Further Investigation of the Waihola STP discharge to the Lake Waihola Outlet Channel

Prepared for

Clutha District Council

By

Ryder Environmental

June 2018

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EXECUTIVE SUMMARY

Nutrient samples were taken at representative locations around Lake Waihola and upstream and downstream of the channel into which the Waihola STP discharges. This was done during dry and wet weather conditions, at low and high tide to determine the likely contributions of nutrients from the Waihola STP.

Nutrient levels were highest at the sewage oxidation pond, with negligible values at the rest of the sampling locations.

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1. Introduction

Clutha District Council (CDC) currently holds Consent No. 2002.046, which authorises the discharge of treated sewage to the Lake Waihola outflow channel. The grid reference of the discharge point is NZTM 1376557E 4902692N (Figure 1.1). This consent expired on 1 September 2017.

Figure 1.1 *Location of sewage treatment plant (yellow spot) and outfall (red spot), Waihola.*

To better understand the behaviour of the discharge plume, the CDC engaged Ryder Consulting to undertake an investigation of the plume in September 2016 (Stewart *et al.* 2016). This study provides data on the fate of the plume and likely dilution, but does not address the issue of nutrient inputs.

The major concerns of the ORC centre on the perceived potential for further eutrophication of the Waipori/Waihola lake-Wetland Complex (LWC) by the introduction of excess phosphorus and nitrogen from the Waihola STP discharge. This is exacerbated by the knowledge that the volumes currently discharged may be at the lower end of the spectrum. i.e. daily flows average 102 m^3/d, but there is the potential for significant increase, with consented the volume being 680 m^3/d, and up to 1020 m^3/d allowable under wet weather conditions.

In recent years Lake Waihola has experienced cyanobacteria (blue-green algae) blooms that have impacted on the recreation values of the lake. Any increases in nutrient loadings are expected to increase the potential for such blooms to reoccur.

The ORC has already calculated likely nutrient loads based on provided CDC values for nitrogen and phosphorus (Table 1).

Table 1 *Likely nutrient loads from Waihola STP (from ORC memorandum).*

	Nitrogen		**Phosphorus**	
	Daily (kg N)	Annual (kg N)	Daily (kg P)	Annual (kg P)
Current (102 m^3/day)	1.68	610	0.6	220
Consented (680 m^3/day)	11.22	4100	4.01	1460

Note: nitrogen loads are based on CDC measured mean ammoniacal nitrogen concentrations of effluent.

These values need to be verified. Based on the investigation of the effluent plume (Stewart et al. 2016) it is expected that considerable dilution will take place before nutrients from the STP reach Lake Waihola. Additionally, it is expected that there will be input of nutrients from sources other than the Waihola STP (e.g. rural runoff).

Consequently, more data are needed with respect to nutrient loads likely to be introduced from the STP, the fate of those nutrients, and the likelihood of those nutrients contributing to further eutrophication of the

LWC. Further, the contribution of nutrients introduced from the STP needs to be weighed against the contribution of nutrients introduced from other sources.

CDC engaged Ryder to carry out the investigations that will furnish answers to the ORC's requests.

2. Methodology

To determine the likely contributions of nutrients from the Waihola STP, samples of effluent leaving the oxidation pond were collected along with samples at each of the locations shown in Figure 2.1. Water samples were tested for nitrate – nitrogen, ammonia nitrogen and dissolved reactive phosphorus (DRP). Conductivity at each site was also recorded as an indicator of saline intrusion. This monitoring was carried out at high and low tide, under wet weather and dry weather conditions.

Sampling locations seven and eight (Figure 2.1) were only sampled during the initial monitoring round (dry weather, low tide on 6 Dec 2017) due to the limited access to the sites. Note that despite our best efforts to locate a suitable vessel, no boats were available for transportation to these sites for the remaining sampling rounds and access on foot was not practicable.

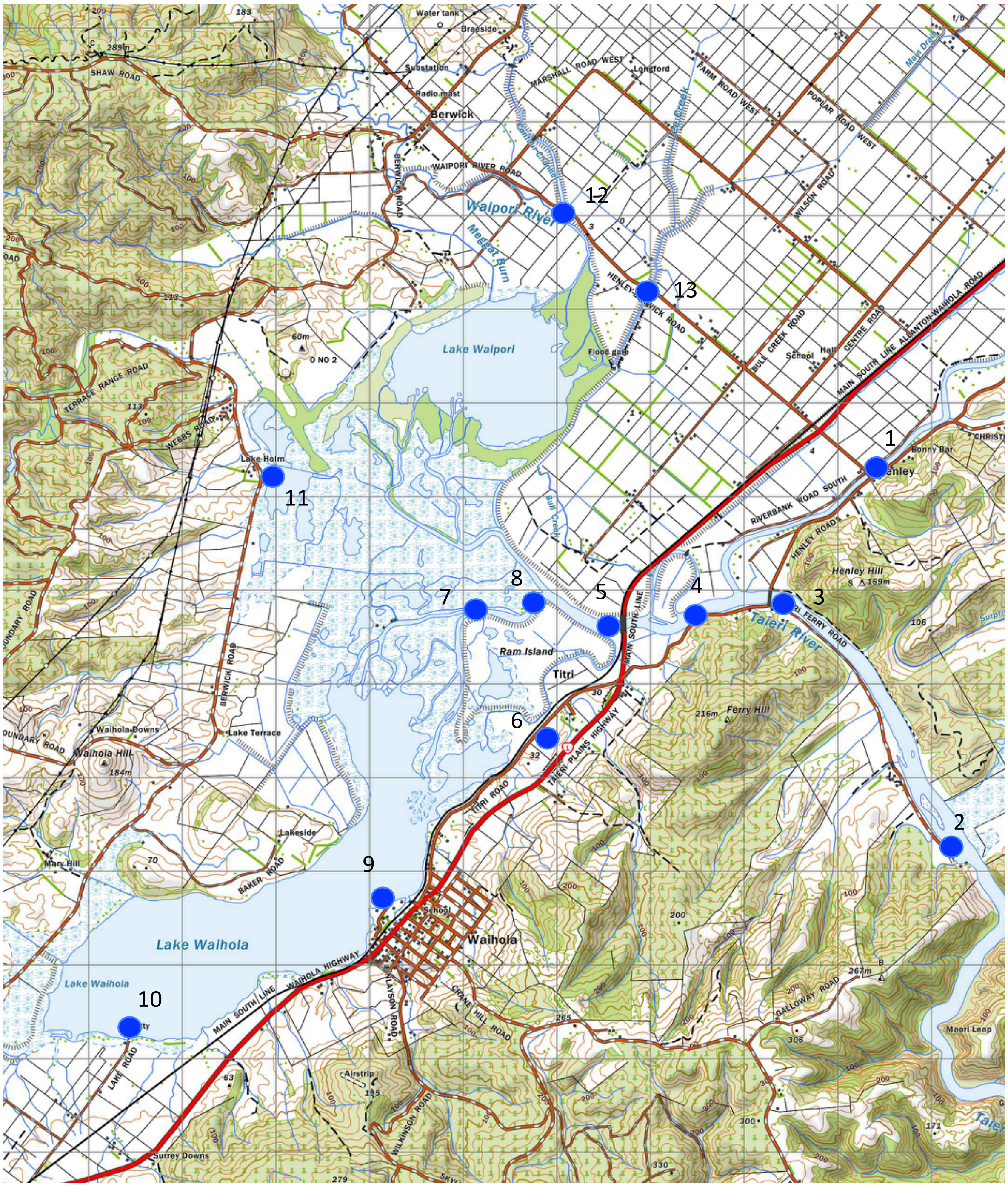

Figure 2.1 *Nutrient sampling locations.*

3. Results

The dry weather monitoring was undertaken on 6th and 8th December 2017. Wet weather sampling was carried out on February 2018 during a four-day long rainfall event that yielded 78 mm of rain. The conductivity at each site is displayed in Figure 3.1 as salinity. Nutrient levels are shown in Figures 3.2 – 3.4.

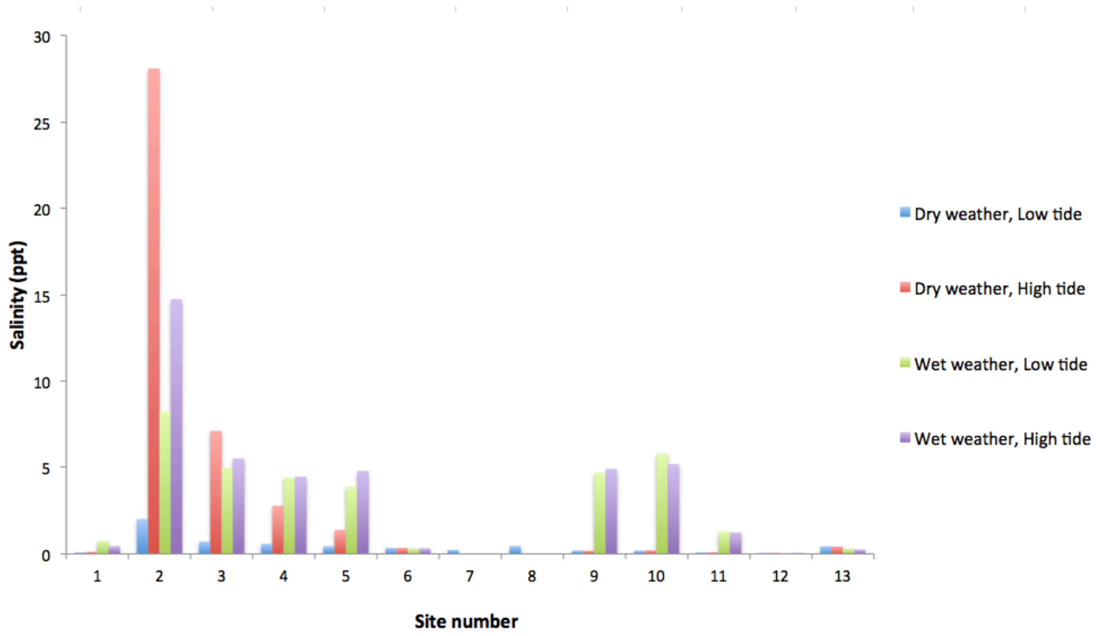

Figure 3.1 *Salinity in parts per thousand for each sampling location and condition.*

The three nutrients of interest were nitrate-nitrogen, ammoniacal nitrogen and dissolved reactive phosphorus (DRP). As expected, higher levels of each of these nutrients were detected at site 6, the sewage oxidation pond, than at the other sites (Figures 3.2, 3.3 and 3.4).

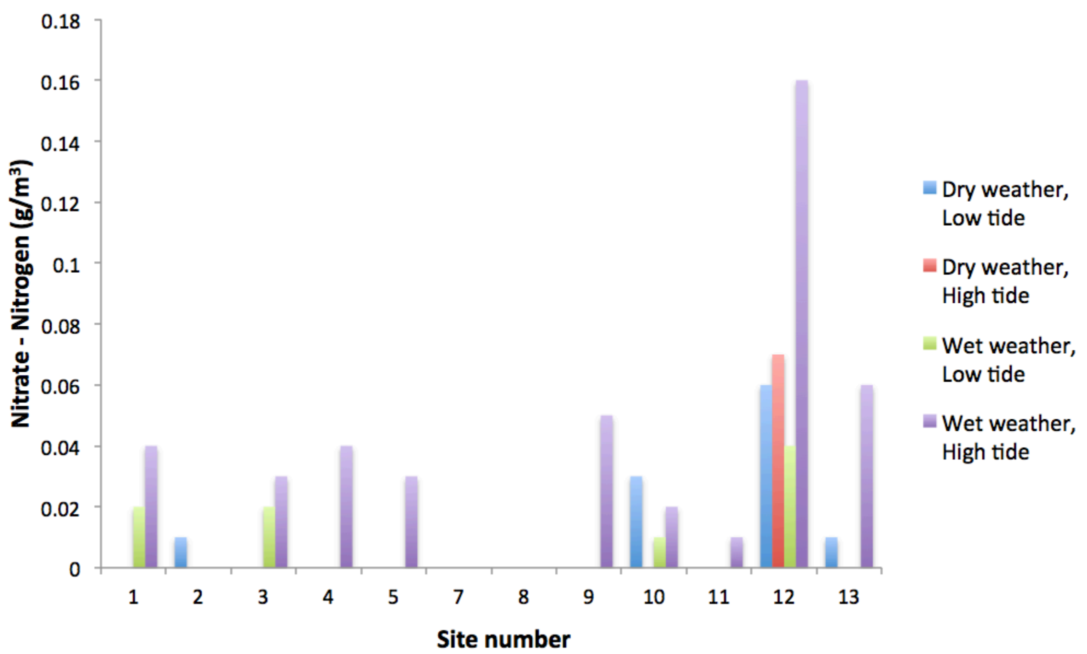

Figure 3.2 *Nitrate–nitrogen levels for each sampling location and condition.*

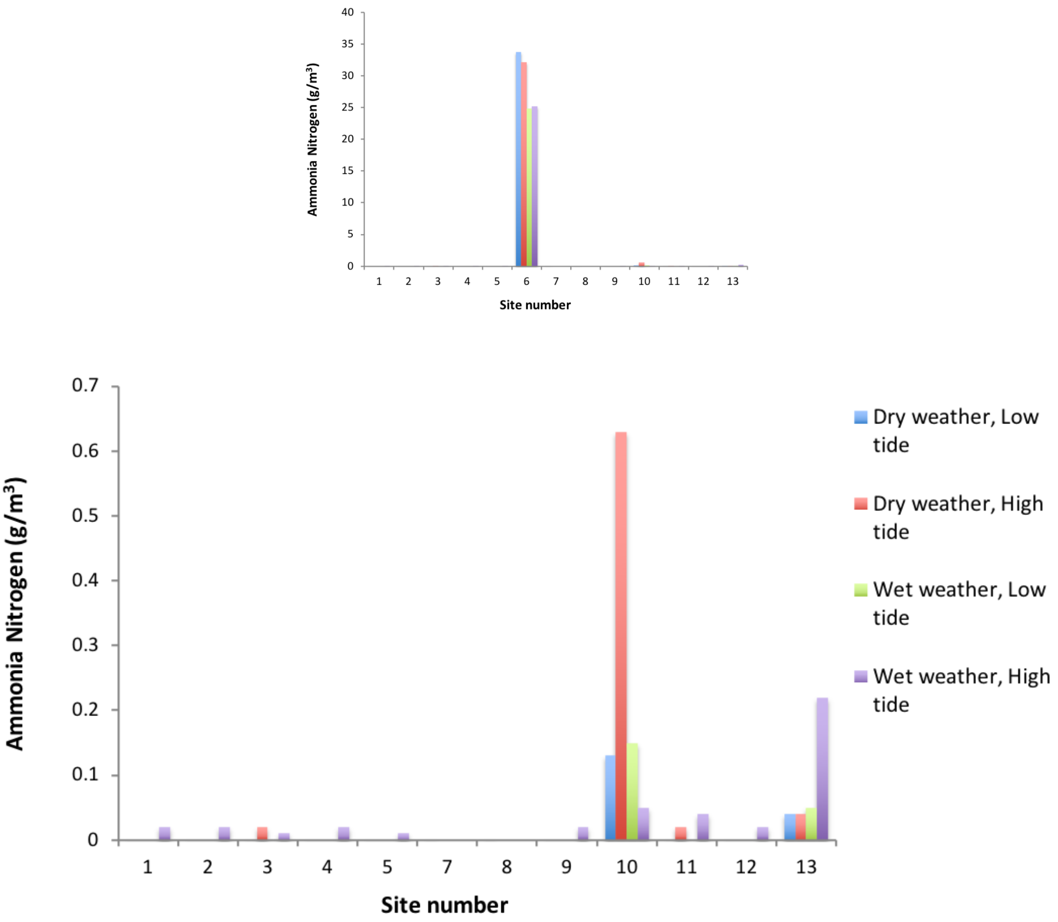

Figure 3.3 *Ammoniacal nitrogen levels for each sampling location and condition. Top: including site 6 (the sewage oxidation pond), and bottom: the same data excluding site 6 and rescaled to show differences between the other monitoring sites.*

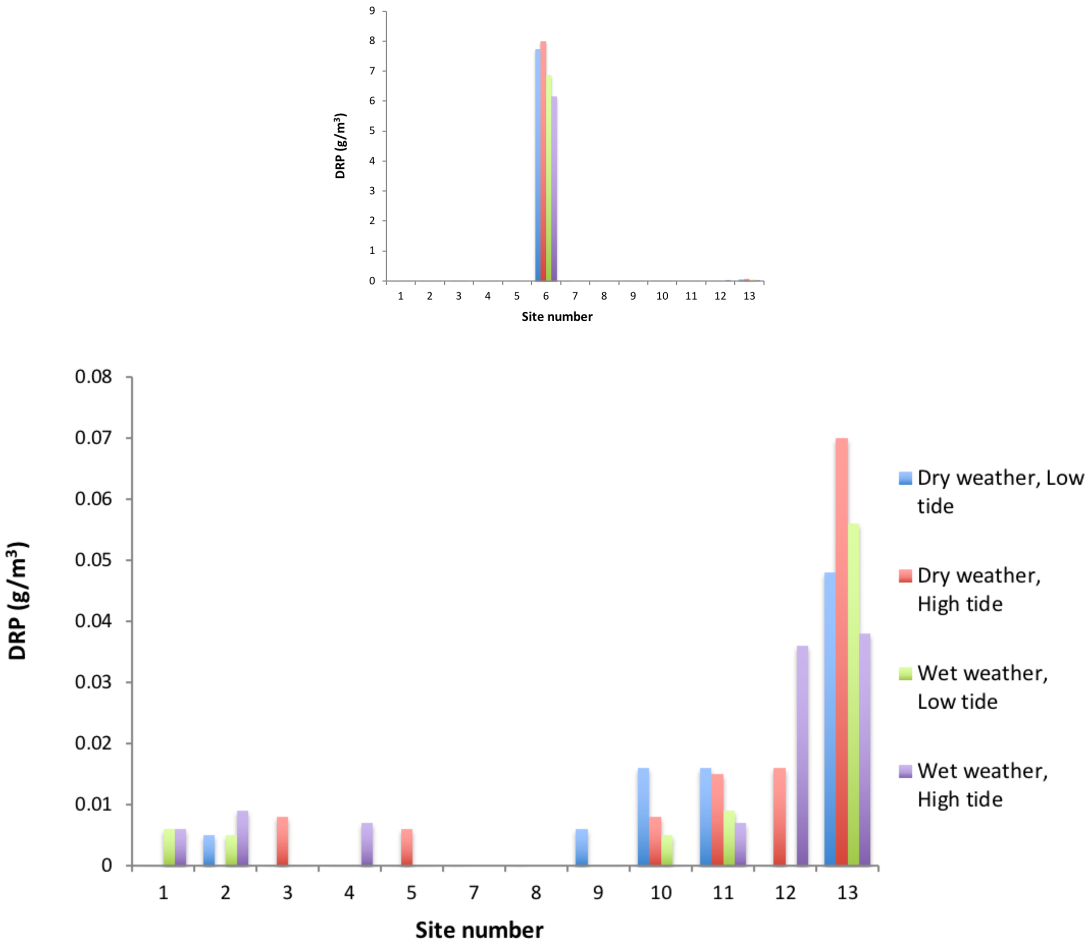

Figure 3.4 *Dissolved reactive phosphorus levels for each sampling location and condition. Top: including site 6 (the sewage oxidation pond), and bottom: the same data excluding site 6 and rescaled to show differences between the other monitoring sites.*

4. Discussion

As can be seen from the monitoring data, nutrient concentrations in Lake Waihola and surrounding waterways are generally two orders of magnitude lower than those in the effluent leaving the treatment complex. This is not unexpected as the previous investigations (Stewart *et al.* 2016) showed rapid and considerable dilution within a few tens of metres of the discharge point. Locations that had slightly elevated levels of nutrients were sites 10, 12 and 13. Once again, this is not unexpected. Site 10 is at the head of Lake Waihola and thus, is not readily flushed. Site 12 and 13 are on the Waipori River/Contour Channel and Lee Creek respectively, and will likely be indicative of runoff from intensively farmed land on the West Taieri Plain.

It is interesting to note that wet weather appears to have a greater effect on nitrate-nitrogen and ammoniacal nitrogen than on DRP, and that this is most noticeable at high tide.

As expected, salinity is highest at sites furthest downstream (i.e. sites 2, 3, 4 and 5), with the salt water wedge likely to reach at least as far as the SH1 Bridge. What is unexpected is the apparent increase in salinity during wet weather at sites 9 and 10, both some distance from the Lake outlet.

In summary, nutrient levels in the Lake Waihola wetland complex are substantially lower that levels observed for effluent leaving the WWTP. Slightly elevated levels of nutrients in some parts of the complex are most likely attributable to runoff from farmed land, with wet weather exacerbating nutrient ingress.

5. References

Stewart, B., Goldsmith, R., and Ryder, G. (2016). *Assessment of the Waihola STP discharge to Lake Waihola outlet channel*. Prepared for Clutha District Council by Ryder Consulting Ltd.