

19 September 2025
Job No: 1092485.0030

Christchurch City Council
PO BOX 237
CHRISTCHURCH
Christchurch 8140

Attention: Emily Tredinnick

Dear Emily

CCC stormwater treatment wetland assessment - No.1 Drain, Shirley

1 Introduction

The Christchurch City Council (CCC) Three Waters Team has requested an assessment of the current performance of a floating wetland with respect to the treatment of stormwater related contaminants. The wetland is located in the No. 1 Drain, at the Christchurch Golf Course, Shirley.

The floating wetland was constructed in 2019, approximately 200 m upstream of the Horseshoe Lake Road, as a trial stormwater treatment device to support stormwater management under CCC's Comprehensive Stormwater Network Discharge Consent (CSNDC, CRC252525). Post construction monitoring of field water quality parameters and stream ecology was conducted in 2020.

Tonkin & Taylor Ltd (T+T) has been engaged by CCC to undertake surface water monitoring to assess the current performance of the wetland with respect to surface water quality (Contract dated 1 March 2024 and Variation 04 dated 28 November 2024).

1.1 Scope of work

Our scope of work comprised the following:

- Review of existing information.
- Undertake two (2) dry weather monitoring events. Each event included collection of surface water samples and field water quality measurements upstream and downstream of the wetland.
- Undertake two (2) wet weather monitoring events. Each event included collection of surface water samples and field water quality measurements upstream and downstream of the wetland through each rainfall event (first flush, peak rainfall event, and day-after rain).
- Laboratory testing at an IANZ accredited laboratory of surface water samples for a selection of parameters.
- Data analysis.
- Preparation of this report summarising the water quality findings.

2 Site description

No. 1 Drain is a small waterway located in the suburb of Shirley, flowing northeast through the Christchurch Golf Club (the golf course). Further downstream, it drains into Waikakariki – Horseshoe Lake, which serves as a tributary to the Ōtākaro – Avon River (Appendix A). Upstream of the golf course, the drain is piped, while downstream of Joy Street it transitions into an open channel. This spring-fed waterway also collects stormwater runoff from the upstream urban catchment.

Historically, the section of No. 1 Drain within the golf course was lined with concrete. The 2010 and 2011 Christchurch earthquakes caused damage to the concrete-lined segments, affecting the bed and banks of the waterway. In response, CCC undertook a restoration and enhancement project for a 500 m section of No. 1 Drain within the golf course. This project was finalised in 2019 and consists of native riparian planting, naturalised channels, two in-line stormwater ponds with a floating wetland system with an orifice outlet weir and naturalised plantings. Spring discharges connected to the underlying aquifer upstream of the wetland are likely present¹.

Previous investigations (summarised in Appendix A) conducted in 2020 and 2023 demonstrated increasing species richness and diversity in macroinvertebrate and fish communities, as well as improvements in habitat quality and fish abundance, following the completion of the restoration work. However, these investigations did not include monitoring of the performance of the wetland with respect to treatment of stormwater contaminants – such as copper, zinc, lead, total suspended solids, and polycyclic aromatic hydrocarbons (PAH).

3 Investigation approach

3.1 General

The monitoring plan² involved surface water monitoring at two wetland locations (upstream and downstream of the wetland) in the No. 1 Drain during two rainfall events and two events of prolonged dry weather.

Dry weather events:

- A dry event is defined in the monitoring plan as at least five days with no rainfall.
- Collection of surface water grab samples and field water quality measurements upstream and downstream of the wetland.
- Two dry weather monitoring events were completed.

Wet weather event:

- Wet weather event is defined in the monitoring plan as rainfall forecast of more than 10 mm within 24 hours, and preceded by at least 3 days of dry weather.
- Autosamplers were used to collect stream water samples with every millimetre of rainfall recorded.
- Tasks were divided according to time before, during and after rainfall, with the intention being to target the first flush of stormwater, peak conditions during rainfall, and conditions approximately 1 day after rainfall.
- Day before rainfall: setup and calibrate two autosamplers the day before a rainfall event.
- One day after rainfall (end-rainfall): field composition of samples from the autosamplers into a first-flush sample (after at least 3 mm of rainfall) and a mid-rainfall sample (at peak of rain and

¹ 04/05/2022. Collaborations. No. 1 Drain Wetpond Hydrological Data Review. Report sent by Stuart Easton and Gareth Taylor to Christchurch City Council.

² Waikakariki/Horseshoe lake closed landfill monitoring plan, October 2024, Prepared for CCC by T+T, Ref 1092485.002.

at least 20 mm of rain recorded) upstream and downstream of the wetland; and collection of grab samples upstream and downstream the day after rainfall.

- Two wet weather monitoring events were completed.

A summary of the water sampling and analysis plan is presented in Table 3.1.

Table 3.1: Water sampling and analysis plan

Sampling type	Number of events	Media sampled	Sample analysis
Dry weather	2	Surface water at 2 locations	Electrical conductivity, pH, dissolved organic carbon and total hardness as CaCO ₃ , suspended sediment concentration (SSC), ammonia-N, nitrate-N, nitrite-N, and total kjeldahl nitrogen, dissolved metals (copper, lead, boron, zinc), trace-level polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH).
Wet weather	2	Surface water at 2 locations, three samples per event	Electrical conductivity, pH, dissolved organic carbon and total hardness as CaCO ₃ , suspended sediment concentration (SSC), total suspended solids (TSS), ammonia-N, nitrate-N, nitrite-N, and total kjeldahl nitrogen, dissolved metals (copper, lead, boron, zinc), trace-level polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH).

3.2 Sampling methodology

Water samples were collected following T+T contaminated sites field procedure manual ³.

Grab surface water samples were collected directly into laboratory supplied sample containers using a 'mighty gripper' sampling rod and the sampling location recorded. Water field parameters (including dissolved oxygen, pH, temperature, and electrical conductivity) were recorded using a YSI multiparameter field meter.

CCC supplied auto-samplers (6712 Full-size Portable Sampler, Teledyne Isco, with a rainfall gauge) were used at the upstream and downstream sites to collect surface water samples from the stream into transitional containers. The autosamplers were set to collect samples of stream water into transitional containers with every 1 mm of rainfall that was recorded by the dedicated rain-gauges. For the second rainfall event the autosampler collection interval was adjusted to collect one sample into transitional containers every 2 mm of rain to ensure the autosamplers did not fill all 24 transitional containers before the peak rain event conditions had occurred.

The day following the rainfall event, samples were composited in the field into laboratory supplied containers to represent first flush, peak rainfall and post rainfall stream conditions by evaluating the intensity and duration of rainfall recorded by the autosampler rain-gauges.

3.3 Assessment criteria

- No. 1 Drain and Broomfield Waterway are categorized as Spring-fed Plains-Urban streams under Environment Canterbury's Land and Water Regional Plan (LWRP).
- Dissolved oxygen (DO) levels were compared against the LWRP Freshwater Outcome minimum of 70% saturation for Spring-fed Plains-Urban streams and the National Bottom Line of 4 mg/L set by the National Policy Statement for Freshwater Management 2020 (NPSFM).

³ T+T. contaminated site field procedures manual. December 2025.

- In the absence of an LWRP Freshwater Outcome value for pH, the LWRP Receiving Water Standard (Schedule 5) range of 6.5–8.5 was used for reference.
- Temperature measurements were compared against the LWRP Freshwater Outcome threshold of 20°C.
- Water chemistry parameters were compared with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality⁴ (ANZG) for 90% and 99% freshwater species protection. Adjusted guideline values have been calculated based on reported dissolved organic carbon (DOC), total hardness, pH and/or temperature where appropriate for select contaminants (e.g. copper, lead, zinc, ammonia, nitrate).
- The Comprehensive Stormwater Network Discharge Consent (CRC252424) Mahere Wai āwhā and Stormwater Management Plan for the Ōtākaro-Avon Catchment Draft 2024 documents maximum attribute limits for dissolved copper, zinc, lead, and total suspended solids in water.

3.4 Data quality

A quality assurance and quality control (QA/QC) programme was implemented as part of the field procedures, which included:

- Decontamination of sampling equipment between sampling locations and events.
- Collection of field blank and duplicate samples⁵.
- Collection directly into laboratory supplied sample containers and the sampling location recorded.
- Preservation of samples for chemical analysis with ice during transport from the field to the laboratory.
- Transportation of samples with accompanying chain of custody documentation.
- Compliance with laboratory sample holding times.
- Laboratory testing by an accredited laboratory.

The laboratory testing was undertaken by Hill Laboratories. The laboratories quality control measures include testing of blanks with all batches of samples and frequent replicates and spikes, along with peer review of worksheets. Standard laboratory QA/QC reports were not examined as part of this project but are available from the laboratories on request.

Data quality results are reported in Appendix G.

3.5 Sampling summary

Surface water sampling details are presented in Table 3.2 and sampling location plan in Appendix A.

Table 3.2: Water sampling summary

Sampling date	Event	Media sample	Sample type	Locations
05/02/2025	Dry events 1	Surface water	Grab sample	2
03/03/2025	Dry event 2	Surface water	Grab sample	2

⁴ ANZG. 2018. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

⁵ Field blank and duplicates were collected as part of a wider investigation which included investigation of the Horseshoe lake landfill.

Sampling date	Event	Media sample	Sample type	Locations
17/03/2025	Wet event 1, fist flush	Surface water	Auto-sampler (collected on 19/03/2025)	2
19/03/2025	Wet event 1, mid-rainfall	Surface water	Auto-sampler (collected on 19/03/2025)	2
20/03/2025	Wet event 1, End-rainfall	Surface water	Grab sample	2
30/04/2025	Wet event 2, fist flush	Surface water	Auto-sampler (collected on 01/05/2025)	2
30/04/2025	Wet event 2, mid-rainfall	Surface water	Auto-sampler (collected on 01/05/2025)	2
04/05/2025	Wet event 2, End-rainfall	Surface water	Grab sample	2

Details regarding composite samples are presented in Table 3.3 and Table 3.4 for respectively wet event 1 and wet event 2.

During wet event 1, the first flush sample consisted of a composite of 3 bottles covering stream conditions following rainfall from 3 to 5 mm and a mid-event sample of a composite of 7 bottles covering stream conditions following rainfall from 10 to 16 mm.

During wet event 2, the first flush sample consisted of composite of 3 bottles covering stream conditions following rainfall from 6 to 10 mm and the mid event sample of a composite of 5 bottles covering stream conditions following rainfall from 36 to 44 mm for SW09 and 3 bottles covering rainfall from 20 to 24 mm for SW10 due to battery failure occurring after 26 mm of rain had fallen.

Rainfall data for the monitoring period are presented in Appendix B.

Table 3.3: Composite samples for SW10 and SW09 during wet event 1 (March 2025)

	Bottles sampled details						
	SW10			SW09			
Bottle #	Date	time	Composite sample	Date	time	Composite sample	Rainfall (mm)
1	18/03/2025	10:47		18/03/2025	10:56		1
2	18/03/2025	12:10		18/03/2025	12:13		2
3	18/03/2025	12:37	First Flush	18/03/2025	12:38	First Flush	3
4	18/03/2025	14:19		18/03/2025	14:23		4
5	18/03/2025	16:50		18/03/2025	17:13		5
6	18/03/2025	18:30		18/03/2025	18:39		6
7	18/03/2025	19:01		18/03/2025	19:04		7
8	18/03/2025	19:26		18/03/2025	19:42		8
9	18/03/2025	20:05		18/03/2025	20:09		9
10	18/03/2025	20:29	Mid event	18/03/2025	20:40	Mid event	10
11	18/03/2025	21:06		18/03/2025	21:13		11
12	18/03/2025	21:44		18/03/2025	21:46		12
13	18/03/2025	22:18		18/03/2025	22:21		13

Bottle #	Bottles sampled details						Rainfall (mm)
	SW10			SW09			
Date	time	Composite sample	Date	time	Composite sample		
14	18/03/2025	22:57		18/03/2025	23:00		14
15	18/03/2025	23:38		18/03/2025	23:41		15
16	19/03/2025	01:24		19/03/2025	02:04		16
17	Total						16.5

Table 3.4: Composite samples for SW10 and SW09 during wet event 2 (April-May 2025)

	Bottles sampled details						
	SW10			SW09			
Bottle #	Date	Time	Composite sample	Date	Time	Composite sample	Rainfall (mm)
1	29/04/2025	22:16		29/04/2025	22:13		2
2	30/04/2025	02:10		30/04/2025	02:11		4
3	30/04/2025	02:44	First flush	30/04/2025	04:09	First flush	6
4	30/04/2025	06:13		30/04/2025	06:26		8
5	30/04/2025	07:34		30/04/2025	07:58		10
6	30/04/2025	08:32		30/04/2025	08:44		12
7	30/04/2025	09:10		30/04/2025	09:30		14
8	30/04/2025	10:02		30/04/2025	10:38		16
9	30/04/2025	11:03		30/04/2025	11:19		18
10	30/04/2025	11:36	Mid event	30/04/2025	11:55		20
11	30/04/2025	12:13		30/04/2025	12:42		22
12	30/04/2025	12:52		30/04/2025	13:28		24
13	30/04/2025	13:35		30/04/2025	14:14		26
14	Autosampler failure			30/04/2025	15:17		28
15				30/04/2025	16:19		30
16				30/04/2025	17:38		32
17				30/04/2025	18:56		34
18				30/04/2025	20:26	Mid event	36
19				30/04/2025	21:08		38
20				30/04/2025	22:11		40
21				30/04/2025	23:39		42
22				01/05/2025	00:59		44
23				01/05/2025	02:20		46
24	Total			01/05/2025	03:16		48

4 Surface water results

4.1 Water quality parameters

Graphs of water quality parameters and assessment criteria are presented in Appendix D.

Temperatures upstream and downstream of the wetland were cool to moderate, ranging from 12.3°C to 20.6°C. These temperatures generally complied with relevant guidelines, except for a slight exceedance downstream of the wetland during the second dry event on 03/03/2025. Downstream temperatures were slightly higher during both dry events, while upstream temperatures were slightly higher during both wet events, likely due to water retention within the wetland during dry periods. Recorded temperatures were consistent with those observed in previous years (2022¹ and 2023⁶).

pH values were generally neutral, ranging between 6.92 and 7.73, complying with relevant guidelines, except during the first wet event on 20/03/2025, when higher pH levels were recorded in the field both upstream and downstream of the wetland with reported values of up to 11.59. Tap water was tested during this event, registering a pH of 7.1, but no explanation for the anomalously high field pH values was identified. Laboratory reported pH values for the same samples were within the range of the other results. Interestingly, higher pH values exceeding 8.5 were recorded within the pond system in February 2023⁶. No significant differences in pH were observed between upstream and downstream locations.

Dissolved oxygen (DO) concentrations in the pond were generally low, ranging from 4.01 mg/L to 6.92 mg/L. These values met relevant guidelines, with the highest DO concentration recorded downstream during a wet event. DO levels have improved since the 2016 baseline survey; however, DO concentrations remained consistently lower downstream in both post-restoration monitoring rounds. The observed concentrations are consistent with data from recent surveys in 2022¹ and 2023⁶.

Dissolved oxygen percent saturation ranged between 40.1% and 96.9%, falling below the LWRP Freshwater Outcome threshold of 70% during three out of four monitoring events, both upstream and downstream of the wetland. Percent saturation was generally higher upstream than downstream and was consistent with previously reported values from 2022 and 2023.

Total hardness was moderate ranging between 10 and 85 g/m³ as CaCO₃. Dissolved organic carbon (DOC) ranged between 0.5 and 7 g/m³.

⁶ August 2023. No. 1 Drain Restoration Ecological Monitoring 2023. Prepared for Christchurch City Council by instream Consulting Ltd.

4.2 Stormwater related contaminants

Water chemistry summary tables and figures are presented in Appendix E along with assessment criteria. Laboratory analysis certificates are included in Appendix F.

4.2.1 Total Suspended Solids (TSS) and SSC (Suspended Solid Concentration)

TSS was analysed during wet event monitoring only and SSC during dry and wet events.

TSS concentrations ranged from <3 mg/L to 220 mg/L (Figure 8.8).

A notable spike in TSS concentrations, reaching up to 220 mg/L, was observed upstream in the first flush sample collected during the second wet monitoring event. This elevated TSS level may be attributed to stream maintenance activities, including weed removal, carried out by Citycare during the beginning of the rainfall event. These activities likely contributed to elevated TSS levels both upstream and downstream during the first flush sampling of this event.

In general, TSS concentrations were lower downstream compared to upstream, except for the mid-rainfall sample collected during the second wet monitoring event. This anomaly could also be linked to the weed removal work conducted by Citycare during the start of rainfall in the second wet weather event.

SSC concentrations ranged from <11 and 25 mg/L. SSC concentrations were reported below or the laboratory reporting limit detection upstream and downstream during all monitoring events with the exemption of samples collected during the first flush for both wet weather monitoring event.

4.2.2 Copper, lead, zinc

Copper, lead, and zinc results are presented in Figure 8.9, Figure 8.10 and Figure 8.11, respectively. All three metals exhibit similar patterns, with low concentrations during dry conditions, then elevated concentrations upstream during first flush and mid-rainfall. Downstream concentrations did not exceed peak upstream concentrations at any point, though were generally highest at the end of both wet weather events. Downstream concentrations exceeded upstream concentrations at the end of wet weather event 2. This may be attributed to wetland saturation and reduced water residence time during the high-volume rainfall event.

Copper

Dissolved copper concentrations ranged from <0.0005 mg/L to 0.0064 mg/L, while total copper concentrations ranged from 0.00068 mg/L to 0.0077 mg/L.

- During dry weather, dissolved copper was detected at low levels (<0.0005–0.0005 mg/L), with comparable concentrations upstream and downstream.
- Wet weather monitoring revealed a significant increase in both dissolved and total copper concentrations (relative to dry conditions), which was more pronounced during the second wet weather event. Concentrations peaked during the first flush and mid-rainfall samples but decreased in the post-rainfall samples.
- Upstream dissolved and total copper concentrations were generally higher than downstream values, except in the post-rainfall sample during the second wet weather event. This is likely due to reduced water retention and saturation in the wetland caused by the prolonged and intense rainfall.
- Downstream dissolved copper concentrations exceed the ANZG 99% freshwater species protection criteria during the second wet weather only in samples collected during mid and post rainfall. No exceedance of site specific ANZG 90% freshwater species protection criteria and Avon catchment maximum attribute level for Cu were noted downstream.

- Upstream, no exceedance of the Cu ANZG 99% freshwater species protection criteria was observed during both dry weather monitoring events. Dissolved copper exceedance of the ANZG site specific 90% freshwater species protection criteria and the Cu Avon catchment maximum attribute level is noted for the first flush sample collected during the first wet event monitoring and the mid-rainfall sample collected during the second wet event monitoring.
- No other exceedances were observed.

Lead

Dissolved lead concentrations ranged from <0.0001 mg/L to 0.00102 mg/L, while total lead concentrations ranged from <0.00011 mg/L to 0.0042 mg/L.

- During dry weather, dissolved lead concentrations were low and consistent between upstream and downstream (<0.0001–0.0001 mg/L).
- Wet weather monitoring revealed an increase in both total and dissolved lead concentrations compared to dry weather, particularly at upstream locations. These increases were most pronounced in total lead during first flush samples, with concentrations reaching 0.0042 mg/L.
- Upstream concentrations were generally higher than downstream for both dissolved and total lead, except in the post-rainfall sample during the second wet event. As with copper, this may be due to reduced water retention and wetland saturation caused by the rainfall intensity and duration.
- A minor exceedance of the ANZG 99% freshwater species protection criterion was observed for dissolved lead (0.00102 mg/L, exceeding the criterion of 0.001 mg/L). No other exceedances were reported.

Zinc

Dissolved zinc concentrations ranged from <0.001 mg/L to 0.133 mg/L, while total zinc concentrations ranged from 0.0061 mg/L to 0.137 mg/L.

- During dry weather, dissolved zinc concentrations were consistent and low, with similar values upstream and downstream.
- Wet weather conditions resulted in increased zinc concentrations (both dissolved and total), with upstream concentrations generally higher than downstream. However, an exception was observed during the second wet weather event, where higher downstream concentrations were recorded in post-rainfall samples. As with copper and lead, this may be due to reduced water retention and wetland saturation caused by the rainfall intensity and duration.
- Exceedances of the ANZG 99% freshwater species protection criteria for dissolved zinc were observed in all samples collected during wet weather, both upstream and downstream. Exceedances of the ANZG site specific 90% freshwater species protection criteria and CCC Avon catchment maximum attribute level for Zn were observed in all wet weather samples collected upstream, and in downstream samples during the second wet weather event, specifically in the mid-rainfall and post-rainfall samples. No exceedances were recorded during dry weather monitoring.
- During wet weather, the ratio of total to dissolved zinc remained comparable between upstream and downstream locations.

4.2.3 Nutrients

Ammonia

Ammonia concentrations ranged from 0.01 mg/L to 0.109 mg/L (Figure 8.12). Higher concentrations were observed upstream in samples collected during dry weather, first flush, and mid-rainfall, while post-rainfall samples showed higher concentrations downstream. The lowest concentrations were generally recorded during dry weather. During wet weather, ammonia concentrations tended to increase from the first flush through to post-rainfall samples. No exceedances of the ANZG 90% or 99% freshwater species protection criteria were observed.

Nitrate

Nitrate concentrations ranged from 0.02 mg/L to 1.92 mg/L (Figure 8.13). During dry weather, nitrate concentrations were low, with similar levels recorded upstream and downstream (up to 0.046 mg/L). Concentrations increased during wet weather, with higher levels typically observed upstream, except in post-rainfall samples collected during the second wet weather monitoring event, where downstream concentrations were higher. No exceedances of the ANZG 90% and ANZG site specific 90% freshwater species protection criteria were recorded. However, exceedances of the ANZG 99% freshwater species protection criteria were observed during the second wet weather event in the upstream mid-rainfall sample and the downstream post-rainfall sample.

4.2.4 PAHs

PAH results are presented in Figure 8.7. No PAHs were detected above the laboratory reporting limit downstream of the wetland during either dry or wet events. Similarly, no PAHs were detected upstream of the wetland during the dry events, after rainfall for both wet events, or during mid-rainfall sampling for the second wet event.

PAHs were, however, detected above the reporting limit upstream of the wetland during the first wet event in both the first flush and mid-event samples, and during the second wet event in the first flush sample. Low levels of fluoranthene (0.000018 mg/L) and pyrene (0.000013 mg/L) were detected in the first flush sample from the first wet event, with fluoranthene (0.00009 mg/L) also detected in the mid-event sample. Multiple PAHs were detected in the first flush sample from the second wet weather event, with pyrene detected at the highest concentration (0.000032 mg/L).

The differences in PAH detection during mid-rainfall sampling between the two wet events likely reflect variations in rainfall intensity and duration. The second wet event was significantly larger, with mid-event sampling conducted after 20 mm of rainfall had fallen, compared to 10 mm during the first wet event.

No exceedances of the ANZG 90% or 99% freshwater species protection criteria for PAH compounds were recorded.

5 Discussion

Water Quality Parameters

The water quality results provide insight into the conditions within the wetland system and its ability to maintain ecological health under both dry and wet weather scenarios. Temperatures upstream and downstream were within the expected range and largely complied with relevant guidelines, aside from a minor exceedance downstream during the second dry event, likely attributed to water retention in the wetland. The observed temperature trends, including slightly higher downstream temperatures during dry weather and higher upstream temperatures during wet events, align with previous monitoring years and highlight the wetland's moderating influence.

pH values were mostly neutral and compliant with guidelines. Historical monitoring data suggests elevated pH (8.5) occasionally occur within the wetland pond system, possibly related to localised water chemistry changes or biological activity.

Dissolved oxygen (DO) concentrations generally met relevant guidelines and have improved since baseline monitoring. However, percent saturation fell below the LWRP Freshwater Outcome threshold in most events, consistent with prior years. The observed variations between upstream and downstream DO concentrations reflect the wetland's dynamics, with lower downstream levels likely influenced by slower water flow and increased organic processes.

Potential Pollutants

Key characteristics of potential pollutants, including PAHs, TSS and SSC, metals, and nutrients, were also evaluated to assess wetland performance:

- **PAHs:** No exceedances of the ANZG freshwater species protection criteria were recorded. PAHs were mostly below detection limits, except during first flush and mid-rainfall samples, where low levels were detected. Variations in PAH detection between wet events likely reflect differences in rainfall intensity and stormwater runoff mobilisation.
- **TSS and SSC:** A significant TSS spike (220 mg/L) was observed upstream during the second wet event, attributed to stream maintenance activities, such as weed removal, which contributed to elevated levels downstream as well. This highlights the potential impact of external interventions on wetland water quality. Excluding these cases, TSS was generally higher upstream than downstream, suggesting effective sediment retention by the wetland under normal conditions. SSC concentrations, analysed during both wet and dry events, ranged from <11 to 25 mg/L and were typically below detection limits, except for elevated values observed during the first flush of both wet monitoring events.
- **Metals (Copper, Lead, and Zinc):** All three metals displayed similar patterns, with concentrations increasing during rainfall events, particularly for total concentrations during first flush samples. While concentrations were generally higher upstream than downstream, an exception was observed during the second wet event, where downstream measurements were elevated, likely due to wetland saturation and reduced water retention during intense rainfall. Dissolved copper and zinc exceeded ANZG site specific 90% and 99% protection criteria and (for zinc only) the Avon Maximum Attribute Level during wet events, emphasizing the influence of stormwater inputs on water quality. Dissolved lead concentrations showed minimal exceedances, limited to specific wet weather samples. The wetland appears to moderately treat heavy metal loads during smaller rainfall events but may be less effective during high-intensity, high-volume rainfall (Appendix H).
- **Nutrients (Ammonia and Nitrate):** Ammonia concentrations were highest upstream during most sampling events but increased downstream post-rainfall. The lowest ammonia levels were consistently observed during dry weather, likely reflecting reduced inputs under these conditions. No exceedances of protection criteria were observed for ammonia. Nitrate concentrations followed a similar trend, with higher wet weather values observed upstream, except during post-rainfall sampling in the second wet event, where downstream concentrations exceeded upstream levels. Exceedances of the ANZG 99% protection criteria for nitrate were observed in select wet weather samples, indicating increased nutrient mobilisation during stormwater events.

Key Observations and Wetland Performance

Overall, the wetland demonstrates its capacity to manage pollutants under normal conditions, with lower downstream concentrations observed for most parameters, indicating treatment is occurring. However, the system's effectiveness is challenged during high rainfall events, where wetland saturation and reduced residence times lead to higher downstream concentrations of metals, TSS,

and nutrients. This suggests that enhancing the wetland's capacity to manage stormwater surges and maintain retention times during heavy rainfall could further improve its ability to protect downstream water quality.

The consistent compliance with most ANZG criteria during dry weather indicates that inputs under baseflow conditions are not a significant concern. However, the observed exceedances for copper, zinc, and nitrate during wet weather highlight the importance of stormwater runoff as a source of contamination. Targeted efforts to control stormwater inputs upstream of the wetland, such as sediment and erosion control measures, as well as pollution source management, may provide additional benefits in reducing pollutant loads entering the wetland system.

Compliance with CSNDC attribute levels

The wetland is situated at least 1.5 km (or 2 km) upstream of the nearest Avon River surface water monitoring point. Therefore, while the results have been compared to maximum attribute levels, they are not intended to suggest that water quality at downstream monitoring points would exceed compliance thresholds. The focus is instead on assessing the differences in water quality upstream and downstream of the wetland, particularly in relation to the uptake and removal of stormwater contaminants and the performance thresholds that can be inferred from the data.

6 Conclusion

In conclusion, the evaluation of key stormwater contaminants – PAHs, TSS and SSC, metals, and nutrients—demonstrates that the wetland generally reduces stormwater contamination to below guideline values under typical conditions, except during high intensity rainfall events.

This assessment underscores the role of the wetland in improving water quality, particularly under baseflow and moderate rainfall conditions. However, it also highlights areas for improvement to handle the increased pollutant loads during intense wet weather events. Continued monitoring and adaptive management will be essential to optimize the wetland's performance and ensure compliance with water quality protection criteria under varying environmental conditions.

7 Next steps

7.1 Enhance understanding of water quality trends

- **Address Temperature Variability:** Investigate potential factors contributing to downstream temperature exceedances during dry weather (e.g., flow rates, shading, or retention times). Consider increasing planting around the wetland area to mitigate temperature increases.
- **Resolve pH Anomalies:** Further investigate the potentially high pH values during wet events. This could include:
 - Sampling during future events to determine if there is a recurrence.
 - Examining potential sources of alkalinity in stormwater inflows, in particular sampling from separate upstream laterals.
 - Investigating sediment interactions in the wetland by assessing accumulation depths and compaction to evaluate whether maintenance (e.g., excavation) is required to restore capacity or flow paths.
- **Focus on Dissolved Oxygen:** Identify reasons for consistent dissolved oxygen (DO) percent saturation falling below the LWRP threshold. Possible measures include:
 - Enhancing aeration processes within the wetland (e.g., introducing aerators or optimizing vegetation management).

- Conducting a detailed assessment of biological oxygen demand (BOD) and organic load in inflows.

7.2 Characterize and mitigate pollutant sources

- **TSS Management:** Address spikes in total suspended solids (TSS) during wet events, particularly upstream of the wetland by implementing upstream controls, such as sediment traps or erosion control measures. Note also the timing of planned in-stream maintenance works in relation to weather events.
- **Metals (Copper, Lead, Zinc):** Further assess the efficacy of the wetland in removing metals during varying flow conditions (e.g. zinc and copper). If needed, improve metal attenuation by introducing additional vegetative, chemical, or sediment-based filtration.
- **Nutrient Control (Ammonia and Nitrate):** Explore additional measures to improve nutrient retention and assimilation in the wetland, such as nutrient-binding substrates or planting nutrient-absorbing wetland vegetation.

7.3 Wetland optimisation

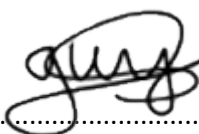
- **Capacity and Retention Time:** Review the hydraulic design of the wetland with regard to water retention and flow rates to optimise performance during high-intensity rainfall events. Measures such as modifying inlet/outlet structures to enhance storage capacity could be considered. Assess hydraulic performance for short-circuiting, identifying preferential flow paths that may be reducing residence time and bypassing treatment zones.
- **Pollutant Treatment Upgrades:** Evaluate whether additional treatment features, such as sedimentation ponds could supplement the current system.
- **Review vegetation maintenance schedules:** Ensure planting is establishing effectively and trimming is timed to support treatment performance and seasonal flow conditions.

8 Applicability

This report has been prepared for the exclusive use of our client CHRISTCHURCH CITY COUNCIL, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

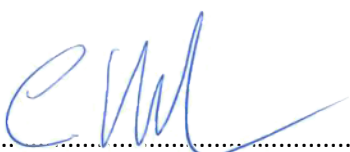
Tonkin & Taylor Ltd

Report prepared by:


.....

Sarah Guy
Environmental Scientist

Authorised for Tonkin & Taylor Ltd by:


.....

Chris Hillman
Project Director

Technical reviewer: Andrea Tuohy, Senior Environmental Scientist; Brad Tiller, Senior Water Resources Advisor

19-Sep-25

t:\christchurch\tt projects\1092485\1092485.0030\issueddocuments\ccc no.1 wetland assessment report. 19.09.2025.docx

Appendix A Location plan and previous investigations

A1 Previous investigation summary

A 2022¹ investigation confirmed that No. 1 Wetland is performing as intended from a hydrological perspective. Key findings include water levels consistently remaining below the weir spillway crest of 11.2 m RL, smaller water level peaks observed at the downstream compared to the upstream (indicating effective lake storage following rainfall), and stable baseflows during periods of low rainfall. The investigation also highlighted a gradual increase in water levels over the year, attributed to the growth of aquatic vegetation in the outlet channel, which reduced outflow conveyance and elevated water levels across the system.

In addition to hydrological performance, the investigation monitored water temperature and dissolved oxygen (DO) levels between January 2021 and May 2021. Pond temperatures showed a seasonal decrease, peaking above 22°C in late January and dropping below 12°C by early May. Seasonal trends revealed that temperatures in the pond and downstream areas were warmer in summer and cooler in winter compared to the upstream inflows. This variation is attributed to the pond's direct exposure to climatic conditions with little shading, while the upstream channel maintained more stable year-round temperatures due to consistent spring-fed groundwater inputs.

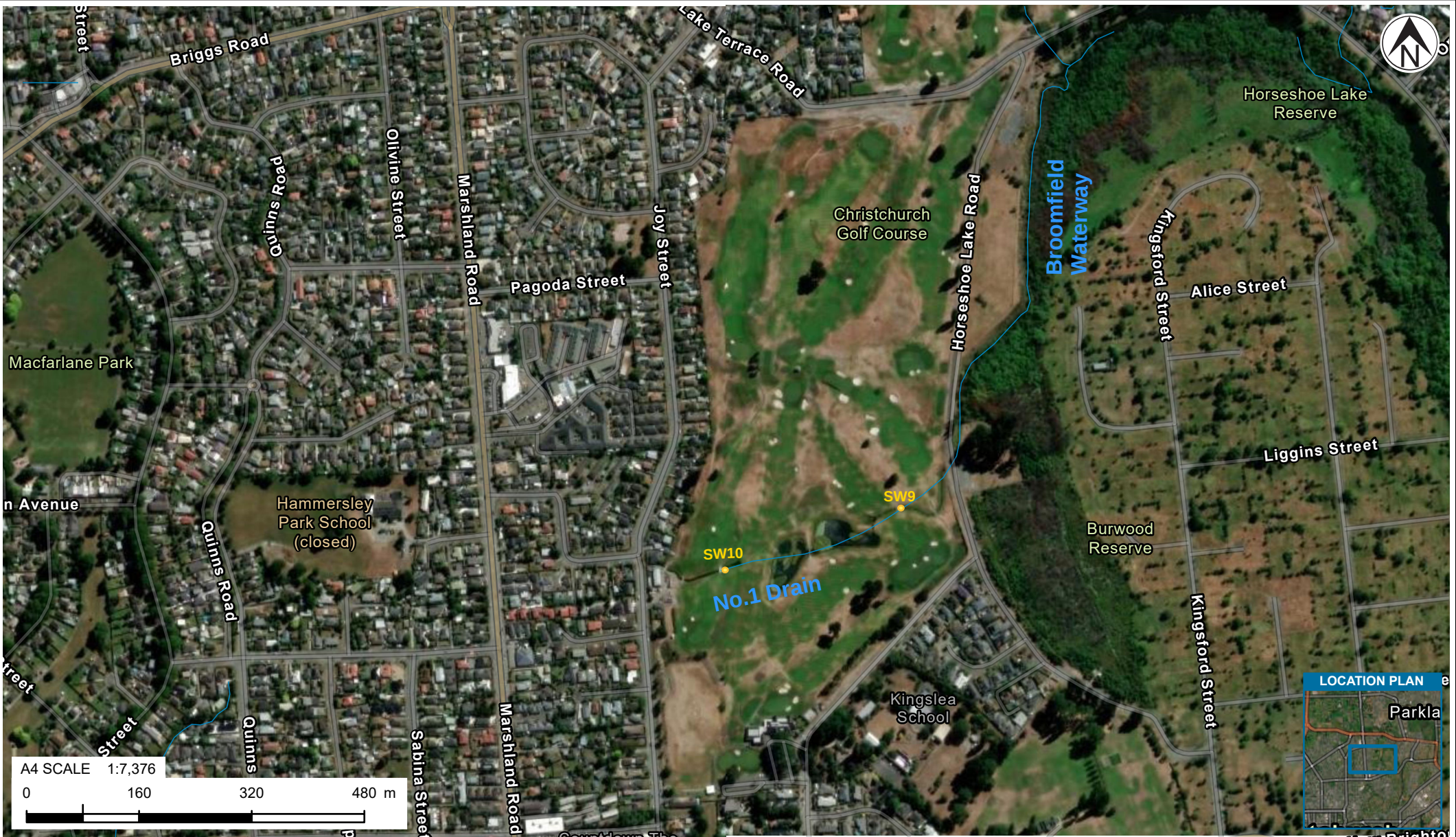
DO concentrations in the pond were generally low, ranging between 4 and 9 mg/L. DO levels were higher at the downstream site during summer, likely due to photosynthetic activity from aquatic vegetation and increased turbulence in the channel. Importantly, no evidence of anoxic conditions or eutrophication was observed in the system during the monitoring period.

A 2023 investigation⁷ reported water temperatures upstream and downstream of the pond ranging from 14.0–15.7°C, neutral pH levels and low DO levels, ranging from 3.91 mg/L (39% saturation) to 6.79 mg/L (66% saturation). Within the pond, water temperature peaked at 23.1°C in February 2023. DO levels were low overall (just above 5 mg/L), with notable increases in February 2023 up to 15 mg/L. Water pH remained neutral during May sampling rounds but increased in February through the pond system to above 8.5.

The Council conducted an ecological monitoring programme to evaluate the success of the restoration. Baseline sampling in No. 1 Drain was conducted in May 2016, prior to the restoration efforts, with subsequent surveys completed in May 2020 and February 2023⁶. Both the 2020 and 2023 studies demonstrated increasing species richness and diversity in macroinvertebrate and fish communities, as well as improvements in habitat quality and fish abundance, following the completion of the restoration work.

⁷ August 2023. No. 1 Drain Restoration Ecological Monitoring 2023. Prepared for Christchurch City Council by instream Consulting Ltd.

A2 Site and sampling locations





www.tonkintaylor.co.nz

Exceptional thinking together

NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS, Earthstar Geographics, LINZ, Stats NZ, Esri, TomTom, Garmin, METI/NASA, USGS, Maxar

PROJECT No. 1092485.0030		
DESIGNED	XXXX	JUL.25
DRAWN	-WEB-	JUL.25
CHECKED		
APPROVED DATE		

CLIENT CHRISTCHURCH CITY COUNCIL
PROJECT CCC STORMWATER TREATMENT WETLAND
TITLE SITE AND SAMPLING LOCATION
SCALE (A4) 1:7,376 FIG No. FIGURE 1. REV 0

Appendix B Autosampler specification

6712

Full-size Portable Sampler

The 6700 Series Portable Samplers have set the industry standard, providing the most comprehensive and durable performance available. With the introduction of our 6712, Teledyne ISCO takes another step toward the ultimate by including SDI-12 interface capabilities.

*Wide range of bottle configurations,
plug-in flow and parameter monitoring*

This full-size portable lets you take full advantage of the advanced 6712 Controller, with its powerful pump, versatile programming, and optional plug-in modules for integrated flow measurement. Setup is fast and simple, with online help just a key stroke away.

The environmentally-sealed 6712 controller delivers maximum accuracy and easily handles all of your sampling applications.

In the Standard Programming Mode, the controller walks you through the sampling sequence step-by-step, allowing you to choose all parameters specific to your application. Selecting the Extended Programming Mode lets you enter more complex programs.

Optional land-line and GSM and CDMA cellular telephone modems allow programming changes and data collection to be performed remotely, from a touch-tone phone. They also provide dial-out alarm.

With eleven bottle choices, the 6712 Sampler lets you quickly adapt for simple or intricate sampling routines. Up to 30 pounds (13.5 kg) of ice fits in the insulated base, preserving samples for extended periods, even in extreme conditions. The 6712 with the "Jumbo Base" option holds bottles up to 5.5 gallon (21 liter).

The 6712 Portable Sampler features a vacuum formed ABS plastic shell to withstand exposure and abuse. Its tapered design and trim 20-inch (50.8 cm) diameter result in easy manhole installation and removal. Large, comfortable handles make transporting safe and convenient—even when wearing gloves.

Teledyne ISCO's 6712 Portable Sampler carries a NEMA 4X, 6 (IP67) enclosure rating. Superior capability, rugged construction, and unmatched reliability make the 6712 the ideal choice for portable sampling in just about any application.



Bottle options are available for practically any sequential or composite application.



Applications:

- Wastewater effluent
- Stormwater monitoring
- CSO monitoring
- Permit compliance
- Pretreatment compliance

Standard Features:

- SDI-12 interface provides "plug and play" connection with multi-parameter water-quality sondes and other compatible devices
- Choice of 11 different glass and plastic bottle configurations ranging from 24 x 1 liter to 1 x 5.5 gallon
- NEMA 4X, 6 (IP67) controller enclosure
- Rugged ABS plastic shell
- Foam-insulated base holds up to 30 pounds (13.5 kg) of ice to preserve samples even in extreme conditions
- Sample delivery at the EPA-recommended velocity of 2 ft/sec., even at head heights of 26 feet
- Pump revolution counter and patented liquid detection sensor ensure accurate sample volumes—and tells you when tubing should be replaced

6712 Full-size Portable Sampler

Size (H x Dia):	27 x 20 in (68.6 x 50.7 cm)
Weight:	Dry, less battery—32 lbs (15 kg)
Bottle Configurations:	24 – 1 Liter PP or 350 ml Glass 24 – 1 Liter ProPak Disposable Sample Bags 12 – 1 Liter PE or 950 ml Glass 8 – 2 Liter PE or 1.8 Liter Glass 4 – 3,8 Liter PE or Glass 1 – 9,5 Liter PE or Glass 1 – 5.5 gallon (21 Liter)PE or 5 gallon (19 Liter Glass, (with optional Jumbo Base)
Power Requirements:	12 VDC (Supplied by battery or AC power converter.)

Pump

Suction Tubing:	
-Length:	3 to 99 ft (1 to 30 m)
-Material:	Vinyl or Teflon
-Inside Dimension:	3/8 in (1.0 cm)
Pump Tubing Life:	Typically 1,000,000 pump counts
Maximum Lift:	28 ft (8.5 m)
Typical Repeatability:	± 5 ml or ± 5 of the average volume in a set
Typical Line velocity at Head height of:	
	@ 3 ft (0.9 m) head height: 3.0 ft/s (0.91m/s) @10 ft (3.1 m) head height: 2.9 ft/s (0.87 m/s) @15 ft (4.6 m) head height: 2.7 ft/s (0.83 m/s)

Liquid Presence Detector:	
	Non-wetted, nonconductive sensor detects when liquid sample reaches the pump to automatically compensate for changes in head heights.

Controller

Dimensions (HxWxD):	10.3 x 12.5 x 10.0 in (26.1 x 31.7 x 25.4 cm)
Weight (dry):	13 lbs (5.9 kg)
Operating Temperature:	32 to 120 °F (0 to 49 °C)
Enclosure Rating:	NEMA 4X, 6 (IP67)
Program Memory:	Non-volatile ROM
Flow Meter Signal Input:	5 to 15 volt DC pulse or 25 millisecond isolated contact closure
Number of Composite Samples:	Programmable from 1 to 999 samples
Real Time Clock Accuracy:	1 minute per month, typical

Software

Sample Frequency:	1 minute to 99 hours 59 minutes, in 1 minute increments. Non-uniform times in minutes or clock times 1 to 9,999 flow pulses
Sampling Modes:	Uniform time, non-uniform time, flow, event. (Flow mode is controlled by external flow meter pulses.)
Programmable Sample Volumes:	10 to 9,999 ml, in 1 ml increments
Sample Retries:	If no sample is detected, up to 3 attempts; user selectable
Rinse Cycles:	Automatic rinsing of suction line up to 3 rinses for each sample collection
Program Storage:	5 sampling programs
Sampling Stop/Resume:	Up to 24 real time/date sample stop/resume commands
Controller Diagnostics:	Tests for RAM, ROM, pump, display, and distributor

Ordering Information

6712 Portable Sampler, Full-size

Includes controller with 512kB RAM, top cover, center section, base, distributor arm, instruction manual, pocket guide 68-6710-070

6712 Portable Sampler, with Jumbo Base

As described above 68-6710-082

Note: Power source, bottle configuration, suction line, and strainer must be ordered separately. Many options and accessories are available for 6712 Samplers; see separate literature for 700 Series Modules and other components to expand your monitoring capabilities. Contact Teledyne ISCO, or your local representative for pricing and additional information.



The 6712 Controller is also an SDI-12 data logger, and has many optional capabilities. Please contact your Teledyne ISCO distributor for more information.

Teledyne ISCO

P.O. Box 82531, Lincoln, Nebraska, 68501 USA
Toll-free: (800) 228-4373 • Phone: (402) 464-0231 • Fax: (402) 465-3091

teledyneisco.com



Teledyne ISCO is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.



L-1107 Rev 2.0
9/18

Appendix C Rainfall data

Rainfall recorded at the closest monitoring station (Botanic Garden)⁸ across the entire monitoring period and sampling event dates are presented in Figure 8.1

Records show that the condition of 5 days without rain prior monitoring event for dry monitoring is satisfied for both dry monitoring events.

Records show that the conditions of at least 10 mm in 24 hr preceded by at least 3 days of dry weather for wet monitoring are satisfy for both monitoring events.

Total rainfall recorded for wet event 1 was 20.2 mm 18-19 March 2025, while total rainfall of 128 mm was recorded between 29 April and 2 May 2025.

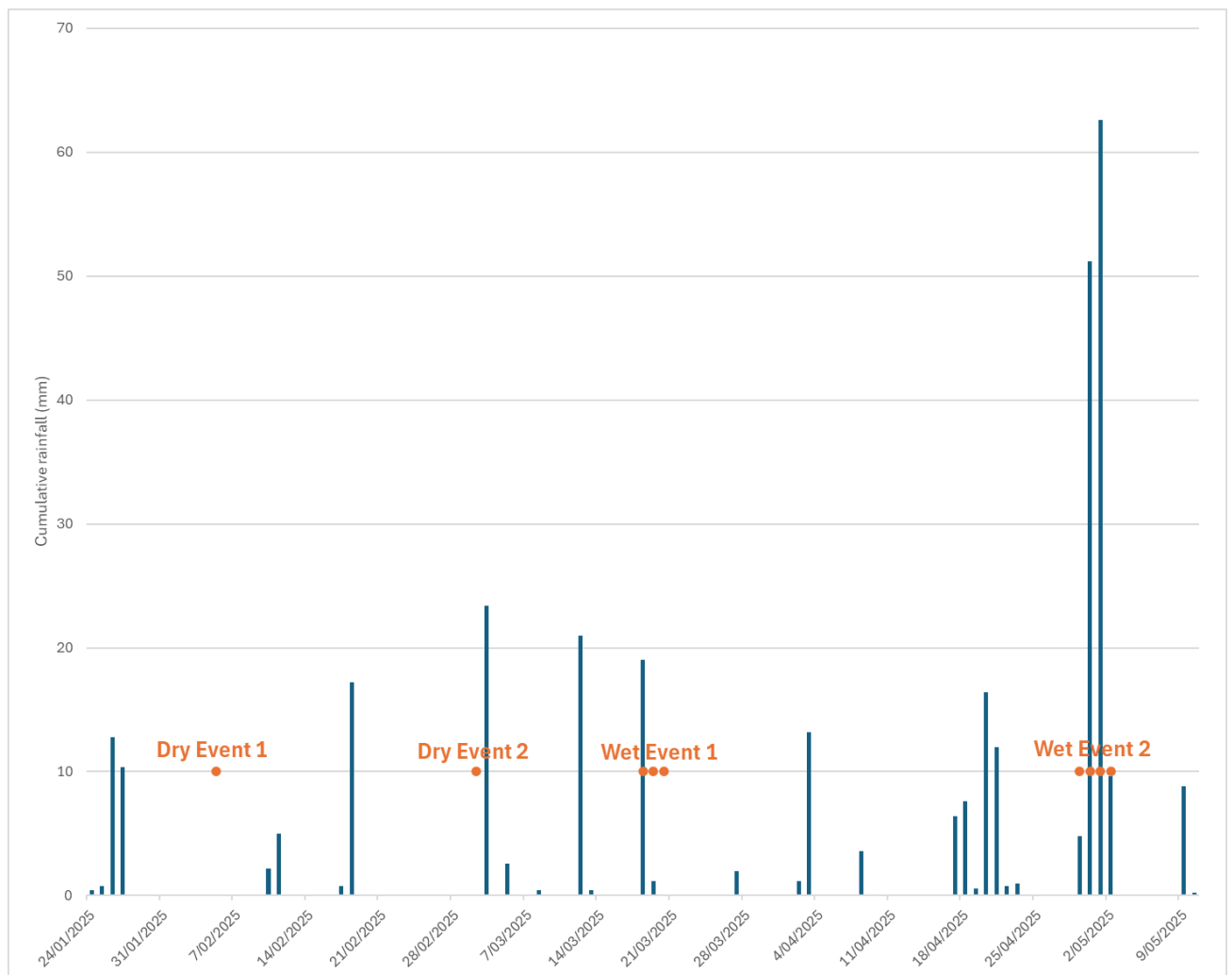


Figure 8.1: Rainfall recorded at the botanic Garden for the duration of the monitoring.

⁸ [Rainfall data | Environment Canterbury](#)

Appendix D Water quality parameters

D1 Field water quality parameter summary table

Appendix D.1 : CCC stormwater treatment wetland assessment - No.1 Drain - Water quality parameters

Sampling site			SW10				SW9			
Location			Above wetland				Below wetland			
Event			DE1	DE2	WE1-End	WE2-End	DE1	DE2	WE1-End	WE2-End
Sample Date			5/02/2025	3/03/2025	20/03/2025	4/05/2025	5/02/2025	3/03/2025	20/03/2025	4/05/2025
Water quality paramters	Unit	Assessment criteria								
Temperature	°C	20 ¹	15.8	17.7	16	15.3	19	20.6	14.9	12.3
Dissolved Oxygen	%	70% ¹	48	96.9	57	40.1	45.5	92.2	53.56	64.7
Dissolved Oxygen	mg/L	4 ²	NR	NR	5.59	4.01	NR	NR	5.37	6.92
Specific Conductance	-µS/cm		NR	134.8	217	240.03	NR	137.8	145.1	197.9
pH	pH Units	6.5-8.5 ³	7.33	7.46	11.59	6.92	7.73	7.62	11.2	7.07

1. Environment Canterbury Land and Water Regional Plan. Spring-fed Plains-Urban streams

2. National Policy Statement for Freshwater Management 2020. National bottom line

3. Environment Canterbury Land and Water Regional Plan. Receiving Water Standard (Schedule 5)

D2 Field water quality parameters figures

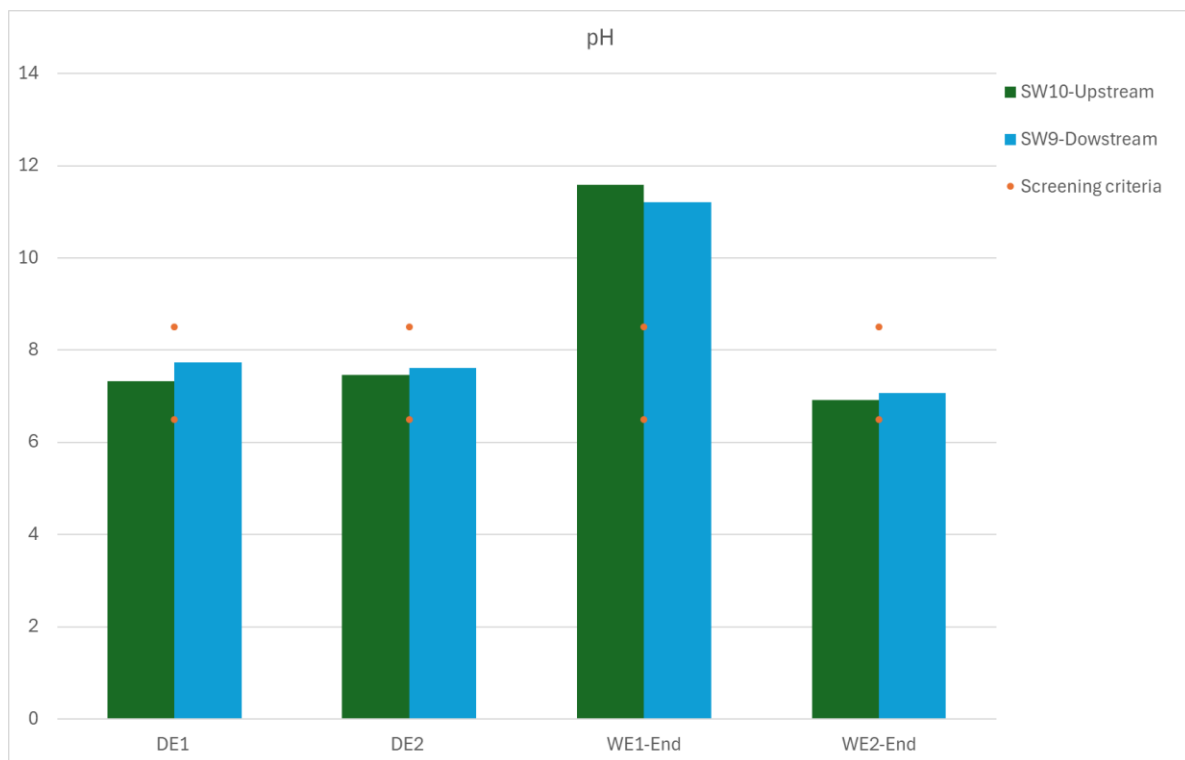


Figure 8.2: Field pH recorded at investigation locations SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

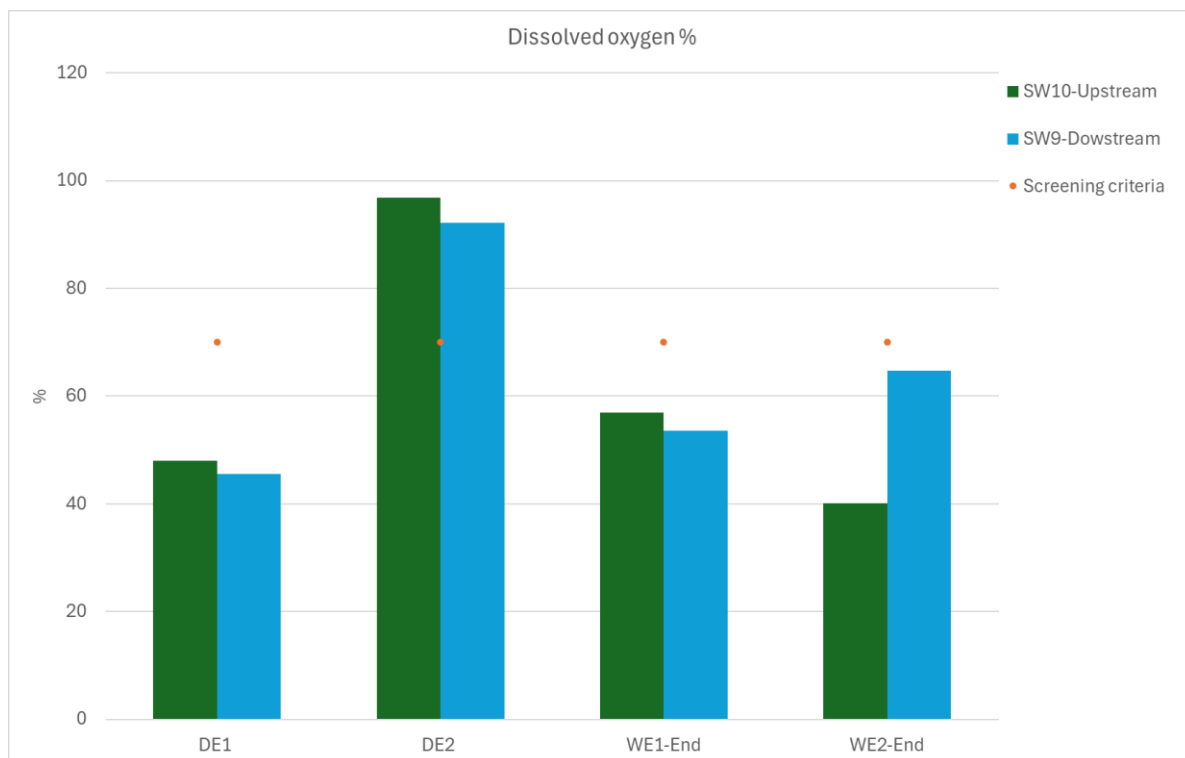


Figure 8.3: Dissolved oxygen (%) recorded at investigation locations SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

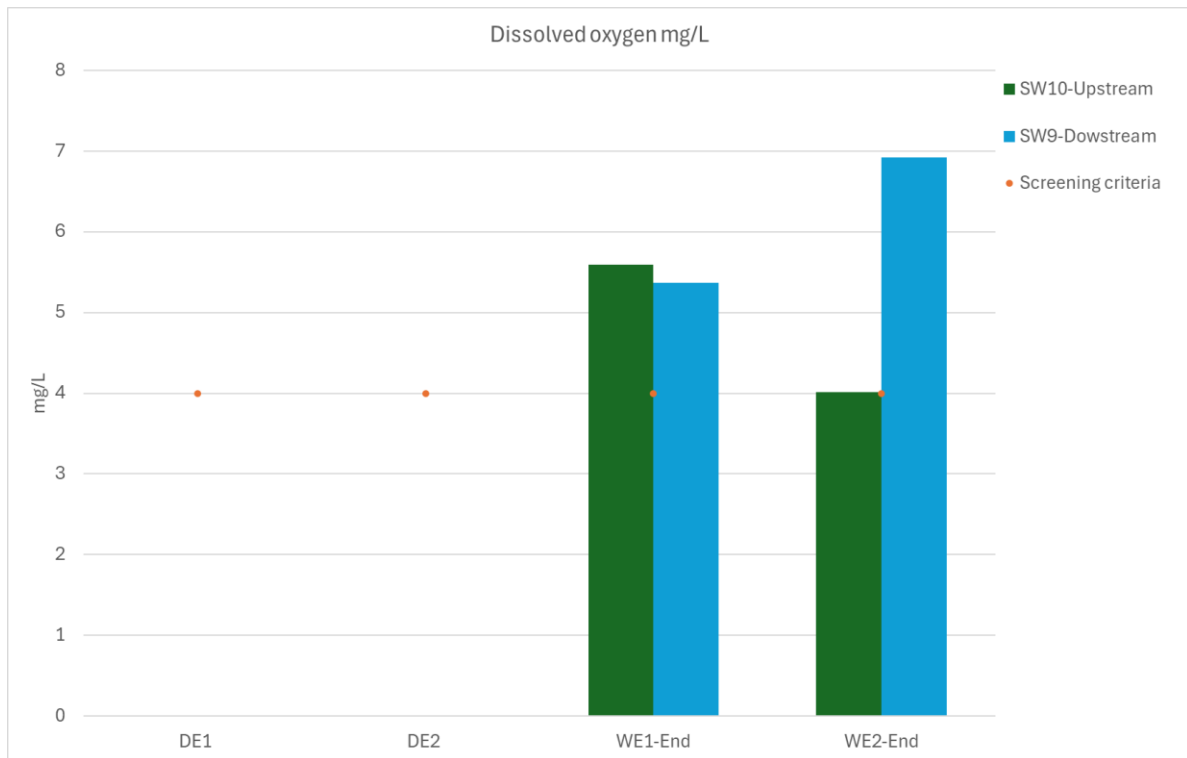


Figure 8.4: Dissolved oxygen (mg/L) recorded at investigation locations SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

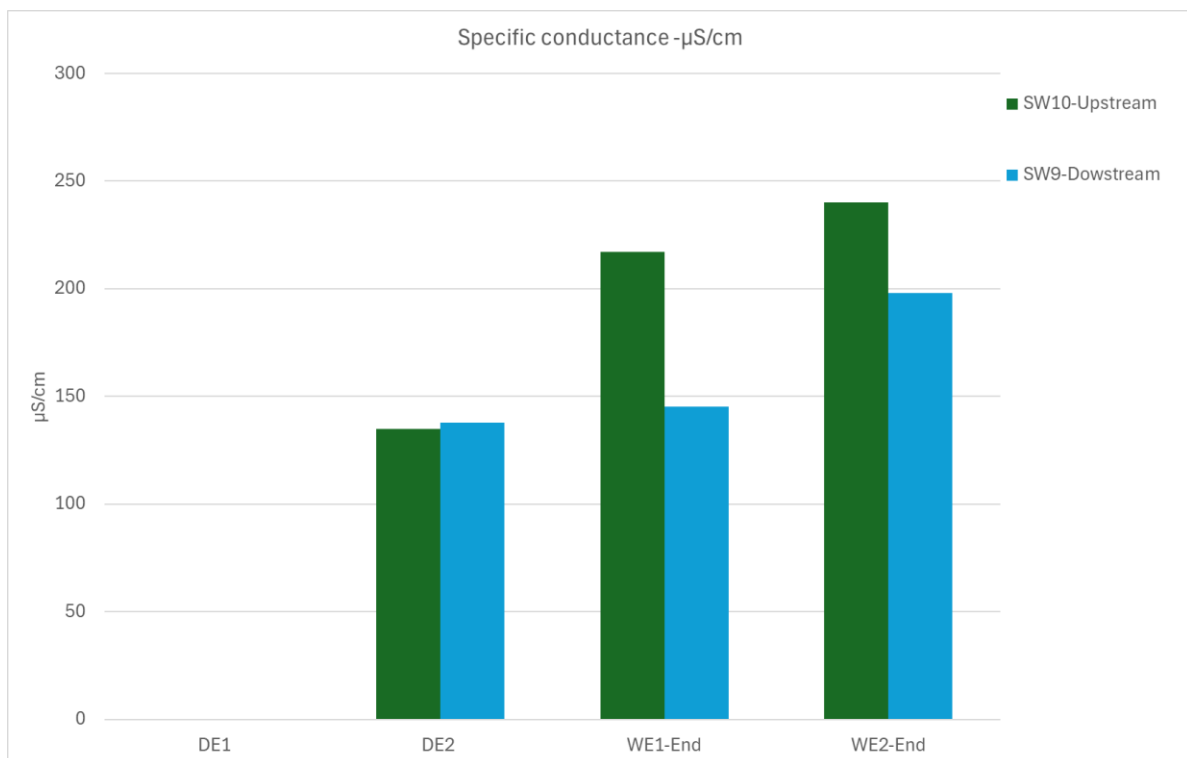


Figure 8.5: Specific conductance (-µS/cm) recorded at investigation locations SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

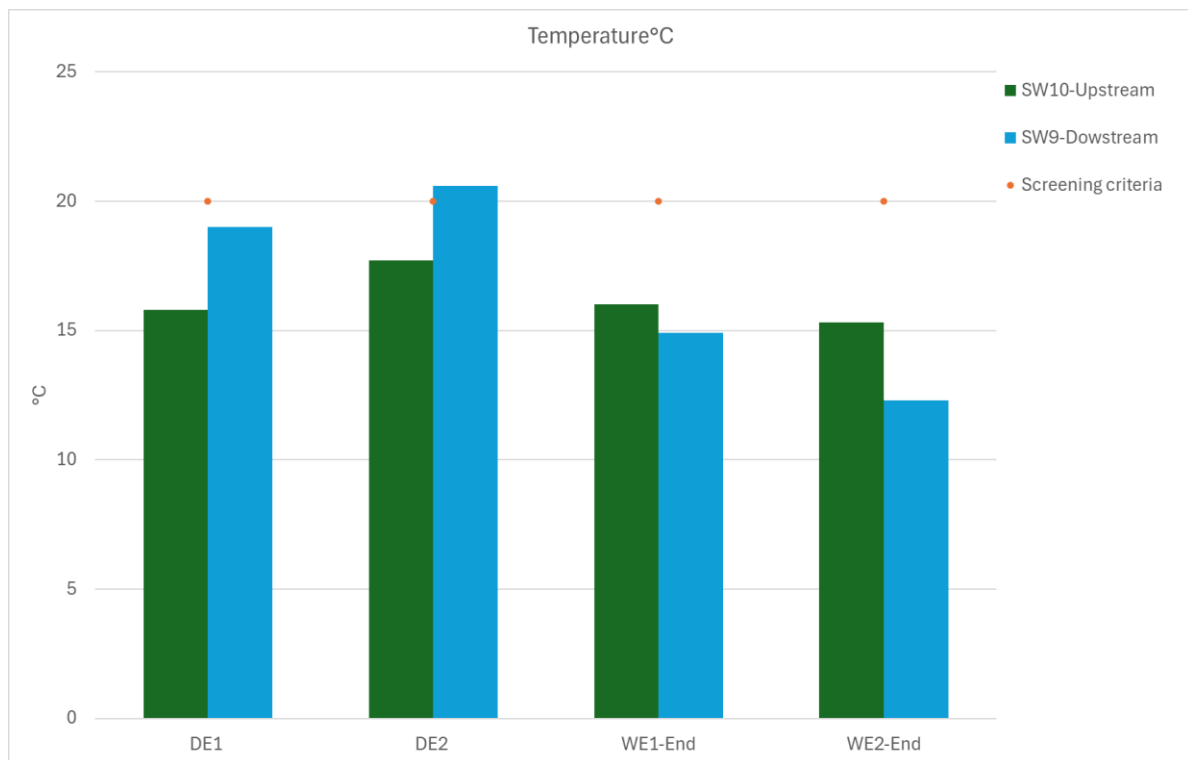


Figure 8.6: Temperature (°C) recorded at investigation locations SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

Appendix E Analytical results

E1.1 Analytical results summary table

1. ANZG. 2018. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

2. Comprehensive Stormwater Network Discharge Consent (CRC231955) Mahere Wai āwhā Stormwater Management Plan for the Ōtākaro-Avon Catchment 2024

3. ANZG 2018. Modified guidelines for select species based on Technical Guidance published by The Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

For copper - DOC adjusted guideline value, using an average DOC of 3g/m3

For hardness modified values - average total alkalinity of 55 g/m3 as CaCO3

For pH and temperature modified values - average pH = 7.44 and average temperature = 16.5 deg celcius

For hardness modified values - average total alkalinity of 55 g/m³ as CaCO₃

For pH and temperature modified values - average pH = 7.44 and average temperature = 16.5 deg celcius

E1.2 Analytical results figures.

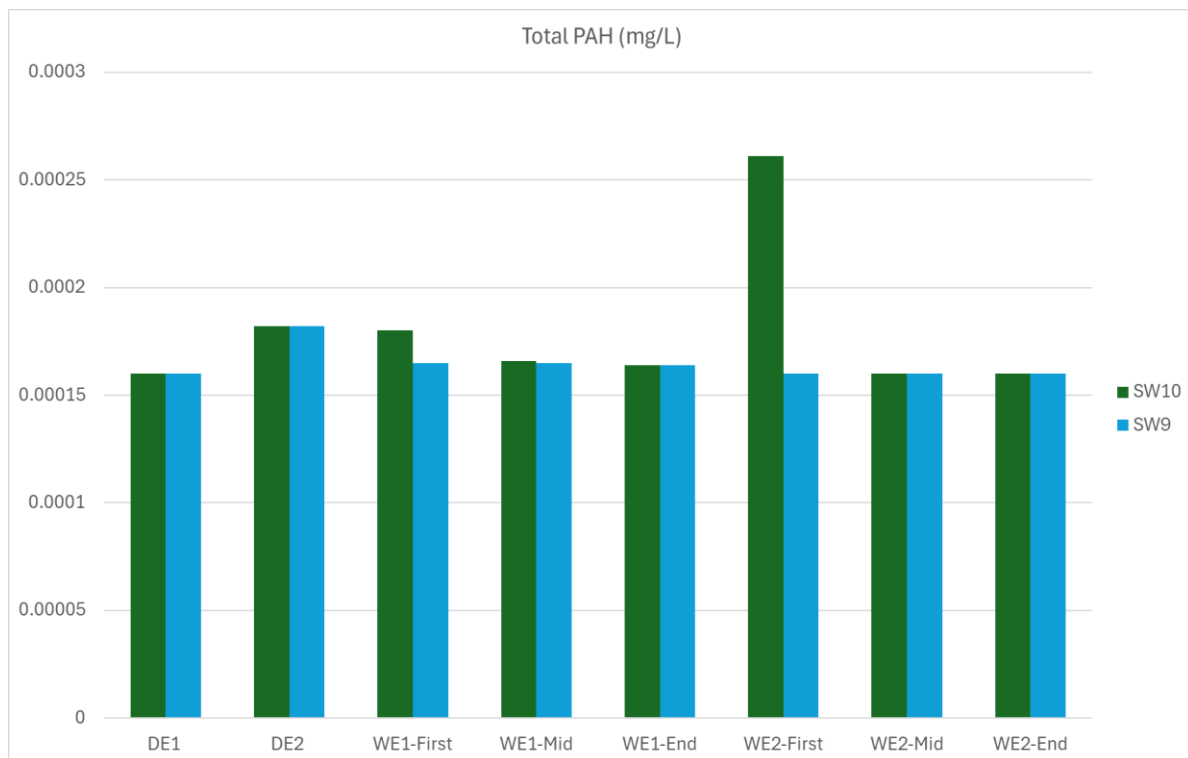


Figure 8.7: PAHs detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

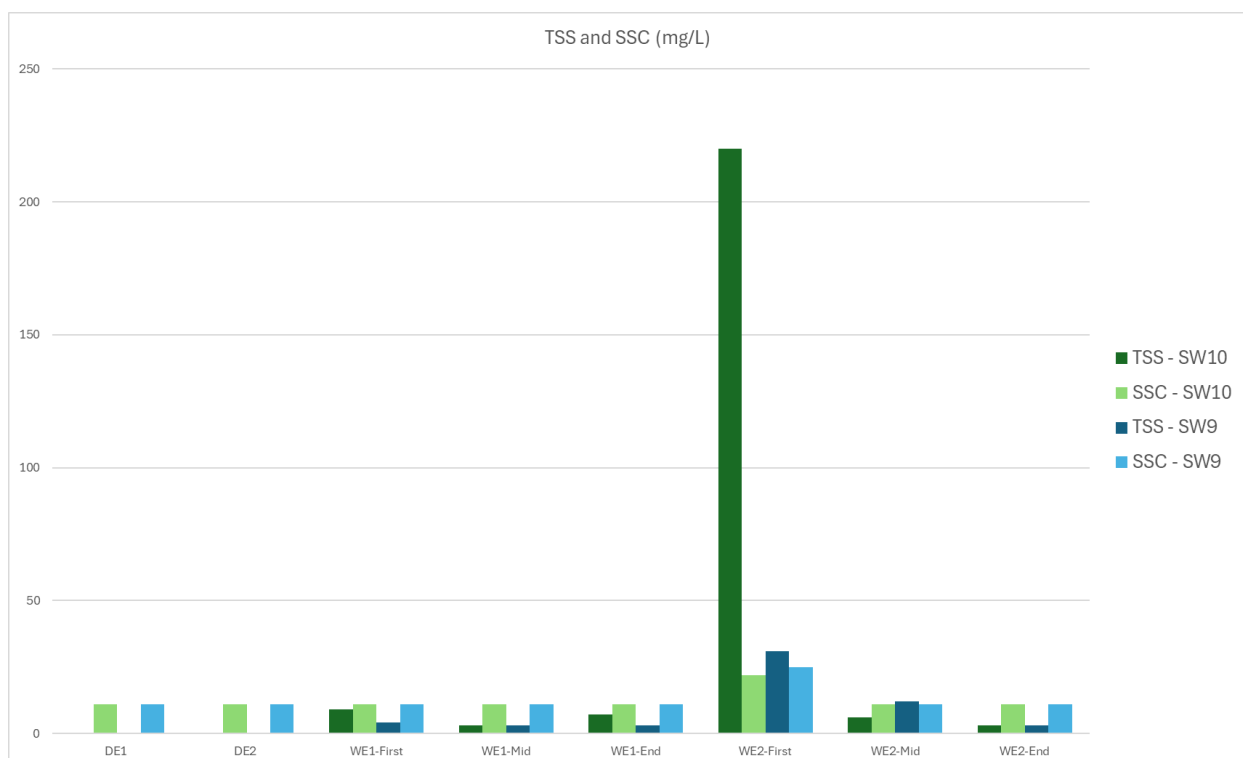


Figure 8.8: TSS detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events.

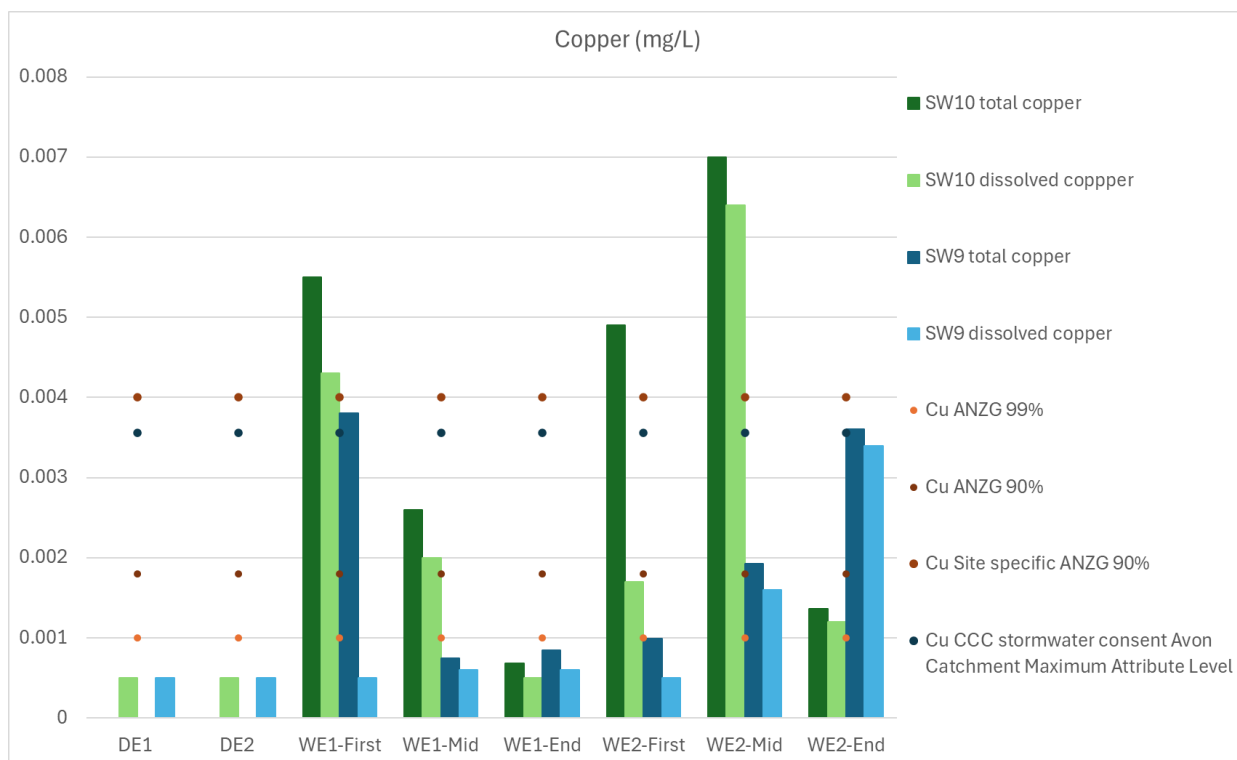


Figure 8.9: Total and dissolved copper detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events and screening criteria ANZG 99% freshwater species protection.

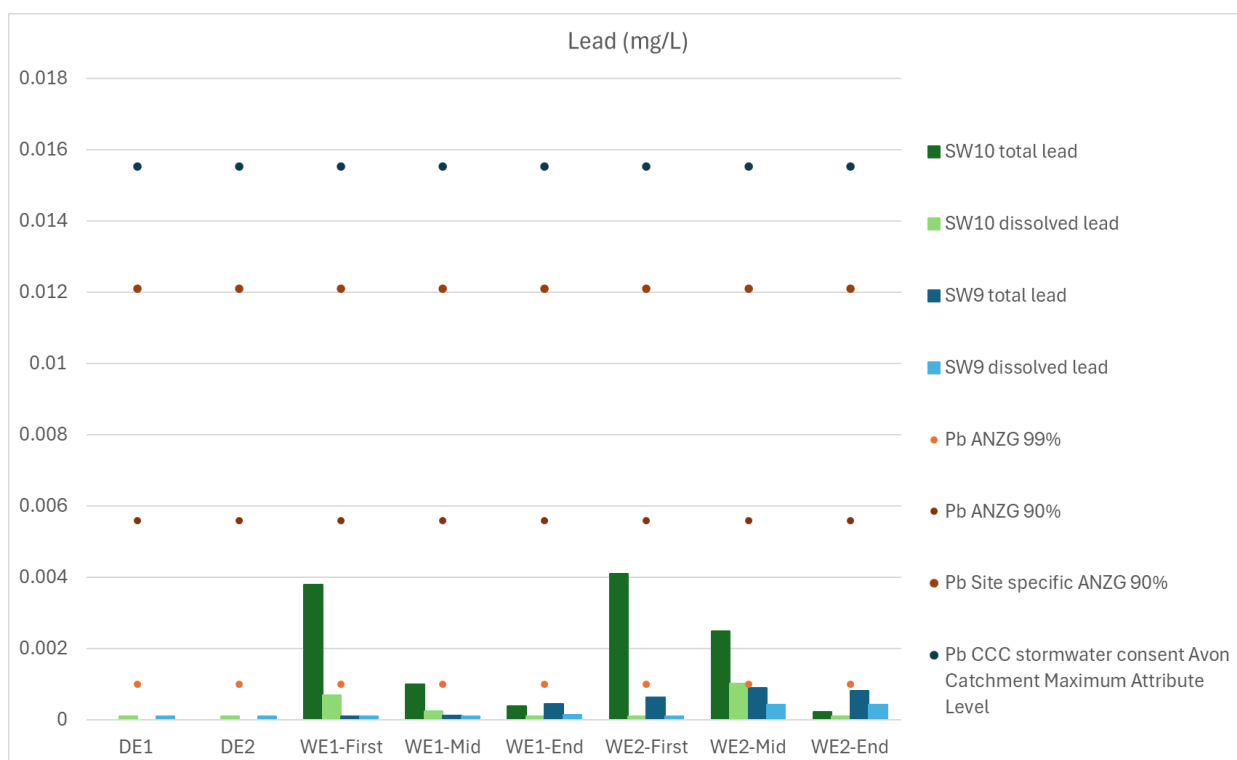


Figure 8.10: Total and dissolved lead detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events and screening criteria ANZG 99% freshwater species protection.

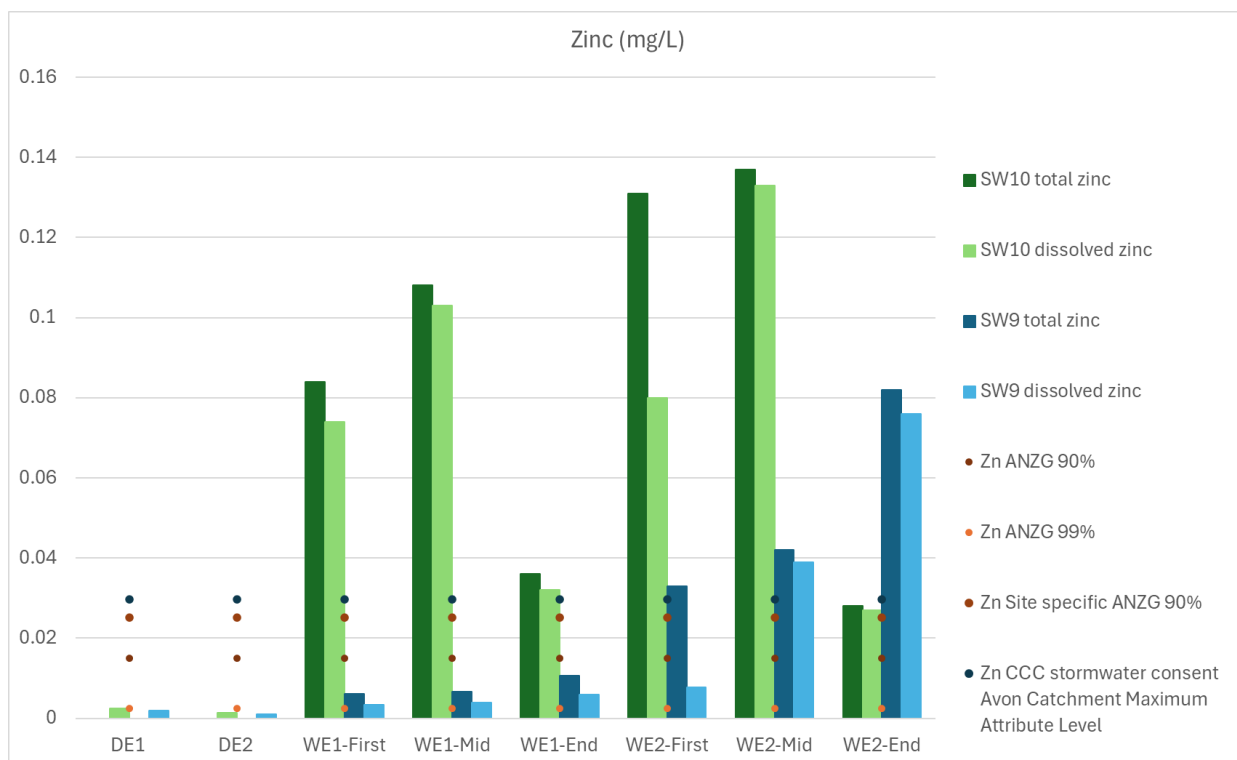


Figure 8.11: Total and dissolved zinc detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events and screening criteria ANZG 99% freshwater species protection.

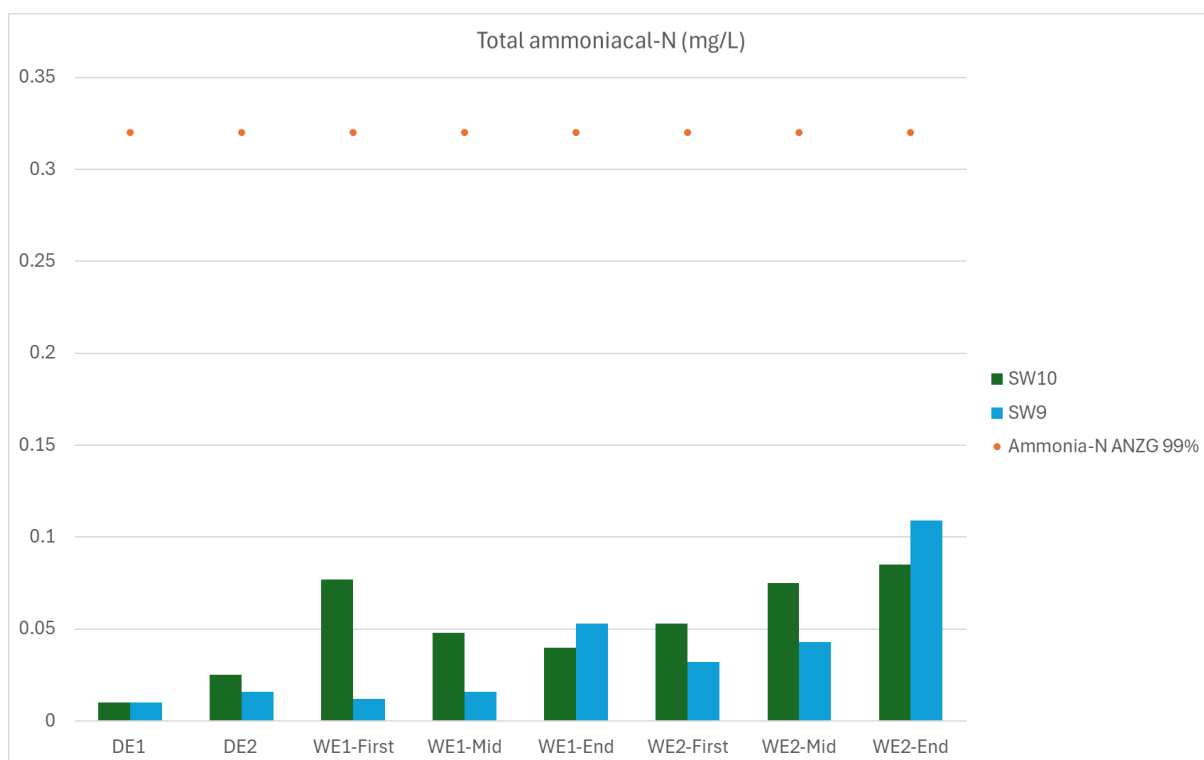


Figure 8.12: Total ammoniacal-N detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events and screening criteria ANZG 99% freshwater species protection. Note: ANZG 90% and site specific 90% are not presented in the figure as all values are below the ANZG 99%.

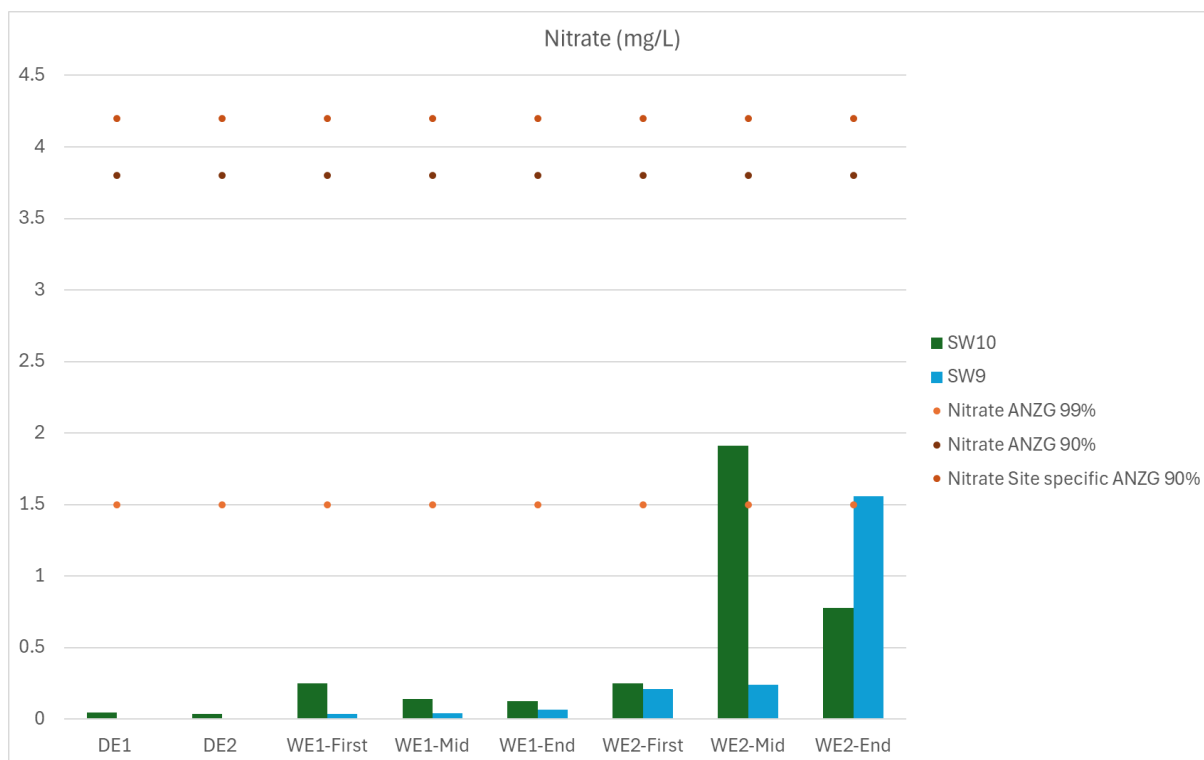


Figure 8.13: Nitrate detected in samples collected from SW10 (upstream) and SW09 (downstream) of the wetland during both dry and wet monitoring events and screening criteria ANZG 99% freshwater species protection.

Appendix F Laboratory transcript

Certificate of Analysis

Page 1 of 5

Client:	Tonkin & Taylor	Lab No:	3772164	SPV2
Contact:	Sarah Guy	Date Received:	07-Feb-2025	
	C/- Tonkin & Taylor	Date Reported:	17-Feb-2025	
	PO Box 13055	Quote No:	135967	
	Christchurch 8141	Order No:	1092485.0030	
		Client Reference:	1092485.0030	
		Submitted By:	Sarah Guy	

Sample Type: Aqueous

Sample Name:	DE1-SW1 05-Feb-2025 12:15 pm	DE1-SW2 05-Feb-2025 11:45 am	DE1-SW3 05-Feb-2025 9:00 am	DE1-SW4 05-Feb-2025 11:00 am	DE1-SW5 05-Feb-2025 10:45 am
Lab Number:	3772164.1	3772164.2	3772164.3	3772164.4	3772164.5

Individual Tests

pH	pH Units	7.8	7.9	7.0	7.6	7.2
Total Hardness	g/m ³ as CaCO ₃	76	81	115	93	92
Electrical Conductivity (EC)	mS/m	20.5	21.0	30.3	24.3	26.1
Suspended Sediment Concentration*	g/m ³	< 11	33	34	< 12	< 11
Dissolved Boron	g/m ³	0.040	0.044	0.028	0.071	0.083
Total Calcium	g/m ³	22	23	30	26	25
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	0.00024	< 0.00010	< 0.00010
Total Magnesium	g/m ³	5.4	5.7	9.6	7.0	7.0
Dissolved Zinc	g/m ³	< 0.0010	0.0099	0.0012	0.0015	0.0012
Total Ammoniacal-N	g/m ³	< 0.010	< 0.010	0.060	0.57	1.07
Nitrite-N	g/m ³	< 0.002	< 0.002	< 0.02 #1	0.006	0.022
Nitrate-N	g/m ³	< 0.002	< 0.002	0.08	0.004	0.055
Nitrate-N + Nitrite-N	g/m ³	< 0.002	< 0.002	0.08 #1	0.010	0.077
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.28	0.78	2.8	1.43	1.27
Dissolved Organic Carbon (DOC)	g/m ³	2.5	2.6	33	4.8	4.9

Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq

Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	0.000011	0.000009	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	0.000015	0.000013	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.000004	< 0.000004	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	< 0.000008	0.000014	0.000014	< 0.000008	< 0.000008
Pyrene	g/m ³	< 0.000008	0.000015	0.000013	< 0.000008	< 0.000008



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Aqueous						
Sample Name:		DE1-SW1 05-Feb-2025 12:15 pm	DE1-SW2 05-Feb-2025 11:45 am	DE1-SW3 05-Feb-2025 9:00 am	DE1-SW4 05-Feb-2025 11:00 am	DE1-SW5 05-Feb-2025 10:45 am
Lab Number:		3772164.1	3772164.2	3772164.3	3772164.4	3772164.5
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		DE1-SW6 05-Feb-2025 10:30 am	DE1-SW7 05-Feb-2025 8:15 am	DE1-SW8 05-Feb-2025 7:30 am	DE1-SW9 05-Feb-2025 10:00 am	DE1-SW10 05-Feb-2025 9:30 am
Lab Number:		3772164.6	3772164.7	3772164.8	3772164.9	3772164.10
Individual Tests						
pH	pH Units	7.6	7.7	8.0	7.8	7.6
Total Hardness	g/m ³ as CaCO ₃	89	69	66	74	77
Electrical Conductivity (EC)	mS/m	24.9	16.6	16.6	20.4	20.8
Suspended Sediment Concentration*	g/m ³	< 11	< 11	< 11	< 11	< 11
Dissolved Boron	g/m ³	0.086	0.030	0.030	0.037	0.044
Total Calcium	g/m ³	24	22	21	21	22
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Total Magnesium	g/m ³	6.9	3.5	3.3	5.2	5.2
Dissolved Zinc	g/m ³	< 0.0010	0.0016	0.0016	0.0020	0.0024
Total Ammoniacal-N	g/m ³	0.79	0.026	0.017	< 0.010	< 0.010
Nitrite-N	g/m ³	0.022	0.004	0.005	< 0.002	0.005
Nitrate-N	g/m ³	0.031	0.27	0.26	< 0.002	0.046
Nitrate-N + Nitrite-N	g/m ³	0.053	0.27	0.27	< 0.002	0.052
Total Kjeldahl Nitrogen (TKN)	g/m ³	1.46	0.12	0.15	0.28	0.29
Dissolved Organic Carbon (DOC)	g/m ³	7.0	1.0	0.9	3.0	2.2
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	0.000017	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	0.000015	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		DE1-DUP01 05-Feb-2025 11:00 am	DE1-WS01 05-Feb-2025 2:45 pm	DE1-WS07 05-Feb-2025 5:30 pm	DE1-WS10 05-Feb-2025 3:45 pm	DE1-DUP02 05-Feb-2025
Lab Number:		3772164.11	3772164.12	3772164.13	3772164.14	3772164.15
Individual Tests						
pH	pH Units	7.7	7.0	6.6	7.1	7.3

Sample Type: Aqueous						
Sample Name:		DE1-DUP01 05-Feb-2025 11:00 am	DE1-WS01 05-Feb-2025 2:45 pm	DE1-WS07 05-Feb-2025 5:30 pm	DE1-WS10 05-Feb-2025 3:45 pm	DE1-DUP02 05-Feb-2025
Lab Number:		3772164.11	3772164.12	3772164.13	3772164.14	3772164.15
Individual Tests						
Total Hardness	g/m³ as CaCO₃	86	690	63	480	490
Electrical Conductivity (EC)	mS/m	24.1	230	23.0	222	223
Suspended Sediment Concentration*	g/m³	< 11	-	-	-	-
Dissolved Boron	g/m³	0.069	6.2	0.045	4.3	4.2
Total Calcium	g/m³	24	136	15.9	104	105
Dissolved Copper	g/m³	< 0.0005	< 0.0010	0.0046	< 0.0010	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.0002	0.00011	< 0.0002	< 0.00010
Total Magnesium	g/m³	6.4	85	5.7	54	56
Dissolved Zinc	g/m³	0.0014	< 0.002	< 0.0010	< 0.002	< 0.0010
Total Ammoniacal-N	g/m³	0.58	105 #2	< 0.010	144	143
Nitrite-N	g/m³	0.006	0.005	< 0.002	< 0.002	0.003 #3
Nitrate-N	g/m³	0.002	0.070	2.5	< 0.002	< 0.002
Nitrate-N + Nitrite-N	g/m³	0.009	0.075	2.5	< 0.002	0.002 #3
Total Kjeldahl Nitrogen (TKN)	g/m³	1.03	101 #2	0.54	145	145
Dissolved Organic Carbon (DOC)	g/m³	5.5	< 5	5.5	< 5	14
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	0.00175	< 0.000008	0.00039	0.00040
Acenaphthylene	g/m³	< 0.000008	0.000051	< 0.000008	< 0.000008	0.000008
Anthracene	g/m³	< 0.000008	0.00021	< 0.000008	0.000135	0.000137
Benzo[a]anthracene	g/m³	< 0.000008	0.000019	< 0.000008	< 0.000008	0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	0.000028	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.000008	0.000033	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	0.000024	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	0.000012	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	0.000017	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	0.00024	< 0.000008	0.00027	0.00029
Fluorene	g/m³	< 0.000008	0.00118	< 0.000008	0.00033	0.00035
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	0.000023	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	0.0099	< 0.00004	0.0065	0.0064
Phenanthrene	g/m³	< 0.000008	0.00177	< 0.000012	0.00113	0.00114
Pyrene	g/m³	< 0.000008	0.000196	< 0.000008	0.00021	0.00022
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Analyst's Comments						
#1 Due to the nature of this sample a dilution was performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO2N, NO3N and NOxN analysis.						
#2 It has been noted that the result for Total Ammoniacal-N was greater than that for Total Kjeldahl Nitrogen, but within the analytical variation of these methods.						
#3 It has been noted that the result for Nitrite-N was greater than that for Nitrate-N + Nitrite-N, but within the analytical variation of these methods.						
Samples 1-2, 4-5, 9-10 Comment: Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).						
Samples 7-8, 15 Comment: Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (>300% at the 95% confidence level).						

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch.	-	1-15
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-15
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-15
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-15
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-15
Suspended Sediment Concentration*	Filtration using Advantec GC-50 or equivalent 125mm diameter filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Entire sample filtered. No correction for density. Note: g/m ³ units are equivalent to mg/L. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. ASTM D3977-97 (Modified).	10 g/m ³	1-11
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-15
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.005 g/m ³	1-15
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.053 g/m ³	1-15
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m ³	1-15
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00010 g/m ³	1-15
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m ³	1-15
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m ³	1-15
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-15
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₂ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-15
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-15
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-15
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) : Online Edition.	0.10 g/m ³	1-15
Dissolved Organic Carbon (DOC)	Filtered sample, Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) : Online Edition.	0.5 g/m ³	1-15
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.000005 g/m ³	1-15
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-15
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-15
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-15
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-15

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 07-Feb-2025 and 17-Feb-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, consisting of several overlapping loops and a long horizontal stroke extending to the right.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 5

Client:	Tonkin & Taylor	Lab No:	3795686	SPv1
Contact:	Sarah Guy	Date Received:	03-Mar-2025	
	C/- Tonkin & Taylor	Date Reported:	11-Mar-2025	
	PO Box 13055	Quote No:	135967	
	Christchurch 8141	Order No:	1092485.0030	
		Client Reference:	1092485.0030	
		Submitted By:	Sarah Guy	

Sample Type: Aqueous

Sample Name:	DE2-SW1 03-Mar-2025 12:00 pm	DE2-SW2 03-Mar-2025 10:15 am	DE2-SW3 03-Mar-2025 12:30 pm	DE2-SW4 03-Mar-2025 9:30 am	DE2-SW5 03-Mar-2025 8:40 am
Lab Number:	3795686.1	3795686.2	3795686.3	3795686.4	3795686.5

Individual Tests

pH	pH Units	7.9	7.7	7.2	7.0	7.1
Total Hardness	g/m ³ as CaCO ₃	77	82	117	92	101
Electrical Conductivity (EC)	mS/m	21.0	21.5	29.4	25.3	29.3
Suspended Sediment Concentration*	g/m ³	< 11 #1	< 11 #1	185	< 11 #1	35
Dissolved Boron	g/m ³	0.037	0.039	0.025	0.069	0.113
Total Calcium	g/m ³	22	23	31	25	27
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	0.00025	< 0.00010	< 0.00010
Total Magnesium	g/m ³	5.5	5.9	9.7	7.2	8.2
Dissolved Zinc	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0012
Total Ammoniacal-N	g/m ³	< 0.010	0.017	0.101	0.62	1.39
Nitrite-N	g/m ³	< 0.002	< 0.002	< 0.02 #2	0.004	0.009
Nitrate-N	g/m ³	0.003	0.003	< 0.02	0.002	0.025
Nitrate-N + Nitrite-N	g/m ³	0.004	0.004	< 0.02 #2	0.006	0.034
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.30	0.29	1.88	0.98	2.4
Dissolved Organic Carbon (DOC)	g/m ³	1.9	2.2	25	4.3	3.0

Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq

Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	0.000013	< 0.000008	0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	0.000021	< 0.000008	0.000015
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	0.000024	< 0.000008	0.000016
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	0.000013	< 0.000008	0.000010
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	0.000010	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	0.000017	< 0.000008	0.000010
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	0.000037	< 0.000008	0.000017
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	0.000015	< 0.000008	0.000012
Naphthalene	g/m ³	< 0.000004	< 0.000004	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Pyrene	g/m ³	< 0.000008	< 0.000008	0.000037	< 0.000008	0.000018



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Aqueous						
Sample Name:		DE2-SW1 03-Mar-2025 12:00 pm	DE2-SW2 03-Mar-2025 10:15 am	DE2-SW3 03-Mar-2025 12:30 pm	DE2-SW4 03-Mar-2025 9:30 am	DE2-SW5 03-Mar-2025 8:40 am
Lab Number:		3795686.1	3795686.2	3795686.3	3795686.4	3795686.5
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		DE2-SW6 03-Mar-2025 8:05 am	DE2-SW7 03-Mar-2025 7:40 am	DE2-SW8 03-Mar-2025 7:17 am	DE2-SW9 03-Mar-2025 11:17 am	DE2-SW10 03-Mar-2025 11:00 am
Lab Number:		3795686.6	3795686.7	3795686.8	3795686.9	3795686.10
Individual Tests						
pH	pH Units	7.1	7.6	7.6	7.7	7.5
Total Hardness	g/m ³ as CaCO ₃	95	67	68	79	77
Electrical Conductivity (EC)	mS/m	26.1	16.7	16.7	21.1	21.3
Suspended Sediment Concentration*	g/m ³	23	< 11 #1	< 11 #1	< 11 #1	< 11 #1
Dissolved Boron	g/m ³	0.083	0.026	0.028	0.037	0.044
Total Calcium	g/m ³	26	21	22	22	22
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Total Magnesium	g/m ³	7.5	3.3	3.4	5.7	5.4
Dissolved Zinc	g/m ³	< 0.0010	0.0029	0.0021	< 0.0010	0.0014
Total Ammoniacal-N	g/m ³	0.93	0.029	0.027	0.016	0.025
Nitrite-N	g/m ³	0.006	0.005	0.004	< 0.002	0.009
Nitrate-N	g/m ³	0.006	0.29	0.27	0.009	0.037
Nitrate-N + Nitrite-N	g/m ³	0.012	0.29	0.27	0.010	0.046
Total Kjeldahl Nitrogen (TKN)	g/m ³	1.73	0.15	0.13	0.27	0.18
Dissolved Organic Carbon (DOC)	g/m ³	4.0	< 0.5	< 0.5	3.9	< 0.5
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	0.000018	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	0.000009	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	0.000009	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	0.000017	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	0.000017	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.00003	< 0.00003	< 0.00003	< 0.00003	< 0.00003
Pyrene	g/m ³	0.000017	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		DE2-DUP01 03-Mar-2025	DE2-WS01 03-Mar-2025 8:15 am	DE2-WS10 03-Mar-2025 9:10 am	DE2-WS07 03-Mar-2025 11:35 am	DE2-DUP02 03-Mar-2025
Lab Number:		3795686.11	3795686.12	3795686.13	3795686.14	3795686.15
Individual Tests						
pH	pH Units	7.1	6.8	6.7	6.2	6.7

Sample Type: Aqueous						
Sample Name:		DE2-DUP01 03-Mar-2025	DE2-WS01 03-Mar-2025 8:15 am	DE2-WS10 03-Mar-2025 9:10 am	DE2-WS07 03-Mar-2025 11:35 am	DE2-DUP02 03-Mar-2025
Lab Number:		3795686.11	3795686.12	3795686.13	3795686.14	3795686.15
Individual Tests						
Total Hardness	g/m³ as CaCO₃	92	710	470	52	470
Electrical Conductivity (EC)	mS/m	25.4	244	231	20.9	231
Suspended Sediment Concentration*	g/m³	< 11 ^{#1}	-	-	-	-
Dissolved Boron	g/m³	0.067	6.3	4.1	0.043	4.1
Total Calcium	g/m³	25	130	97	12.2	98
Dissolved Copper	g/m³	< 0.0005	< 0.0010	0.0011	0.0070	< 0.0010
Dissolved Lead	g/m³	< 0.00010	< 0.0002	< 0.0002	0.00015	< 0.0002
Total Magnesium	g/m³	7.3	94	55	5.2	56
Dissolved Zinc	g/m³	< 0.0010	< 0.002	0.003	0.0013	< 0.002
Total Ammoniacal-N	g/m³	0.61	88	121	0.043	115
Nitrite-N	g/m³	0.004	0.003	0.002	< 0.002	< 0.002
Nitrate-N	g/m³	0.004	0.004	< 0.002	1.95	< 0.002
Nitrate-N + Nitrite-N	g/m³	0.009	0.006	0.003	1.95	0.002
Total Kjeldahl Nitrogen (TKN)	g/m³	1.06	113	140	0.70	142
Dissolved Organic Carbon (DOC)	g/m³	3.9	< 100	110	7.5	< 100
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	0.0024	0.00045	< 0.000008	0.00046
Acenaphthylene	g/m³	< 0.000008	0.000079	0.000014	< 0.000008	0.000015
Anthracene	g/m³	< 0.000008	0.00038	0.000160	< 0.000008	0.000167
Benzo[a]anthracene	g/m³	< 0.000008	0.000038	0.000013	< 0.000008	0.000014
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	0.000048	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.000008	0.000055	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	0.000040	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	0.000018	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m³	< 0.000008	0.000041	0.000013	< 0.000008	0.000014
Dibenzo[a,h]anthracene	g/m³	< 0.000008	0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	0.00037	0.00030	< 0.000008	0.00031
Fluorene	g/m³	< 0.000008	0.00181	0.00040	< 0.000008	0.00040
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	0.000036	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	0.0147	0.0081	< 0.00004	0.0079
Phenanthrene	g/m³	< 0.00003	0.0026	0.00127	< 0.00003	0.00132
Pyrene	g/m³	< 0.000008	0.00032	0.00026	< 0.000008	0.00026
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Analyst's Comments						
^{#1} The volume supplied for Suspended Sediment Concentration analysis was insufficient to produce a result above detection limit for this sample, so the detection limit is higher than usual.						
^{#2} Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO2N, NO3N and NOxN analysis.						
Sample 1 Comment: Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 200-300% at the 95% confidence level).						
Samples 2, 4-6, 9, 11 Comment: Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).						

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch.	-	1-15
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-15
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-15
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-15
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-15
Suspended Sediment Concentration*	Filtration using Advantec GC-50 or equivalent 125mm diameter filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Entire sample filtered. No correction for density. Note: g/m ³ units are equivalent to mg/L. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. ASTM D3977-97 (Modified).	10 g/m ³	1-11
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-15
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.005 g/m ³	1-15
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.053 g/m ³	1-15
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m ³	1-15
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00010 g/m ³	1-15
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m ³	1-15
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m ³	1-15
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-15
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₂ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-15
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-15
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-15
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) : Online Edition.	0.10 g/m ³	1-15
Dissolved Organic Carbon (DOC)	Filtered sample, Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) : Online Edition.	0.5 g/m ³	1-15
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.000005 g/m ³	1-15
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-15
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-15
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-15
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-15

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 04-Mar-2025 and 11-Mar-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, appearing to read 'G Corban', is positioned above the printed name.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 7

Client:	Tonkin & Taylor	Lab No:	3819917	SPV1
Contact:	Sarah Guy	Date Received:	19-Mar-2025	
	C/- Tonkin & Taylor	Date Reported:	27-Mar-2025	
	PO Box 13055	Quote No:	135967	
	Christchurch 8141	Order No:	1092485.0030	
		Client Reference:	1092485.0030	
		Submitted By:	Sarah Guy	

Sample Type: Aqueous

Sample Name:	SW8_WE1_First 18-Mar-2025 1:50 pm	SW7_WE1_First 18-Mar-2025 2:10 pm	SW6_WE1_First 18-Mar-2025 2:30 pm	SW5_WE1_First 18-Mar-2025 2:45 pm	SW2_WE1_First 18-Mar-2025 3:00 pm
Lab Number:	3819917.1	3819917.2	3819917.3	3819917.4	3819917.5

Individual Tests

pH	pH Units	7.8	7.8	7.3	7.3	7.6
Total Hardness	g/m ³ as CaCO ₃	60	54	80	89	62
Electrical Conductivity (EC)	mS/m	15.1	13.3	21.5	22.2	17.1
Suspended Sediment Concentration*	g/m ³	< 11 #1	< 13 #1	19	270	19
Dissolved Boron	g/m ³	0.026	0.025	0.065	0.099	0.034
Total Calcium	g/m ³	19.0	17.1	22	24	17.8
Dissolved Copper	g/m ³	0.0010	0.0010	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	0.00013	0.00014	< 0.00010	< 0.00010	< 0.00010
Total Magnesium	g/m ³	3.0	2.7	6.2	6.9	4.4
Dissolved Zinc	g/m ³	0.0119	0.0172	0.0032	0.0022	0.0024
Total Ammoniacal-N	g/m ³	0.024	0.018	0.47	0.64	0.021
Nitrite-N	g/m ³	0.006	0.006	0.007	0.005	< 0.002
Nitrate-N	g/m ³	0.28	0.25	0.008	0.041	0.008
Nitrate-N + Nitrite-N	g/m ³	0.28	0.25	0.014	0.047	0.009
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.22	0.23	1.49	2.8	0.36
Dissolved Organic Carbon (DOC)	g/m ³	1.3	2.3	8.1	9	2.6

Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq

Acenaphthene	g/m ³	< 0.000008	< 0.000008	0.000011	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	0.000010	0.000009	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000021	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000031	0.000009
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000033	0.000010
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000022	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000016	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000025	0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	0.000012	0.000049	0.000011
Fluorene	g/m ³	< 0.000008	< 0.000008	0.000014	0.000010	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000025	< 0.000008
Naphthalene	g/m ³	< 0.000004	< 0.000004	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	< 0.000014	< 0.000014	0.000030	0.000027	< 0.000014
Pyrene	g/m ³	< 0.000008	< 0.000008	0.000012	0.000051	0.000012



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Aqueous						
Sample Name:		SW8_WE1_First 18-Mar-2025 1:50 pm	SW7_WE1_First 18-Mar-2025 2:10 pm	SW6_WE1_First 18-Mar-2025 2:30 pm	SW5_WE1_First 18-Mar-2025 2:45 pm	SW2_WE1_First 18-Mar-2025 3:00 pm
Lab Number:		3819917.1	3819917.2	3819917.3	3819917.4	3819917.5
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW1_WE1_First 18-Mar-2025 3:20 pm	DUP01 18-Mar-2025	SW8_WE1_Mid 19-Mar-2025 6:00 am	SW7_WE1_Mid 19-Mar-2025 6:20 am	SW6_WE1_Mid 19-Mar-2025 6:40 am
Lab Number:		3819917.6	3819917.7	3819917.8	3819917.9	3819917.10
Individual Tests						
pH	pH Units	7.6	-	7.6	7.6	7.5
Total Hardness	g/m ³ as CaCO ₃	61	-	39	38	73
Electrical Conductivity (EC)	mS/m	16.6	-	10.5	10.6	19.7
Suspended Sediment Concentration*	g/m ³	< 11 #1	-	< 15 #1	< 12 #1	< 11 #1
Dissolved Boron	g/m ³	0.031	0.028	0.023	0.025	0.062
Total Calcium	g/m ³	17.4	-	12.1	11.7	19.5
Dissolved Copper	g/m ³	< 0.0005	0.0009	0.0015	0.0015	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	0.00011	0.00025	0.00030	< 0.00010
Total Magnesium	g/m ³	4.3	-	2.0	2.0	5.8
Dissolved Zinc	g/m ³	0.0026	0.0109	0.040	0.046	0.0019
Total Ammoniacal-N	g/m ³	0.015	-	0.025	0.024	0.27
Nitrite-N	g/m ³	< 0.002	-	0.004	0.005	0.025
Nitrate-N	g/m ³	0.016	-	0.21	0.22	0.068
Nitrate-N + Nitrite-N	g/m ³	0.018	-	0.22	0.23	0.093
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.28	-	0.25	0.36	0.77
Dissolved Organic Carbon (DOC)	g/m ³	2.1	-	2.8	2.6	5.6
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	-	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	0.000017	-	< 0.000013	< 0.000013	< 0.000013
Pyrene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	-	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	-	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	-	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	-	< 0.7	< 0.7	< 0.7
Sample Name:		SW5_WE1_Mid 19-Mar-2025 7:00 am	SW2_WE1_Mid 19-Mar-2025 7:20 am	SW1_WE1_Mid 19-Mar-2025 7:40 am	DUP02 19-Mar-2025	SW4_WE1_First 19-Mar-2025 8:40 am
Lab Number:		3819917.11	3819917.12	3819917.13	3819917.14	3819917.15
Individual Tests						
pH	pH Units	7.5	7.7	7.6	-	7.5

Sample Type: Aqueous						
Sample Name:	SW5_WE1_Mid 19-Mar-2025 7:00 am	SW2_WE1_Mid 19-Mar-2025 7:20 am	SW1_WE1_Mid 19-Mar-2025 7:40 am	DUP02 19-Mar-2025	SW4_WE1_First 19-Mar-2025 8:40 am	
Lab Number:	3819917.11	3819917.12	3819917.13	3819917.14	3819917.15	
Individual Tests						
Total Hardness	g/m ³ as CaCO ₃	72	64	64	-	74
Electrical Conductivity (EC)	mS/m	19.8	17.5	17.2	-	20.2
Suspended Sediment Concentration*	g/m ³	< 11 #1	< 11 #1	< 11 #1	-	< 11 #1
Dissolved Boron	g/m ³	0.055	0.035	0.033	0.052	0.048
Total Calcium	g/m ³	19.6	18.0	18.2	-	20
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Total Magnesium	g/m ³	5.6	4.6	4.6	-	5.7
Dissolved Zinc	g/m ³	0.0024	0.0041	0.0053	0.0012	0.0023
Total Ammoniacal-N	g/m ³	0.27	0.028	0.023	-	0.32
Nitrite-N	g/m ³	0.023	0.003	0.003	-	0.003
Nitrate-N	g/m ³	0.054	0.035	0.043	-	0.013
Nitrate-N + Nitrite-N	g/m ³	0.077	0.038	0.046	-	0.017
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.66	0.26	0.28	-	0.94
Dissolved Organic Carbon (DOC)	g/m ³	6.0	2.3	1.8	-	8.9
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	-	< 0.00004
Phenanthrene	g/m ³	< 0.000013	0.000018	< 0.000013	-	< 0.000013
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	-	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	-	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	-	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	-	< 0.7
Sample Name:	SW4_WE1_Mid 19-Mar-2025 9:00 am	SW3_WE1_First 19-Mar-2025 9:50 am	SW3_WE1_Mid 19-Mar-2025 10:00 am	DUP03 19-Mar-2025	SW10_WE1_First 19-Mar-2025 10:40 am	
Lab Number:	3819917.16	3819917.17	3819917.18	3819917.19	3819917.20	
Individual Tests						
pH	pH Units	7.6	7.4	7.3	-	7.5
Total Hardness	g/m ³ as CaCO ₃	68	117	112	-	30
Electrical Conductivity (EC)	mS/m	18.6	29.0	28.7	-	8.9
Total Suspended Solids	g/m ³	-	-	-	-	9
Suspended Sediment Concentration*	g/m ³	< 11 #1	12	12	-	11
Dissolved Boron	g/m ³	0.052	0.028	0.025	0.052	0.028 #2
Total Boron	g/m ³	-	-	-	-	0.024 #2
Total Calcium	g/m ³	18.7	31	29	-	9.0
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0043
Total Copper	g/m ³	-	-	-	-	0.0055
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00071

Sample Type: Aqueous						
Sample Name:		SW4_WE1_Mid 19-Mar-2025 9:00 am	SW3_WE1_First 19-Mar-2025 9:50 am	SW3_WE1_Mid 19-Mar-2025 10:00 am	DUP03 19-Mar-2025	SW10_WE1_First 19-Mar-2025 10:40 am
Lab Number:		3819917.16	3819917.17	3819917.18	3819917.19	3819917.20
Individual Tests						
Total Lead	g/m³	-	-	-	-	0.0038
Total Magnesium	g/m³	5.1	9.9	9.4	-	1.89
Dissolved Zinc	g/m³	0.0022	0.0040	0.0028	0.0017	0.074
Total Zinc	g/m³	-	-	-	-	0.084
Total Ammoniacal-N	g/m³	0.27	0.058	0.053	0.27	0.077
Nitrite-N	g/m³	0.011	0.006	0.006	0.011	0.013
Nitrate-N	g/m³	0.051	0.008	0.018	0.052	0.25
Nitrate-N + Nitrite-N	g/m³	0.062	0.015	0.024	0.063	0.27
Total Kjeldahl Nitrogen (TKN)	g/m³	0.68	2.3	2.1	0.60	0.72
Dissolved Organic Carbon (DOC)	g/m³	3.7	35	33	-	5.9
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Acenaphthylene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[a]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[a]pyrene (BAP)	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[g,h,i]perylene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Benzo[k]fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Chrysene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Dibenzo[a,h]anthracene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Fluoranthene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	0.000018
Fluorene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	< 0.000008
Naphthalene	g/m³	< 0.00004	< 0.00004	< 0.00004	-	< 0.00004
Phenanthrene	g/m³	< 0.000013	< 0.000013	< 0.000013	-	< 0.000013
Pyrene	g/m³	< 0.000008	< 0.000008	< 0.000008	-	0.000013
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	< 0.10	< 0.10	-	< 0.10
C10 - C14	g/m³	< 0.2	< 0.2	< 0.2	-	< 0.2
C15 - C36	g/m³	< 0.4	< 0.4	< 0.4	-	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	< 0.7	< 0.7	-	< 0.7
Sample Name:		SW10_WE1_Mid 19-Mar-2025 10:45 am		SW09_WE1_First 19-Mar-2025 11:10 am		SW09_WE1_Mid 19-Mar-2025 11:20 am
Lab Number:		3819917.21		3819917.22		3819917.23
Individual Tests						
pH	pH Units	7.1		7.9		7.9
Total Hardness	g/m³ as CaCO₃	9.5		61		64
Electrical Conductivity (EC)	mS/m	4.1		16.5		17.5
Total Suspended Solids	g/m³	< 3		4		< 3
Suspended Sediment Concentration*	g/m³	< 11 ^{#1}		< 11 ^{#1}		< 11 ^{#1}
Dissolved Boron	g/m³	0.010 ^{#2}		0.030 ^{#2}		0.032 ^{#2}
Total Boron	g/m³	0.0090 ^{#2}		0.028 ^{#2}		0.029 ^{#2}
Total Calcium	g/m³	3.0		17.1		17.9
Dissolved Copper	g/m³	0.0020		0.0005		0.0006
Total Copper	g/m³	0.0026		0.0038		0.00075
Dissolved Lead	g/m³	0.00026		< 0.00010		< 0.00010
Total Lead	g/m³	0.00101		< 0.00011		0.00012
Total Magnesium	g/m³	0.51		4.4		4.6
Dissolved Zinc	g/m³	0.103		0.0033		0.0040
Total Zinc	g/m³	0.108		0.0061		0.0067
Total Ammoniacal-N	g/m³	0.048		0.012		0.016
Nitrite-N	g/m³	0.004		< 0.002		< 0.002

Sample Type: Aqueous				
Sample Name:		SW10_WE1_Mid 19-Mar-2025 10:45 am	SW09_WE1_First 19-Mar-2025 11:10 am	SW09_WE1_Mid 19-Mar-2025 11:20 am
Lab Number:		3819917.21	3819917.22	3819917.23
Individual Tests				
Nitrate-N	g/m ³	0.140	0.038	0.044
Nitrate-N + Nitrite-N	g/m ³	0.143	0.040	0.045
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.21	0.27	0.31
Dissolved Organic Carbon (DOC)	g/m ³	1.5	1.3	1.8
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq				
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	0.000009	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	< 0.000013	< 0.000013	< 0.000013
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water				
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7

Analyst's Comments

#1 The volume supplied for Suspended Sediment Concentration analysis was insufficient to produce a result above detection limit for this sample, so the detection limit is higher than usual.

#2 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Samples 1, 22 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 200-300% at the 95% confidence level).

Samples 2, 5-6, 12-13, 16, 23 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch.	-	1-6, 8-13, 15-23
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-6, 8-13, 15-18, 20-23

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-6, 8-13, 15-18, 20-23
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-6, 8-13, 15-18, 20-23
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-6, 8-13, 15-18, 20-23
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m ³	20-23
Suspended Sediment Concentration*	Filtration using Advantec GC-50 or equivalent 125mm diameter filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Entire sample filtered. No correction for density. Note: g/m ³ units are equivalent to mg/L. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. ASTM D3977-97 (Modified).	10 g/m ³	1-6, 8-13, 15-18, 20-23
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-23
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.005 g/m ³	1-23
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0053 g/m ³	20-23
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.053 g/m ³	1-6, 8-13, 15-18, 20-23
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m ³	1-23
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00053 g/m ³	20-23
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00010 g/m ³	1-23
Total Lead	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00011 g/m ³	20-23
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m ³	1-6, 8-13, 15-18, 20-23
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m ³	1-23
Total Zinc	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0011 g/m ³	20-23
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-6, 8-13, 15-23
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-6, 8-13, 15-23
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-6, 8-13, 15-23
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-6, 8-13, 15-23
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) : Online Edition.	0.10 g/m ³	1-6, 8-13, 15-23
Dissolved Organic Carbon (DOC)	Filtered sample, Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) : Online Edition.	0.5 g/m ³	1-6, 8-13, 15-18, 20-23
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.000005 g/m ³	1-6, 8-13, 15-18, 20-23
Total Petroleum Hydrocarbons in Water			

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-6, 8-13, 15-18, 20-23
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-6, 8-13, 15-18, 20-23
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-6, 8-13, 15-18, 20-23
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-6, 8-13, 15-18, 20-23

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 20-Mar-2025 and 27-Mar-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 5

Client:	Tonkin & Taylor	Lab No:	3822013	SPv1
Contact:	Sarah Guy	Date Received:	20-Mar-2025	
	C/- Tonkin & Taylor	Date Reported:	27-Mar-2025	
	PO Box 13055	Quote No:	135967	
	Christchurch 8141	Order No:	1092485.0030	
		Client Reference:	1092485.0030	
		Submitted By:	Sarah Guy	

Sample Type: Aqueous

Sample Name:	WS01-WE1-End 20-Mar-2025 6:53 am	WS10-WE1-End 20-Mar-2025 7:18 am	WS07-WE1-End 20-Mar-2025 9:30 am	DUP04 20-Mar-2025	DUP05 20-Mar-2025
Lab Number:	3822013.1	3822013.2	3822013.3	3822013.4	3822013.5

Individual Tests

pH	pH Units	7.4	7.2	6.7	-	-
Total Hardness	g/m ³ as CaCO ₃	530	460	47	-	-
Electrical Conductivity (EC)	mS/m	181.0	220	18.7	-	-
Dissolved Boron	g/m ³	5.1	4.3	0.045	-	0.039
Total Calcium	g/m ³	102	97	11.8	-	-
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	0.0051	-	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	0.00014	-	0.00011
Total Magnesium	g/m ³	67	54	4.4	-	-
Dissolved Zinc	g/m ³	0.0019	< 0.0010	0.0018	-	0.0021
Total Ammoniacal-N	g/m ³	69	123	< 0.010	139	-
Nitrite-N	g/m ³	0.013	0.012 #1	< 0.002	0.005	-
Nitrate-N	g/m ³	0.22	< 0.002	1.86	0.004	-
Nitrate-N + Nitrite-N	g/m ³	0.23	0.011 #1	1.86	0.009	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	77	141	0.62	140	-
Dissolved Organic Carbon (DOC)	g/m ³	< 50	25	7.3	-	-

Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq

Acenaphthene	g/m ³	0.00139	0.00046	< 0.000008	0.00050	-
Acenaphthylene	g/m ³	0.000061	0.000018	< 0.000008	0.000016	-
Anthracene	g/m ³	0.00022	0.000188	< 0.000008	0.000193	-
Benzo[a]anthracene	g/m ³	0.000028	0.000012	< 0.000008	0.000014	-
Benzo[a]pyrene (BAP)	g/m ³	0.000052	< 0.000008	< 0.000008	< 0.000008	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	0.000063	< 0.000008	< 0.000008	< 0.000008	-
Benzo[g,h,i]perylene	g/m ³	0.000051	< 0.000008	< 0.000008	< 0.000008	-
Benzo[k]fluoranthene	g/m ³	0.000022	< 0.000008	< 0.000008	< 0.000008	-
Chrysene	g/m ³	0.000023	0.000009	< 0.000008	0.000012	-
Dibenzo[a,h]anthracene	g/m ³	0.000014	< 0.000008	< 0.000008	< 0.000008	-
Fluoranthene	g/m ³	0.00025	0.00031	< 0.000008	0.00034	-
Fluorene	g/m ³	0.00095	0.00040	< 0.000008	0.00042	-
Indeno(1,2,3-c,d)pyrene	g/m ³	0.000049	< 0.000008	< 0.000008	< 0.000008	-
Naphthalene	g/m ³	0.0074	0.0096	< 0.00004	0.0107	-
Phenanthrene	g/m ³	0.00141	0.00132	< 0.000012	0.00136	-
Pyrene	g/m ³	0.000198	0.00027	< 0.000008	0.00027	-



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Aqueous						
Sample Name:		WS01-WE1-End 20-Mar-2025 6:53 am	WS10-WE1-End 20-Mar-2025 7:18 am	WS07-WE1-End 20-Mar-2025 9:30 am	DUP04 20-Mar-2025	DUP05 20-Mar-2025
Lab Number:		3822013.1	3822013.2	3822013.3	3822013.4	3822013.5
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	-
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	-
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	-
Sample Name:		SW1-WE1-End 20-Mar-2025 9:15 am	SW2-WE1-End 20-Mar-2025 9:30 am	SW3-WE1-End 20-Mar-2025 10:00 am	SW4-WE1-End 20-Mar-2025 7:20 am	SW5-WE1-End 20-Mar-2025 8:00 am
Lab Number:		3822013.6	3822013.7	3822013.8	3822013.9	3822013.10
Individual Tests						
pH	pH Units	7.6	7.6	7.0	7.1	7.4
Total Hardness	g/m ³ as CaCO ₃	47	51	111	67	76
Electrical Conductivity (EC)	mS/m	14.0	14.8	28.4	18.5	20.9
Suspended Sediment Concentration*	g/m ³	< 11 #2	< 11 #2	24	< 11 #2	< 11 #2
Dissolved Boron	g/m ³	0.026	0.028	0.023	0.037	0.087
Total Calcium	g/m ³	13.6	14.5	30	18.8	21
Dissolved Copper	g/m ³	0.0006	0.0005	< 0.0005	< 0.0005	0.0009
Dissolved Lead	g/m ³	0.00014	0.00013	< 0.00010	0.00011	0.00013
Total Magnesium	g/m ³	3.2	3.5	9.0	4.9	5.9
Dissolved Zinc	g/m ³	0.0047	0.0039	0.0032	0.0025	0.0074
Total Ammoniacal-N	g/m ³	0.056	0.026	0.056	0.26	0.59
Nitrite-N	g/m ³	0.004	0.004	< 0.02 #3	0.004	0.008
Nitrate-N	g/m ³	0.056	0.048	< 0.02	0.005	0.198
Nitrate-N + Nitrite-N	g/m ³	0.061	0.052	< 0.02 #3	0.009	0.21
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.28	0.30	2.1	0.64	1.20
Dissolved Organic Carbon (DOC)	g/m ³	2.1	2.3	31	4.2	5.6
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000012	< 0.000012	< 0.000012	< 0.000012	< 0.000012
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW06-WE1-End 20-Mar-2025 8:00 am	SW07-WE1-End 20-Mar-2025 6:30 am	SW08-WE1-End 20-Mar-2025 6:15 am	SW09-WE1-End 20-Mar-2025 10:50 am	SW10-WE1-End 20-Mar-2025 10:40 am
Lab Number:		3822013.11	3822013.12	3822013.13	3822013.14	3822013.15
Individual Tests						
pH	pH Units	7.4	7.9	7.8	7.6	7.7

Sample Type: Aqueous						
Sample Name:	SW06-WE1-End 20-Mar-2025 8:00 am	SW07-WE1-End 20-Mar-2025 6:30 am	SW08-WE1-End 20-Mar-2025 6:15 am	SW09-WE1-End 20-Mar-2025 10:50 am	SW10-WE1-End 20-Mar-2025 10:40 am	
Lab Number:	3822013.11	3822013.12	3822013.13	3822013.14	3822013.15	
Individual Tests						
Total Hardness	g/m ³ as CaCO ₃	69	64	62	46	73
Electrical Conductivity (EC)	mS/m	19.6	16.1	16.0	13.3	19.9
Total Suspended Solids	g/m ³	-	-	-	< 3	7
Suspended Sediment Concentration*	g/m ³	< 11 #2	< 11 #2	< 12 #2	< 11 #2	< 11 #2
Dissolved Boron	g/m ³	0.045	0.027	0.028	0.025	0.040
Total Boron	g/m ³	-	-	-	0.027	0.044
Total Calcium	g/m ³	18.9	20	19.7	13.1	21
Dissolved Copper	g/m ³	< 0.0005	0.0005	0.0005	0.0006	< 0.0005
Total Copper	g/m ³	-	-	-	0.00085	0.00068
Dissolved Lead	g/m ³	0.00012	0.00012	0.00012	0.00015	< 0.00010
Total Lead	g/m ³	-	-	-	0.00046	0.00040
Total Magnesium	g/m ³	5.3	3.2	3.1	3.2	5.0
Dissolved Zinc	g/m ³	0.0021	0.0104	0.0103	0.0059	0.032
Total Zinc	g/m ³	-	-	-	0.0106	0.036
Total Ammoniacal-N	g/m ³	0.33	0.046	0.042	0.053	0.040
Nitrite-N	g/m ³	0.008	0.005	0.005	0.005	0.007
Nitrate-N	g/m ³	0.008	0.28	0.28	0.066	0.128
Nitrate-N + Nitrite-N	g/m ³	0.017	0.28	0.29	0.071	0.135
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.75	0.26	0.26	0.32	0.19
Dissolved Organic Carbon (DOC)	g/m ³	6.0	2.1	1.8	2.1	< 0.5
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000012	< 0.000012	< 0.000012	< 0.000012	< 0.000012
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

Analyst's Comments

#1 It has been noted that the result for Nitrite-N was greater than that for Nitrate-N + Nitrite-N, but within the analytical variation of these methods.

#2 The volume supplied for Suspended Sediment Concentration analysis was insufficient to produce a result above detection limit for this sample, so the detection limit is higher than usual.

#3 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO₂N, NO₃N and NO_xN analysis.

Sample 2 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 200-300% at the 95% confidence level).

Samples 6-7, 12-14 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch.	-	1-4, 6-15
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-3, 6-15
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3, 6-15
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3, 6-15
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-3, 6-15
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m ³	14-15
Suspended Sediment Concentration*	Filtration using Advantec GC-50 or equivalent 125mm diameter filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Entire sample filtered. No correction for density. Note: g/m ³ units are equivalent to mg/L. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. ASTM D3977-97 (Modified).	10 g/m ³	6-15
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-3, 5-15
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.005 g/m ³	1-3, 5-15
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0053 g/m ³	14-15
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.053 g/m ³	1-3, 6-15
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m ³	1-3, 5-15
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00053 g/m ³	14-15
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00010 g/m ³	1-3, 5-15
Total Lead	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00011 g/m ³	14-15
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m ³	1-3, 6-15

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m ³	1-3, 5-15
Total Zinc	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0011 g/m ³	14-15
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-4, 6-15
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-4, 6-15
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-4, 6-15
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-4, 6-15
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) : Online Edition.	0.10 g/m ³	1-4, 6-15
Dissolved Organic Carbon (DOC)	Filtered sample, Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) : Online Edition.	0.5 g/m ³	1-3, 6-15
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.000005 g/m ³	1-4, 6-15
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-4, 6-15
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-4, 6-15
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-4, 6-15
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-4, 6-15

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 21-Mar-2025 and 27-Mar-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 10

Client:	Tonkin & Taylor	Lab No:	3875197	SPv1
Contact:	Andrea Tuohy C/- Tonkin & Taylor PO Box 13055 Christchurch 8141	Date Received:	01-May-2025	
		Date Reported:	19-May-2025	
		Quote No:	135967	
		Order No:	1092485.0030	
		Client Reference:	1092485.0030	
		Submitted By:	Sarah Guy	

Sample Type: Aqueous

Sample Name:	SW1-WE2-First 30-Apr-2025 8:20 am	SW2-WE2-First 30-Apr-2025 7:45 am	SW4-WE2-First 01-May-2025 9:00 am	SW5-WE2-First 30-Apr-2025 7:25 am	SW6-WE2-First 30-Apr-2025 7:06 am
Lab Number:	3875197.1	3875197.2	3875197.3	3875197.4	3875197.5

Individual Tests

pH	pH Units	7.2	7.2	7.6	7.1	7.1
Total Hardness	g/m ³ as CaCO ₃	73	75	79	83	80
Electrical Conductivity (EC)	mS/m	20.4	20.8	21.9	23.0	22.8
Suspended Sediment Concentration*	g/m ³	< 11	< 11	< 11	11 #1	< 11
Dissolved Boron	g/m ³	0.038	0.039	0.055	0.072	0.063
Total Calcium	g/m ³	21	21	22	23	22
Dissolved Copper	g/m ³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m ³	< 0.00010	< 0.00010	0.00031	< 0.00010	< 0.00010
Total Magnesium	g/m ³	5.1	5.3	5.8	6.3	6.3
Dissolved Zinc	g/m ³	0.0088	0.0058	0.0048	0.0031	0.0026
Total Ammoniacal-N	g/m ³	0.071	0.067	0.38	0.45	0.44
Nitrite-N	g/m ³	0.008	0.008	0.012	0.019	0.017
Nitrate-N	g/m ³	0.136	0.120	0.145	0.108	0.065
Nitrate-N + Nitrite-N	g/m ³	0.144	0.128	0.157	0.127	0.081
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.36	0.35	0.86	1.03	0.91
Dissolved Organic Carbon (DOC)	g/m ³	1.7	0.6	2.9	3.8	6.0

Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq

Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.00006	< 0.00006	< 0.00006	< 0.00006	< 0.00006
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Sample Type: Aqueous						
Sample Name:		SW1-WE2-First 30-Apr-2025 8:20 am	SW2-WE2-First 30-Apr-2025 7:45 am	SW4-WE2-First 01-May-2025 9:00 am	SW5-WE2-First 30-Apr-2025 7:25 am	SW6-WE2-First 30-Apr-2025 7:06 am
Lab Number:		3875197.1	3875197.2	3875197.3	3875197.4	3875197.5
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW7-WE2-First 30-Apr-2025 6:40 am	SW8-WE2-First 30-Apr-2025 6:30 am	SW9-WE2-First 01-May-2025 10:00 am	SW10-WE2-First 01-May-2025 10:03 am	SW1-WE2-Mid 30-Apr-2025 8:35 pm
Lab Number:		3875197.6	3875197.7	3875197.8	3875197.9	3875197.10
Individual Tests						
pH	pH Units	7.1	7.1	7.5	6.8	7.1
Total Hardness	g/m ³ as CaCO ₃	40	43	73	13.7	39
Electrical Conductivity (EC)	mS/m	11.0	11.4	20.2	4.7	11.4
Total Suspended Solids	g/m ³	-	-	31 ^{#2}	220 ^{#3}	-
Suspended Sediment Concentration*	g/m ³	< 11	< 11	25 ^{#1}	22 ^{#1}	< 11
Dissolved Boron	g/m ³	0.025	0.025	0.038	0.016 ^{#4}	0.025
Total Boron	g/m ³	-	-	0.038	0.0150 ^{#4}	-
Total Calcium	g/m ³	12.5	13.4	21	4.2	11.2
Dissolved Copper	g/m ³	0.0016	0.0017	< 0.0005	0.0017	0.0011
Total Copper	g/m ³	-	-	0.00099	0.0049	-
Dissolved Lead	g/m ³	0.00026	0.00023	< 0.00010	0.00010	0.00013
Total Lead	g/m ³	-	-	0.00063	0.0041	-
Total Magnesium	g/m ³	2.1	2.3	5.1	0.77	2.7
Dissolved Zinc	g/m ³	0.027	0.027	0.0077	0.080	0.021
Total Zinc	g/m ³	-	-	0.033	0.131	-
Total Ammoniacal-N	g/m ³	0.027	0.035	0.032	0.053	0.057
Nitrite-N	g/m ³	0.005	0.006	0.010	0.003	0.006
Nitrate-N	g/m ³	0.188	0.194	0.21	0.25	0.155
Nitrate-N + Nitrite-N	g/m ³	0.193	0.199	0.22	0.25	0.161
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.37	0.42	0.58	0.32	0.47
Dissolved Organic Carbon (DOC)	g/m ³	2.8	4.6	1.9	1.5	1.8
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000011	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000015	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000023	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000014	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000018	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000028	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000013	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000019	< 0.000008
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	0.000032	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

Sample Type: Aqueous						
Sample Name:		SW 2-WE2-Mid 30-Apr-2025 8:20 pm	SW3-WE2-Mid 01-May-2025 9:40 am	SW4-WE2-Mid 30-Apr-2025 9:00 am	SW5-WE2-Mid 30-Apr-2025 7:55 pm	SW6-WE2-Mid 30-Apr-2025 7:40 pm
Lab Number:		3875197.11	3875197.12	3875197.13	3875197.14	3875197.15
Individual Tests						
pH	pH Units	7.2	6.9	8.0	7.2	7.0
Total Hardness	g/m ³ as CaCO ₃	40	31	58	73	25
Electrical Conductivity (EC)	mS/m	12.0	10.0	18.4	22.1	7.3
Suspended Sediment Concentration*	g/m ³	< 11	41 ^{#1}	< 11	< 11	< 11
Dissolved Boron	g/m ³	0.029	0.027	0.068	0.094	0.027
Total Calcium	g/m ³	11.4	8.3	15.6	19.4	7.2
Dissolved Copper	g/m ³	0.0011	0.0016	0.0009	0.0008	0.0024
Dissolved Lead	g/m ³	0.00013	0.00045	0.00013	0.00017	0.00033
Total Magnesium	g/m ³	2.9	2.5	4.7	6.0	1.58
Dissolved Zinc	g/m ³	0.0143	0.0136	0.0070	0.0055	0.029
Total Ammoniacal-N	g/m ³	0.059	0.044	0.43	0.48	0.038
Nitrite-N	g/m ³	0.007	0.007	0.014	0.028	0.009
Nitrate-N	g/m ³	0.169	0.23	0.22	0.24	0.41
Nitrate-N + Nitrite-N	g/m ³	0.176	0.23	0.23	0.26	0.42
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.47	0.61	0.87	1.34	0.50
Dissolved Organic Carbon (DOC)	g/m ³	2.4	7.1	6.3	7.7	5.8
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000008	< 0.000008	0.000012	< 0.000008	< 0.000008
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW 7-WE2-Mid 30-Apr-2025 7:25 pm	SW8-WE2-Mid 30-Apr-2025 7:15 pm	SW9-WE2-Mid 01-May-2025 10:00 am	SW10-WE2-Mid 01-May-2025 10:03 am	DUP01 30-Apr-2025
Lab Number:		3875197.16	3875197.17	3875197.18	3875197.19	3875197.20
Individual Tests						
pH	pH Units	7.0	7.0	7.2	6.8	7.2
Total Hardness	g/m ³ as CaCO ₃	27	26	31	36	84
Electrical Conductivity (EC)	mS/m	7.7	7.5	9.3	12.9	23.3
Total Suspended Solids	g/m ³	-	-	12 ^{#2}	6	-
Suspended Sediment Concentration*	g/m ³	24 ^{#1}	33 ^{#1}	< 11	< 11	24 ^{#1}
Dissolved Boron	g/m ³	0.025	0.025	0.022	0.036 ^{#4}	0.073
Total Boron	g/m ³	-	-	0.022	0.035 ^{#4}	-
Total Calcium	g/m ³	8.2	7.9	8.9	11.0	23
Dissolved Copper	g/m ³	0.0026	0.0027	0.0016	0.0064	< 0.0005
Total Copper	g/m ³	-	-	0.00193	0.0070	-

Sample Type: Aqueous						
Sample Name:		SW 7-WE2-Mid 30-Apr-2025 7:25 pm	SW8-WE2-Mid 30-Apr-2025 7:15 pm	SW9-WE2-Mid 01-May-2025 10:00 am	SW10-WE2-Mid 01-May-2025 10:03 am	DUP01 30-Apr-2025
Lab Number:		3875197.16	3875197.17	3875197.18	3875197.19	3875197.20
Individual Tests						
Dissolved Lead	g/m ³	0.00037	0.00041	0.00044	0.00102	< 0.00010
Total Lead	g/m ³	-	-	0.00091	0.0025	-
Total Magnesium	g/m ³	1.55	1.50	2.1	2.0	6.5
Dissolved Zinc	g/m ³	0.041	0.040	0.039	0.133	0.0029
Total Zinc	g/m ³	-	-	0.042	0.137	-
Total Ammoniacal-N	g/m ³	0.031	0.027	0.043	0.075	0.49
Nitrite-N	g/m ³	0.009	0.009	0.008	0.009	0.024
Nitrate-N	g/m ³	0.49	0.48	0.24	1.91	0.129
Nitrate-N + Nitrite-N	g/m ³	0.50	0.49	0.25	1.92	0.153
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.55	0.51	0.42	0.82	1.02
Dissolved Organic Carbon (DOC)	g/m ³	5.7	5.8	2.6	7.0	4.7
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	0.000009	0.000010	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	0.000012	0.000012	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	0.000011	0.000011	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	0.000011	0.000009	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	0.000008	0.000010	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Phenanthrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m ³	0.000012	0.000012	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		DUP02 01-May-2025	SW 1-WE2-End 04-May-2025 12:35 pm	SW2-WE2-End 04-May-2025 12:10 pm	SW3-WE2-End 04-May-2025 1:10 pm	SW4-WE2-End 04-May-2025 10:10 am
Lab Number:		3875197.21	3875197.24	3875197.25	3875197.26	3875197.27
Individual Tests						
pH	pH Units	-	7.1	7.1	6.7	6.9
Total Hardness	g/m ³ as CaCO ₃	-	63	62	81	66
Electrical Conductivity (EC)	mS/m	-	20.6	20.2	23.7	21.3
Suspended Sediment Concentration*	g/m ³	-	< 11	< 11	34 #1	< 11 #1
Dissolved Boron	g/m ³	0.069	0.044	0.045	0.039	0.052
Total Calcium	g/m ³	-	18.9	18.3	19.2	18.1
Dissolved Copper	g/m ³	0.0008	0.0033	0.0036	0.0013	0.0025
Dissolved Lead	g/m ³	0.00011	0.00042	0.00046	0.00014	0.00030
Total Magnesium	g/m ³	-	3.9	3.9	7.9	5.0
Dissolved Zinc	g/m ³	0.0067	0.074	0.076	0.0086	0.049
Total Ammoniacal-N	g/m ³	-	0.103	0.085	< 0.10 #5	0.30
Nitrite-N	g/m ³	-	0.026	0.028	< 0.02 #6	0.064
Nitrate-N	g/m ³	-	1.58	1.54	< 0.02	0.85
Nitrate-N + Nitrite-N	g/m ³	-	1.61	1.57	< 0.02 #6	0.92
Total Kjeldahl Nitrogen (TKN)	g/m ³	-	0.98	0.95	2.8	1.26

Sample Type: Aqueous						
Sample Name:		DUP02 01-May-2025	SW1-WE2-End 04-May-2025 12:35 pm	SW2-WE2-End 04-May-2025 12:10 pm	SW3-WE2-End 04-May-2025 1:10 pm	SW4-WE2-End 04-May-2025 10:10 am
Lab Number:		3875197.21	3875197.24	3875197.25	3875197.26	3875197.27
Individual Tests						
Dissolved Organic Carbon (DOC)	g/m ³	-	6.0	7.5	43	13.9
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]anthracene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	-	< 0.000004	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m ³	-	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	-	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	-	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	-	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	-	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW5-WE2-End 04-May-2025 10:50 am	SW6-WE2-End 04-May-2025 9:20 am	SW7-WE2-End 04-May-2025 9:00 am	SW8-WE2-End 04-May-2025 8:10 am	SW9-WE2-End 04-May-2025 1:15 pm
Lab Number:		3875197.28	3875197.29	3875197.30	3875197.31	3875197.32
Individual Tests						
pH	pH Units	7.0	7.0	7.2	7.2	7.1
Total Hardness	g/m ³ as CaCO ₃	70	68	86	86	62
Electrical Conductivity (EC)	mS/m	21.8	21.4	24.6	24.7	20.2
Total Suspended Solids	g/m ³	-	-	-	-	< 3
Suspended Sediment Concentration*	g/m ³	< 11	< 11	< 11 ^{#1}	< 11	< 11
Dissolved Boron	g/m ³	0.055	0.059	0.059	0.058	0.045 ^{#4}
Total Boron	g/m ³	-	-	-	-	0.044 ^{#4}
Total Calcium	g/m ³	19.0	18.6	26	26	18.5
Dissolved Copper	g/m ³	0.0023	0.0022	0.0032	0.0033	0.0034
Total Copper	g/m ³	-	-	-	-	0.0036
Dissolved Lead	g/m ³	0.00028	0.00029	0.00032	0.00031	0.00043
Total Lead	g/m ³	-	-	-	-	0.00082
Total Magnesium	g/m ³	5.4	5.2	5.1	5.2	3.9
Dissolved Zinc	g/m ³	0.041	0.033	0.027	0.025	0.076
Total Zinc	g/m ³	-	-	-	-	0.082
Total Ammoniacal-N	g/m ³	0.34	0.27	0.176	0.176	0.109
Nitrite-N	g/m ³	0.074	0.072	0.032	0.032	0.025
Nitrate-N	g/m ³	0.83	0.74	0.71	0.72	1.56
Nitrate-N + Nitrite-N	g/m ³	0.91	0.81	0.74	0.75	1.59
Total Kjeldahl Nitrogen (TKN)	g/m ³	1.25	1.17	1.28	1.34	0.75
Dissolved Organic Carbon (DOC)	g/m ³	15.0	15.6	15.0	15.2	5.4
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Acenaphthylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008

Sample Type: Aqueous						
Sample Name:		SW5-WE2-End 04-May-2025 10:50 am	SW6-WE2-End 04-May-2025 9:20 am	SW7-WE2-End 04-May-2025 9:00 am	SW8-WE2-End 04-May-2025 8:10 am	SW9-WE2-End 04-May-2025 1:15 pm
Lab Number:		3875197.28	3875197.29	3875197.30	3875197.31	3875197.32
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Benzo[a]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Chrysene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Dibenzo[a,h]anthracene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Fluorene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m ³	< 0.000004	< 0.000004	< 0.000004	< 0.000004	< 0.000004
Phenanthrene	g/m ³	0.000009	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Pyrene	g/m ³	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sample Name:		SW10-WE2-End 04-May-2025 1:30 pm	DUP04 04-May-2025	WS01-WE2-End 04-May-2025 7:30 am	WS07-WE2-End 04-May-2025 11:40 am	WS10-WE2-End 04-May-2025 9:45 am
Lab Number:		3875197.33	3875197.34	3875197.35	3875197.36	3875197.37
Individual Tests						
pH	pH Units	7.4	-	7.0	6.5	6.9
Total Hardness	g/m ³ as CaCO ₃	85	-	690	37	520
Electrical Conductivity (EC)	mS/m	24.5	-	222	15.5	226
Total Suspended Solids	g/m ³	< 3	-	64	< 3	76
Suspended Sediment Concentration*	g/m ³	< 11	-	-	-	-
Dissolved Boron	g/m ³	0.053	0.051	5.9	0.034 #4	4.1
Total Boron	g/m ³	0.054	-	5.9	0.033 #4	4.2
Total Calcium	g/m ³	25	-	134	8.9	116
Dissolved Copper	g/m ³	0.0012	0.0024	< 0.0005	0.0045	< 0.0005
Total Copper	g/m ³	0.00136	-	< 0.00053	0.0045	< 0.00053
Dissolved Lead	g/m ³	< 0.00010	0.00028	< 0.00010	0.00021	< 0.00010
Total Lead	g/m ³	0.00023	-	0.00126	0.00030	0.00167
Total Magnesium	g/m ³	5.7	-	85	3.6	57
Dissolved Zinc	g/m ³	0.027	0.043	0.0012	< 0.0010	0.0015
Total Zinc	g/m ³	0.028	-	0.0036	0.0015	0.0095
Total Ammoniacal-N	g/m ³	0.085	-	74	< 0.010	125
Nitrite-N	g/m ³	0.010	-	< 0.002	< 0.002	< 0.10 #8
Nitrate-N	g/m ³	0.78	-	< 0.002	1.99	< 0.10
Nitrate-N + Nitrite-N	g/m ³	0.79	-	< 0.002	1.99	< 0.10 #8
Total Kjeldahl Nitrogen (TKN)	g/m ³	0.64	-	91	0.98	131
Dissolved Organic Carbon (DOC)	g/m ³	1.4	-	< 50 #7	7.2	< 50
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m ³	< 0.000008	-	0.00147	< 0.000008	0.00040
Acenaphthylene	g/m ³	< 0.000008	-	0.000046	< 0.000008	0.000012
Anthracene	g/m ³	< 0.000008	-	0.00021	< 0.000008	0.000156
Benzo[a]anthracene	g/m ³	< 0.000008	-	0.000010	< 0.000008	0.000010
Benzo[a]pyrene (BAP)	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.000008	-	0.000009	< 0.000008	< 0.000008
Benzo[g,h,i]perylene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Benzo[k]fluoranthene	g/m ³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008

Sample Type: Aqueous						
Sample Name:		SW10-WE2-End 04-May-2025 1:30 pm	DUP04 04-May-2025	WS01-WE2-End 04-May-2025 7:30 am	WS07-WE2-End 04-May-2025 11:40 am	WS10-WE2-End 04-May-2025 9:45 am
Lab Number:		3875197.33	3875197.34	3875197.35	3875197.36	3875197.37
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Chrysene	g/m³	< 0.000008	-	0.000010	< 0.000008	0.000011
Dibenzo[a,h]anthracene	g/m³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Fluoranthene	g/m³	< 0.000008	-	0.00021	< 0.000008	0.00029
Fluorene	g/m³	< 0.000008	-	0.00107	< 0.000008	0.00035
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008	-	< 0.000008	< 0.000008	< 0.000008
Naphthalene	g/m³	< 0.00004	-	0.0072	< 0.00004	0.0082
Phenanthrene	g/m³	< 0.000008	-	0.00158	< 0.000008	0.00109
Pyrene	g/m³	< 0.000008	-	0.000163	< 0.000008	0.00021
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	-	< 0.10	< 0.10	< 0.10
C10 - C14	g/m³	< 0.2	-	< 0.2	< 0.2	< 0.2
C15 - C36	g/m³	< 0.4	-	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	-	< 0.7	< 0.7	< 0.7
Sample Name:		DUP05 04-May-2025				
Lab Number:		3875197.38				
Individual Tests						
pH	pH Units	6.9				
Total Hardness	g/m³ as CaCO₃	510				
Electrical Conductivity (EC)	mS/m	226				
Total Suspended Solids	g/m³	78				
Dissolved Boron	g/m³	4.1 ^{#4}				
Total Boron	g/m³	4.0 ^{#4}				
Total Calcium	g/m³	113				
Dissolved Copper	g/m³	< 0.0005				
Total Copper	g/m³	< 0.00053				
Dissolved Lead	g/m³	< 0.00010				
Total Lead	g/m³	0.00186				
Total Magnesium	g/m³	56				
Dissolved Zinc	g/m³	< 0.0010				
Total Zinc	g/m³	0.020				
Total Ammoniacal-N	g/m³	122				
Nitrite-N	g/m³	< 0.10 ^{#8}				
Nitrate-N	g/m³	< 0.10				
Nitrate-N + Nitrite-N	g/m³	< 0.10 ^{#8}				
Total Kjeldahl Nitrogen (TKN)	g/m³	130				
Dissolved Organic Carbon (DOC)	g/m³	< 50 ^{#7}				
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	0.00037				
Acenaphthylene	g/m³	0.000013				
Anthracene	g/m³	0.000145				
Benzo[a]anthracene	g/m³	0.000012				
Benzo[a]pyrene (BAP)	g/m³	< 0.000008				
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.000008				
Benzo[g,h,i]perylene	g/m³	< 0.000008				
Benzo[k]fluoranthene	g/m³	< 0.000008				
Chrysene	g/m³	0.000013				
Dibenzo[a,h]anthracene	g/m³	< 0.000008				
Fluoranthene	g/m³	0.00028				
Fluorene	g/m³	0.00032				
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.000008				
Naphthalene	g/m³	0.0076				
Phenanthrene	g/m³	0.00101				
Pyrene	g/m³	0.00021				

Sample Type: Aqueous		
Sample Name:		DUP05 04-May-2025
Lab Number:		3875197.38
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	< 0.10
C10 - C14	g/m³	< 0.2
C15 - C36	g/m³	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7

Analyst's Comments

#1 Please note that the result reported for Suspended Sediment Concentration should be interpreted with caution. The container received was overfilled and some volume was lost in processing.

#2 It has been noted that the result for Suspended Solids was greater than that for Suspended Sediment Concentration but within the analytical variation of these methods.

#3 It has been noted that the result for Total Suspended Solids was greater than that for Suspended Sediment Concentration. These results have been confirmed by reanalysis.

#4 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

#5 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NH₄N analysis.

#6 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO_xN /NO₂N analysis.

#7 It should be noted that the level of uncertainty of measurement for the Dissolved Organic Carbon (DOC) determination is significant due to the high level of Dissolved Inorganic Carbon relative to Total Dissolved Carbon present in these samples. DOC is determined by subtracting a result obtained for Dissolved Inorganic Carbon (DIC) from a result obtained for Total Dissolved Carbon (TDC). There may be an uncertainty of measurement of up to 10% in each of these measurements (at the 95% confidence level). The high inorganic carbon, and the relatively small difference between TDC and DIC for these samples mean that the DOC has a higher uncertainty than would normally be achieved for natural waters.

#8 Severe matrix interferences required that a dilution be performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO_xN /NO₂N analysis.

Samples 1, 33 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 200-300% at the 95% confidence level).

Sample 2 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (>300% at the 95% confidence level).

Samples 3-4, 8, 10 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the DOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch.	-	1-20, 24-33, 35-38
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-20, 24-33, 35-38

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-20, 24-33, 35-38
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-20, 24-33, 35-38
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-20, 24-33, 35-38
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) : Online Edition.	3 g/m ³	8-9, 18-19, 32-33, 35-38
Suspended Sediment Concentration*	Filtration using Advantec GC-50 or equivalent 125mm diameter filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Entire sample filtered. No correction for density. Note: g/m ³ units are equivalent to mg/L. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. ASTM D3977-97 (Modified).	10 g/m ³	1-20, 24-33
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-21, 24-38
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.005 g/m ³	1-21, 24-38
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0053 g/m ³	8-9, 18-19, 32-33, 35-38
Total Calcium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.053 g/m ³	1-20, 24-33, 35-38
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m ³	1-21, 24-38
Total Copper	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00053 g/m ³	8-9, 18-19, 32-33, 35-38
Dissolved Lead	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00010 g/m ³	1-21, 24-38
Total Lead	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00011 g/m ³	8-9, 18-19, 32-33, 35-38
Total Magnesium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.021 g/m ³	1-20, 24-33, 35-38
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m ³	1-21, 24-38
Total Zinc	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0011 g/m ³	8-9, 18-19, 32-33, 35-38
Total Ammoniacal-N	Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-20, 24-33, 35-38
Nitrite-N	Filtered sample from Christchurch. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₂ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-20, 24-33, 35-38
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-20, 24-33, 35-38
Nitrate-N + Nitrite-N	Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-20, 24-33, 35-38
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D (modified) 4500 NH ₃ F (modified) : Online Edition.	0.10 g/m ³	1-20, 24-33, 35-38
Dissolved Organic Carbon (DOC)	Filtered sample, Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC - TIC. APHA 5310 C (modified) : Online Edition.	0.5 g/m ³	1-20, 24-33, 35-38
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS/MS analysis. In-house based on US EPA 8270.	0.000005 g/m ³	1-20, 24-33, 35-38
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-20, 24-33, 35-38

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-20, 24-33, 35-38
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-20, 24-33, 35-38
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-20, 24-33, 35-38

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 10-May-2025 and 19-May-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix G Data Quality

Duplicate samples were collected as part of a broader investigation, which included the nearby Horseshoe Lake landfill investigation⁹. Relative percentage differences (RPDs) for the duplicate samples are summarized in Table G.1.

For samples collected using an auto-sampler (two in total), RPDs ranged from 0% to 26% for samples collected mid-rainfall during the first wet event and from 7% to 83% for samples collected mid-rainfall during the second wet event. The RPDs from the first wet event were within the expected range (below 30%), with the analytical suite covering dissolved boron, copper, lead, and zinc. The second wet event involved an extended analytical suite, including all parameters tested in this investigation (see Table 3.2). Exceedance of RPD ranges was noted for several parameters, such as total hardness (37%), TSS (74%), total calcium (38%), dissolved copper (57%), total magnesium (32%), dissolved zinc (83%), nitrate-N+nitrite-N (40%), and phenanthrene (40%). These exceedances suggest variability potentially linked to field compositing and laboratory reporting limits

Duplicate grab samples were collected on 11 occasions, with some exceedances of expected RPD ranges noted. In general, non-detect results in primary samples corresponded to non-detect results in duplicates. However, some minor exceedances were observed for PAHs in samples with concentrations near or below detection limits.

Exceedances beyond the 30% RPD threshold were observed for the following:

- Suspended sediment concentration: One occurrence in the first flush sample collected during the second wet event.
- Dissolved copper, lead, and zinc: Slight RPD exceedances were observed in low or near-detection limit samples, while exceedances were noted for zinc (67%) during both DE1 and WE 1 mid-rainfall sample, and for copper and lead (67%) during DE1.
- Nitrate and nitrite: RPDs for total nitrate+nitrite did not exceed 40%.
- Dissolved organic carbon (DOC): An RPD of 95% was reported during DE1 with one sample recording DOC below the laboratory reporting limit.

Despite these RPD exceedances, the data quality is generally sufficient for interpretation. However, caution is advised for dissolved zinc, copper, and lead, as well as for results influenced by field compositing. To minimize variability in future assessments, field compositing should be avoided whenever possible.

⁹ Waikakariki/Horseshoe Lake Closed Landfill Water Quality Monitoring, August 2025, prepared for CCC, T+T ref: 1092485.003.

Table G.1: Duplicate sample analytical results and RPDs

	Sample name Sample type sampling date laboratory number	DE1-WS10 05-Feb-	DE1-DUP02 05-Feb-	RPD	DE1-SW4 05-Feb-	DE1-DUP01 05-Feb-	RPD	DE2-SW4 03-Mar-	DE2-DUP01 03-Mar-	RPD
		2025 3:45 pm	2025		2025 11:00 am	2025 11:00 am		2025 9:30 am	2025	
		Grab sample	Grab sample		Grab sample	Grab sample		Grab sample	Grab sample	
		5/02/2025	5/02/2025		5/02/2025	5/02/2025		3/03/2025	3/03/2025	
		3772164.14	3772164.15		3772164.4	3772164.11		3795686.4	3795686.11	
pH	pH Units	7.1	7.3	3	7.6	7.7	1	7	7.1	1
Total Hardness	g/m3 as Ca	480	490	2	93	86	8	92	92	0
Electrical Conductivity (EC)	mS/m	222	223	0	24.3	24.1	1	25.3	25.4	0
Total Suspended Solids	g/m3	-	-	-	12	11	9	< 11	< 11	N/A
Suspended Sediment Concentration	g/m3	-	-	-	-	-	-	-	-	-
Dissolved Boron	g/m3	4.3	4.2	2	0.071	0.069	3	0.069	0.067	3
Total Boron	g/m3	-	-	-	-	-	-	-	-	-
Total Calcium	g/m3	104	105	1	26	24	8	25	25	0
Dissolved Copper	g/m3	0.001	0.0005	67	0.0005	0.0005	0	< 0.0005	< 0.0005	N/A
Total Copper	g/m3	-	-	-	-	-	-	-	-	-
Dissolved Lead	g/m3	0.0002	0.0001	67	0.0001	0.0001	0	< 0.00010	< 0.00010	N/A
Total Lead	g/m3	-	-	-	-	-	-	-	-	-
Total Magnesium	g/m3	54	56	4	7	6.4	9	7.2	7.3	1
Dissolved Zinc	g/m3	0.002	0.001	67	0.0015	0.0014	7	< 0.0010	< 0.0010	N/A
Total Zinc	g/m3	-	-	-	-	-	-	-	-	-
Total Ammoniacal-N	g/m3	144	143	1	0.57	0.58	2	0.62	0.61	2
Nitrite-N	g/m3	0.002	0.003	40	0.006	0.006	0	0.004	0.004	0
Nitrate-N	g/m3	0.002	0.002	0	0.004	0.002	67	0.002	0.004	67
Nitrate-N + Nitrite-N	g/m3	0.002	0.002	0	0.01	0.009	11	0.006	0.009	40
Total Kjeldahl Nitrogen (TKN)	g/m3	145	145	0	1.43	1.03	33	0.98	1.06	8
Dissolved Organic Carbon (DOC)	g/m3	5	14	95	4.8	5.5	14	4.3	3.9	10
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	g/m3	0.00039	0.0004	3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Acenaphthylene	g/m3	< 0.000008	0.000008	0	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Anthracene	g/m3	0.000135	0.000137	1	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Benzo[a]anthracene	g/m3	< 0.000008	0.000008	0	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Benzo[a]pyrene (BAP)	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Benzo[g,h,i]perylene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Benzo[k]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Chrysene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Dibenzo[a,h]anthracene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Fluoranthene	g/m3	0.00027	0.00029	7	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Fluorene	g/m3	0.00033	0.00035	6	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Indeno(1,2,3-c,d)pyrene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
Naphthalene	g/m3	0.0065	0.0064	2	< 0.00004	< 0.00004	N/A	< 0.00004	< 0.00004	N/A
Phenanthrene	g/m3	0.00113	0.00114	1	< 0.000008	< 0.000008	N/A	< 0.00003	< 0.00003	N/A
Pyrene	g/m3	0.00021	0.00022	5	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A
	Min			0			0			0
	max			95			67			67

Table G.1: Duplicate sample analytical results and RPDs

		DE2-WS10 03-Mar-2025 9:10 am			DE2-DUP02 03-Mar-2025			SW8_WE1_First 18-Mar-2025 1:50 pm			SW5_WE1_Mid 19-Mar-2025 7:00 am		
Sample name		Grab sample			Grab sample			Grab sample			Grab sample		
Sample type													
sampling date		3/03/2025			3/03/2025			17/03/2025			19/03/2025		
laboratory number		3795686.13			3795686.15			3819917.1			3819917.11		
		RPD						RPD			RPD		
pH	pH Units	6.7	6.7	0				7.8	-	-	7.5	-	-
Total Hardness	g/m3 as Ca	470	470	0				60	-	-	72	-	-
Electrical Conductivity (EC)	mS/m	231	231	0				15.1	-	-	19.8	-	-
Total Suspended Solids	g/m3	-	-	-				-	-	-	-	-	-
Suspended Sediment Concentration	g/m3	-	-	-				< 11	-	-	< 11 #1	-	-
Dissolved Boron	g/m3	4.1	4.1	0				0.026	0.028	7	0.055	0.052	6
Total Boron	g/m3	-	-	-				-	-	-	-	-	-
Total Calcium	g/m3	97	98	1				19	-	-	19.6	-	-
Dissolved Copper	g/m3	0.0011	< 0.0010	10				0.001	0.0009	11	< 0.0005	< 0.0005	N/A
Total Copper	g/m3	-	-	-				-	-	-	-	-	-
Dissolved Lead	g/m3	< 0.0002	< 0.0002	N/A				0.00013	0.00011	17	< 0.00010	< 0.00010	N/A
Total Lead	g/m3	-	-	-				-	-	-	-	-	-
Total Magnesium	g/m3	55	56	2				3	-	-	5.6	-	-
Dissolved Zinc	g/m3	0.003	< 0.002	40				0.0119	0.0109	9	0.0024	0.0012	67
Total Zinc	g/m3	-	-	-				-	-	-	-	-	-
Total Ammoniacal-N	g/m3	121	115	5				0.024	-	-	0.27	-	-
Nitrite-N	g/m3	0.002	< 0.002	0				0.006	-	-	0.023	-	-
Nitrate-N	g/m3	< 0.002	< 0.002	N/A				0.28	-	-	0.054	-	-
Nitrate-N + Nitrite-N	g/m3	0.003	0.002	40				0.28	-	-	0.077	-	-
Total Kjeldahl Nitrogen (TKN)	g/m3	140	142	1				0.22	-	-	0.66	-	-
Dissolved Organic Carbon (DOC)	g/m3	110	< 100	10				1.3	-	-	6	-	-
Polycyclic Aromatic Hydrocarbons													
Acenaphthene	g/m3	0.00045	0.00046	2				< 0.000008	-	-	< 0.000008	-	-
Acenaphthylene	g/m3	0.000014	0.000015	7				< 0.000008	-	-	< 0.000008	-	-
Anthracene	g/m3	0.00016	0.000167	4				< 0.000008	-	-	< 0.000008	-	-
Benzo[a]anthracene	g/m3	0.000013	0.000014	7				< 0.000008	-	-	< 0.000008	-	-
Benzo[a]pyrene (BAP)	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Benzo[g,h,i]perylene	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Benzo[k]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Chrysene	g/m3	0.000013	0.000014	7				< 0.000008	-	-	< 0.000008	-	-
Dibenzo[a,h]anthracene	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Fluoranthene	g/m3	0.0003	0.00031	3				< 0.000008	-	-	< 0.000008	-	-
Fluorene	g/m3	0.0004	0.0004	0				< 0.000008	-	-	< 0.000008	-	-
Indeno(1,2,3-c,d)pyrene	g/m3	< 0.000008	< 0.000008	N/A				< 0.000008	-	-	< 0.000008	-	-
Naphthalene	g/m3	0.0081	0.0079	2				< 0.00004	-	-	< 0.00004	-	-
Phenanthrene	g/m3	0.00127	0.00132	4				< 0.000014	-	-	< 0.000013	-	-
Pyrene	g/m3	0.00026	0.00026	0				< 0.000008	-	-	< 0.000008	-	-
Min		0						7			6		
max		40						17			67		

Table G.1: Duplicate sample analytical results and RPDs

		SW4_WE1_Mid 19-Mar-2025 9:00 am			WS10-WE1-End 20-Mar-2025 7:18 am			SW4-WE1-End 20-Mar-2025 7:20 am		
Sample name		DUP03 19-Mar-2025			DUP04 20-Mar-2025			DUP05 20-Mar-2025		
Sample type		Auto-sampler			Grab sample			Grab sample		
sampling date		19/03/2025			20/03/2025			20/03/2025		
laboratory number		3819917.16			3822013.2			3822013.9		
		3819917.19			3822013.4			3822013.5		
		RPD			RPD			RPD		
pH	pH Units	7.6	-	-	7.2	-	-	7.1	-	-
Total Hardness	g/m3 as Ca	68	-	-	460	-	-	67	-	-
Electrical Conductivity (EC)	mS/m	18.6	-	-	220	-	-	18.5	-	-
Total Suspended Solids	g/m3	-	-	-	-	-	-	-	-	-
Suspended Sediment Concentration	g/m3	< 11	-	-	-	-	-	< 11	-	-
Dissolved Boron	g/m3	0.052	0.052	0	4.3	-	-	0.037	0.039	5
Total Boron	g/m3	-	-	-	-	-	-	-	-	-
Total Calcium	g/m3	18.7	-	-	97	-	-	18.8	-	-
Dissolved Copper	g/m3	< 0.0005	< 0.0005	N/A	< 0.0005	-	-	< 0.0005	< 0.0005	N/A
Total Copper	g/m3	-	-	-	-	-	-	-	-	-
Dissolved Lead	g/m3	< 0.00010	< 0.00010	N/A	< 0.00010	-	-	0.00011	0.00011	0
Total Lead	g/m3	-	-	-	-	-	-	-	-	-
Total Magnesium	g/m3	5.1	-	-	54	-	-	4.9	-	-
Dissolved Zinc	g/m3	0.0022	0.0017	26	< 0.0010	-	-	0.0025	0.0021	17
Total Zinc	g/m3	-	-	-	-	-	-	-	-	-
Total Ammoniacal-N	g/m3	0.27	0.27	-	123	139	12	0.26	-	-
Nitrite-N	g/m3	0.011	0.011	-	0.012	0.005	82	0.004	-	-
Nitrate-N	g/m3	0.051	0.052	-	< 0.002	0.004	67	0.005	-	-
Nitrate-N + Nitrite-N	g/m3	0.062	0.063	-	0.011	0.009	20	0.009	-	-
Total Kjeldahl Nitrogen (TKN)	g/m3	0.68	0.6	-	141	140	1	0.64	-	-
Dissolved Organic Carbon (DOC)	g/m3	3.7	-	-	25	-	-	4.2	-	-
Polycyclic Aromatic Hydrocarbons				-						-
Acenaphthene	g/m3	< 0.000008	-	-	0.00046	0.0005	8	< 0.000008	-	-
Acenaphthylene	g/m3	< 0.000008	-	-	0.000018	0.000016	12	< 0.000008	-	-
Anthracene	g/m3	< 0.000008	-	-	0.000188	0.000193	3	< 0.000008	-	-
Benzo[a]anthracene	g/m3	< 0.000008	-	-	0.000012	0.000014	15	< 0.000008	-	-
Benzo[a]pyrene (BAP)	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Benzo[g,h,i]perylene	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Benzo[k]fluoranthene	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Chrysene	g/m3	< 0.000008	-	-	0.000009	0.000012	29	< 0.000008	-	-
Dibenzo[a,h]anthracene	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Fluoranthene	g/m3	< 0.000008	-	-	0.00031	0.00034	9	< 0.000008	-	-
Fluorene	g/m3	< 0.000008	-	-	0.0004	0.00042	5	< 0.000008	-	-
Indeno(1,2,3-c,d)pyrene	g/m3	< 0.000008	-	-	< 0.000008	< 0.000008	N/A	< 0.000008	-	-
Naphthalene	g/m3	< 0.00004	-	-	0.0096	0.0107	11	< 0.00004	-	-
Phenanthrene	g/m3	< 0.000013	-	-	0.00132	0.00136	3	< 0.000012	-	-
Pyrene	g/m3	< 0.000008	-	-	0.00027	0.00027	0	< 0.000008	-	-
Min		0			0			0		
max		26			82			17		

Table G.1: Duplicate sample analytical results and RPDs

	Sample name	SW5-WE2-First 30-			SW4-WE2-Mid 30-			DUP02 01-May-			SW4-WE2-End 04-			DUP04 04-May-		
		Apr-2025 7:25 am			Apr-2025 9:00 am			2025			May-2025 10:10 am			2025		
		Grab sample			Auto-sampler			Auto-sampler			Grab sample			Grab sample		
		30/04/2025			30/04/2025			1/05/2025			4/05/2025			45781		
	laboratory number	3875197.4	3875197.2	RPD	3875197.13	3875197.21	RPD	3875197.27	3875197.34	RPD						
pH	pH Units	7.1	7.2	1	8	7.2	11	6.9	-	-						
Total Hardness	g/m3 as Ca	83	84	1	58	84	37	66	-	-						
Electrical Conductivity (EC)	mS/m	23	23.3	1	18.4	23.3	24	21.3	-	-						
Total Suspended Solids	g/m3	-	-	-	-	-	-	-	-	-						
Suspended Sediment Concentration	g/m3	11	24	74	< 11	24	74	< 11 #1	-	-						
Dissolved Boron	g/m3	0.072	0.073	1	0.068	0.073	7	0.052	0.051	2						
Total Boron	g/m3	-	-	-	-	-	-	-	-	-						
Total Calcium	g/m3	23	23	0	15.6	23	38	18.1	-	-						
Dissolved Copper	g/m3	< 0.0005	< 0.0005	N/A	0.0009	< 0.0005	57	0.0025	0.0024	4						
Total Copper	g/m3	-	-	-	-	-	-	-	-	-						
Dissolved Lead	g/m3	< 0.00010	< 0.00010	N/A	0.00013	< 0.00010	26	0.0003	0.00028	7						
Total Lead	g/m3	-	-	-	-	-	-	-	-	-						
Total Magnesium	g/m3	6.3	6.5	3	4.7	6.5	32	5	-	-						
Dissolved Zinc	g/m3	0.0031	0.0029	7	0.007	0.0029	83	0.049	0.043	13						
Total Zinc	g/m3	-	-	-	-	-	-	-	-	-						
Total Ammoniacal-N	g/m3	0.45	0.49	9	0.43	0.49	13	0.3	-	-						
Nitrite-N	g/m3	0.019	0.024	23	0.014	0.024	53	0.064	-	-						
Nitrate-N	g/m3	0.108	0.129	18	0.22	0.129	52	0.85	-	-						
Nitrate-N + Nitrite-N	g/m3	0.127	0.153	19	0.23	0.153	40	0.92	-	-						
Total Kjeldahl Nitrogen (TKN)	g/m3	1.03	1.02	1	0.87	1.02	16	1.26	-	-						
Dissolved Organic Carbon (DOC)	g/m3	3.8	4.7	21	6.3	4.7	29	13.9	-	-						
Polycyclic Aromatic Hydrocarbons																
Acenaphthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Acenaphthylene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Anthracene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Benzo[a]anthracene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Benzo[a]pyrene (BAP)	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Benzo[g,h,i]perylene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Benzo[k]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Chrysene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Dibenzo[a,h]anthracene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Fluoranthene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Fluorene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Indeno(1,2,3-c,d)pyrene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
Naphthalene	g/m3	< 0.00004	< 0.00004	N/A	< 0.00004	< 0.00004	N/A	< 0.00004	-	-						
Phenanthrene	g/m3	< 0.00006	< 0.000008	N/A	0.000012	< 0.000008	40	< 0.000008	-	-						
Pyrene	g/m3	< 0.000008	< 0.000008	N/A	< 0.000008	< 0.000008	N/A	< 0.000008	-	-						
	Min	0			7			2								
	max	74			83			13								

Table G.1: Duplicate sample analytical results and RPDs

		WS10-WE2-End 04- May-2025 9:45 am	DUP05 04-May- 2025	
Sample name		Grab sample	Grab sample	
Sample type				
sampling date		4/05/2025	4/05/2025	
laboratory number		3875197.37	3875197.38	RPD
pH	pH Units	6.9	6.9	0
Total Hardness	g/m3 as Ca	520	510	2
Electrical Conductivity (EC)	mS/m	226	226	0
Total Suspended Solids	g/m3	76	78	3
Suspended Sediment Concentration	g/m3	-	-	-
Dissolved Boron	g/m3	4.1	4.1	0
Total Boron	g/m3	4.2	4	5
Total Calcium	g/m3	116	113	3
Dissolved Copper	g/m3	< 0.0005	< 0.0005	N/A
Total Copper	g/m3	< 0.00053	< 0.00053	N/A
Dissolved Lead	g/m3	< 0.00010	< 0.00010	N/A
Total Lead	g/m3	0.00167	0.00186	11
Total Magnesium	g/m3	57	56	2
Dissolved Zinc	g/m3	0.0015	< 0.0010	40
Total Zinc	g/m3	0.0095	0.02	71
Total Ammoniacal-N	g/m3	125	122	2
Nitrite-N	g/m3	< 0.10	< 0.10	N/A
Nitrate-N	g/m3	< 0.10	< 0.10	N/A
Nitrate-N + Nitrite-N	g/m3	< 0.10	< 0.10	N/A
Total Kjeldahl Nitrogen (TKN)	g/m3	131	130	1
Dissolved Organic Carbon (DOC)	g/m3	< 50	< 50	N/A
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	g/m3	0.0004	0.00037	8
Acenaphthylene	g/m3	0.000012	0.000013	8
Anthracene	g/m3	0.000156	0.000145	7
Benzo[a]anthracene	g/m3	0.00001	0.000012	18
Benzo[a]pyrene (BAP)	g/m3	< 0.000008	< 0.000008	N/A
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A
Benzo[g,h,i]perylene	g/m3	< 0.000008	< 0.000008	N/A
Benzo[k]fluoranthene	g/m3	< 0.000008	< 0.000008	N/A
Chrysene	g/m3	0.000011	0.000013	17
Dibenzo[a,h]anthracene	g/m3	< 0.000008	< 0.000008	N/A
Fluoranthene	g/m3	0.00029	0.00028	4
Fluorene	g/m3	0.00035	0.00032	9
Indeno(1,2,3-c,d)pyrene	g/m3	< 0.000008	< 0.000008	N/A
Naphthalene	g/m3	0.0082	0.0076	8
Phenanthrene	g/m3	0.00109	0.00101	8
Pyrene	g/m3	0.00021	0.00021	0
Min				0
max				71

Appendix H Treatment efficiency

We note that there is more detail that could be extracted from the monitoring data with regarding to the treatment efficiency during different rainfall stages (e.g. first flush, peak rainfall, day after rainfall), but for the purpose of comparing to an annual treatment efficiency we suggest averaging the percentage reduction (upstream-downstream) across a weather event.

Rainfall conditions during Wet Event 1 comprised 20.2 mm of rainfall over two days, during Wet Event 2 rainfall conditions comprised 128 mm over 4 days.

Appendix H Table 1: Wet event 1 – average upstream/downstream concentrations and percentage reduction

Parameter	Upstream concentration (g/m3)	Downstream concentration (g/m3)	% reduction (upstream minus downstream)
Copper – dissolved	0.00227	0.00057	75%
Copper – total	0.00293	0.0018	38%
Lead – dissolved	0.00036	0.00012	67%
Lead – total	0.00174	0.00023	87%
Zinc – dissolved	0.06967	0.0044	94%
Zinc – total	0.076	0.0078	90%
Nitrate	0.17267	0.04933	71%
Total PAHs	0.00017	0.00016	3%
TSS	6.33333	3.33333	47%

Note: The concentrations comprise the average of the following samples: first flush, mid-rainfall, end-rainfall.

Appendix H Table 2: Wet event 2 – average upstream/downstream concentrations and percentage reduction

Parameter	Upstream concentration (g/m3)	Downstream concentration (g/m3)	% reduction (upstream minus downstream)
Copper – dissolved	0.0031	0.00183	41%
Copper – total	0.00442	0.00217	51%
Lead – dissolved	0.00041	0.00032	20%
Lead – total	0.00228	0.00079	65%
Zinc – dissolved	0.08	0.0409	49%
Zinc – total	0.09867	0.05233	47%
Nitrate	0.98	0.67	32%
Total PAHs	0.00019	0.00016	17%
TSS	76.3333	15.3333	80%

Note: The concentrations comprise the average of the following samples: first flush, mid-rainfall, end-rainfall.

These two tables indicate that there is less of a reduction in the second wet weather event, and that for some metals there is a difference in the reduction of dissolved vs total concentrations. Note that as already reported, the TSS in Wet Event 2 was influenced by work being conducted in the stream at the start of the rainfall event. For PAHs, the low percentage reduction is a result of the low concentrations of Total PAHs detected – i.e. concentrations are already close to the laboratory reporting limit.

The conclusions include that the wetland generally reduces stormwater contaminants in water but is less efficient during higher intensity/longer duration rainfall events. E.g. during large rainfall events saturation of the wetland and reduced water retention time leads to higher downstream concentrations of metals, TSS, and nutrients. This suggests that during bigger storm events the treatment efficiency could be further reduced.

The efficiency of the wetland at treating/reducing stormwater contaminants will likely vary during different rainfall events. Therefore, the treatment efficiency for stormwater contaminants during individual rainfall events is not directly comparable to an assumed annual treatment efficiency. However, these individual events could be used to understand the range of treatment efficiency expected. In other words, the assumed annual treatment efficiency will be comprised of the variable efficiency over individual rainfall events and could be between 45% and 75% for metals.