au arm of Lake Dunstan, a hydro-electric operational storage lake for the Clyde Power Station. Figure 1 below shows the location of the Parkburn sub-division in relation to the Clutha arm of Lake Dunstan, and the balance of the area forming an unconfined alluvial aquifer (at moderate depth below land surface). Figure 1 also shows the location of water wells and resource consents in relation to the sub-division area.

The lake is part of the Clutha River Mata-Au catchment, in which for the Clutha River Mata-Au arm, receives an average river flow of approximately 300 cubic metres per second. The Kawarau arm of Lake Dunstan typically receives approximately 240 cubic metres per second of Kawarau River flow, in which totals about 540 cubic metres per second (on average), as total lake inflow.

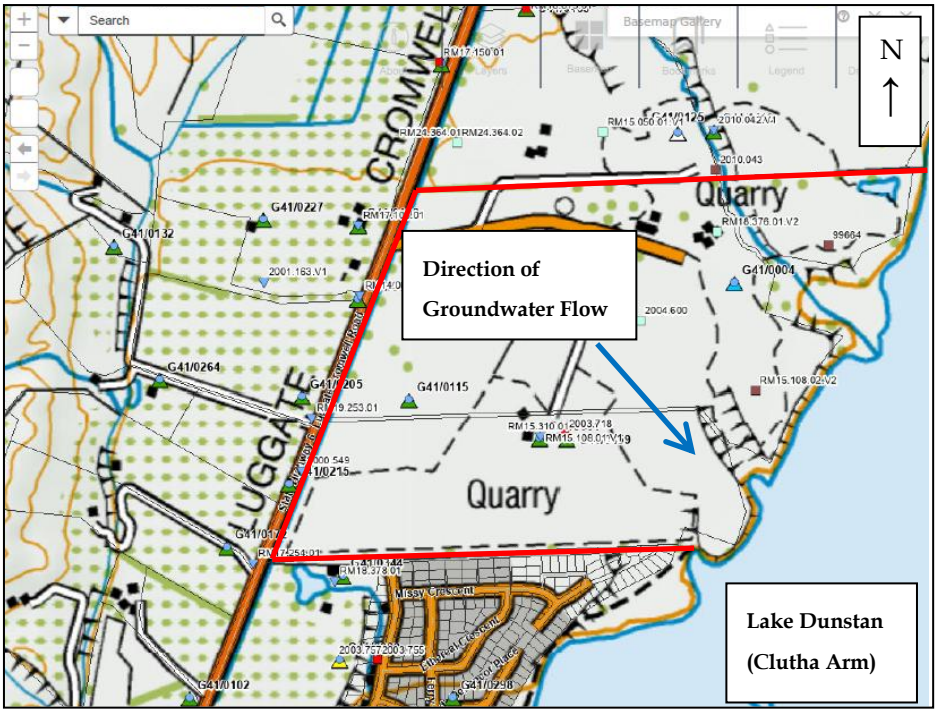


Figure 1 General Parkburn Sub-division Area (bounded by the red perimeter line and Lake Dunstan)

Parkburn Development Plans are provided with the Planning Proposal Report, and should be referred to in respect of sub-division areas, amenity irrigation areas and extent of the proposed (2) lakeside amenity Coves.

The general direction of local groundwater flow from the adjacent alluvial aquifer is assessed to be in a south-easterly direction to Lake Dunstan based on the occurrence of waterways, the receiving lake environment and land surface topography (Figure 1). Recharge sources include local rainfall, irrigation water application to land surface, and small streams that debouch onto the alluvial aquifer area(s). The lake receives all groundwater flow from any adjacent aquifers, which contributes to surface flow through the Cromwell Gorge to the Clyde Power Station. However, the groundwater flow contribution to Lake Dunstan is relatively small compared to the balance of the Clutha Catchment inflows as discussed above.

Groundwater (the water table aquifer), adjacent to and beneath the Parkburn Development site, is typically at a depth of about 9.0 metres below land surface. Locally available well log, completion and aquifer test data for wells G41/0459, G41/0301, G41/0113, G41/0103, G41/0172, G41/0004 and G41/0378 have been assessed to provide aquifer hydraulics and groundwater occurrence in relation to the Parkburn Development. These wells occur on Figure 1 above.

Typically at the Parkburn Development site, the water table aquifer occurs within coarse sandy gravels of about 19 metres saturated thickness (total depth of approximately 30 metres), extending to Lake Dunstan. The average weighted (conservative) aquifer Transmissivity reported is approximately 2,000 m^2/day with aquifer storage (specific yield) of 0.1. Together with the aquifer saturated thickness, the average hydraulic conductivity for the aquifer is assessed at 100 metres/day. As above, the assessed nominal direction of groundwater flow at the Parkburn Development site is south east to Lake Dunstan, and with a conservatively estimated groundwater gradient of 0.015, the typical velocity of groundwater flow (movement of groundwater through the aquifer), is on average about 1.5 metres/day. The aforementioned aquifer hydraulic information has been utilised for assessment of options and potential effects for amenity irrigation water supply/use at the site, and for effects assessment for potential impact of possible nutrient accumulation (effect upon water quality), for the proposed (2) lakeside amenity Coves for the Parkburn Development.

The Clyde Power Station typically provides a baseline generation of power for the national grid. However, with the Lake Dunstan operational storage, a peak pattern of generation also exists, whereby daily lake levels typically vary on average by approximately 300 mm (in response to power generation periods). Figure 2 below shows a typical (average) monthly period of Lake Dunstan water level responses (variability) to Clyde Power Station peak generation periods.

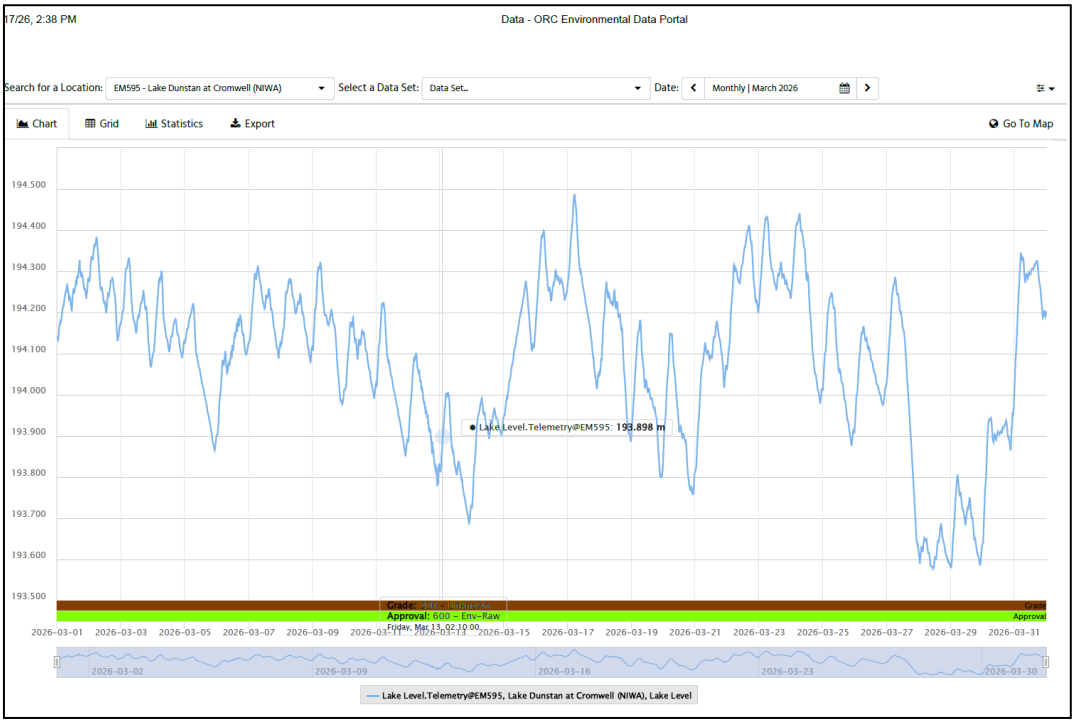


Figure 2 Lake Dunstan Water Levels at Cromwell (for March 2026)

However, whilst the annual average (daily) lake level variation is approximately 300 mm, the winter and summer daily variation is approximately 400 mm and 200 mm respectively. Lake Dunstan also responds to flood events in the Clutha Catchment, with temporary increases in lake water levels up to approximately 1 metre over the duration of a flood. Additionally, Lake Dunstan (Clutha Arm) water quality is of a relatively stable and good standard with very low nutrient concentrations (for Nitrogen and Phosphorus), and generally low bacterial counts (for *E-coli*). The water clarity is also typically good reflecting the generally high quality of water provided from the upper Clutha River catchment. Table 1 shows the average concentrations/counts for water quality parameters monitored for the Clutha Arm of Lake Dunstan.

Table 1

Lake Dunstan (Clutha Arm) at Deadmans Point Water Quality Monitoring Results (Otago Regional Council)

Parameter	Average Result	Comment
Total Phosphorus	0.005 mg/L	Low
Total Nitrogen	0.07 mg/L	Low
E-coli	<1 cfu/100 mL	General result

Groundwater quality as measured at Well G41/0103 in the adjacent alluvial aquifer and in proximity of the Parkburn Development sub-division, also exhibits relatively good results with a generally stable trend over recent years. Phosphorus and Nitrogen concentrations are relatively low and reflect background levels for the unconfined aquifer. Bacterial counts in the aquifer are generally not detected, reflecting the relative security of the aquifer from overlying land use activities. Table 2 shows the average concentrations/counts for water quality parameters monitored for Well G41/0103 within the local alluvial aquifer.

Table 2

Well G41/0103 Water Quality Monitoring Results (Otago Regional Council)

Parameter	Average Result	Comment
Dissolved Reactive Phosphorus	0.005 mg/L	Low
Nitrate-Nitrogen	0.500 mg/L	Low
E-coli	<1 cfu/100 mL	General result

The above (average) water quality monitoring results for Lake Dunstan and local groundwater, have been utilised in effects assessment for potential impact of possible nutrient accumulation (effect upon water quality), for the proposed (2) lakeside amenity Coves for the Parkburn Development sub-division. Well G41/0103 is the only available groundwater monitoring site (with sufficient groundwater quality data), in proximity of the Parkburn Development sub-division. However, the site is fully representative of groundwater quality for the general area, and of which has showed a relatively stable trend over the past 10+ year period.

3.0 Proposed Water Take for Amenity Irrigation

The Parkburn Development requires on-site water for amenity irrigation needs. The water is required to provide dripper and spray irrigation for plantings and grass, to common amenity areas within and surrounding the sub-division development. The total irrigation amenity area(s) for the site is approximately 11.47 ha, which is as shown on the updated site development plans. This area does not include the 2.89 ha set aside for storm-water-land drainage purposes.

It should be noted that potable and amenity household water supply for the development is to be separately provided by the Central Otago District Council water supply scheme for the area. An assessment of the amenity area irrigation water needs for the development, compared to irrigation requirements provided by Aqualinc (2017), is contained in Table 3 below.

Table 3

Efficient Amenity Irrigation Water Requirement for Central Otago for a Nominal 11.47 ha of Pasture

Parameter	Proposed	Aqualinc (2017)
Rate of take (L/s)	20 Average rate = 6.4	4.8 mm/day = 6.4 L/s as an average daily rate
Daily volume (m^3/day)	550	48 m^3/ha = 550 as a daily volume
Monthly volume (m^3/month)	13,649 1,190 m^3/ha/month and 80% of Aqualinc	17,050 1,490 m^3/ha/month
Annual volume (m^3/annum)	57,579 5,020 m^3/ha/annum and 65% of Aqualinc	88,663 7,730 m^3/ha/annum

Notes: MAR 450 mm and PAW 90 mm.

From Table 3, the proposed amenity irrigation requirement seeks to apply water on any day at up to the maximum rates specified by Aqualinc (2017) for the area. However, as the amenity areas are not production farmland, only a proportion of Aqualinc (2017) is required over monthly to annual periods to sustain plantings and pasture at the site.

This has been assessed based on similar project water requirements for the area and equates to 80% and 65% of Aqualinc (2017) for monthly and annual irrigation periods respectively. The maximum rate of take proposed (of 20 L/s), is for daily operational use to apply water at peak rates over the amenity areas during night-time periods to minimise evaporation. The proposed daily, monthly and annual volumes of take are comfortably within the values provided by Aqualinc (2017), which are accepted by the Otago Regional Council, and is thus deemed to be an efficient use of the irrigation water. The maximum seasonal rate and duration is calculated as 5.27 L/s for 126.5 days.

The available options (as shown on Figure 3 below), for the taking of the above amenity irrigation water for the Parkburn Development are as follows:

- (1) A groundwater take from a new riparian well located within 100 m of Lake Dunstan and adjacent to the sub-division site, or
- (2) A surface water take from Lake Dunstan within a proposed amenity Cove, or
- (3) A groundwater take from an existing authorised well(s)/take located within the sub-division site, which is currently used for materials processing and dust suppression/rehabilitation.

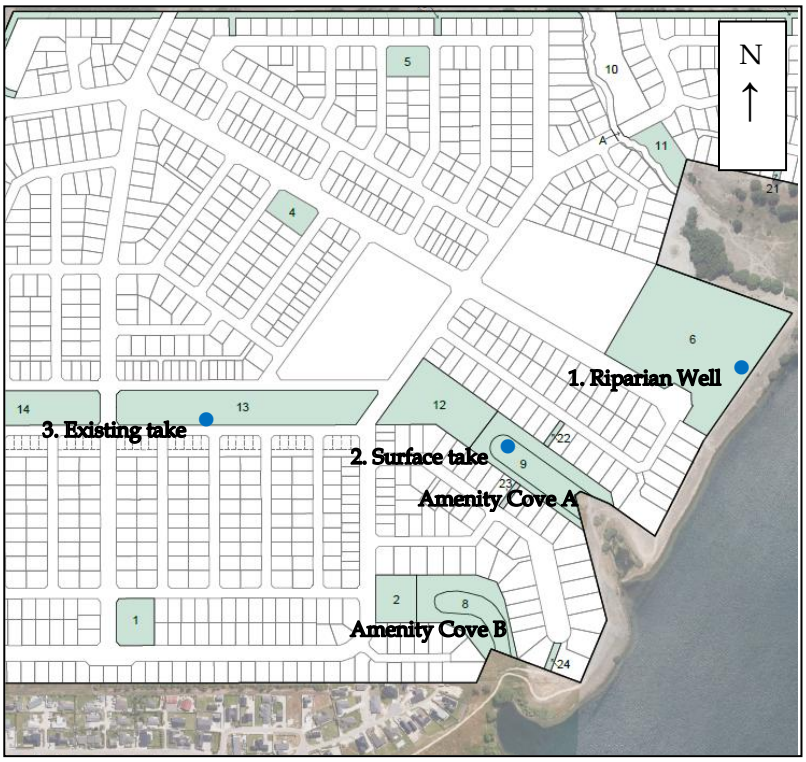


Figure 3 Options (sites) for Taking Amenity Irrigation Water

Amenity water supply Option 1 (Figure 3), would be from a new well located within 100 metres of Lake Dunstan and within the park area (open space) associated with the proposed school complex. Well logs for previously drilled wells in the general area indicate a useful aquifer at up to 9 metres below land surface, of approximately 19 metres in saturated thickness, made up of clean sandy gravels. Additionally, at the proximity to Lake Dunstan, a good connection to the lake is expected. On the basis of previously reported well information and aquifer hydraulics, the required rate and volume of water for Parkburn Development amenity irrigation purposes, is expected to be easily obtained at the indicated site (Figure 3). A Land-use Bore Permit would be required for the drilling/placement of any new well.

Additionally, the required rate and volume of amenity irrigation water from the proposed well at/for Option/Site 1 (maximum of 20 L/s and 550 m^3/day), is within Permitted Activity Rule 12.2.2.4 of the Regional Plan: Water for Otago (Otago Regional Council, 2025). This rule provides for groundwater takes within 100 metres of Lake Dunstan, at up to 100 litres per second and 1,000 m^3/day, to be taken without the need for resource consent. The effects of such a take located within 100 m of Lake Dunstan are assessed to be within Permitted Baseline. The groundwater take would be sufficiently connected to Lake Dunstan, with a limited landward seasonal drawdown effect within the aquifer. There are no other neighbouring site wells located within 700 m of the proposed Option 1 amenity water supply site. There are also no water allocation issues arising with the proposed take being connected to the Clutha River Catchment via Lake Dunstan and being within Permitted Activity.

Amenity water supply Option 2 is to locate a surface-water pump within a protected area of Amenity Cove A (Figure 3). This would typically be installed via a floating platform or fixed at depth, with suitable screening to prevent any fish intake or risk to Amenity Cove users. Given the sufficient depth provided for within the Cove and the typical variability of Lake Dunstan water levels, the required rate and volume of take for amenity irrigation is easily obtainable.

The required rate and volume of amenity irrigation water from the proposed surface water take at/for Option/Site 2 (maximum of 20 L/s and 550 m^3/day), is also within Permitted Activity (Rule 12.1.2.2) of the Regional Plan: Water for Otago (Otago Regional Council, 2025). This rule provides for surface water takes from Lake Dunstan, at up to 100 litres per second and 1,000 m^3/day, to be taken without the need for resource consent. The effects of such a take from Lake Dunstan are assessed to be within Permitted Baseline, with the surface water take being directly connected to the lake. There are no other (consented) surface water takes occurring from Lake Dunstan within about 2 km of the proposed Option 2 amenity water supply site.

There are no water allocation issues arising with the proposed take being part of the Clutha River Catchment via Lake Dunstan and being within Permitted Activity.

Amenity water supply Option 3 (Figure 3), is proposed to be taken adjacent to a proposed storm water infiltration area, from an existing authorised groundwater take/location (Consent RM15.108.01.V1), which is used by Fulton Hogan Limited for gravel processing and some irrigation and dust suppression in association with the Parkburn Quarry which is within the Parkburn Development site. Consent RM15.108.01.V1 (**Appendix B**) expires on 1 November 2050, and also allows the discharge to land of gravel processing water containing sediment. It is assessed that with the Parkburn Development proposal, both the consented groundwater take (in its current form), and discharge activities for operation of the quarry will no longer be required.

The currently authorised groundwater take RM15.108.01.V1 is for 160 litres per second, 6,912 m^3/day and 1,990,656 m^3/annum, although the associated Otago Regional Council s42A Officer Report confirms that 138,058 m^3/annum is of a consumptive nature, with the balance of the groundwater take being non-consumptive (when considering the associated discharge to land of gravel processing water). However, the currently authorised consumptive groundwater allocation to the permit is more (2.4-times) than that required for the proposed amenity irrigation water use at the Parkburn Development. As the site and resource consent (groundwater take) are established and include for a reasonably high yield (rate and volume of take), the groundwater take proposed for amenity irrigation purposes is expected to be easily achievable within the limits of the currently authorised permit. It is expected that an amendment (simple variation of consented rate and volumes), to consent RM15.108.01.V1 would only be required to accommodate the "amenity irrigation" water use for the Parkburn Development.

The Parkburn Development amenity irrigation take requires resource consent for the take from groundwater at the Option 3 site, as the location of the take is not within 100 m of Lake Dunstan, and it otherwise exceeds the 25,000 litre/day Permitted Activity take requirement in Rule 12.2.2.2 of the Regional Plan: Water for Otago. However, as discussed above, the amenity irrigation requirement is comfortably within the consumptive groundwater allocated to existing authorised consent RM15.108.01.V1, and of which the potential effects of the activity upon the receiving environment have been already assessed by the Otago Regional Council s42A Officer Report. The s42A Officer Report assessment considered interference on nearby wells, stream depletion upon Lake Dunstan and groundwater allocation, and found that in all cases the potential effects upon the receiving environment were of a no more than minor nature.

There are very few permitted water takes in vicinity of the Parkburn Development, as those takes are limited to each landholding, and can only occur within 100 m of Lake Dunstan (or direct from the lake), where access to the lake is afforded. As above, there are very few wells in the area, and otherwise there is significant water availability (either connected groundwater or surface water), for the Parkburn Development amenity irrigation needs.

On the basis of the above assessment, the required amenity irrigation water supply for the Parkburn Development is modest and relatively easily obtainable from ether of the three options (for water supply) presented within this report. For the water supply options, the taking of the required water for amenity irrigation is an efficient use of the water, and otherwise, would incur effects (either direct or cumulative), upon the receiving environment of either within Permitted Baseline (less than minor), or within a currently authorised (consented) activity where effects are no more than minor.

4.0 Assessment of Proposed Lakeside Amenity Cove(s) Water Quality

Whilst the formation of the proposed (2) lakeside amenity Coves (as shown in Figure 3 above), is addressed within the Parkside Development earthworks reporting (for detailed concept plans), an assessment of the potential water quality outcome for each of the formed and established Coves is considered below within this report. Earthworks and associated activities are not considered within this report, which are isolated from the water quality outcomes predicted for the fully established Coves.

The amenity Coves are to be constructed to form an extension of the existing two (smaller) lakeside Coves adjacent to the Parkside Development. The physical dimensions of the Coves are also as indicated in Figure 3 above. The Coves are to be approximately 3 metres in depth and will be relatively open to the main lake. Typically, Lake Dunstan water will be the dominant water type occurring within each of the amenity Coves, as inflows and outflows are governed by daily water level fluctuations for power generation within the main lake. Although, there is also a component of groundwater through-flow that occurs within each Cove, and of which is proportional to the dimensions of each Cove normal to the direction of groundwater flow. As above, more detailed concept design of the amenity Coves may be referred to within the Parkside Development earthworks reporting. However, there will be no restriction of lake water flow and an open hydraulic continuity will exist to allow for boat access.

For the amenity Cove(s) water quality outcomes assessment, the available Lake Dunstan and local groundwater average water quality monitoring results (as identified in Section 2 above), have been utilised, along with physical lake and groundwater flow (hydraulic) contribution to each Cove. The amenity Cove(s) nominal depth of water has been taken as 3 metres, and the dimensions/occurrence of each proposed Cove are as indicated by Figure 3 above. The effective length of Cove occurrence normal to the direction of groundwater flow is 134 m and 94 m for Cove A and Cove B respectively. Additionally, for Cove A and Cove B, the nominal volume of water contained within each Cove is 51,000 m^3 and 33,150 m^3 respectively. The daily average Lake Dunstan level variation for power generation purposes is 0.4 m during winter periods and 0.2 m during summer periods respectively as discussed in Section 2 above. Table 4 and Table 5 below provide a summary of each Cove's water and nutrient (Nitrogen) N-balance outcome, which reflects winter and summer seasonal environmental conditions. The above information including that of the groundwater hydraulic data provided in Section 2 of this report enables the seasonal computation of groundwater input and lake flows to the amenity Coves (Table 4 and Table 5).

Table 4

Amenity Cove A Seasonal Physical Flow (mixing) and Water Quality (nutrient) Outcome

Seasonal period	Groundwater inflow (L/s) and quality mg/L N	Lake Dunstan inflow (L/s) and quality mg/L N	Groundwater outflow L/s and quality mg/L N	Outflow to Lake Dunstan L/s and Cove water quality mg/L N
Winter	Flow = 7 L/s	Flow = 78.7 L/s	Flow = 1 L/s	Flow = 84.7 L/s
Winter	N concentration = 0.5 mg/L	N concentration = 0.07 mg/L	N concentration = 0.105 mg/L	N concentration = 0.105 mg/L
Summer	Flow = 7 L/s	Flow = 39.4 L/s	Flow = 1 L/s	Flow = 45.4 L/s
Summer	N concentration = 0.5 mg/L	N concentration = 0.07 mg/L	N concentration = 0.135 mg/L	N concentration = 0.135 mg/L

Table 5

Amenity Cove B Seasonal Physical Flow (mixing) and Water Quality (nutrient) Outcome

Seasonal period	Groundwater inflow (L/s) and quality mg/L N	Lake Dunstan inflow (L/s) and quality mg/L N	Groundwater outflow L/s and quality mg/L N	Outflow to Lake Dunstan L/s and Cove water quality mg/L N
Winter	Flow = 4.9 L/s	Flow = 51.2 L/s	Flow = 0.5 L/s	Flow = 55.6 L/s
Winter	N concentration = 0.5 mg/L	N concentration = 0.07 mg/L	N concentration = 0.108 mg/L	N concentration = 0.108 mg/L
Summer	Flow = 4.9 L/s	Flow = 25.6 L/s	Flow = 0.5 L/s	Flow = 30.0 L/s
Summer	N concentration = 0.5 mg/L	N concentration = 0.07 mg/L	N concentration = 0.139 mg/L	N concentration = 0.139 mg/L

For each of the amenity Cove(s) water quality outcomes (Table 4 and Table 5), the groundwater contribution is solely from the top 3-metres of the aquifer, and the corresponding seasonal Lake Dunstan (main lake) daily inflow is for a 0.4 metre and 0.2 metre lake level variation or conservatively 13% and 7% of the volume of water within each Cove respectively. The water balances show that the dominant source of water (for mixing) within each Cove is from the main lake, with a much lesser input from groundwater. This means that there is a reasonable and consistent flushing effect upon each Cove from the main lake. Effectively, residence time for lake water contribution to each Cove is no greater than 24-hours in each case, reflecting the daily peak power generation from Clyde hydro.

The above seasonal (winter and summer) nutrient outcomes (Table 4 and Table 5), show that the respective Cove water quality is relatively insensitive to the range of seasonal (temporal) daily lake inflows, with N-concentrations ranging overall from 0.105 mg/L to 0.139 mg/L. The N-concentration (for seasonal physical flow conditions), that occurs within each Cove (Table 4 and Table 5), ranges from 0.105 mg/L to 0.108 mg/L during winter, and 0.135 mg/L to 0.139 mg/L during summer, which is approximately 1.5-times to 1.9-times the existing main lake concentration of 0.07 mg/L. However, the increased concentrations are still relatively low and only occur within the confines of each Cove. Cove outflow water quality is quickly dispersed within the main lake. Additionally, the overall outcome for Lake Dunstan water quality does not change with the formation of the Coves. The same groundwater through-flow, water quality, and discharge to the lake, would otherwise naturally occur.

The resulting Cove(s) water quality (for Nitrogen), compares to ANZECC 2000 values for protection of surface (in-stream) water environments of 0.44 mg/L Nitrate-N, and lake water quality guidelines of 0.35 mg/L Nitrate-N. In each case, the resulting Cove(s) water quality (for Nitrogen), is comfortably within the aforementioned environmental protection limits.

An assessment for Phosphorus and *E-coli* in relation to resultant Cove(s) water quality is not required, as both the groundwater source and Lake Dunstan exhibit the same or similarly low concentrations and counts for each parameter respectively. It is not considered that the low concentration of Phosphorus in Lake Dunstan, coupled with the predicted Nitrogen concentration(s) within the amenity Cove(s) would give rise to any effects that were not otherwise apparent in the main lake.

The above Cove water quality outcome(s) assessment are additionally conservative, as only one lake flushing event per day has been utilised. There are many days per year when peak power generation periods at Clyde hydro exceed 1 per day, and consequently, additional lake water flushing of the amenity Coves will occur. Also, for the above calculations, the lake flushing flows have been conservatively applied as the average seasonal daily lake level variation per Cove depth.

This underestimates the actual lake inflow, which is also a relatively small volume compared to the total Cove(s) water volume. Additional Cove water dilution from flood events, wind shear and boating (physical mixing) have not been included for.

As discussed above in Section 2 of this report, groundwater quality data has been utilised for the above Cove nutrient outcome assessment, from Well G41/0103. G41/0103 is the only well in vicinity of the Parkburn development that includes for groundwater quality monitoring information, which has been performed over a number of years. Additionally, Well G41/0103 is immediately up-groundwater gradient of the Parkburn development, and is representative of groundwater quality for the Parkburn development area. The resulting groundwater quality monitored from G41/0103 (as discussed in Section 2 of this report), has undergone little to no change over the 10+ year period of monitoring. Nutrients continue to be low and *E.coli* counts show no direct surface contamination from land use.

The land use resulting from the Parkburn development is for household sub-division purposes, which together with any amenity water uses, represents a low risk of any significant additional nitrogen leaching to the local groundwater environment. Thus, it is highly unlikely that N-concentrations in the local groundwater resource would increase over time and as result of the sub-division activity. Any additional Phosphorus leaching to the groundwater environment is also considered to be highly unlikely for the sub-division activity, and of which is currently measured as very low within the existing groundwater environment.

It is also considered to be highly unlikely that lake-Cove internal nutrient cycling processes would give rise to any significant sediment release. The Coves will not be thermally stratified and oxygenation of waters will continue to occur with the mixing (daily flushing), with main lake water, that is itself, well mixed. Additionally, nutrient concentrations within the Coves (as above) will be relatively low in concentration.

There are other existing Coves and inlets in the lower part of Clutha Arm of Lake Dunstan, which include McNulty Inlet, Lowburn and lower Lowburn Inlets, and four amenity Coves associated with sub-division development immediately to the south-west of the Parkburn Development. These Coves and Inlets are varied in size and nature, although all have a similarly good connection to Lake Dunstan (similar to the Parkburn Development amenity Coves).

Particularly for the amenity Coves located adjacent to the Parkburn Development, which were established for an existing sub-division, there are no identifiable water quality impacts that occur within any seasonal period. The lake provides good flushing of water which maintains a good standard of aquatic environment within each Cove. Given that the Parkburn Development Coves are smaller and there is a similar connection to Lake Dunstan with relatively good lake flushing and low nutrient concentrations, the Coves are expected to maintain an equally good standard of aquatic environment.

Whilst there is no apparent or obvious potential impact upon Cove(s) water quality for the proposal, Cove(s) nutrient water quality monitoring post development is proposed to be undertaken. This could be undertaken at both Coves at within each upper Cove occurrence for Nitrogen (TN and NNN), and Phosphorus (TP and DRP), on a quarterly basis, with a view to cease monitoring after 2-years (24-months) based on confirmation of satisfactory results.

From the above assessment, resultant amenity Cove(s) water quality is most unlikely to produce any undesirable water quality or in-stream effects that would be any more than minor, and be solely limited to within each Cove's local environment.

5.0 Summary Outcomes from this Report

Proposed Water Take for Amenity Irrigation

There are three viable options for water supply (solely for irrigation of sub-division amenity areas totalling approximately 11.47 ha), which includes:

- A groundwater take from a new riparian well located within 100 m of Lake Dunstan and adjacent to the sub-division site (previously drilled wells in the general area indicate saturated clean sandy gravels of a thickness of approximately 19 metres), or
- A surface water take direct from Lake Dunstan within proposed amenity Cove A, or
- A groundwater take from an existing authorised well(s)/take located within the sub-division site, which is currently used for materials processing and dust suppression/rehabilitation.

For the first two options, the irrigation water requirement is within the Permitted Activity take requirements of the Regional Plan: Water for Otago, and may be comfortably taken without the need for resource consent (for the take). A land use bore permit would be required to drill/establish any new well for the taking of water. The third option requires resource consent for the take (as it is not within 100 m of Lake Dunstan). However, the water requirement is comfortably within the rate and volume of the existing authorised consent (RM15.108.01.V1), and would otherwise only require a simple variation to the permit to accommodate the "amenity irrigation" water use.

For each of the aforementioned amenity irrigation water supply options, the potential effects upon the receiving environment (for the take), are either within the permitted baseline or are of a no more than minor impact.

Lakeside Amenity Cove(s) Water Quality

From the physical flow and water quality balance assessment, Cove(s) water quality will be buffered by inflows (and outflows), and water quality from the main lake (Lake Dunstan). A correspondingly smaller contribution of flow and nutrient quality from local groundwater is also evident. The outcome for Cove(s) water quality is that a marginally increased concentration of Nitrogen would be evident within each Cove compared to Nitrogen levels in the main lake. However, the increased levels of Nitrogen with each Cove are still relatively low and are within ANZECC 2000 values for protection of surface water and lake environments. There are otherwise no other measured water quality parameters that are of any significance to Cove(s) water quality which is assessed as being of a no more

than minor impact upon the environment. However, some ongoing Cove(s) nutrient water quality monitoring is proposed.

I would be pleased to be of assistance if you have any further queries on any of the above matters.

Yours faithfully
Tom Heller
Director: Water & Environment



Environmental Associates Ltd
Email: [redacted]

References:

Aqualinc (2017), Guidelines for Reasonable Irrigation Water Requirements in the Otago Region

ANZECC (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Otago Regional Council (2025), Regional Plan: Water for Otago

Attachments:

Appendix A – Response Notes to ORC Reviews of Application

Appendix B – Resource Consent RM15.108.01.V1

Fulton Hogan Land Development Limited
C/- Fulton Hogan Limited
Level 2, 15 Sir William Pickering Drive
Burnside
Christchurch 8053

22 October 2026
Environmental Associates Ltd
Our Ref: EA00165

Attention Mr Greg Dewe

Parkburn Development Project - Subdivision Adjacent to Lake Dunstan, Cromwell. Response Notes to Hydrology Items Raised in the Otago Regional Council Review(s) of the Substantive Application, for Fulton Hogan Land Development Limited

1.0 Introduction

The following report provides the responses to the Hydrology Items raised by the Otago Regional Council (ORC) initial and final reviews of the Parkburn FTAA Substantive Application, for Fulton Hogan Land Development Limited. Where applicable, the items raised have been addressed in the updated Parkburn Hydrology Assessment Report.

2.0 ORC Hydrology Review Items Raised

Cumulative effects of water abstraction

This has been further addressed within the updated Parkburn Hydrology Assessment Report. The options for amenity irrigation water are clearly allowed within the permitted activity framework and/or as a variation to the existing groundwater take permit currently held by the applicant. This is not disputed by ORC. Given the constraints around accessing permitted activity water takes and the significance of the water body associated with the taking of water (Lake Dunstan), any future cumulative impact of permitted activity water takes will (clearly and obviously) be very small to not-measureable. Overall, ORC conclude that the effects of the proposed amenity water abstraction are likely to be minor.

The requirements and context for each amenity irrigation water source option are clearly identified within the updated Hydrology Assessment Report including variation to Groundwater Take Permit RM15.108.01.V1 if required. The taking of water under permitted activity can be done as of right without the need for resource consent.

Cove flushing and connectivity

This has been further addressed within the updated Parkburn Hydrology Assessment Report. The provision of detailed plans and dimensions of the proposed Coves, detailed design for Cove connection to Lake Dunstan, and structure hydraulic assessment, is outside of the Hydrology Assessment reporting. However, detailed plans and dimensions of the proposed Coves is appended to the EMP and substantive application. Some further discussion of Cove occurrence is provided within the updated Parkburn Hydrology Assessment Report.

As far as practicable, Cove(s) design and outlet connectivity will remain unchanged up to any pre-construction period. Appropriate Cove dimensions and associated water volumes have been taken into account for the purposes of the flow and water quality balance assessment (which have been scaled from the aforementioned plans), and of which are not disputed by ORC.

Whilst there is no apparent or obvious potential impact upon Cove(s) water quality for the proposal, Cove(s) water quality monitoring post development may be undertaken. This could be undertaken at both Coves at within each upper Cove occurrence for Nitrogen and Phosphorus on a quarterly basis, with a view to cease monitoring after 2-years based on confirmation of satisfactory results. This has been addressed within the updated Parkburn Hydrology Assessment Report.

Lake level fluctuations

This has been further addressed within the updated Parkburn Hydrology Assessment Report. Seasonal (winter-summer) lake level variability was provided for within flow and water quality balance assessments as previously required by the initial ORC review.

An inter-seasonal monthly example of daily lake level variability was provided for illustrative purposes only and to show that Contact Energy manage Lake Dunstan and Clyde Dam Hydropower Generation as a run of river situation involving daily variability of lake levels. The winter-summer lake level variability of 400 mm and 200 mm respectively has been taken from respective seasonal period hydrographs and conservatively presented for the purposes of the assessment and of which are not refuted by ORC.

Water balance and flow inputs

This has been further addressed within the updated Parkburn Hydrology Assessment Report. Groundwater inflows and outflows have been calculated consistent with the supporting aquifer hydraulic parameters and dimensions presented within the updated Hydrology Assessment Report. Additional discussion within the report was included to assist with interpretation of the data (Tables).

Again, there does not appear to be any dispute (or alternative numbers presented), by ORC over the scale of groundwater inflows and outflows utilised within the flow and water quality balance assessment. The assessment has been deliberately conservatively undertaken and reflects good resultant Cove(s) water quality outcomes, similar to other Cove(s) outcomes in nearby similar developments.

Water quality assessment (including Groundwater)

This has been further addressed within the updated Parkburn Hydrology Assessment Report. Integration of earthworks and sediment impacts during and after construction, is outside of the Hydrology Assessment reporting. However, some further discussion of earthworks and sediment mobilisation is provided within the updated Parkburn Hydrology Assessment Report.

The reason why Phosphorus was not assessed (for resultant Cove water quality), was clearly identified within the updated Hydrology Assessment Report. Phosphorus concentrations measured within any contributing groundwater are either commensurate with or lower than Phosphorus concentrations measured within Lake Dunstan. Thus, a flow and water quality balance assessment for Phosphorus would be meaningless.

There is no apparent requirement to include for wastewater servicing within the flow and water quality assessment as all wastewater for the site is fully reticulated via the Central Otago District Council wastewater scheme. The development of the site with minimal and efficient amenity irrigation will not alter the current groundwater Nitrate-N or Phosphorus concentrations, as the resulting land use and aquifer protection will be a significant improvement upon the current open quarry land use.

Groundwater quality monitoring data and the reliability of that data was clearly discussed within the updated Hydrology Assessment Report. There is no obvious wastewater quality that requires monitoring and otherwise no indication of site contaminants present that would warrant the monitoring or further assessment of groundwater quality.

Tom Heller
Director: Water & Environment



Environmental Associates Ltd
Email: [redacted]

Our Reference: A862089

Consent No. RM15.108.01.V1

WATER PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Fulton Hogan Limited

Address: 15 Sir William Pickering Drive, Burnside, Christchurch

To take and use groundwater for the purpose of processing aggregate, asphalt and concrete, truck washing, domestic use, irrigation and dust suppression.

For a term expiring 1 November 2050

Location of Point of Abstraction: Bore 1: Mount Pisa, approximately 1.7 kilometres north west of the intersection of Luggate-Cromwell Road (State Highway 6) and Pisa Moorings Road, Cromwell.

Bore 2: Mount Pisa, approximately 1.74 kilometres north west of the intersection of Luggate-Cromwell Road (State Highway 6) and Pisa Moorings Road, Cromwell.

Bore 3 and 4: Mount Pisa, approximately 1.5 kilometres south east of the intersection of Smiths' Way and Luggate-Cromwell Road (State Highway 8).

Legal description of land at point of abstraction: Bore 1 and 2: Pt Sec 64-65 Blk IV Wakefield SD
Bore 3: Section 9 SO 22536
Bore 4: Section 65 Block IV Wakefield SD

Legal Description of land where water is to be used: Part Sec 62-63 Blk IV Wakefield SD, Sec 64-65 Blk IV Wakefield SD, Sec 1 SO Plan 365897

Map Reference at point of abstraction: Bore 1: NZTM 2000 E1304286 N5013958
Bore 2: NZTM 2000 E1304340 N5013960
Bore 3: NZTM 2000: E1300431 N5014656
Bore 4: NZTM 2000: E1304175 N5013704

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Conditions

Specific

1. This permit shall not commence until Water Permit 2003.719.V1, RM17.359.02 and RM17.359.04 have been surrendered or expired.

2. The rate of abstraction from each point of take shall not exceed:

Bore	Litres per second	Cubic metres per day	Cubic metres per month	Cubic metres per year
Bore 1 Bore 2	160 combined	6,912 combined	165,888 combined	1,990,656 combined
Bore 3	40	N/A	31,160	380,160
Bore 4	30	N/A	23,760	285,120

3. Water taken for domestic supply or irrigation shall only be taken from Bore 3 only.

4. This permit shall be exercised in conjunction with Discharge Permit RM15.108.02.V1.

5. This permit shall be exercised or suspended in accordance with any Council approved rationing regime that applies to the Pisa Groundwater Management Zone.

Performance Monitoring

6. (a) The consent holder shall install a water meter at each point of take to record the water take, within an error accuracy range of +/- 5% over the meter's nominal flow range, and telemetry compatible datalogger with at least 24 months data storage to record the rate and volume of take, at each point of take, and the date and time this water was taken.

(b) The dataloggers shall record the date, time and flow in litres per second.

(c) The water meters shall be installed in a straight length of pipe, before any diversion of water occurs. The straight length of pipe shall be part of the pump outlet plumbing, easily accessible, have no fittings and obstructions in it. There shall be a straight length of pipe on either side of each water meter: on the upstream side there shall be a distance that is 10 times the diameter of the pipe and on the downstream side there shall be a distance of 5 times the diameter of the pipe.

(d) The water meters shall be installed in accordance with the information on the Non-Standard Installation Form available from the Consent Authority dated 4 February 2011.

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(e) The consent holder shall ensure the full operation of the water meters and dataloggers at all times during the exercise of this consent. All malfunctions of the water meters and/or dataloggers during the exercise of this consent shall be reported to the Consent Authority within 5 working days of observation and appropriate repairs shall be performed within 5 working days. Once the malfunction has been remedied, a Water Measuring Device Verification Form completed with photographic evidence must be submitted to the Consent Authority within 5 working days of the completion of repairs

(f) The installation of the water meters shall be completed to full and accurate operation prior to the exercise of this consent. The consent holder shall forward a copy of the installation certificate to the Consent Authority within one month of installing each water meter and datalogger.

(g) (i) If a mechanical insert water meter is installed it shall be verified for accuracy each and every year from the first exercise of this consent.
(ii) Any electromagnetic or ultrasonic flow meter shall be verified for accuracy every five years from the first exercise of this consent.
(iii) Each verification shall be undertaken by a Consent Authority approved operator and a Water Measuring Device Verification Form shall be completed and supplied to the Consent Authority with receipts of service. These shall be supplied within 5 working days of the verification, and at any time upon request.

(h) The consent holder shall provide records from the dataloggers to the Consent Authority by 31 July each year and at any other time on request. Data shall be available electronically giving date, time and flow rates in no more than 15 minute increments, via a datalogger approved by the Consent Authority.

General

7. The consent holder shall take all practicable steps to ensure that:
(a) there is no leakage from pipes and structures;
(b) the use of water is confined to targeted areas,
(c) there is no run off of water in areas either on site or off site; and
(d) a back flow preventer device is fitted to prevent any contaminants from being drawn into the source of the water.

8. Copies of the results of any water quality analyses performed on the groundwater shall be forwarded to the Consent Authority within two weeks of the analysis being undertaken.

9. The permit shall be exercised as directed by the Consent Authority or any Water Allocation Committee established by the Consent Authority which operates in the Clutha catchment.

10. All water taken at the point of abstraction, having regard to use for irrigation, dust suppression and domestic use shall be returned to the Pisa Aquifer via soakage ponds.

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11. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent for the purpose of imposing aquifer restriction levels, if and when an operative regional plan sets aquifer restriction levels.

12. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within 3 months of each anniversary of the commencement of this consent for the purpose of:

    (a) adjusting the consented rate or volume of water under condition 2, should monitoring under condition 6 or future changes in water use indicate that the consented rate or volume is not able to be fully utilised; or

    (b) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage; or

    (c) ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, and/or relevant required plans; or

    (d) adjusting or altering the method of water take data recording and transmission.

Notes to Consent Holder

1. *If you require a replacement permit upon the expiry date of this permit, any new application should be lodged at least 6 months prior to the expiry date of this permit. Applying at least 6 months before the expiry date may enable you to continue to exercise this permit until a decision is made, and any appeals are resolved, on the replacement application.*

2. *Each water meter, datalogger and telemetry unit should be safely accessible by the Consent Authority and its contractors at all times.*

Issued at Dunedin this 30th day of November 2015.
Reissued at Dunedin this 21st day of December 2018 to merge resource consents RM15.108.01, RM17.359.02 and RM17.359.04 into RM15.108.01.V1.

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Kylie M. Galbraith
Acting Manager Consents

Our Reference: A862089

Consent No. RM15.108.02.V1

DISCHARGE PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Fulton Hogan Limited

Address: 15 Sir William Pickering Drive, Burnside, Christchurch

To discharge silt, sediment and water to land for the purpose of aggregate washing, processing aggregate, asphalt and concrete, truck washing and dust suppression.

For a term expiring 1 November 2050

Location of consent activity: Site 1: Mount Pisa, approximately 2.2 kilometres north west of the intersection of Luggate-Cromwell Road (State Highway 6) and Pisa Moorings Road, Cromwell
Site 2, 3 and 4: Mount Pisa, approximately 1.5 kilometres south east of the intersection of Smiths' Way and Luggate-Cromwell Road (State Highway 8)
Site 4:

Legal description of land at point of discharge: Part Sec 62-63 Blk IV Wakefield SD, Sec 64-65 Blk IV Wakefield SD, Sec 1 SO Plan 365897

Map Reference: Approximate location (NZTM 2000):
Site 1: E1304857 N5014082
Site 2: E1304784 N5014492
Site 3: E1304766 N5014389
Site 4: E1304855 N5014046

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Conditions

Specific

1. This permit shall not commence until Discharge Permit 98128, Water Permits RM17.359.01 and RM17.359.03 have been surrendered or expired.

2. This consent shall only be exercised in conjunction with Water Permit RM15.108.01.V1.

3. The discharge shall not exceed;

Site	Litres per second	Cubic metres per month	Cubic metres per year
Site 1	160	165,888	1,990,656
Site 2	40 (combined)	31,680 (combined)	380,160 (combined)
Site 3			
Site 4	30	23,760	285,120

4. The discharges shall be located as per the Asphalt plant sediment ponds and soakage areas shown on the map attached as Appendix 1.

5. The discharge shall be located a minimum of 50 metres from Lake Dunstan

6. The soakage pits shall be maintained in an efficient operating condition at all times.

Performance Monitoring

7. Records of maintenance, complaints and malfunctions shall be kept in a log and this log shall be submitted to the Consent Authority by 30 June each year and upon request.

8. This consent holder shall record the location of the centre of each soakage pond used, in New Zealand Transverse Mercator 2000 format. The locations shall be recorded in the log required under Condition 7 and submitted to the Consent Authority by 30 June each year and upon request.

General

9. The consent holder shall take all necessary measures to prevent the release of hazardous contaminants including hydrocarbons into the water used for gravel washing prior to discharge.

10. The consent holder shall ensure that the discharge authorised by this consent does not cause any flooding, erosion, scouring, land instability or property damage.

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11. The consent holder shall ensure that the discharge does not give rise to any significant adverse effect on aquatic life.

12. The consent holder shall take all practical steps to minimise the release sediment to any water body.

Review

13. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within three months of each anniversary of the commencement of this consent, and on receiving any monitoring results under Conditions 7 of this permit, for the purpose of:

(a) Determining whether the conditions of this permit are adequate to deal with any adverse effect on the environment which may arise from the exercise of the permit and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the permit; or

(b) Ensuring the conditions of this consent are consistent with any National Environmental Standards, regulations and/or relevant regional plans; or

(c) Ensuring the discharge limits are appropriate and take into consideration appropriate methods to reduce particulate discharge; or

(d) Amending the monitoring conditions; or

(e) Adding or adjusting compliance limits for the parameters that are analysed in the samples taken under Condition 7 of this permit; or

(f) Requiring the consent holder to adopt the best practicable option to remove or reduce any adverse effect on the environment arising as a result of the exercise of this permit.

Notes to Consent Holder

1. *It is an offence under S87 of the Heritage New Zealand Pouhere Taonga Act 2014 to modify or destroy an archaeological site without an Authority from Heritage New Zealand irrespective of whether the works are permitted or a consent has been issued under the Resource management Act or Building Act.*

2. *If you require a replacement consent upon the expiry date of this consent, any new application should be lodged at least 6 months prior to the expiry date of this consent. Applying at least 6 months before the expiry date may enable you to continue to exercise this consent until a decision is made, and any appeals are resolved, on the replacement application.*

Issued at Dunedin this 30th day of November 2015.
Reissued at Dunedin this 21st day of December 2018 to merge resource consents RM15.108.02, RM17.359.01 and RM17.359.03 into RM15.108.02.V1.

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Kylie M. Galbraith
Acting Manager Consents

Appendix 1. Map showing approximate location of discharge points.



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