OPUHA WATER LTD
Enabling | Sustainable | Growth

Quarterly Water Quality Report

April 2023 to June 2023

Key Findings

- Moderate to small rain events during the reporting period resulted in short-term increases in **turbidity** in **Lake Opuha** (four days to two weeks).
- The **cyanobacteria (blue-green algae)** health warning was current for **Lake Opuha** during the reporting period but has since been lifted.
- **Heavy metals** and **DDT** concentrations in **Lake Opuha** surface **sediments** were **of low ecological risk**.
- Waitohi Stream/Devils Stream (a tributary of the Opuha River) was the likely cause of poor water clarity in the **Opuha River** at Gorge and Skipton Bridge when sampling was undertaken in June 2023.
- **Macroinvertebrate Community Index (MCI)** scores for the **Kakahu River** since 2008 show similar values upstream and downstream of OWL's discharge location.
- **Quantitative Macroinvertebrate Community Index (QMCI)** scores for the **Kakahu River** in 2022 (April and September) showed similar results upstream and downstream of the discharge. QMCI data for other years did show some differences.

Introduction

Water quality is monitored monthly at Lake Opuha and several waterways throughout the Opuha Scheme and wider Opihi catchment. Opuha Water Ltd (OWL) has several water quality monitoring programs that focus on different areas of interest, such as Lake Opuha and its tributaries, the Upper Opihi River and its tributaries, the Opuha River and lower Opihi River, the Te Ana Wai River and the Kakahu River.

Water samples are collected and analysed for nitrogen, phosphorus, chlorophyll-a, iron, manganese, heavy metals, pesticides, *E. coli*, cyanobacteria, water clarity, dissolved oxygen, pH, and conductivity. River surveys for benthic periphyton (material attached to the surface of rocks in the water) are also undertaken to better understand river health and to quantify the coverage of cyanobacteria and nuisance algae. The specific parameters analysed at each site depends on the objectives of the individual sampling programs.

OWL reviews the data on a monthly basis to identify any significant changes in water quality throughout the scheme and produces a quarterly report for shareholders and stakeholders.

The objective of this report is to highlight interesting data observed during the quarter for OWL's water quality monitoring programs, and to track short-term changes. A more in-depth investigation of the water quality data – such as trend analysis, statistical analysis, and comparison to guidelines – will be undertaken for OWL's Annual Water Quality Report.

Additional information regarding sampling sites is given in *Appendix A – Sampling Locations.*

Lake Opuha

Continuous water quality monitoring occurs at Lake Opuha via sensors located on, or close to, the lake tower. Sensors measure dissolved oxygen, conductivity, turbidity, and temperature close to the lake surface (5m below the surface) and at depth (close to the bottom of the lake). Water quality samples are also collected at the lake and sent to a laboratory for analysis. This type of sampling is undertaken for monitoring cyanobacteria, chlorophyll-a, total nitrogen, and total phosphorus. The chlorophyll-a, total nitrogen and total phosphorus data is combined to produce a lake health metric called the Trophic Level Index (TLI).

The water quality parameters of interest for the 2023 April – June period were **turbidity**, **cyanobacteria,** and **lake sediment.**

Turbidity

Turbidity is a water quality parameter that is easily measured and gives insight into the amount of suspended sediment in a waterway and the visual clarity of the water. Increased turbidity generally corresponds to decreased visual water clarity. Turbidity within Lake Opuha is typically below 5 NTU, unless there is a rain event within the catchment. Figure 1 illustrates the turbidity in Lake Opuha from 1 April 2023 to 30 June 2023 along with the North Opuha and South Opuha river flows. The turbidity sensor at depth was not working correctly from early May until it was replaced on 22 May 2023 (circled data).

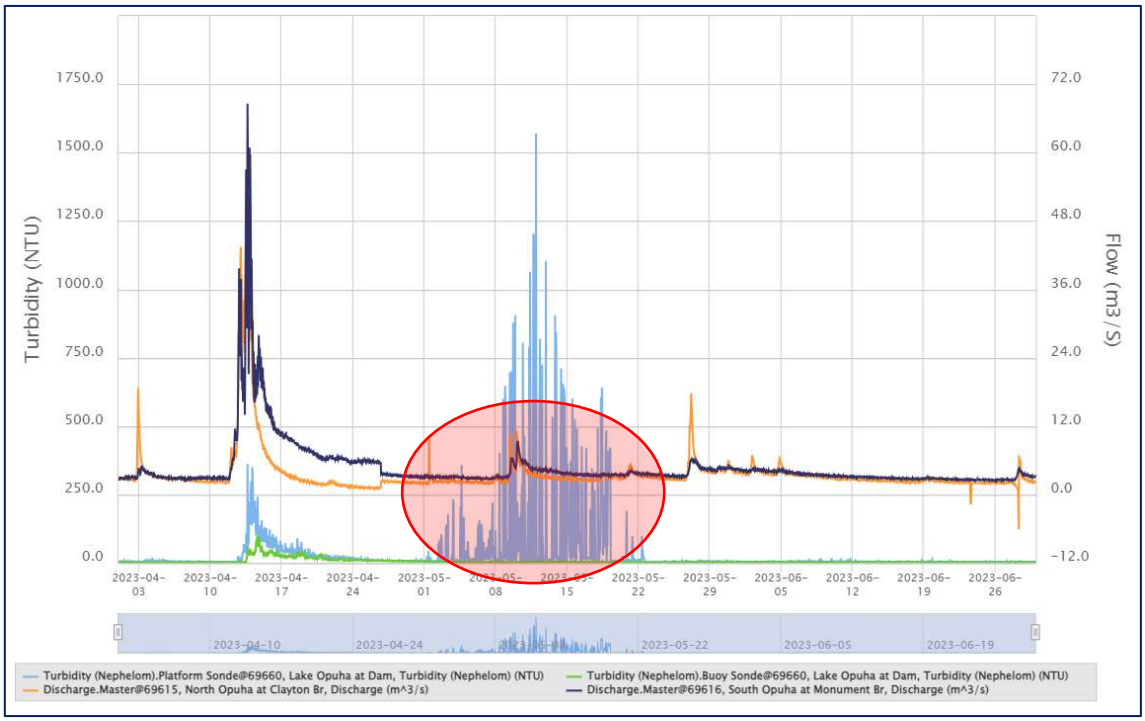


Figure 1: Turbidity in Lake Opuha (depth and surface) and flows from the North Opuha and South Opuha rivers from 1 April 2023 to 30 June 2023.

Increased inflows from the North Opuha River (18 m^3/s) and South Opuha River (4-5 m^3/s) in early April resulted in a small increase in turbidity at depth (increasing from 4 NTU to 10-12 NTU) for approximately 4 days – there was no noticeable increase in turbidity at the surface of the lake (Figure 2).

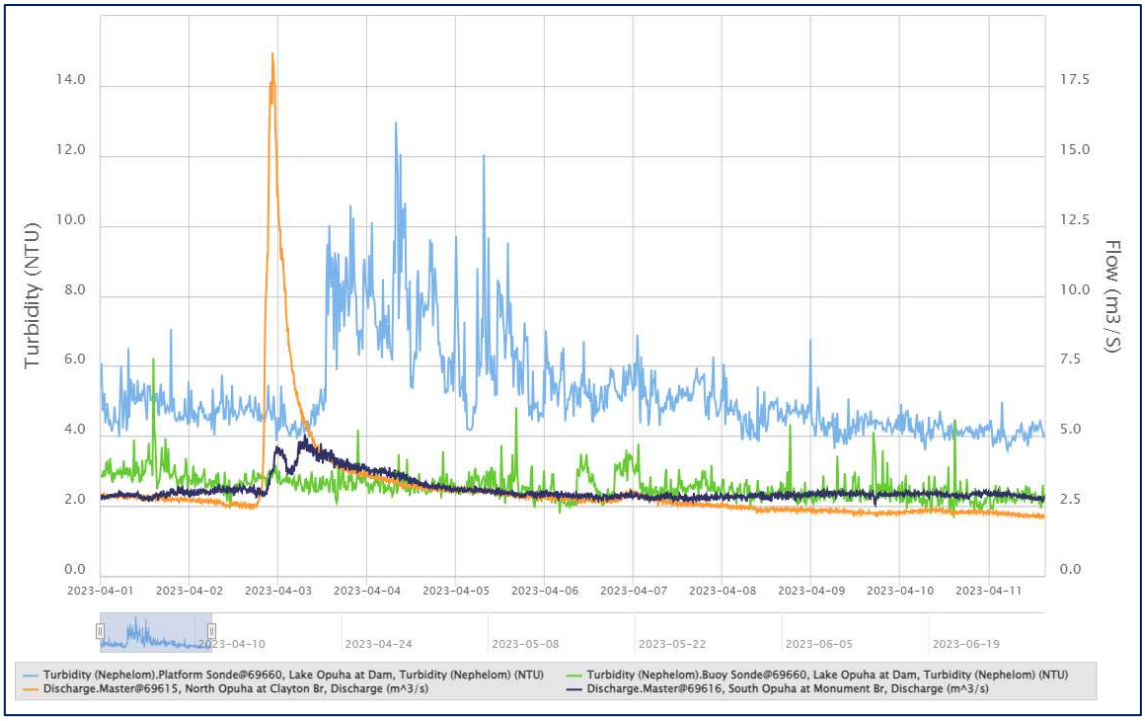


Figure 2: Turbidity in Lake Opuha (depth and surface) and flows from the North Opuha and South Opuha rivers from 1 April 2023 to 11 April 2023.

Increased inflows from the North Opuha River and South Opuha River (approximately 60 m^3/s for both) during 12th April and 13th April 2023 resulted in increased turbidity at depth (>200 NTU) and at the surface (100 NTU) – Figure 3. Turbidity at the surface and at depth returned to <10 NTU around 12 days later on 26th April 2023.

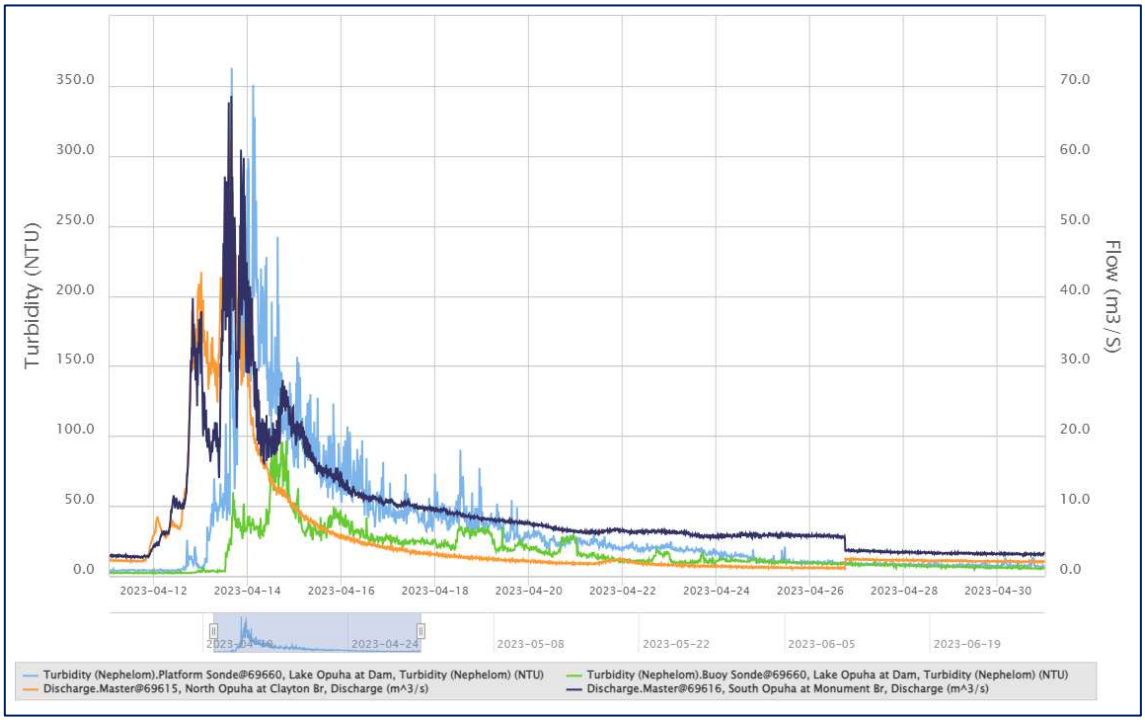


Figure 3: Turbidity in Lake Opuha (depth and surface) and flows from the North Opuha and South Opuha rivers from 12 April 2023 to 30 April 2023.

Another increased flow event from the North Opuha River (17.5 m^3/s) and South Opuha River (6 m^3/s) towards the end of May had only a small effect on turbidity in the lake at depth and at the surface (Figure 4).

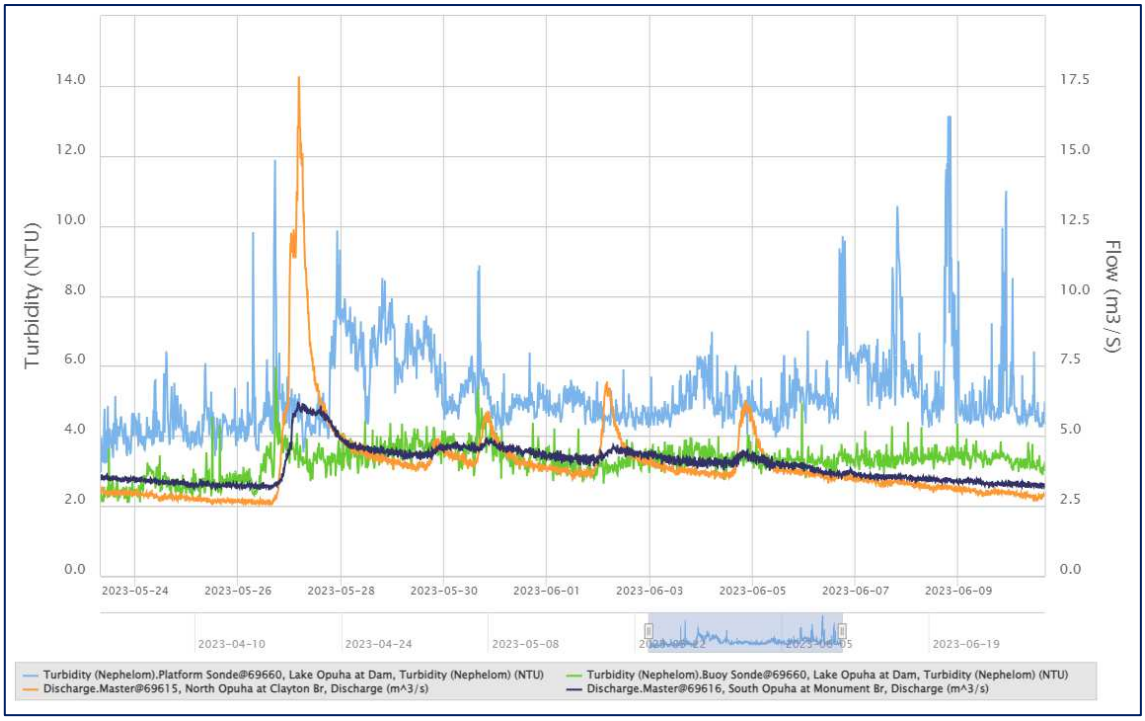


Figure 4: Turbidity in Lake Opuha (depth and surface) and flows from the North Opuha and South Opuha rivers from 23 May 2023 to 10 June 2023.

OWL is working with NIWA, research scientists from the University of Canterbury, and environmental consultants to develop a workplan to better understand the sources of sediment coming into Lake Opuha. This work will give OWL a better understanding of sediment dynamics within the lake and what factors can be controlled to improve water clarity.

Cyanobacteria (blue-green algae)

The cyanobacteria health warning issued on 1 March 2023 was still in place during the April – June period. Cyanobacteria scums were often observed at various locations in the lake (Figure 5) but high levels were never detected in the water samples collected at Bennett's Recreational Reserve Boat Ramp or the Dam Boat Ramp. The health warning was removed in late July 2023 and further details will be provided in the 2023 July – September quarterly water quality report.

Figure 5: Cyanobacteria scums at Bennett's Boat Ramp Area and Dam Wall - 25 May 2023.

Lake Sediment

In June 2023, divers collected surface sediment samples from Lake Opuha that were analysed for total recoverable heavy metals and DDT. Eight samples were collected at various lake locations over two days (12 and 15 June 2023) – Figure 6. The results were averaged across the eight sampling locations (for ease of presentation) and are presented in Table 1.

The average results show that the concentration of antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc and total DDT are all less than their respective sediment guideline values (https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants), indicating low ecological risk. These heavy metal and DDT results are similar to those reported by ECan in 2015.

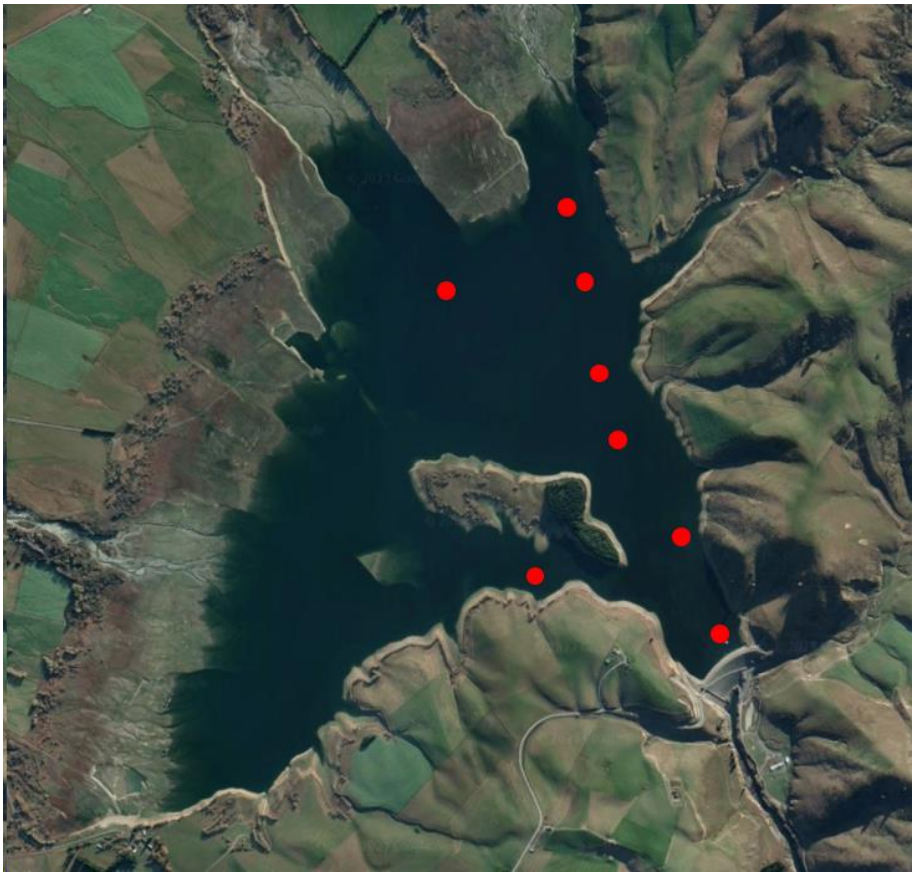


Figure 6: Sediment sampling locations in Lake Opuha (■). Samples collected on 12 June 2023 and 15 June 2023.

Table 1: Heavy metal and Total DDT concentrations in Lake Opuha surface sediment averaged across eight sampling locations. Results are presented as Average ± Standard Deviation. Results are compared to Default Sediment Guideline Values (https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants).

Analyte	Concentration (mg/kg dry wt)	Default Sediment Guideline Value (mg/kg dry wt)
Antimony	0.7 ± 0.1	2
Arsenic	6.0 ± 1.5	20
Cadmium	0.07 ± 0.01	1.5
Chromium	17 ± 1	80
Copper	24 ± 3	65
Lead	22 ± 3	50
Mercury	0.08 ± 0.02	0.15
Nickel	18 ± 2	21
Zinc	80 ± 9	200
Total DDT	<0.006	1.2

Opuha and Lower Opihi Rivers

Data from the Opuha River and lower Opihi River was generally unremarkable during the April to June 2023 period. At times there were small to moderate increases in nutrients (nitrogen and phosphorus) and lower water clarity, with increasing flows.

The 28 June sampling showed some interesting results and observations. The **water clarity** in the Opuha River at Skipton Bridge and the Gorge was considerably poorer than water clarity in the Opuha River below the Downstream Weir. The black disc measurement at Skipton Bridge and the Gorge was 0.14m and 0.1m, respectively, whereas the corresponding value for the Downstream Weir location was 1.9m. Photos of the Opuha River – Skipton Bridge and Opuha River – below Downstream Weir sampling locations (Figure 6) clearly show the difference in water clarity.

Figure 7: Photos of Opuha River – Skipton Bridge and Opuha River – Below Downstream Weir sampling locations on 28 June 2023.

Laboratory results also showed differences between the Skipton Bridge, Gorge, and Downstream Weir sampling locations, with Skipton Bridge and the Gorge reporting higher levels for **suspended sediment concentration**, **dissolved inorganic nitrogen** and **dissolved reactive phosphorus** (Figure 8).

On 27 and 28 June 2023 there was rainfall within the general catchment, with 15mm of rainfall recorded at the Opuha Dam rainfall gauge. This rainfall affected the Opuha River at the Gorge and Skipton Bridge sampling locations but not the water quality in the Opuha River below the Downstream Weir – any low clarity water had not moved through the lake at the time of sampling.

A subsequent investigation located a tributary of the Opuha River that was the likely source affecting the water quality at the Gorge and Skipton Bridge. Waitohi Stream/Devils Stream enters the Opuha River between the below Downstream Weir and Gorge sampling locations (Figure 9). Landowners within the region advised that Waitohi Stream/Devils Stream runs very dirty after rain events. OWL's current assessment of the situation is that this is not caused by the surrounding land use but, rather, due to riverbank destabilisation and erosion after the May 2021 weather event.

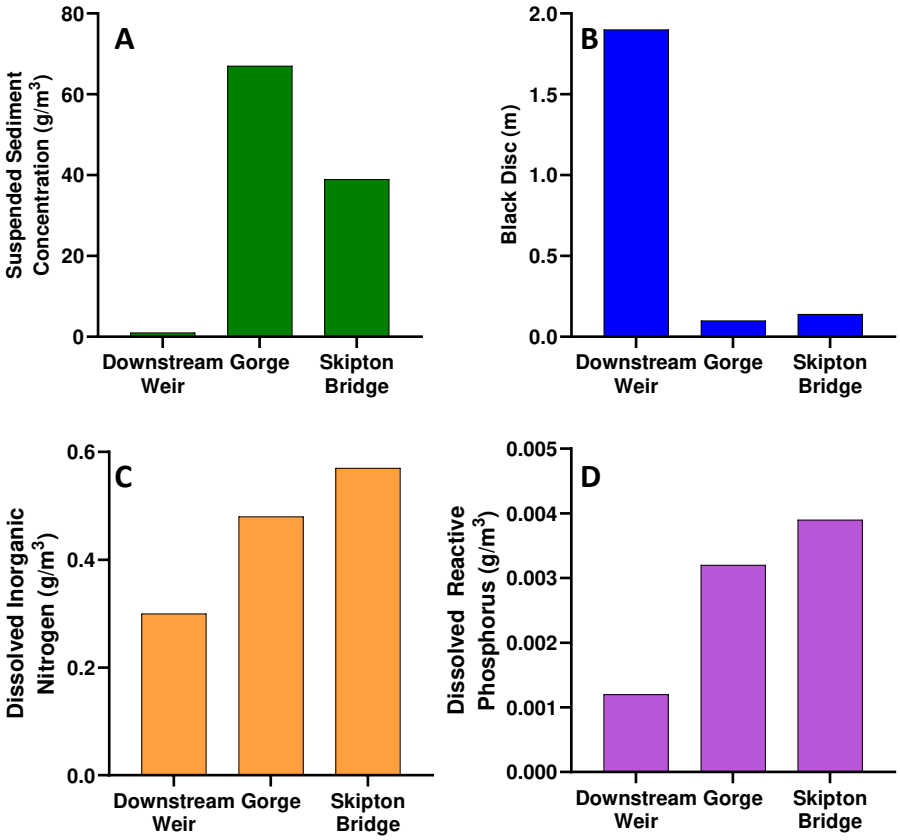


Figure 8: June 2023 water quality data for Downstream Weir, Gorge, and Skipton Bridge sampling locations for A) suspended sediment concentration, B) black disc, C) dissolved inorganic nitrogen and D) dissolved reactive phosphorus.

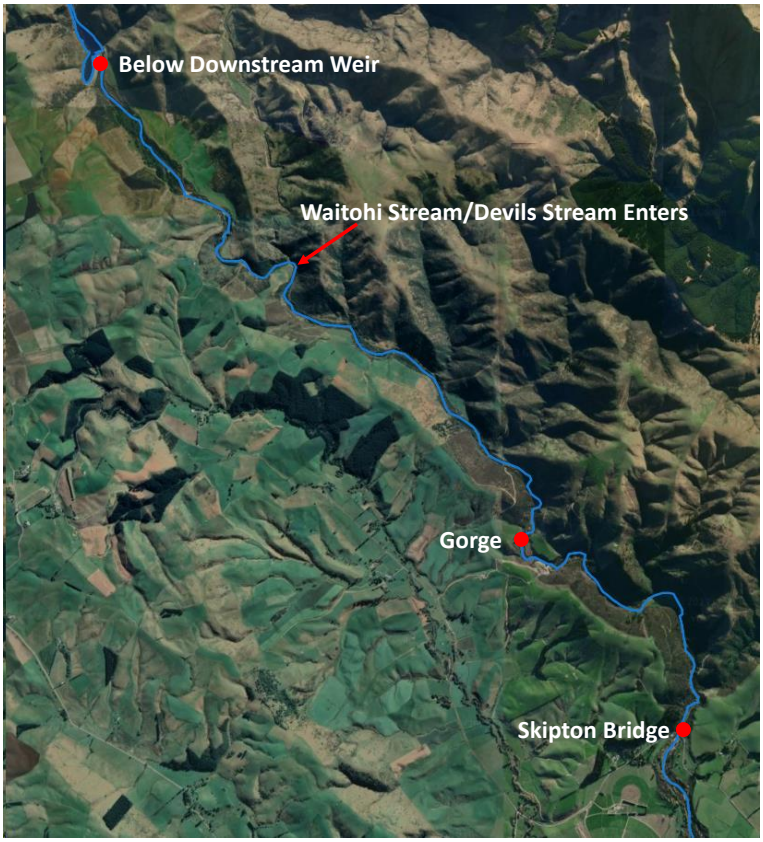


Figure 9: Sampling locations on the Opuha River and the point at which Waitohi Stream/Devils Stream enters the Opuha River.

Kakahu River

Sampling from April to June 2023 in the Kakahu River showed typical increases in suspended solids, nitrate, phosphorus, and turbidity due to small rain events within this period.

An ecological study will be carried out in the Kakahu River in August/September 2023 by 4Sight Consulting. As part of this study, a macroinvertebrate survey will be undertaken. Given this upcoming work, OWL has taken this quarterly report as an opportunity to share results from previous ecological monitoring. Ecological studies are undertaken to investigate the impact that the OWL discharge has on the Kakahu River.

Macroinvertebrates are small animals without backbones that live on or just below the stream bed. Macroinvertebrates include snails, worms, insects, larvae of insects and kōura (crayfish). Macroinvertebrates are an important food source for animals further up the food chain, such as wading birds and fish.

Macroinvertebrates can generally be separated into sensitive species and tolerant species. Sensitive species, as the name indicates, are generally sensitive to pollution and can only thrive in clean and healthy streams, whereas tolerant species can be found in more polluted streams.

Two macroinvertebrate metrics widely adopted by regional councils in New Zealand to assess the health of waterways are the macroinvertebrate community index (MCI) and the quantitative macroinvertebrate community index (QMCI). Generally, the MCI looks at the presence and absence of species (sensitive and tolerant), whereas QMCI also considers the number or abundance of these species.

The **MCI** data from ecological surveys undertaken in the Kakahu River from 2008 to 2022 shows similar MCI scores upstream and downstream of the discharge (data from 2008 to 2021 – Figure 10), indicating that the discharge is having minimal impact on the presence of species within the macroinvertebrate community in the Kakahu River. The 2022 survey showed that the Winchester Hanging Rock Road Bridge (WHR) sampling location (furthest downstream sampling location) was significantly different to other sites (Figure 11), but this is more a reflection of the sampling location rather than the discharge, as WHR tends to have higher nitrogen, phosphorus and *E.coli* than other sampling locations, indicating other inputs within the catchment affecting the health of the Kakahu River.

Figure 10: MCI scores for Kakahu River from 2008 to 2021. Blue bars are for upstream sites and green bars are for downstream sites.

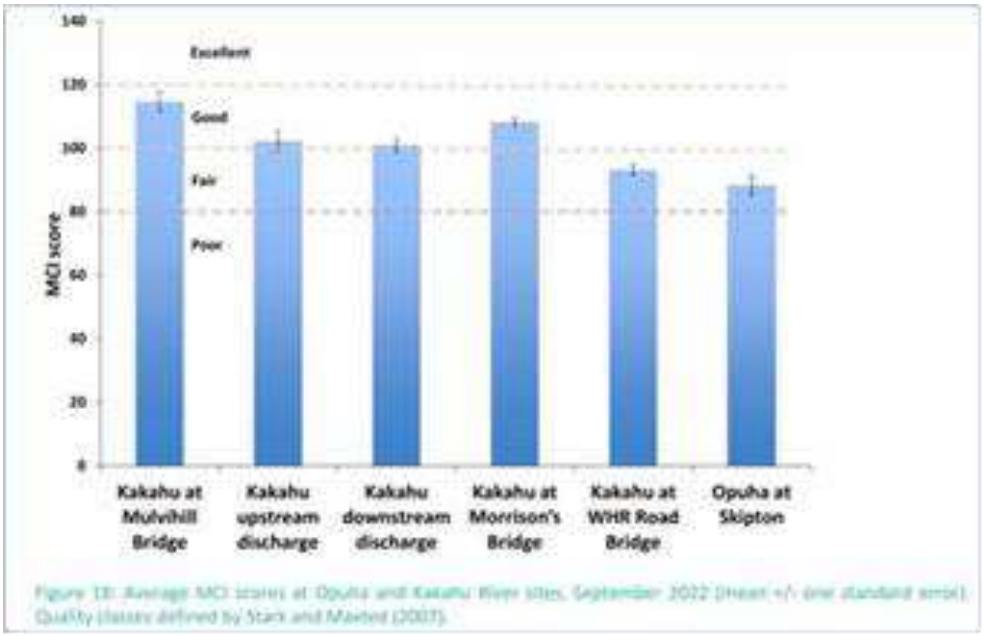


Figure 11: MCI scores for Kakahu River in September 2022.

The **QMCI** data is not as clear as the MCI data, however it does show that in April 2022 and September 2022 there was no evidence to support claims that the discharge affects the ecological health of the river, with similar scores upstream and downstream of the sampling location (Figure 12). Again, the Winchester Hanging Rock Road Bridge sampling location was significantly different to other sites.

The QMCI data for other years (2008-2021) shows differences between upstream and downstream of the discharge on some occasions (Figure 13). During these years there were two downstream sampling locations in the Kakahu River – 100m downstream and 1.3km downstream. The upstream site is significantly different to the 100m downstream site on many occasions, with higher QMCI scores upstream than 100m downstream. During recent years (2015 – 2021), the 1.3km downstream site has not been significantly different to the upstream site, indicating recovery within 1.3km of the discharge.

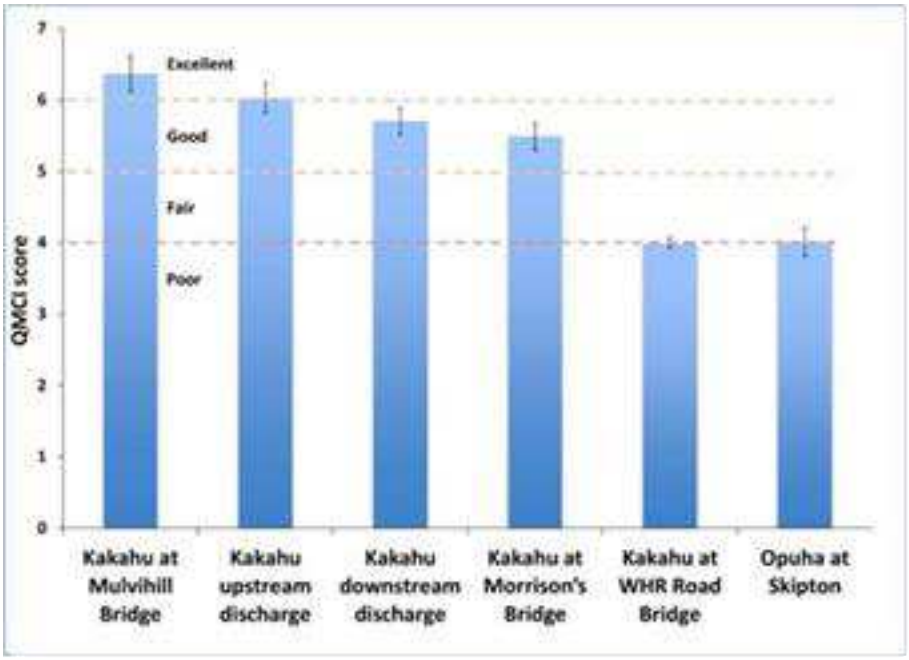


Figure 12: QMCI scores for Kakahu River in September 2022.

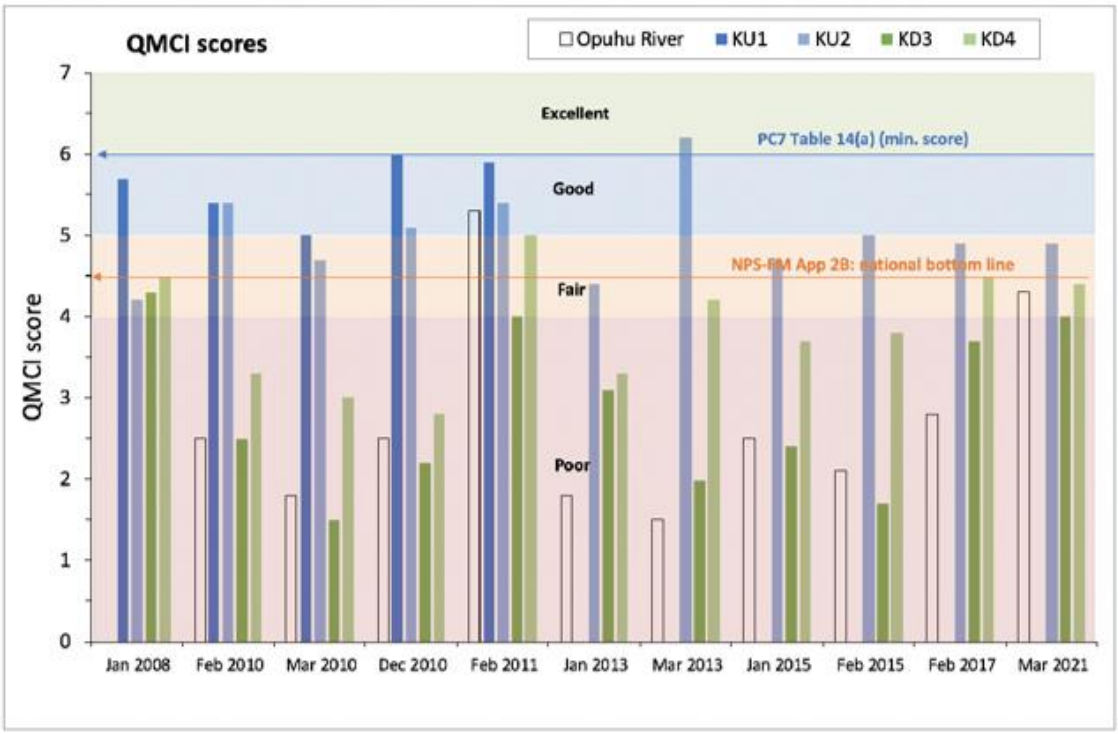


Figure 13: QMCI scores for Kakahu River from 2008 to 2021. Blue bars are for upstream sites and green bars for downstream.

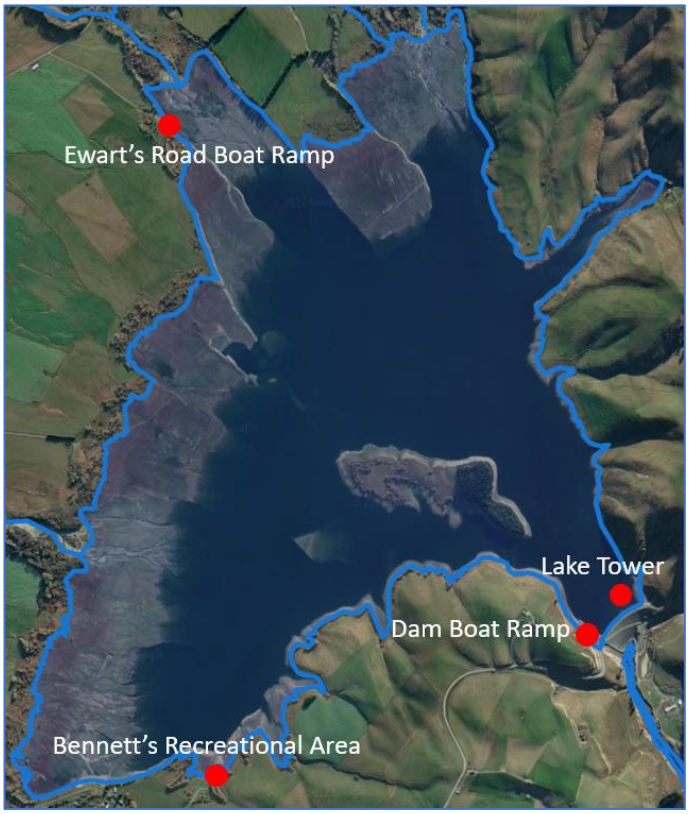
Tributaries of Lake Opuha, Upper Opihi River (including tributaries) and Te Ana Wai River

Sampling from April to June 2023 in the tributaries of Lake Opuha, upper Opihi river (including tributaries) and the Te Ana Wai River showed small increases in nitrate, phosphorus, and turbidity due to small rain events during this period. These increases will be examined further in the next quarterly water quality report when data from the July 2023 rain event is compared to data from previous months .

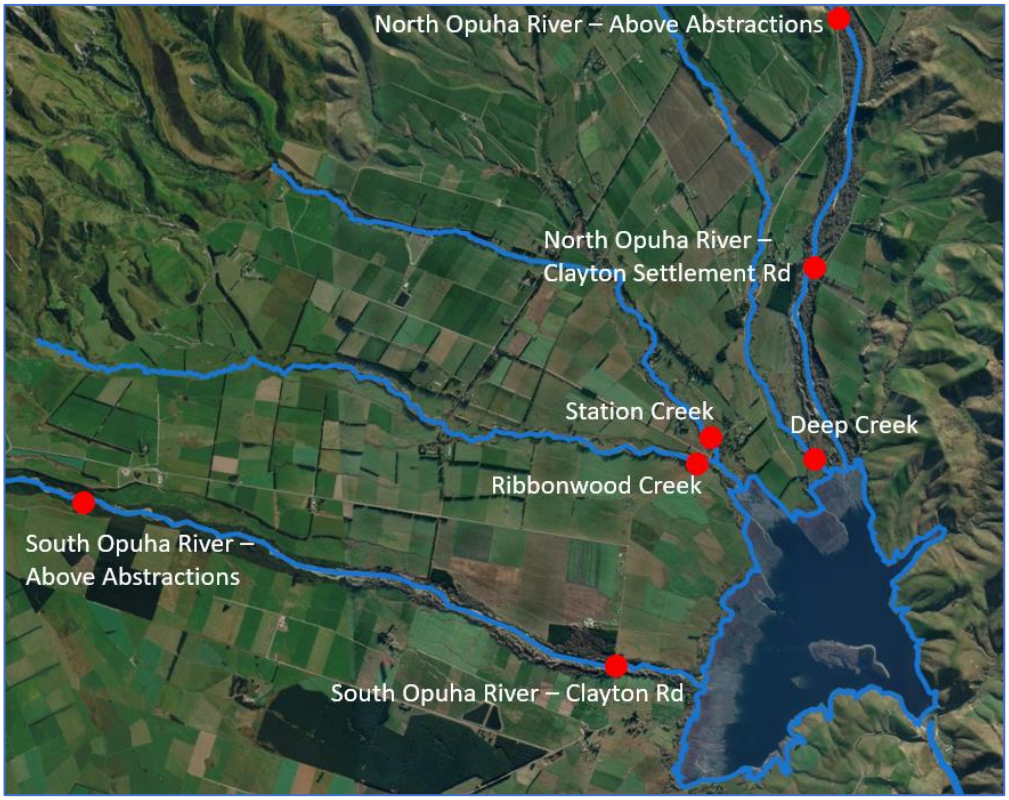
Any questions or feedback regarding the Quarterly Water Quality Report can be directed to Jared Panther (jared@opuha.co.nz; 021 223 7465) or Julia Crossman (julia@opuha.co.nz; 021 535 174).

Appendix A – Sampling Locations

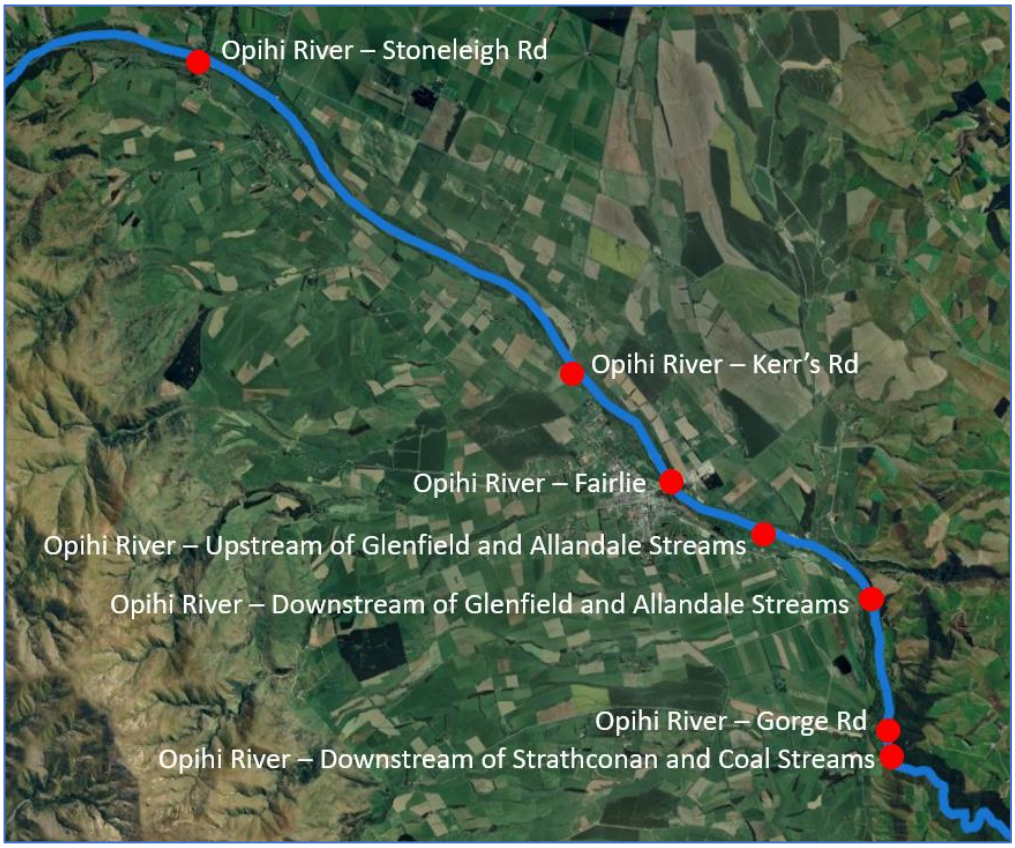
Lake Opuha Sampling Locations



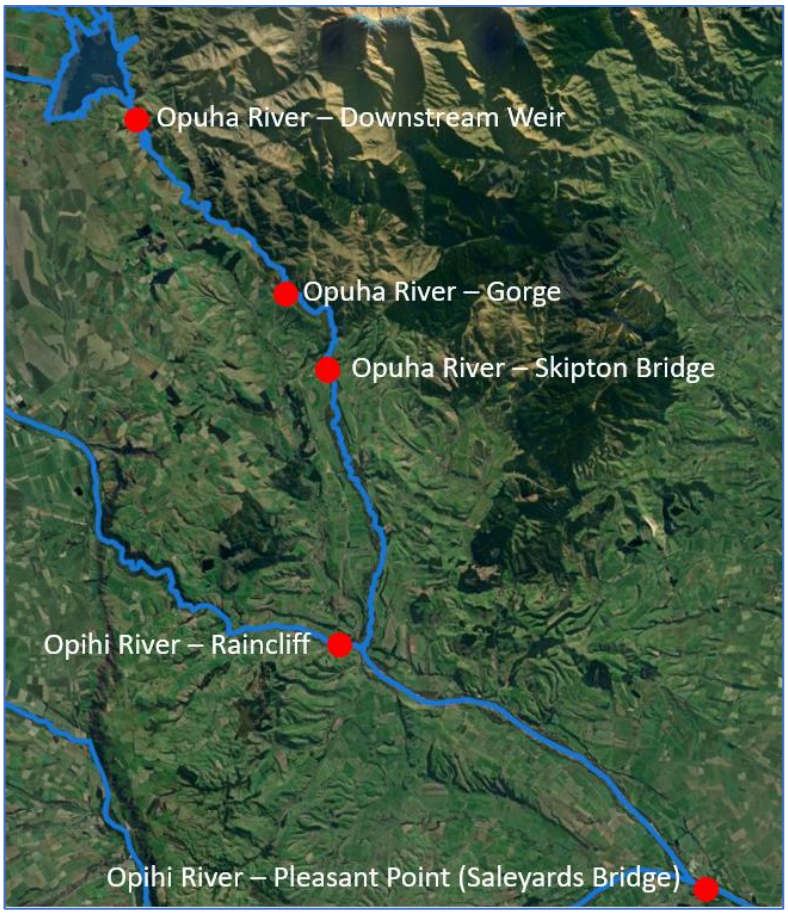
Tributaries of Lake Opuha Sampling Locations



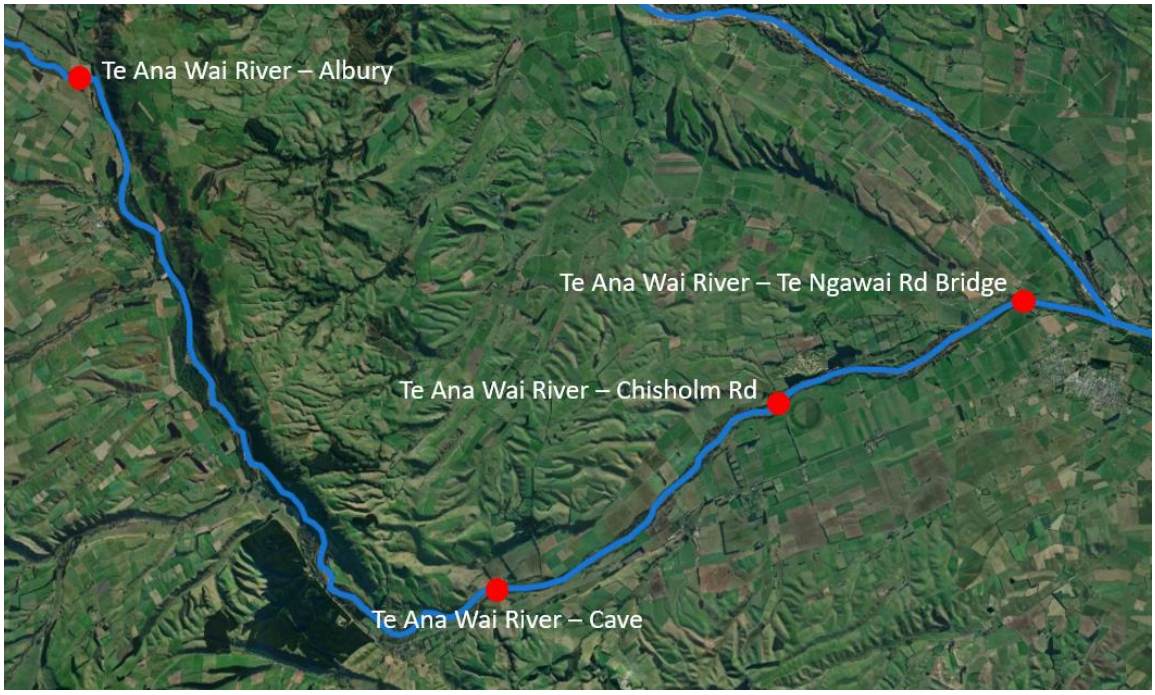
Upper Opihi River Sampling Locations



Opuha River and Lower Opihi River Sampling Locations



Te Ana Wai River Sampling Locations



Kakahu River Sampling Locations