# Condition 59 Responses to Monitoring Report 2022 & 2023 - Surface Water

Prepared to meet the Requirements of CRC214226

Christchurch City Council

December 2022

# Report: Condition 59 Responses to Monitoring Investigation Report 2022 & 2023 – Surface Water

| Document control | |
|---|---|
| Document location | FOLDER21/2060: Comprehensive Stormwater Network Discharge Consent (CSNDC) - Condition 59 - Further Investigations - Surface Water |
| Related documents | CRC214226 consent document (21/838872)<br>CRC214226 2021 annual report (21/1060662)<br>CRC214226 2022 annual report (22/854328)<br>Comprehensive Stormwater Network Discharge Consent Environmental Monitoring Programme Version 8 (21/904749)<br>Christchurch City surface water quality annual report 2020 (https://www.ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2021-reports/CSNDC-Annual-Surface-Water-Quality-Report-2021-FINAL-29.06.21.pdf )<br>Christchurch City surface water quality annual report 2021 (https://www.ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2022-reports/CSNDC-Annual-Surface-Water-Quality-Report-2022-2021-data-FINAL-report-30.06.22.pdf)<br>Targeted wet weather monitoring 2021 report for Haytons and Curlett Streams (https://www.ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2022-reports/TWWM-2022_Curlett-and-Haytons-v2.pdf ) |

| Version control | |
|---|---|
| Version number | 2 |
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| Changes/updates to the new version | N/A |

# Executive Summary

Under the Comprehensive Stormwater Network Discharge Consent (CSNDC), Christchurch City Council (Council) is required to meet Receiving Environment Objectives and Attribute Target Levels (ATLs) in the receiving environment. Condition 59 of the consent subsequently requires that for sites where the ATLs have not been met, investigations shall be undertaken to determine whether this is due to stormwater discharges authorised under the consent. This report assesses compliance with the Total Suspended Solids, copper, lead, and zinc ATLs for surface water (waterways and coastal waters) for the 2020 and 2021 calendar years.

Thirty-two (2020) and 31 (2021) of the 51 monitoring sites were identified as not meeting at least one of these ATLs. As this is a large number of sites, four sites are recommended as priorities for investigation, due to each site not just exceeding guideline levels for the given parameter, but also because of an increasing trend in concentrations. These four sites are Ōpāwaho-Heathcote River at Ferry Road Bridge, Curlett Stream at Motorway, Addington Brook, and Nottingham Stream at Candys Road. This report provides for these four priority sites an evaluation of whether these exceedances of ATLs are due to stormwater discharges authorised under this resource consent and proposed remediation with associated timelines.

Copper, zinc, and TSS issues at the four priority sites are most likely due in part to stormwater discharges authorised under the CSNDC. However, there are also likely other illicit (e.g., dry-weather) discharges not authorised under the consent that may be impacting contaminant levels. To address the impacts from stormwater, a number of remediation actions are proposed. This includes gathering more data on where contaminants are coming from by continuing targeted wet weather monitoring within the Curlett Stream catchment, and adding additional wet weather monitoring in the lower Ōpāwaho-Heathcote River and Nottingham Stream. Dry weather monitoring is also proposed within Curlett Stream and Addington Brook to identify non-stormwater illicit discharges. However, before wet weather monitoring plans for the Ōpāwaho-Heathcote River and Nottingham Stream, and the dry weather monitoring, can be developed, an identification of high-risk sites is required to inform the best location for monitoring sites, focussing on sites of high-risk. This high-risk sites assessment is currently underway and will be completed by the end of 2022. Monitoring will then be implemented as soon as practicable afterwards. To treat stormwater contaminants before discharge to the waterways, it is proposed to construct Council stormwater treatment facilities within Addington Brook and Nottingham Stream. All these remediation options will be supplemented by existing work programmes under the CSNDC, such as Industrial Site Audits and other source control programmes, as well as Environment Canterbury programmes.

Council considers work under this condition to be a long-term project. Each annual report will consider whether sites are regularly being prioritised for investigation, and the project as a whole will be iterative and adaptive, building on lessons learned in previous years.

## Contents

# 1. Introduction

On 19 December 2019, Christchurch City Council (Council) was granted resource consent by Environment Canterbury (ECan) to 'discharge stormwater from within Christchurch City onto or into Land, into Water, and into Coastal Environments' (CRC190445/214226). Under this Comprehensive Stormwater Network Discharge Consent (CSNDC), Council is required to meet Receiving Environment Objectives and Attribute Target Levels (ATLs) in the receiving environment. Furthermore, Condition 59 requires that for sites where the ATLs have not been met, investigations shall be undertaken to determine whether this is due to stormwater discharges authorised under the CSNDC.

Condition 59 states:

*If the monitoring results identify that the TSS, copper, lead and zinc Attribute Target Levels in surface water, as set out in Schedules 7 and 8, and Escherichia coli, copper, lead and zinc in groundwater, as set out in Schedule 9, are not being met, the Consent Holder shall:*

*(a) Engage with Canterbury Regional Council about conducting an investigation into whether this is due to the effects of stormwater discharges authorised under this resource consent, with site investigations prioritised for areas with high levels of contaminants, or with sensitive or high value receiving environments;*

*(b) Carry out an investigation if required under Condition 59(a) and compile the results of such an investigation into a report to be submitted to the Canterbury Regional Council and Papatipu Rūnanga (via Mahaanui Kurataiao Ltd.);*

*(c) Include in the report, at a minimum:*

*(1) An evaluation of whether the monitoring results are due to stormwater discharges authorised under this resource consent or not;*

*(2) An assessment of options for correction/remediation if effects are likely due to stormwater discharges authorised under this resource consent;*

*(3) A timeline for implementation of corrective action/remediation if effects are likely a result of discharges authorised under this resource consent;*

*(d) If, upon submittal of the above report, agreement between Christchurch City Council and Canterbury Regional Council cannot be reached regarding any aspects of the report referenced in (c) above, the Consent Holder shall consult with the WIM group, or successor group, in accordance with the Joint Christchurch City Council and Canterbury Regional Council Stormwater Management Protocol or subsequent revisions of the Protocol, and in accordance with any agreements entered into between the Consent Holder and Papatipu Rūnanga and implement any actions or changes identified as necessary by the WIM group, or successor group, through the consultation;*

*(e) The sites triggering an investigation for a given monitoring year shall be identified in the annual report referred to in Condition 61, and the subsequent investigation report shall be provided with the following annual monitoring report twelve months later; and*

*(f) Implement any actions or changes identified as necessary by the WIM group, or successor group, through the consultation under (d) above.*

*Advice Note: Discussions should be undertaken with the Canterbury Regional Council prior to and following investigations, to try to establish agreed approaches prior to submitting the report.*

Compliance with the Total Suspended Solids (TSS), copper, lead, and zinc ATLs for surface water (waterways and coastal waters) for the 2020 and 2021 calendar years (January – December) were assessed in the last two annual surface water quality monitoring reports (Margetts & Marshall, 2021; Margetts & Poudyal, 2022). Thirty-two (2020) and 31 (2021) of the 51 monitoring sites were identified as not meeting at least one of these ATLs. As this is a large number of sites, the same four sites were recommended in both reports as priorities for investigation, due to each site not just exceeding guideline levels for the given parameter, but also because an increasing trend in concentrations was recorded. These four sites are all within waterway sites (i.e., not coastal waters). Compliance with the ATLs for these four priority sites is outlined in Table 1 and these were the same results for both the 2020 and 2021.

To address part (c) of Condition 59, this report provides for these four priority sites (1) an evaluation of whether these exceedance of ATLs are due to stormwater discharges authorised under this resource consent, and if so, (2) proposed remediation, and (3) associated timelines. This is the first report in accordance with Condition 59 since the consent was granted in 2019. It is important to note that although this report focusses on the results from the 2020 and 2021 monitoring years, Council considers work under this condition to be a long-term project. Each annual report will consider whether sites are regularly being prioritised for investigation, and the project as a whole will be iterative, building on lessons learned in previous years.

Table 1. Four priority sites not meeting Attribute Target Levels (ATLs) for Total Suspended Solids (TSS), copper, and zinc, and which ATLs were exceeded. Note: there were no exceedances for lead.

| Site | ATL Exceeded |
|---|---|
| Ōpāwaho-Heathcote River at Ferry Road Bridge (HEATH01) | Dissolved copper: limit exceeded<br><br>Dissolved zinc: statistically significant increase |
| Curlett Stream at Motorway (HEATH14) | Dissolved copper: limit exceeded and statistically significant increase<br><br>Dissolved zinc: limit exceeded and statistically significant increase<br><br>TSS: statistically significant increase |
| Addington Brook (AVON09) | Dissolved copper: limit exceeded<br><br>Dissolved zinc: limit exceeded and statistically significant increase |
| Nottingham Stream at Candys Road (HALS03) | Dissolved copper: limit exceeded<br><br>Dissolved zinc: limit exceeded and statistically significant increase |

# 2. Sources of Copper, Zinc, and TSS

Copper and zinc are common contaminants in stormwater. The major sources of copper are vehicle brake pad emissions, but copper can also come from roofing material. For zinc, the major sources are roofs and vehicle tyres. Metal manufacturing and processing, and household chemicals such as moss killers may also contribute zinc and copper, and these can enter the receiving environment through surface runoff when applied to land.

TSS is also present in stormwater and can originate from a range of sources, primarily earthworks and runoff from erodible land, such as those on the Port Hills. However, TSS can also originate from resuspension of sediment on the stream bed during high-flow events. Metals may also bind to sediment particles and increase contaminant loadings in the receiving environment.

Metals and TSS can also be present in industrial discharges not related to stormwater. A quick way to identify if this is occurring is to plot sample concentrations against rainfall at the time of sampling, which is the approach taken in the following sections. Technically comparisons to the ATLs should be against the results of an entire data set, not on an event basis, but this does allow dry weather discharges to be highlighted.

This report considers the Christchurch Contaminant Load Model (C-CLM) which has been developed in accordance with Schedule 5 of the consent and predicts annual loads of contaminants for catchments across the City. However, this model is not specific enough to provide detailed sources of contaminants for the purposes of this report, but can indicate relative differences in loads. For example, zinc and copper loads are modelled to be higher in high-traffic and industrial and commercial areas. TSS loads are predicated to be higher in rural areas in the model, but does not capture inputs from other areas with high TSS from construction etc.

# 3. Site Descriptions & Contaminant Inputs

## 3.1. Ōpāwaho-Heathcote River at Ferrymead Bridge

The Ōpāwaho-Heathcote River at Ferrymead Bridge site is a tidally influenced site located at the mouth of the Ōpāwaho-Heathcote River, at the Ihutai-Avon-Heathcote Estuary (Plate 1; Figure 1). Although Ōpāwaho-Heathcote River sites upstream of Ferrymead Bridge also recorded exceedances in guideline levels for copper and zinc, only the Ferrymead Bridge site recorded a statistical increase in zinc concentrations (a 10% increase in both the 2020 and 2021 monitoring years; Margetts & Marshall, 2021; Margetts & Poudyal, 2022). This suggests either (1) sources of zinc entering the river between Tunnel Road and Ferrymead Bridge, or (2) cumulative inputs down the catchment which culminate at this site. It is proposed to first investigate inputs between Tunnel Road and Ferrymead Bridge to rule out nearby site influences, but in the long-term, a catchment-wide investigation may be required. As such, for the purpose of this report, the catchment for this site is focussed on the inputs into the river between Tunnel Road and Ferrymead Bridge.

The waterways discharging in the stretch of the river between Tunnel Road and Ferrymead Bridge include Ferry Esplanade Reserve Drain No 1, Settlers Reserve Drain, Avoca Valley Stream, Truscotts Stream Branch, Matuku Waterway (where the online Ferrymead Stormwater Ponds are located), Ferrymead Reserve Drain, and Steamwharf Stream (Figure 1). The C-CLM predicts a high zinc load (917 kg/yr or 0.79 kg/ha/yr) and a moderate copper load (99 kg/yr or 0.09 kg/ha/yr) at this site. The load per hectare is lower for this site due to the large rural contributing catchment with little metal contamination. There are also a number of direct stormwater discharges from the network that drain commercial and industrial areas, and roads with heavy traffic, such as the Ferrymead commercial district and around Chapman Road.

Ihutai is a receiving environment for a number of other catchments and discharges, such as those associated with the Ōtākaro-Avon River, Linwood Canal, and numerous coastal discharges. The Mount Pleasant Yacht Club is also located nearby to the Ferrymead Bridge, with vehicle and boat movements. These inputs may also impact on the water quality of the Ferrymead Bridge site, due to tidal movement. However, it seems more plausible that discharges from the stormwater system have greater effects on the monitoring site.

Dredging of the Ōpāwaho-Heathcote River occurred from 2018 to 2020 in the stretch of river from Opawa Road to the Woolston Cut. These works were carried out to remove accumulated sediment to improve the drainage capacity of the river and prevent flooding. The monthly surface water monitoring under the CSNDC recorded high levels of sediment in the Ōpāwaho-Heathcote River in association with dredging (Margetts & Marshall, 2021). Dredging may also have resulted in the release of stormwater derived metals bound to sediment, such as copper and zinc. However, dredging did not occur directly at this site, a statistical increase did not occur at the other upstream sites, and this site has recorded exceedances for many years, suggesting that dredging has not caused these high levels of copper and zinc.

To understand whether exceedances of the ATLs are occurring in relation to stormwater or other discharges during dry weather, the results of the monitoring from 2020 were plotted against rainfall and the required ATL (Figure 2). Of note, the highest copper result (0.0054 mg/L) in February was not associated with rainfall. The second highest zinc result (0.017 mg/L) in July was also not associated with rainfall. All other results that were above the ATLs were associated with rainfall. This suggests that exceedances are primarily associated with stormwater discharges, but that there may be other dry weather exceedances occurring.

A statistically significant increase in zinc of 10% has been recorded at this site since monitoring began in 2007 (Margetts & Poudyal, 2022; Figure 3). Although large peaks in concentrations were recorded pre 2017, lower levels around the laboratory limit of detection were consistently recorded between these peaks (Margetts & Poudyal, 2022; Figure 3). Since 2016, background levels appear to be consistently higher between peaks in concentrations. This suggests an increasing source of zinc since 2016.

ECan enforcement records (abatements and infringements) for 2020 and 2021 were assessed to see if there were any events that may have contributed to the exceedances of ATLs at this site. None were identified.

There are a limited number of stormwater treatment facilities in the catchments between Tunnel Road and Ferrymead Bridge. The largest of these are the Ferrymead Ponds, which consist of a first flush pond followed by a detention pond. These provide treatment to the majority of Heathcote Valley. There is also a swale located in Romar Lane and a small silt trap at the bottom of Avoca Valley. Some individual sites within the catchment will have private on-site treatment devices which are not mapped.

Plate 1. Ōpāwaho-Heathcote River at Ferrymead Bridge monitoring site (samples are taken from the middle of the bridge during low tide)

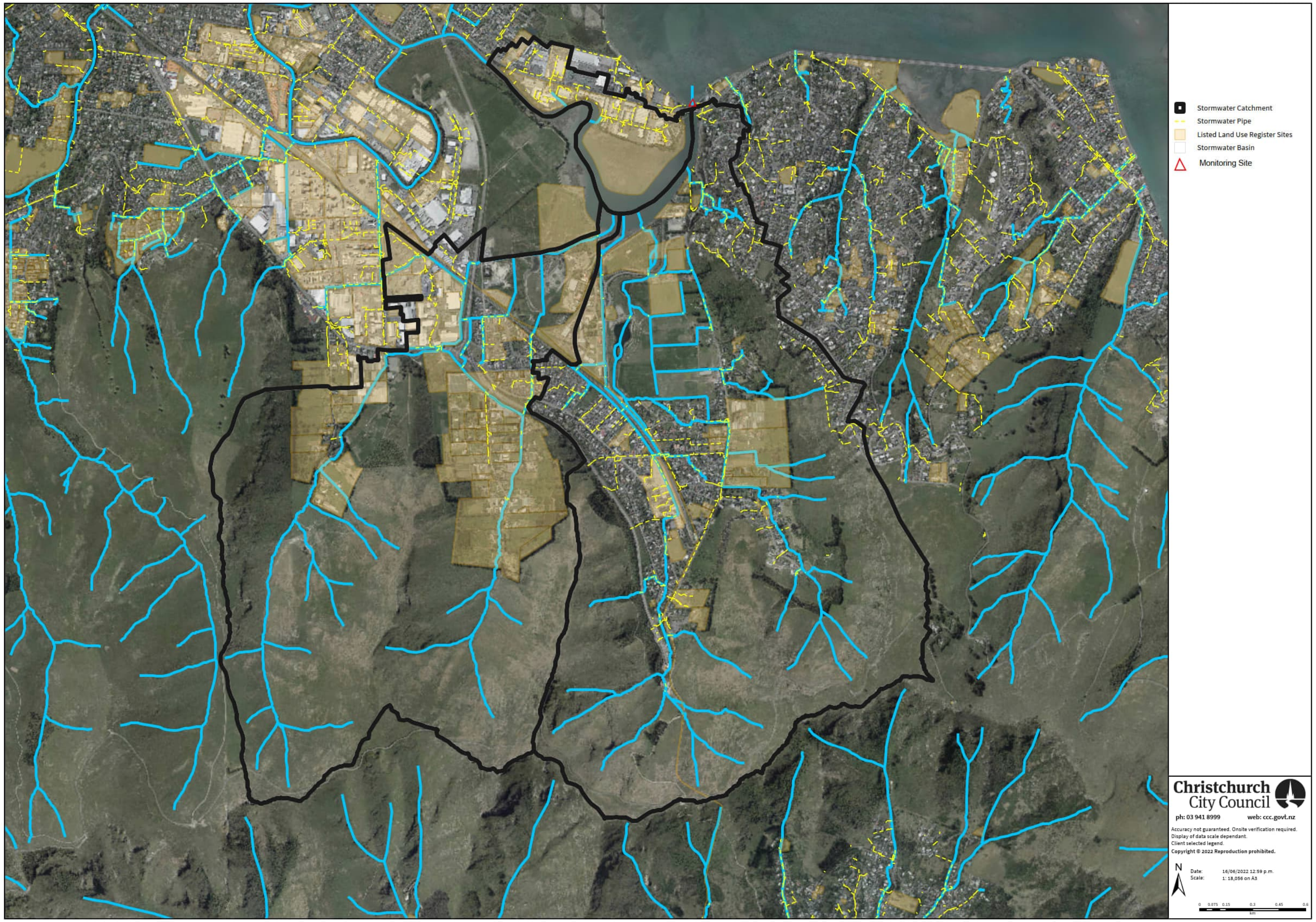



Figure 1. Location of Ōpāwaho-Heathcote River at Ferrymead Bridge monitoring site and contributing stormwater catchment

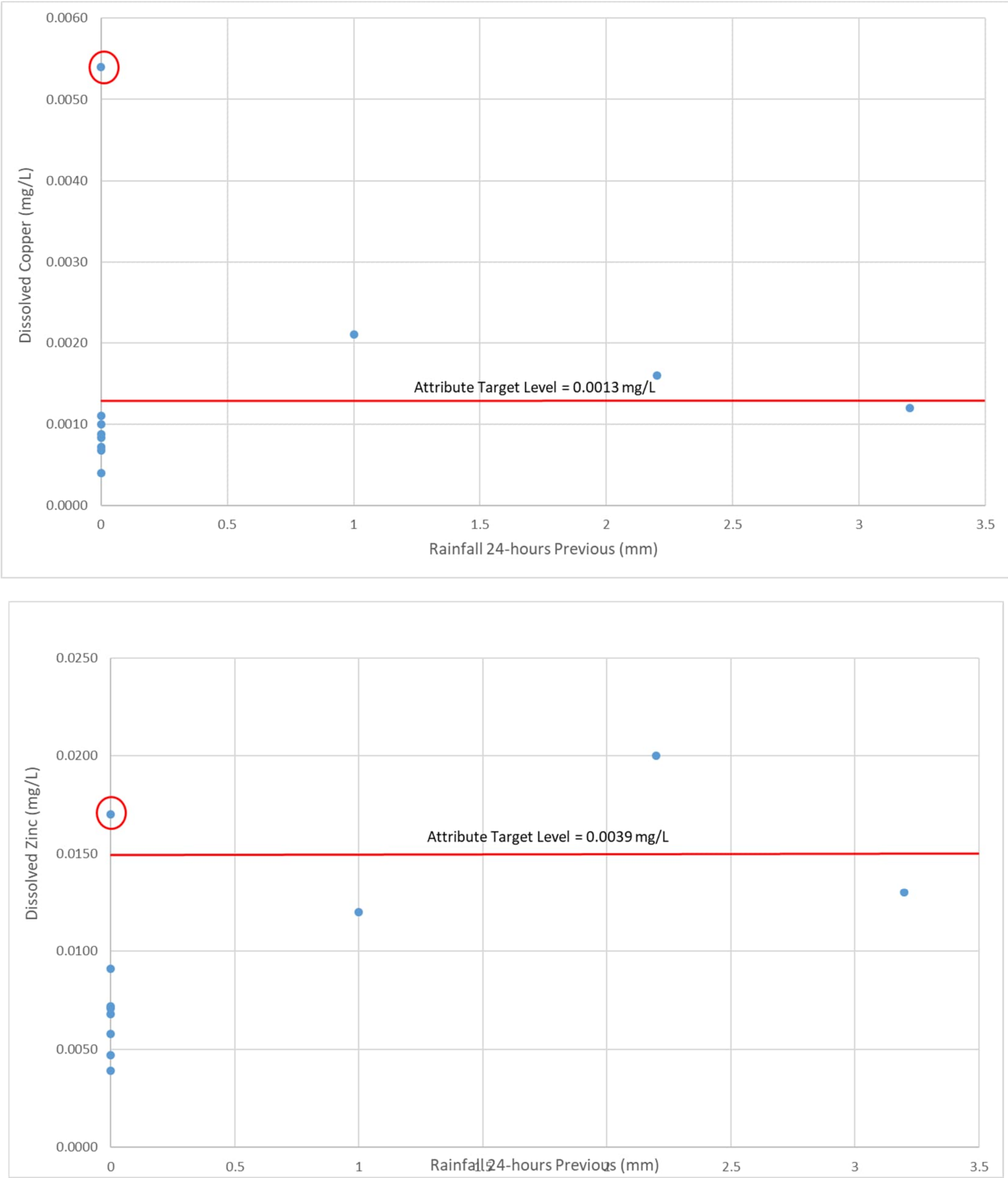



Figure 2. Rainfall versus copper (top graph) and zinc (bottom graph) levels in surface water during monthly monitoring from January – December 2020 at Ōpāwaho-Heathcote River at Ferrymead Bridge. A sample was not taken in April 2020, due to COVID19 impacts. Rainfall was assessed at rain gauge site '325619 Tunnel Road'. Results likely associated with a dry weather discharge are circled.

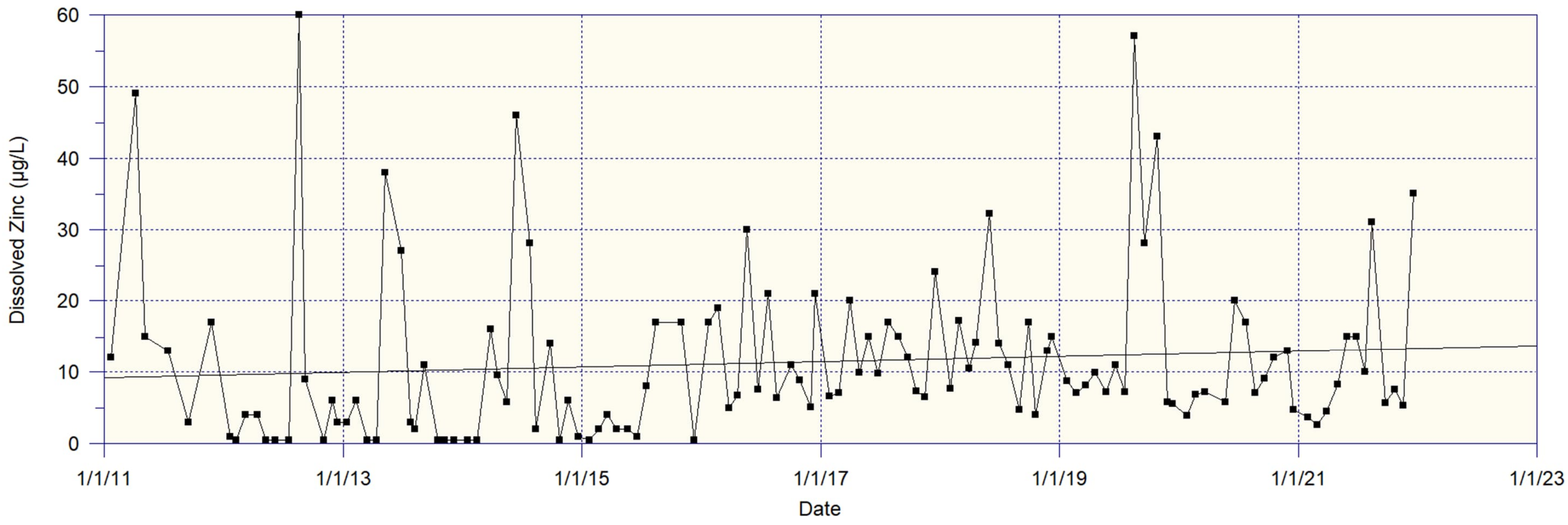



Figure 3. Dissolved zinc concentrations at Ōpāwaho-Heathcote River at Ferrymead Bridge for the monitoring period January 2007 to December 2021. Squares indicate individual sampling events. An increasing trend of 10% was recorded over the sampling period.

## 3.2. Curlett Stream at Southern Motorway

The Curlett Stream at Southern Motorway site is located at the inlet to the recently constructed Curlett stormwater facility, immediately downstream of the motorway (Plate 2; Figure 4). The site at this location consists of a large pond. Land uses upstream of this site are predominantly commercial and industrial. The C-CLM predicts a high zinc load (1,098 kg/yr or 3.08 kg/ha/yr) and a moderate copper load (94 kg/yr or 0.26 kg/ha/yr) at this site. As the C-CLM is not a very good indicator of TSS levels, the results of TSS modelling is not presented here (Gadd et al., 2018).

The monthly monitoring results for copper, zinc, and TSS at this site for the 2020 monitoring year show that copper and zinc generally always exceeded their respective ATL (Figure 5). In addition, at least half of the copper and zinc samples exceeded the ATLs when no rainfall occurred, indicating that dry weather discharges are a significant source of metals. The largest concentrations were generally recorded during rainfall, indicating stormwater is also a major contributor of copper and zinc to the stream. For TSS, exceedances of the ATL were not as common, but they indicated both dry weather and stormwater discharges.

Detailed wet weather monitoring is also being undertaken in the catchment as part of the Targeted Wet Weather Monitoring Programme (TWWMP) under Schedule 3(k) of the CSNDC. The objectives of this project for the Curlett Stream catchment are to (1) map hotspots or localised discharges of contaminants along the length of the streams during base flows and storm flows, (2) investigate whether there are also hotspots of other currently unknown emerging or unusual contaminants, and (3) to establish what discharges from individual sites are contributing to the identified hotspots of contaminants. The results of the first stage of monitoring have been summarised in Borne & Gadd (2022). The monitoring identified high levels of metals and TSS, with concentrations predominantly above the relevant guideline levels. Given the high variability of the data, it was unclear why or where main TSS export to the Curlett Stream occurred. Copper and zinc concentrations were also highly variable between sites and events. Overall, additional wet weather monitoring is required to address the objectives of the project and to determine how corrective action/remediation will be carried out to address Condition 59. The report included a number of recommendations for the next stage of monitoring.

Statistically significant increases in copper, zinc, and TSS have been recorded at this site since monitoring began in 2014 (10%, 16%, and 8%; Margetts & Poudyal, 2022; Figure 6). This is generally due to a consistent increase in concentrations over time, with larger and sometimes more frequent peaks in concentrations occurring towards the end of the monitoring period.

ECan enforcement records (abatements and infringements) for 2020 and 2021 were assessed to see if there were any events that may have contributed to the exceedances of ATLs at this site. None were identified.

The Curlett stormwater facility consists of an online first flush basin and wetland which completed in Curlett Stream in 2019. These facilities are capable of treating the first flush volume (25 mm rainfall depth) from the Curlett Stream industrial catchment. These facilities also provide stormwater storage to reduce flooding downstream on Curlett Stream and the Heathcote River without increasing flood risk upstream of the scheme. Some individual sites within the catchment will have private on-site treatment as well, but this is not mapped.

Plate 2. Curlett Stream at Southern Motorway monitoring site (samples are taken from the culvert at the foreground of the photo)

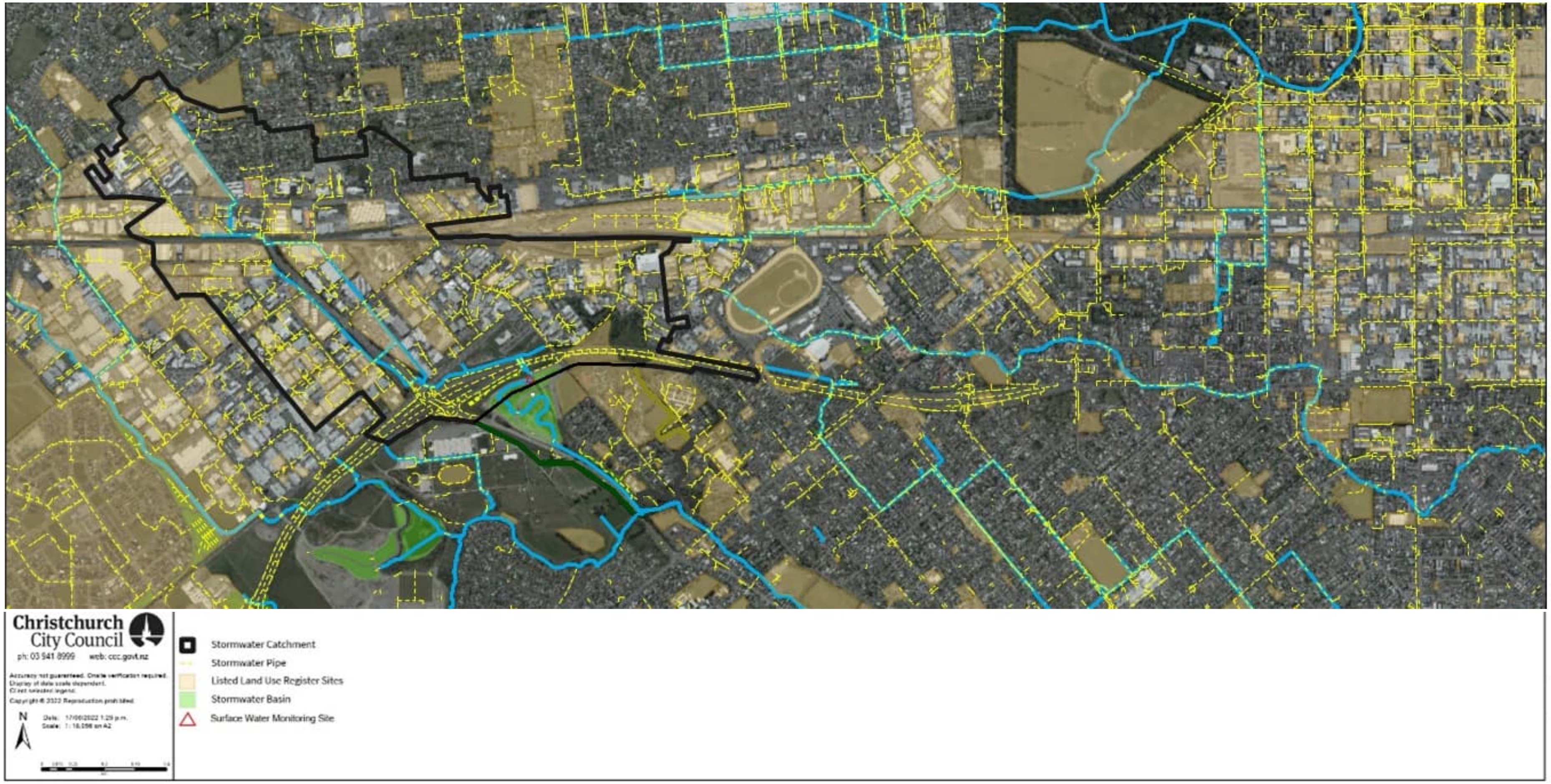



Figure 4. Location of Curlett Stream at Southern Motorway monitoring site and contributing stormwater catchment.

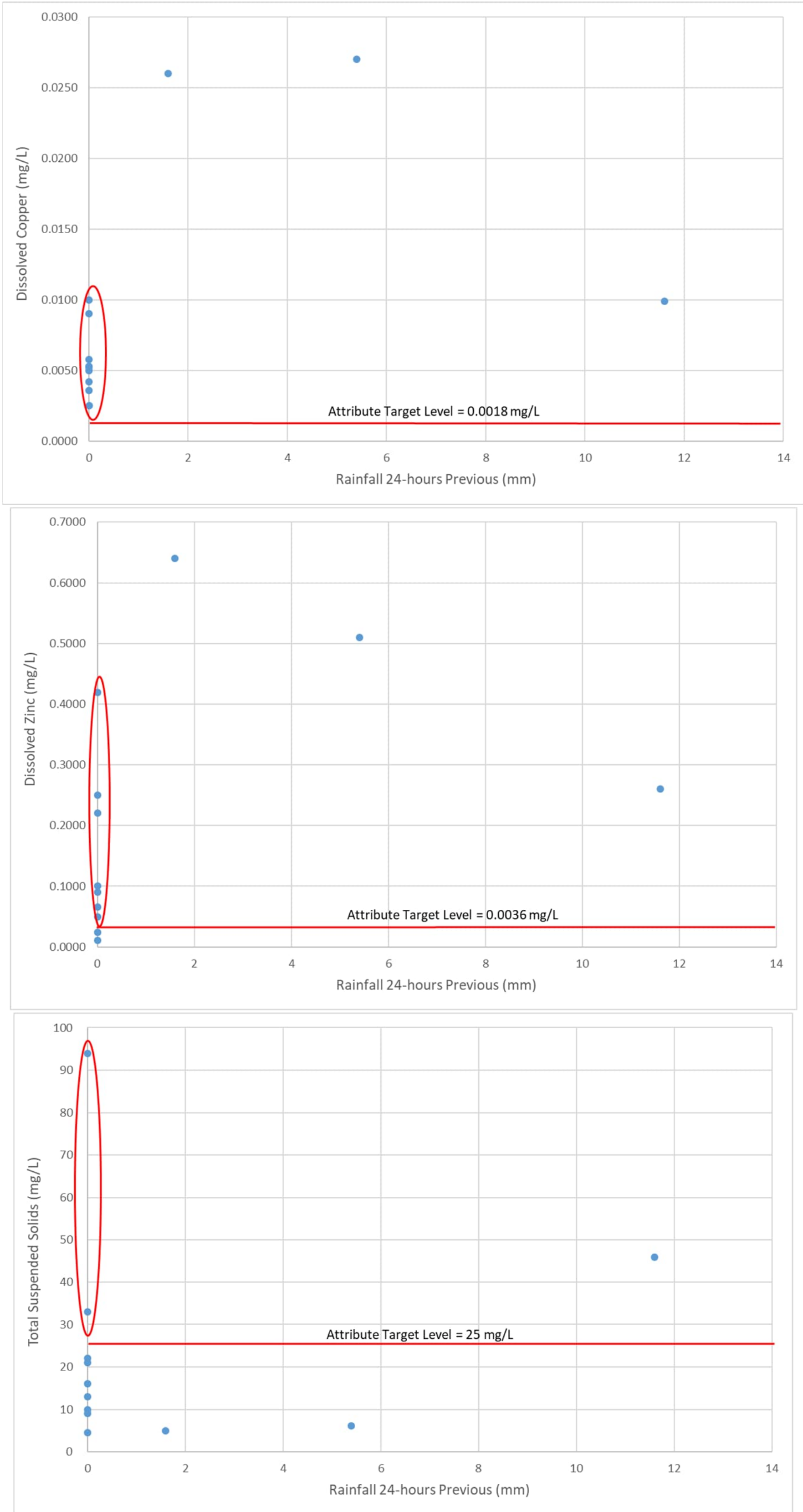



Figure 5. Rainfall versus copper (top graph), zinc (middle graph), and Total Suspended Solids (bottom graph) levels in surface water during monthly monitoring from January – December 2020 at Curlett Stream at Southern Motorway. Rainfall was assessed at rain gauge site '325512 at Dunbars Reservoir'. Results likely associated with a dry weather discharge are circled.

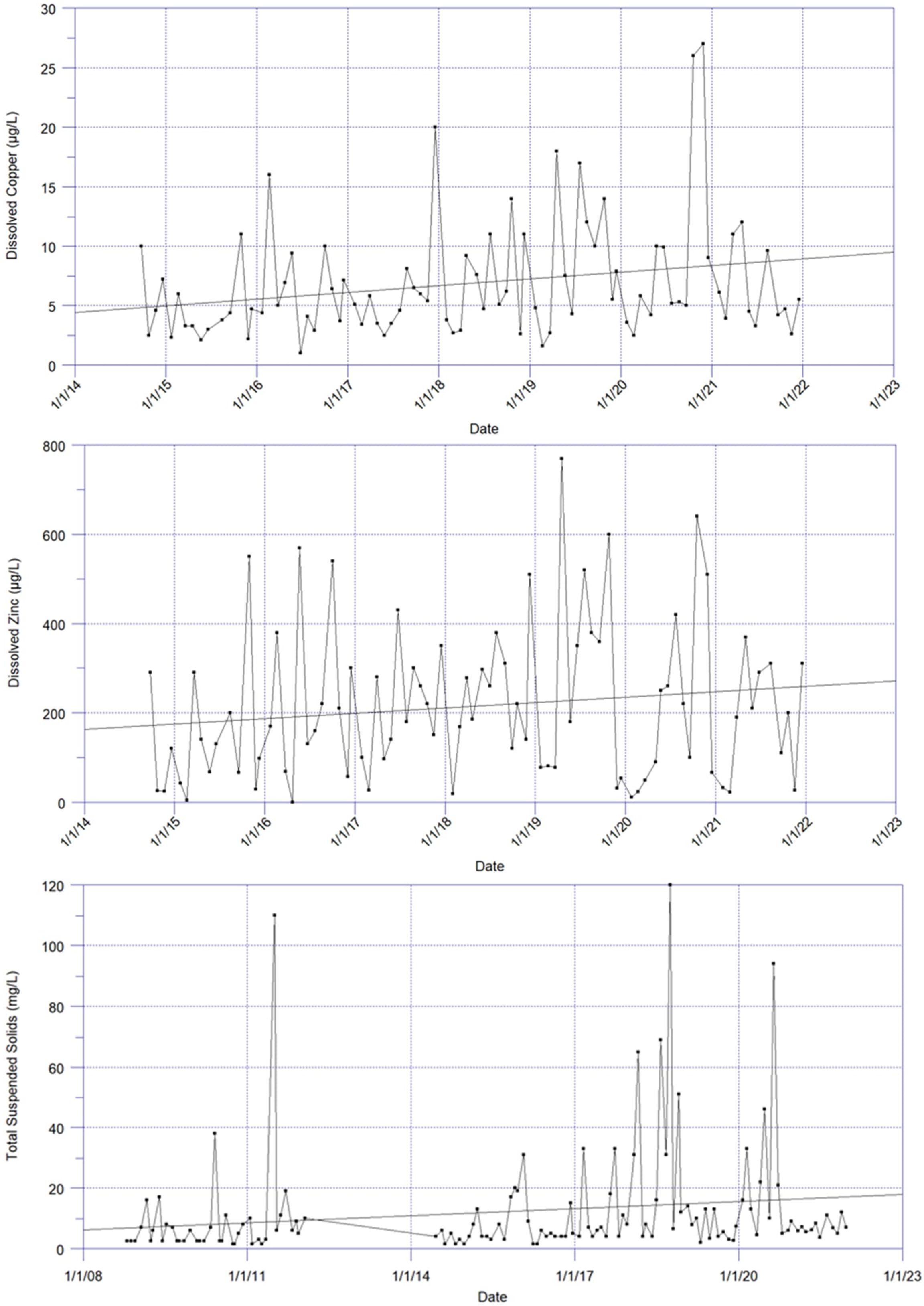



Figure 6. Dissolved copper (top graph), dissolved zinc (middle graph), and Total Suspended Solids (TSS; bottom graph) concentrations at Curlett Stream at Motorway for the monitoring period October 2008 (TSS)/September 2014 (copper and zinc) to December 2021. Squares indicate individual sampling events. Increasing trends of 10%, 16%, and 8% were recorded over the sampling period.

## 3.3. Addington Brook

The Addington Brook site is located at the bottom of the catchment within Hagley Park South, just upstream of Riccarton Avenue (Plate 3; Figure 7). The stream at this location is narrow and shallow, with steeply incised banks. Land use of the upper catchment consists of commercial and industrial, and the lower catchment flows through both North and South Hagley Park. The C-CLM predicts a moderate zinc load (645 kg/yr or 2.23 kg/ha/yr) and a moderate copper load (62 kg/yr or 0.21 kg/ha/yr) for this site.

Approximately a quarter of samples exceeded the ATL for copper during the 2020 monitoring year, whereas the majority of samples exceeded the zinc ATL (Figure 8). Only one copper sample that exceeded the ATL was during dry weather, whereas approximately a quarter of the samples that exceeded the zinc ATL were associated with dry weather. This indicates that there are both dry weather and stormwater sources of metals in this catchment.

A statistically significant increase in zinc of 7% has occurred since monitoring began at this site in 2011 (Margetts & Poudyal, 2022; Figure 9). While peaks in concentrations appear to be consistent across the monitoring period, the lower baseline levels have been higher since 2016.

Water quality monitoring has also been carried out by ECan in the Addington Brook catchment at nine sites since 2014 (*unpublished data*; Figure 10). This includes baseline (dry weather) and wet weather monitoring using grab sampling and autosamplers, over a number of sampling events. Analyses for this report show that dissolved copper levels were above the CSNDC ATL at most sites during both baseline and wet weather monitoring[1]. The ATL for zinc was exceeded at all sites during baseline and wet weather monitoring, with the exception of the Addington Saleyards during baseline monitoring. For both copper and zinc, wet weather monitoring results were greater than the baseline monitoring. There were also no obvious trends downstream, suggesting continual input of copper and zinc across the catchment. The highest values were recorded at the O'Shannessey Place manhole site (0.035 mg/L for copper and 0.64 mg/L for zinc), with this site generally recording the highest values during baseline and wet weather throughout the monitoring for both copper and zinc.

Stormwater modelling by the University of Canterbury using Modelled Estimates of Discharges for Urban Stormwater Assessment (MEDUSA) indicates that the KiwiRail Railway Yards generate some of the highest loads of dissolved copper and zinc in the catchment (O'Sullivan & Cochrane, 2017; Figure 12). The University of Canterbury assessed the longitudinal and spatial patterns of water quality within the catchment during four wet weather events in 2015-2016 (O'Sullivan & Cochrane, 2017). This analysis included an assessment of the treatment performance of the Matipo Street ponds. Dissolved zinc was consistently and highly elevated above the relevant waterway guideline, despite the ponds' ability to retain large portions of this contaminant. It was recommended that zinc should be targeted for treatment at the Deans Ave location where its concentration was consistently highest. However, given the ubiquitous nature of dissolved zinc in Christchurch urban waterways, source control was also identified as being important to implement. In contrast, dissolved copper was effectively removed within the ponds.

ECan enforcement records (abatements and infringements) for 2020 and 2021 were assessed to see if there were any events that may have contributed to the exceedances of ATLs at this site. None were identified.

There is limited stormwater treatment within the catchment currently. The Matipo Street pond provides some treatment in the upper part of the catchment. The catchment upstream of this pond

[1] Based on comparisons of 95th percentile (box and the whiskers) to the ATL, as per the CSNDC EMP

system is largely impervious with activity mainly from the road-rail freight handling facility, and neighbouring industrial and commercial activity (O'Sullivan & Cochrane, 2017). The pond system was designed to detain and treat (to an undefined level) 21.7 ha of runoff from the catchment (City Design, 1999; EOS Ecology, 2009). There are also some rain gardens in parts of Addington serving some residential and partly commercial areas. The largest of these is located at Grove Road. There will also be some private treatment devices on commercial or industrial sites in the catchment, but these are not mapped.

Plate 3. Addington Brook monitoring site (samples are taken from the culvert at the foreground of the photo)

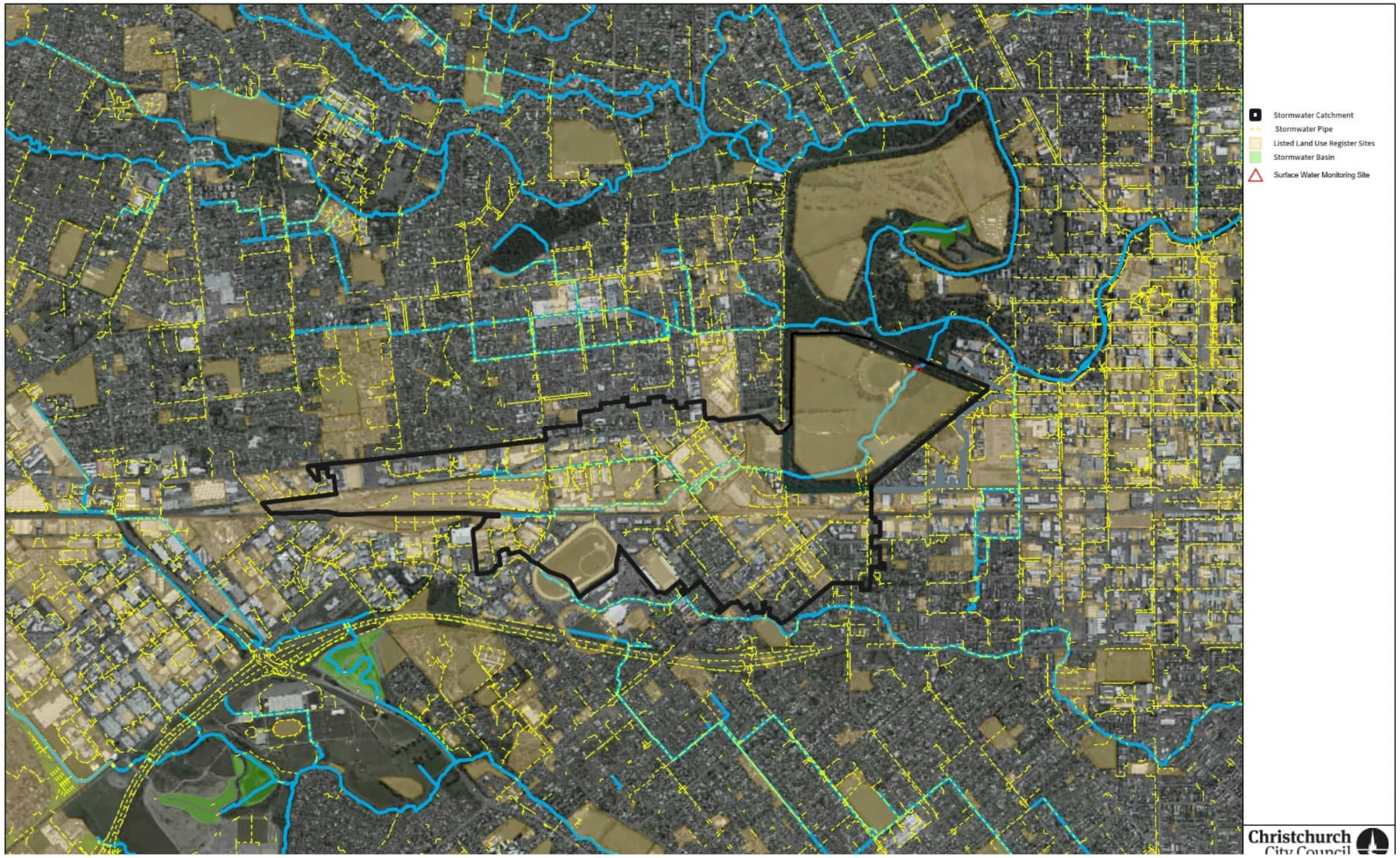
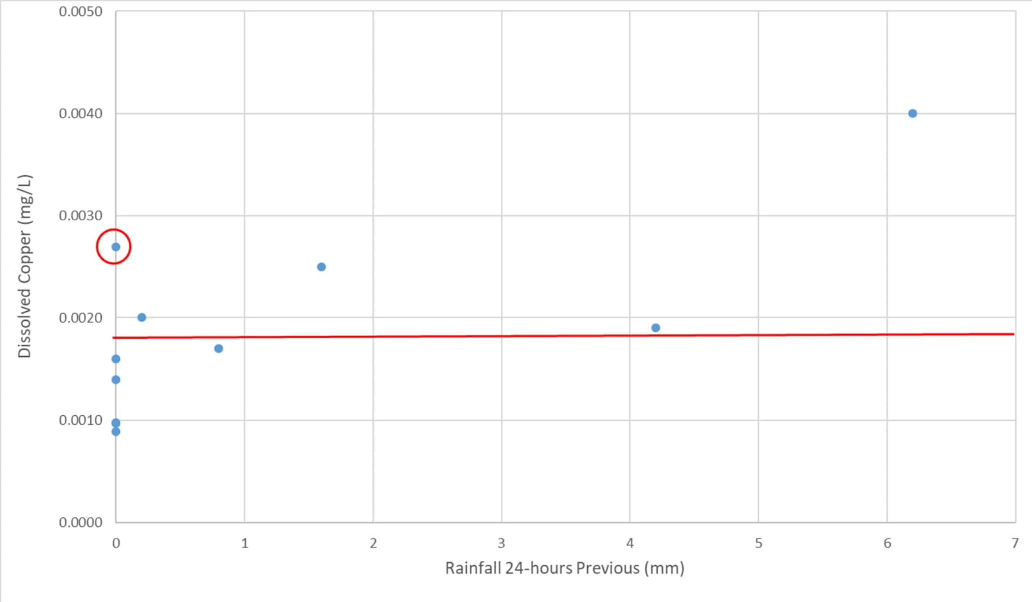



Figure 7. Location of Addington Brook monitoring site and contributing stormwater catchment



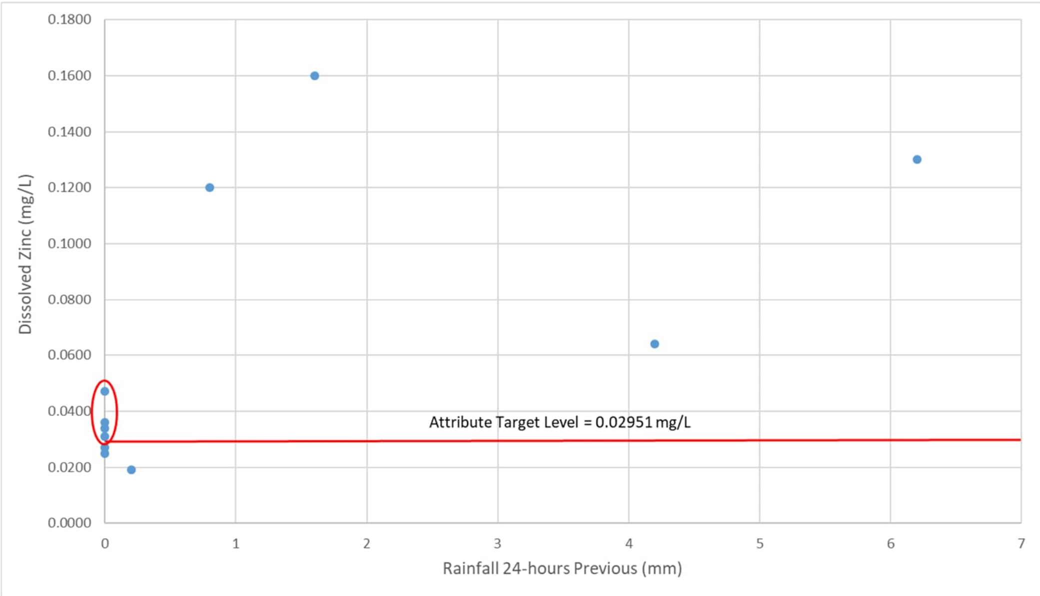




Figure 8. Rainfall versus copper (top graph) and zinc (bottom graph) levels in surface water during monthly monitoring from January – December 2020 at Addington Brook. A sample was not taken in April, due to COVID19 impacts. Rainfall was assessed at rain gauge site '325616 Christchurch Botanical Gardens'. Results likely associated with a dry weather discharge are circled.

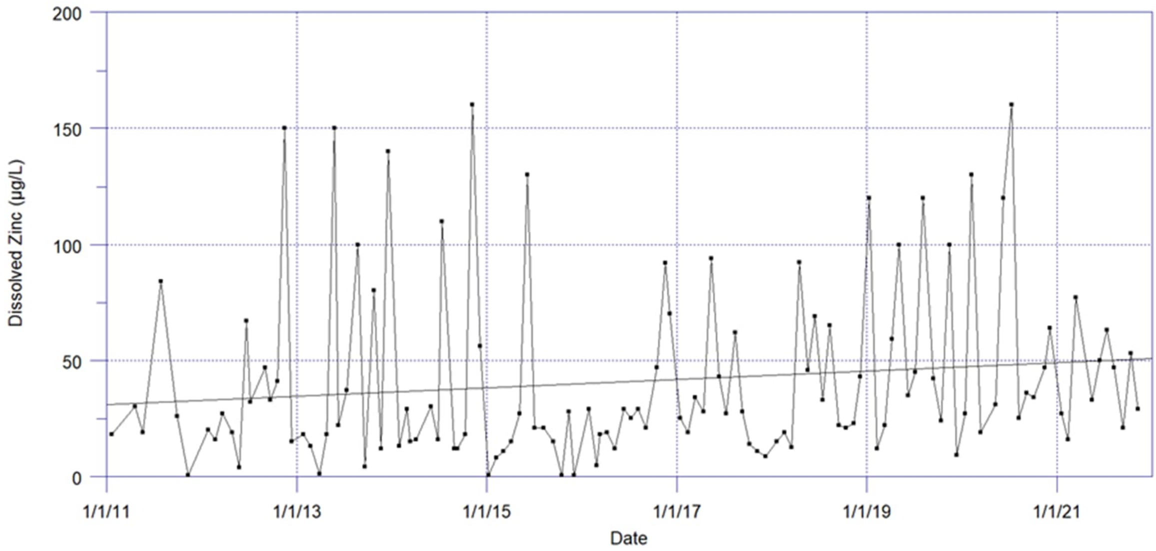



Figure 9. Dissolved zinc concentrations at the Addington Brook site for the monitoring period January 2011 to December 2021. Squares indicate individual sampling events. An increasing trend of 7% was recorded over the sampling period.

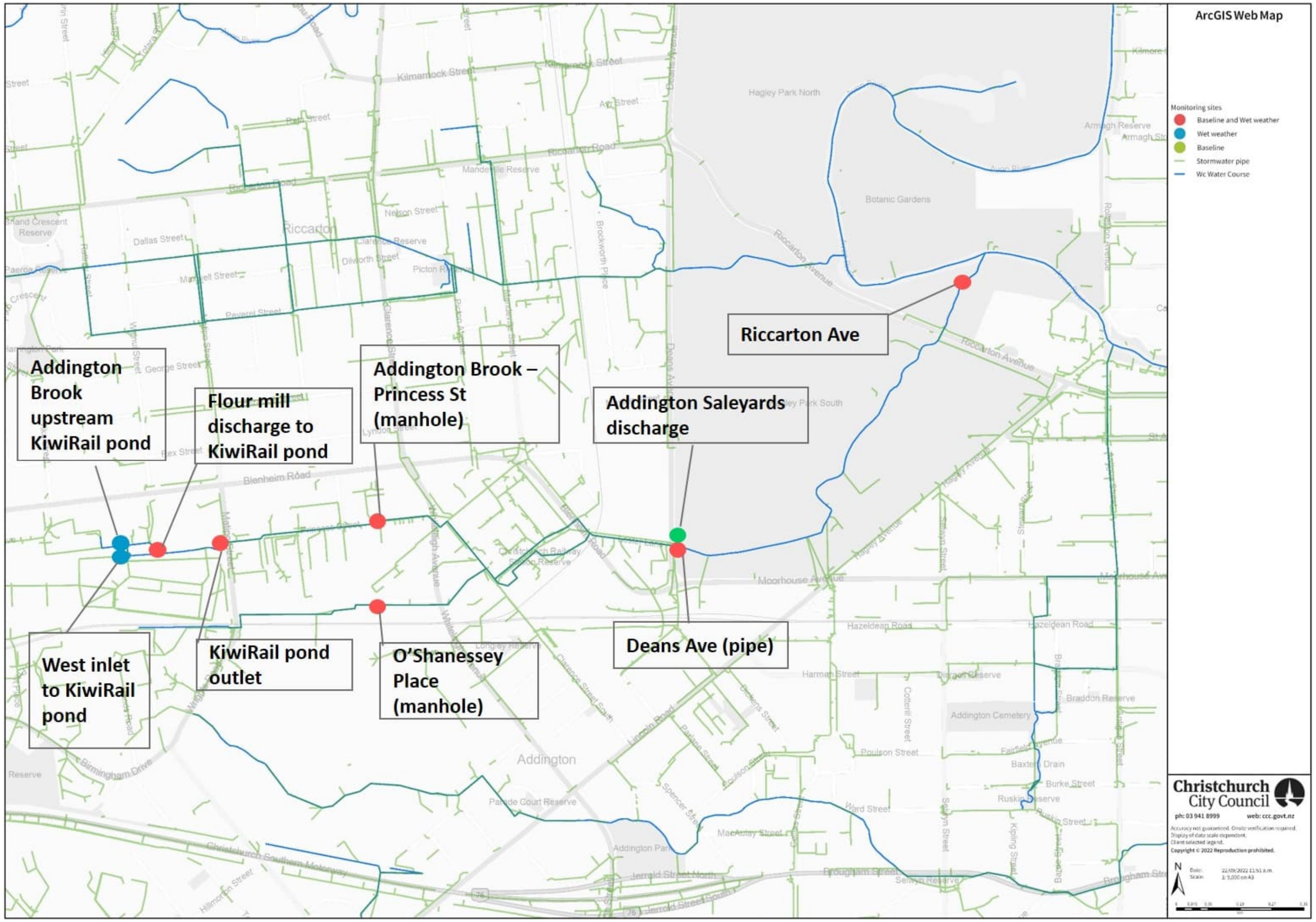
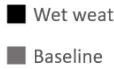
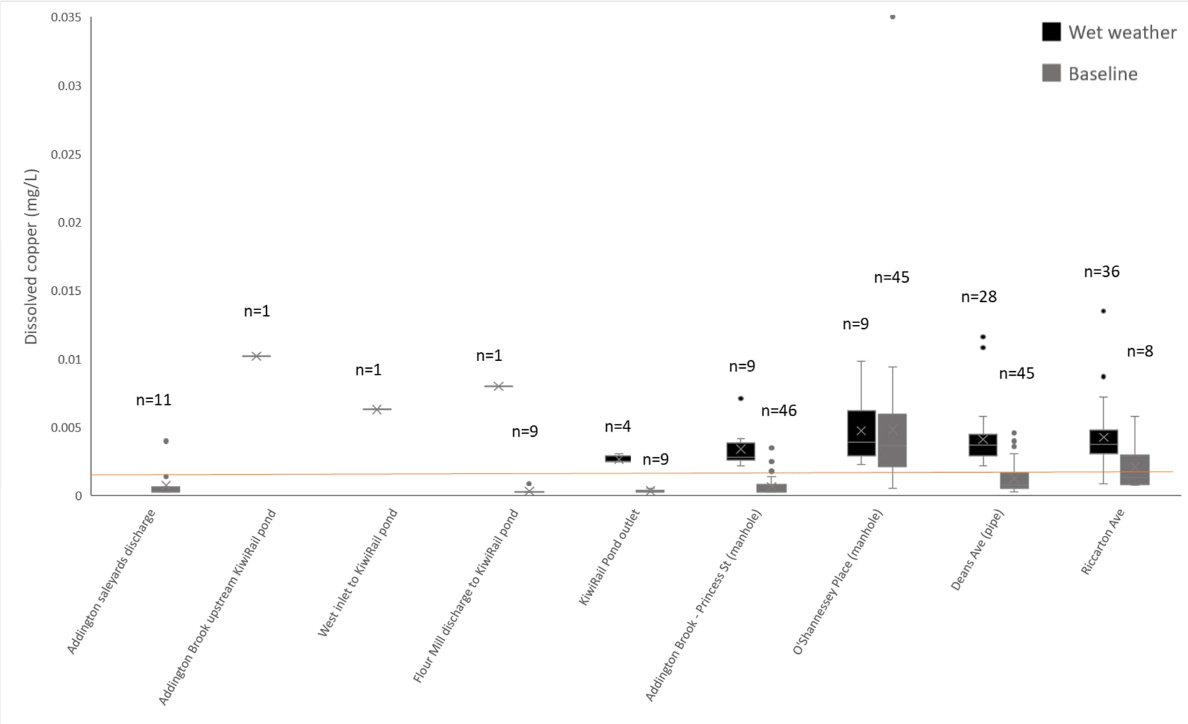



Figure 10. Location of ECan wet weather and baseline surface water quality monitoring sites within Addington Brook



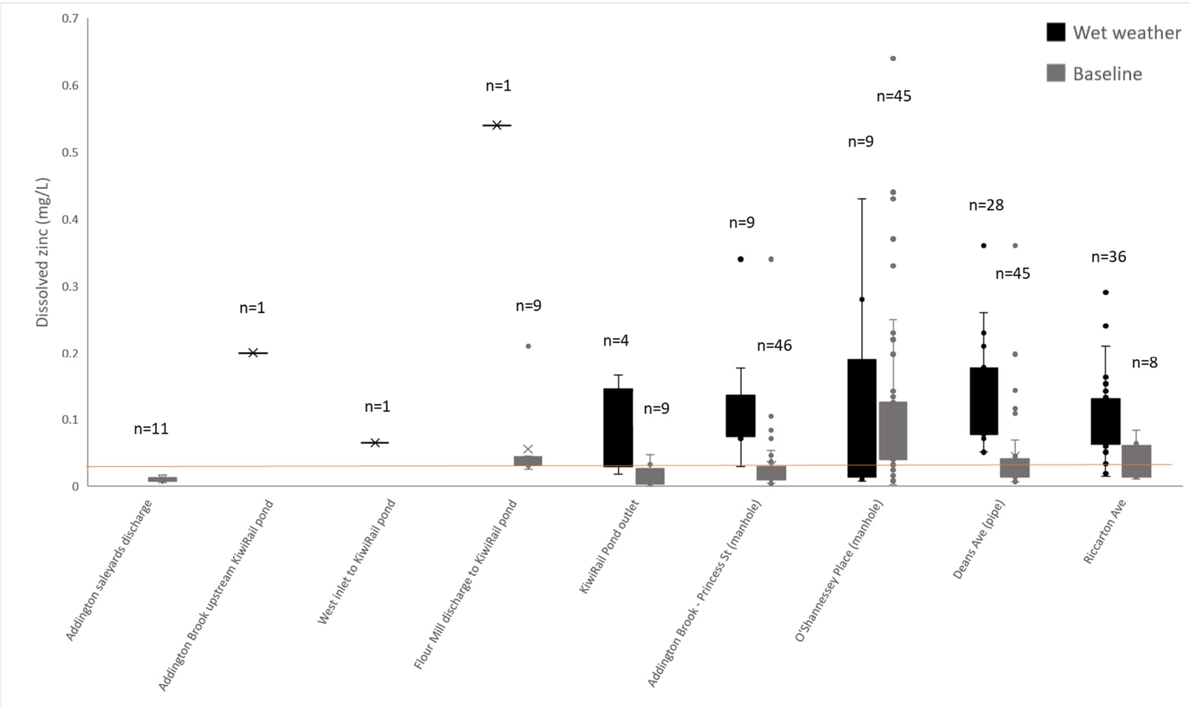




Figure 11. Dissolved copper (top graph) and dissolved zinc (bottom graph) concentrations at nine sites monitored by ECan in the Addington Brook catchment from 2014-2021, during baseline and wet weather. Lines denote the Attribute Target Level for Ōtākaro - Avon River catchment (copper = ≤0.0018 mg/L and zinc = ≤0.02951 mg/L).

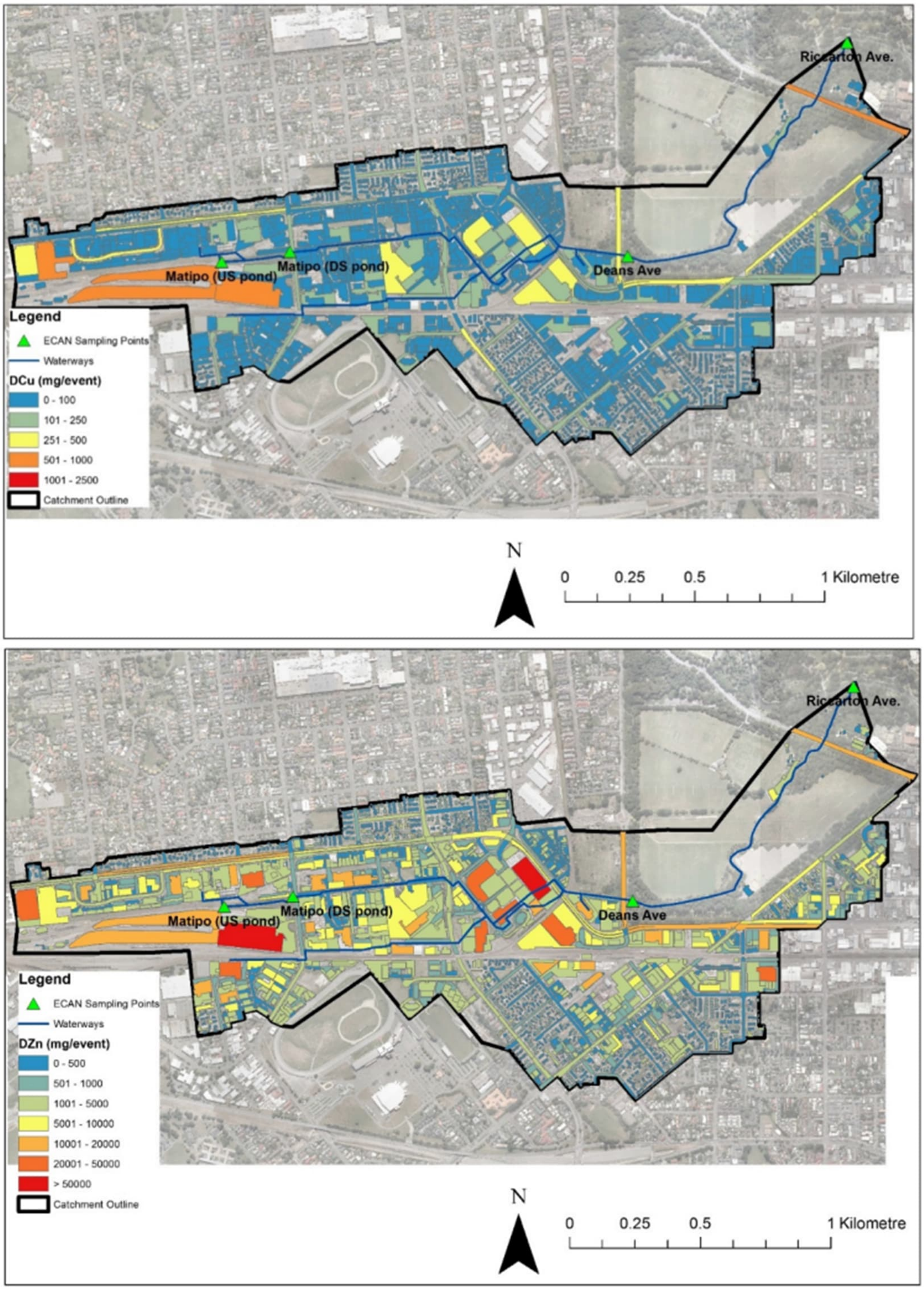



Figure 12. MEDUSA modelled dissolved copper (top) and zinc (bottom) loads (mg/event) from impervious surfaces (roofs, carparks, and roads) within Addington Brook (O'Sullivan & Cochrane, 2017).

## 3.4. Nottingham Stream at Candys Road

The Nottingham Stream at Candys Road site is located in the lower catchment of Nottingham Stream, in a predominantly rural area (Plate 4; Figure 13). The stream at this location is narrow and shallow, with incised banks. Land use in the Nottingham Stream catchment is predominantly residential, with some commercial. Small sections of Dunbars Road and Halswell Road lie in the catchment and discharge to the stream, with Dunbars road discharging to the stream via a treatment swale. The C-CLM predicts for this site a low zinc load (327 kg/yr or 1.79 kg/ha/yr) and a moderate copper load (27 kg/yr or 0.15 kg/ha/yr).

The majority of copper and zinc samples collected during the 2020 monitoring year met the ATL (Figure 14). There was only one dry weather exceedance, which was for zinc in October, and this level was substantially lower than concentrations recorded during rainfall. This indicates that exceedances at this site are mainly due to stormwater inputs.

A statistically significant increase in zinc of 6% has occurred since monitoring began at this site in 2011 (Margetts & Poudyal, 2022; Figure 15). Larger peaks in concentrations have generally occurred in the last couple of years, coupled with higher baseline levels since 2016.

ECan enforcement records (abatements and infringements) for 2020 and 2021 were assessed to see if there were any events that may have contributed to the exceedances of ATLs at this site. None were identified.

At present there are no significant stormwater treatment devices or facilities in the catchment. There is likely limited or no private on-site treatment within the catchment.

Plate 4. Nottingham Stream at Candys Road monitoring site (samples are taken from the culvert at the foreground of the photo)

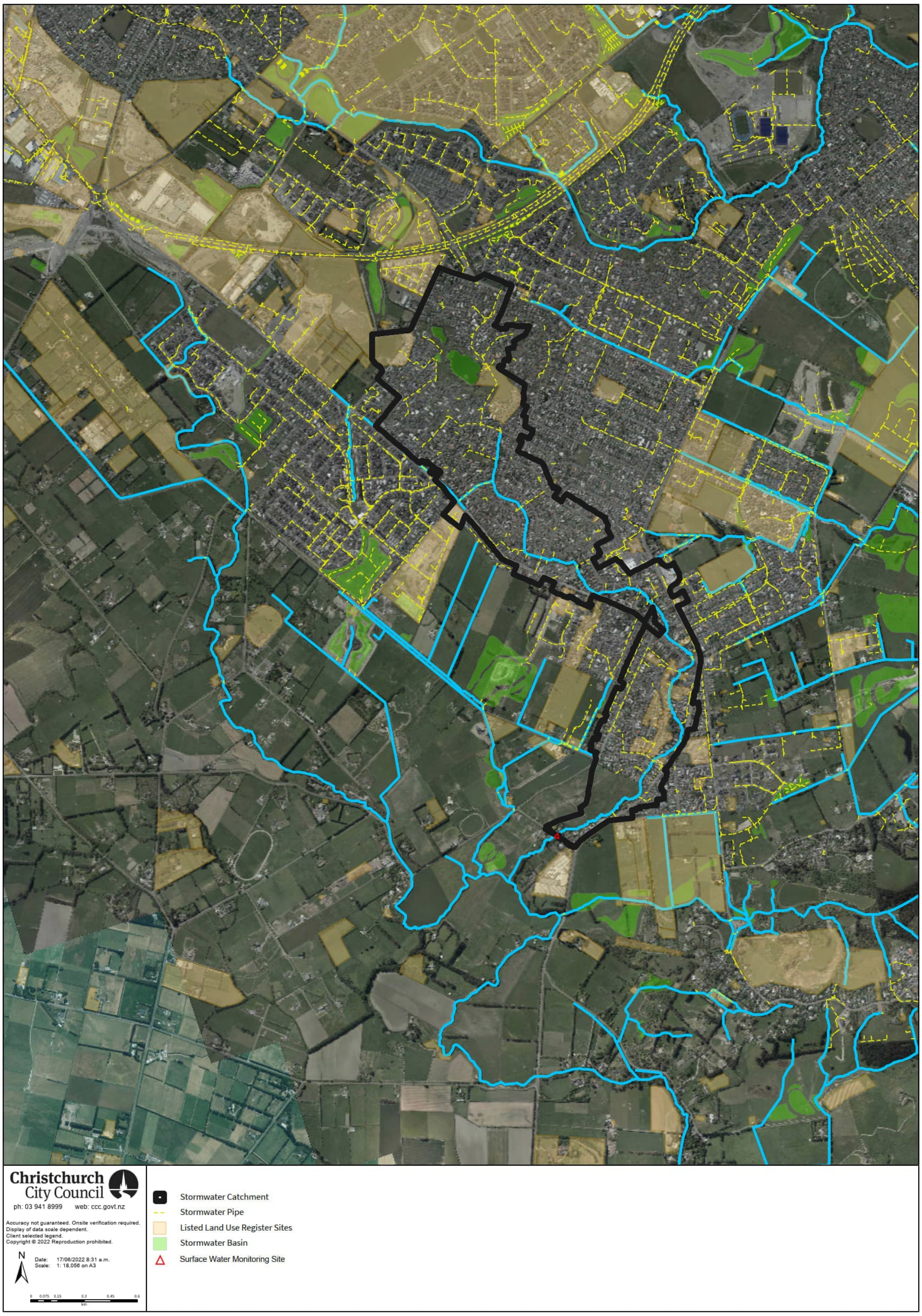
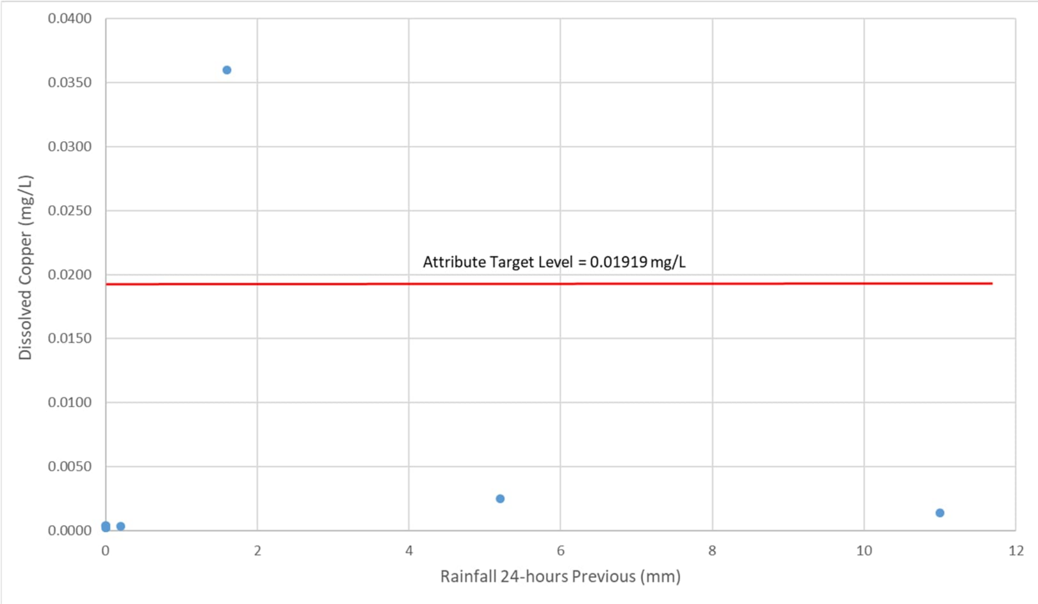



Figure 13. Location of Nottingham Stream at Candys Road monitoring site and contributing stormwater catchment.



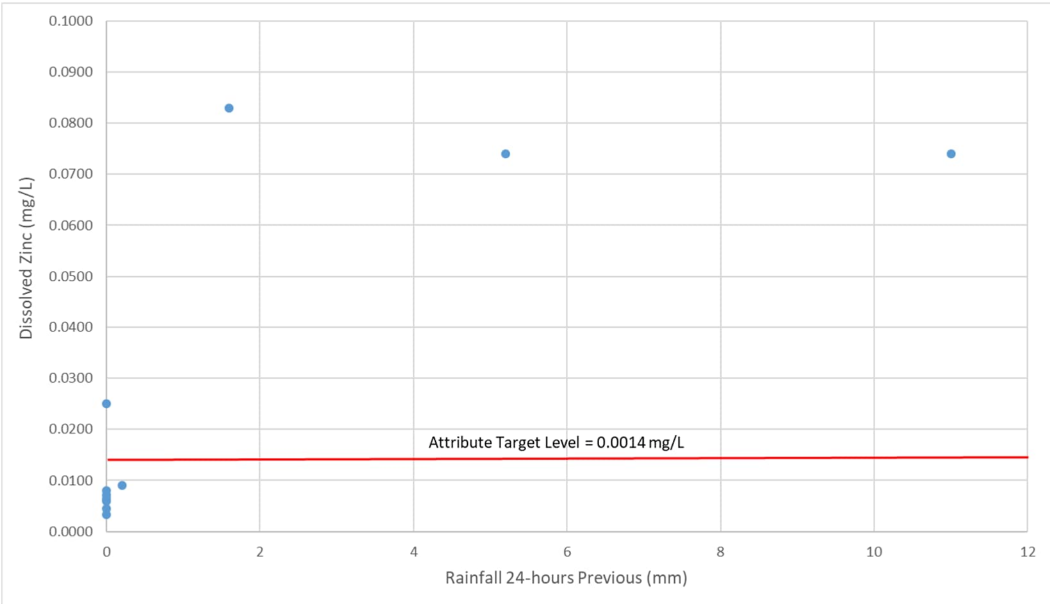




Figure 14. Rainfall versus copper (top graph) and zinc (bottom graph) levels in surface water during monthly monitoring from January – December 2020 at Nottingham Stream at Candys Road. Rainfall was assessed at rain gauge site '325512 at Dunbars Reservoir'. Results likely associated with a dry weather discharge are circled.

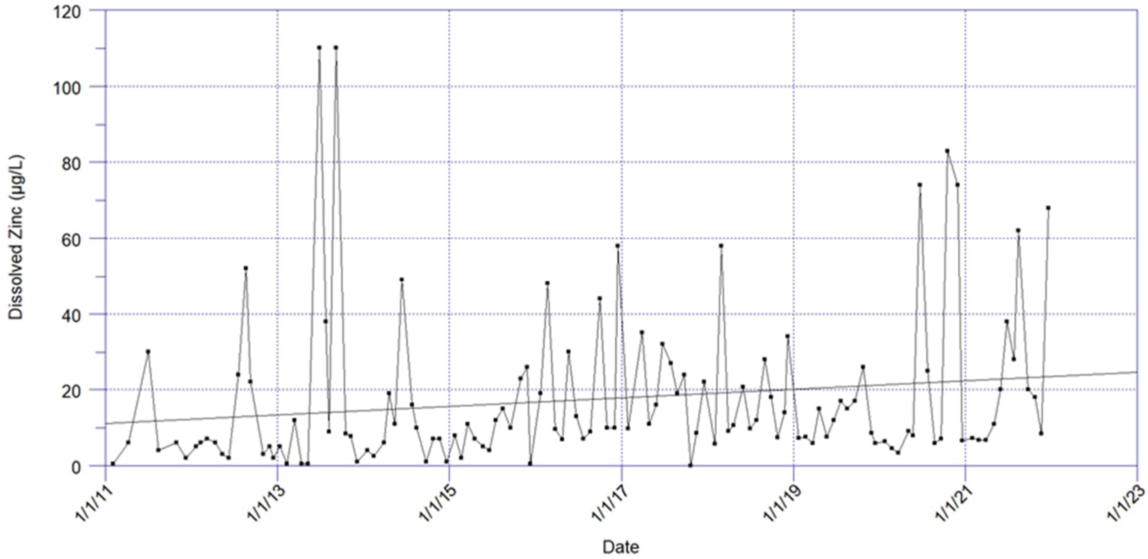



Figure 15. Dissolved zinc concentrations at the Nottingham Stream site for the monitoring period January 2011 to December 2021. Squares indicate individual sampling events. An increasing trend of 6% was recorded over the sampling period.

# 4. Proposed Remediation & Timelines

There are a number of existing programmes being undertaken that will contribute to improving water quality at these priority sites. Council is also proposing to carry-out a significant wet and dry weather monitoring programme, to obtain more information on the sources of contaminants at these sites. Remediation will be centred on implementing these programmes, as well as the construction of Council stormwater facilities. Details on these programmes is contained in the following sections and this report gives an opportunity to collate these measures in one place to ensure Council is working together holistically to improve water quality at these priority sites. A timeline of events is shown in Figure 16.

## 4.1. High-Risk Sites Investigation

The Hazardous Activities and Industries List (HAIL) is a list of industries that have a high probability of causing land contamination or the discharge of contaminants to the stormwater system due to current and historical practices, storage, or disposal of hazardous substances. When assessing stormwater inputs at these monitoring sites, it is important to understand HAIL sites, as they may be having a disproportionally high effect on water quality in the receiving environment.

A project is already underway assessing high-risk sites for the four priority catchments, which includes consideration of (1) HAIL sites, (2) CSNDC Schedule 1 sites[2], and (3) other sites consented by ECan (i.e., not authorised under the CSNDC). This work will provide an assessment of high-risk sites discharging TSS (relevant to Curlett Stream only), copper, and zinc to the stormwater system and waterways within the four priority catchments. Factors to be considered include whether sites are active or passive, activity type and how these relate to the ATLs exceeded, and risks in both wet weather (i.e., via stormwater) and dry weather not related to stormwater (e.g., washdown water and hazardous substances). This work will be completed by December 2022 and will be used as background information to determine sites for future monitoring, as detailed in the following sections.

## 4.2. Targeted Wet Weather Monitoring

In accordance with the recommendations in Borne & Gadd (2022), it is planned to carry-out four more sampling events in Curlett Stream (and Haytons Stream) before revisiting whether sufficient information has been gathered to achieve the aim of identifying contaminant hotspots. This next stage will consider the additional information gained from the high-risk sites investigation.

Nottingham Stream will be added to the TWWMP, as well as the lower catchment of the Ōpāwaho-Heathcote River, to investigate the issues at the Ferrymead Bridge site. The sampling plans for these two catchments will be informed by the results of the high-risk sites investigation project, as well as general widespread roof and road inputs.

Procurement of wet weather monitoring in Curlett Stream, Nottingham Stream, and the lower catchment of the Ōpāwaho-Heathcote River has already begun. Monitoring will start in the New Year and will be carried out until the end of 2023, at which time the results will be analysed and next steps discussed in the 2024 Condition 59 report. ECan will be given an opportunity to review the monitoring plans and final report before they are finalised.

[2] These are generally high-risk sites for contamination generation that have been excluded from the CSNDC and require their own consent from ECan.

Wet weather monitoring is not proposed for Addington Brook. There is already good baseline knowledge of this catchment through the ECan monitoring and they will continue to monitor and analyse this catchment in the coming years. Council will consider the results of this monitoring in future Condition 59 investigations where relevant.

## 4.3. Dry Weather Discharge Investigations

The assessments in this report suggest that all sites to varying degrees are impacted by dry weather exceedances, not just stormwater. However, the results of monitoring from Curlett Stream, and Addington Brook to a lesser degree, suggest significant dry weather inputs of metals and TSS that need to be investigated in collaboration from ECan and stopped. Whilst dry weather exceedances are not covered by the CSNDC, understanding their occurrence will allow a better understanding of what is causing exceedances of ATLs and the relative role of stormwater inputs. Dry weather discharges may also indicate a likelihood of discharges also occurring during wet weather. Once dry discharges have been identified, discussions between Council and ECan need to be undertaken as soon as possible around resourcing and the process of enforcement.

It is proposed to install monitoring devices in Curlett Stream and Addington Brook, and their associated pipe networks, to assess water level, turbidity/TSS, pH, and conductivity[3]. The Council has not undertaken dry weather discharges investigations before, so this will be a useful case study both locally and nationally. Dry weather monitoring plans will be informed by the results of the high-risk sites investigation project, with monitoring carried out concurrently with the wet weather monitoring.

The dry weather monitoring will be carried out concurrently with the targeted wet weather monitoring. Reporting of the results will be combined with the wet weather monitoring, to allow consideration of all sources holistically.

## 4.4. Industrial Site Audits

Condition 47 of the CSNDC details that the Council shall maintain a database of industrial sites that are ranked by their relative risk of discharging contaminants to the stormwater system. As part of this, the Council works with industries to ensure they are carrying out best practice measures on their site and preventing the discharge of contaminants to the stormwater system. Under Condition 48, if the site cannot appropriately mitigate its high risks, the Council may exclude the site from the CSDNC, requiring the owner/occupier to obtain its own consent from ECan.

The industrial site audit programme will continue to target high-risk sites across all catchments, but will focus on the four priority catchments of this report where relevant. However, the programme only assesses a small number of sites a year, so measurable changes to water quality may not occur in the short-term.

The results of the high-risk sites investigation in the four priority catchments will help clarify high risk sites to target in the industrial site audit programme. This will help address sites that may be having disproportionally high impacts on surface water quality, contributing to the exceedances observed in ATLs.

[3] As a proxy for metals, as the technology does not currently exist to measure metals robustly in real time

## 4.5. Council Stormwater Treatment Facilities

For all catchments where development or re-development will result in an increase in contaminants, treatment is required prior to discharge to the Council's stormwater network. The following sections also outline facilities proposed specifically for the four priority catchments.

### 4.5.1. Ōpāwaho-Heathcote River at Ferrymead Bridge

There are currently no plans to construct facilities in this catchment. This area is not a development growth area and mitigation options are limited by land availability. The proposed wet weather monitoring above may help inform future treatment options.

### 4.5.2. Curlett Stream at Southern Motorway

The Curlett first flush basin and wetland are still in the establishment phase and the plantings are not fully mature. Infill planting may be required in the future depending on plant growth over the next few seasons. There is currently an issue with sediment discharge from the wetland, and this is considered likely to be due to highly dispersive soils in the wetland base being disturbed due to wind or wildfowl action. This is likely to reduce over time as the system matures, due to plant growth and consolidation of site soils. At present the first flush basin is not able to operate fully (e.g., store water to its full height) while an investigation is underway into the condition of the embankment adjacent to the control structure. Prior to flood events, detained first flush water may need to be released ahead of the main peak flow if it is considered that this will reduce downstream flooding. This decision will be made on a case-by-case basis and will likely be a rare event.

### 4.5.3. Addington Brook

A stormwater treatment project is proposed for Addington Brook and Riccarton Stream, which will treat stormwater prior to discharge to the Ōtākaro-Avon River (CMPS#41987). This project has a total budget of $25M to be spent across both catchments. Investigations have been undertaken to identify the preferred option and location for treating these catchments. The preferred option is in the process of being recommended to the Project Sponsor with the aim to confirm this option for detailed design in financial year 23/24.

The location of this treatment facility will aim to address the University of Canterbury recommendation to target zinc at the Deans Ave location, where its concentration is consistently highest (O'Sullivan & Cochrane, 2017). There are opportunities for targeted on-site treatment further up the catchment; however, as the stormwater system is primarily closed pipes and there is a lack of space, there is no opportunity to install large Council facilities.

### 4.5.1. Nottingham Stream

The CSNDC Stormwater Management Plan (SMP) for this catchment proposes a first flush basin, wetland and detention basin to provide stormwater treatment and flood mitigation for approximately 19 hectares of residential development. With an estimated cost of $3.5M, this is not currently funded within the 10-year horizon of the Long Term Plan; however, this facility may be delivered by the developer. Council is also investigating whether they could fund an extension to this facility to also treat up to 180 hectares of existing residential stormwater.

## 4.6. Stormwater and Land Drainage Bylaw

The Council has adopted two new water services bylaws. The Water Supply and Wastewater Bylaw 2022 and the Stormwater and Land Drainage Bylaw 2022 replaced the previous Water Supply, Wastewater and Stormwater Bylaw 2014, effective from July 2022. The Stormwater and Land Drainage Bylaw broadly focuses on reducing contaminants in stormwater and helps the Council comply with its requirements under the CSNDC. There is also improved clarity on prohibited substances such as biodegradables, pool water, and washwater. Whilst this bylaw does not specifically focus on the four priority catchments, these district-wide measures will result in a reduction in contaminants in these areas.

There is a new requirement for an Erosion and Sediment Control Plan for earthworks where this is not otherwise required through a building or resource consent. The plan must be prepared by a suitably qualified person and made available to the Council on request. Control measures must be put in place before works begin, maintained throughout, and removed when the land has been stabilised (Clauses 22-23). These provisions are part of a wider system for improved management of erosion and sediment from development sites to reduce sediment-laden water entering the stormwater network. Setbacks for building and earthworks activities have also been increased from 1m to 3m to protect waterways from misuse or damage (Clause 15[1]).

There is a new requirement for premises defined by the Register of Industrial and Trade Activities to obtain an Industrial Stormwater Discharge Licence (ISDL) (Clauses 27-35). Licensees pay an annual risk-based fee and are subject to audits to assess environmental risks and ensure compliance. The ISDL gives the Council greater control and monitoring of industrial sites.

## 4.7. Trade Waste Programme

Trade waste is the commercial and industrial liquid waste that is disposed of through the Council wastewater network, which then makes its way to the wastewater treatment plant. Trade waste includes all non-sewage related discharges (e.g., from restaurant and takeaway outlets, food processors, metal finishers, motor vehicle workshops, and chemical manufacturers). Council has identified many sites in the past where trade waste is entering the stormwater system instead of the wastewater network, meaning that contaminants ultimately end up in waterbodies. This may contribute to poor surface water quality.

Going forward, the Trade Waste team within Council will assess the relevant high-risk sites for copper and zinc (e.g., metal finishers and motor vehicle workshops) in the four catchments to ensure that trade waste is not discharging to the stormwater system. This work may include collaboration with Industrial Site Audits.

## 4.8. Stormwater Management Plans

Under Conditions 4-10 of the CSNDC, SMPs are required to be written for the District's 7 major catchments. Of relevance to this report are the Ōpāwaho – Heathcote River SMP (Ōpāwaho-Heathcote River at Ferry Road Bridge and Curlett Stream at Motorway sites), Ōtākaro – Avon River SMP (Addington Brook site), and Huritini-Halswell SMP (Nottingham Stream at Candys Road site). The purpose of these SMPs is to demonstrate how stormwater discharges will be progressively improved towards meeting the receiving environment objectives of the consent, with a number of requirements for SMPs stipulated within the consent. These three SMPs have all been completed and therefore do not specifically address issues at these four priority sites, but consider catchment-wide source control and contaminant reduction targets amongst other things[4]. Future reviews of these SMPs could consider specific measures at sites triggering Condition 59 at the time of review.

## 4.9. Community Waterways Partnership

The Council has established a Community Waterways Partnership (CWP) in accordance with Schedule 4(m) of the CSDNC. The vision of the CWP is 'a collaborative partnership that supports the development of community-based initiatives to improve the ecological health, indigenous biodiversity and the amenity value of our urban waterways'.

The CWP is currently focussed on developing the programme at a high-level across the entire district. There may be scope in the future to target the programme to the four priority catchments in this report. As a start, the Avon-Ōtākaro Network, Ōpāwaho Heathcote River Network, and Avon-Heathcote Estuary Ihutai Trust are actively engaged in catchment wide advocacy, with key messaging around stormwater and connecting people with their waterways. In the Huritini – Halswell River catchment, the CWP is working with schools and a community group to encourage community connection with waterways.

## 4.10. Other Contributing CSNDC Programmes

There are a number of other work programmes within the CSNDC, which will also contribute to improving surface water quality across the district. These include the:

- Removal of contaminated sediment within stream channels under Schedule 3(g) and (h), which will remove legacy contaminants bound to sediment that may be impacting on surface water quality through resuspension;
- Monitoring of treatment performance of stormwater treatment facilities under Schedule 3(i) and (j) to improve effectiveness;
- Source control measures under Schedule 4;
- Sediment Discharge Management Plan under Condition 41-46 and Schedule 4(i), which aims to reduce the amount of sediment discharged to waterways during construction by the use and inspection of erosion and sediment control measures;

[4] The first Avon SMP was written prior to granting of the CSNDC and the revision is to be lodged with ECan in June 2024

- Investigation of satellite imagery to classify roof condition and identify roof material, which will allow identification of which roofs are the most likely to be producing the most zinc; and
- Communication, education and awareness programmes under Schedule 4, which includes the CWP.

## 4.11. Surface Water Implementation Plan

The Te Wai Ora o Tāne - Integrated Water Strategy (the Strategy) was adopted by Council on 26 September 2019. The Strategy is the guiding document that expresses the intent of the Council, and the community's desires including those of tāngata whenua, on how Christchurch's water resources should be managed. As an overarching high-level long-term strategic approach to integrated water management, other Council plans such as Master Plans, the District Plan, Long Term Plans and Annual Plans should be consistent with the Strategy and its implementation plans. Reviews of the Greater Christchurch Urban Development Strategy and the Resilient Greater Christchurch Plan should also align with the Strategy.

The Surface Water Implementation Plan (SWIP) is the third of three plans prepared for implementing the Strategy. These plans do not have any budget for works, but help to set the direction, both immediate and aspirational, for Council's approach to improving surface water quality. The SWIP is still in development and will be consulted on with the community when it is complete. Of relevance to improving water quality at the four priority sites in this report, this plan will have recommendations around source control, education, and waterbody restoration.

## 4.12. Healthy Waterbodies Action Plan

Council has a Healthy Waterbodies Community Outcome with the aim to achieve the following:

- Water is cared for in a sustainable and integrated way and in partnership with Papatipu Rūnanga and Te Rūnanga o Ngāi Tahu, in line with the principle of kaitiakitanga;
- Water quality and ecosystems are protected and enhanced; and
- Our waterways support diverse and abundant mahinga kai.

The Healthy Waterbodies Action Plan (HWAP) is currently being written by Council and will define what a healthy waterbody is and how we will know when we have achieved the Community Outcome. In particular, the HWAP will include specific tasks to be achieved, many of which will work towards improving surface water quality specifically, such as source control, education, and restoration. The tasks of the HWAP will be incorporated into the SWIP.

## 4.13. ECan Programmes

ECan has historically had catchment specific programmes of work under such things as the Pollution Prevention programme. For example, a Living Catchment Management Plan was created for

Addington Brook in 2019[5]. However, these catchment specific programmes no longer occur, with most of the work now sitting under the Council's CSNDC.

ECan do have general work programmes to improve water quality. They carry out compliance monitoring of resource consents that are deemed high risk, and investigate some permitted activities where there might be impacts on groundwater. They have education programmes planned around general stormwater and targeting building sites, and support University of Canterbury research into stormwater treatment devices (the Storminator). Surface water quality data is also collected from the Addington Brook, Riccarton Stream, and Hayton Stream catchments. Analysis and reporting on this data is planned for the 2022-2023 financial year. They are also responsible for responding to pollution events including hazardous substances and washdown discharges as they arise, assisted by Council where required. All of this work will help reduce contaminant levels at the priority sites investigated in this report. Analysis of the Addington Brook data may also help with pinpointing hotspots of contaminants in the future.

## 4.14. Christchurch West-Melton Water Zone Committee Programmes

In line with ECan's staffing resources, the Christchurch West-Melton Water Zone Committee (CWMWZC) historically had catchment specific working groups within Addington Brook and Curlett Stream, but they now typically focus on zone-wide stormwater awareness. In conjunction with ECan they implement the Stormwater Superhero programme[6], as well as focus on erosion and sediment control issues.

[5] https://www.ecan.govt.nz/your-region/your-environment/water/whats-happening-in-my-water-zone/christchurch-west-melton-water-zone/action-on-the-ground/addington-brook-catchment/

[6] https://www.ecan.govt.nz/your-region/your-environment/water/whats-happening-in-my-water-zone/christchurch-west-melton-water-zone/stormwater/

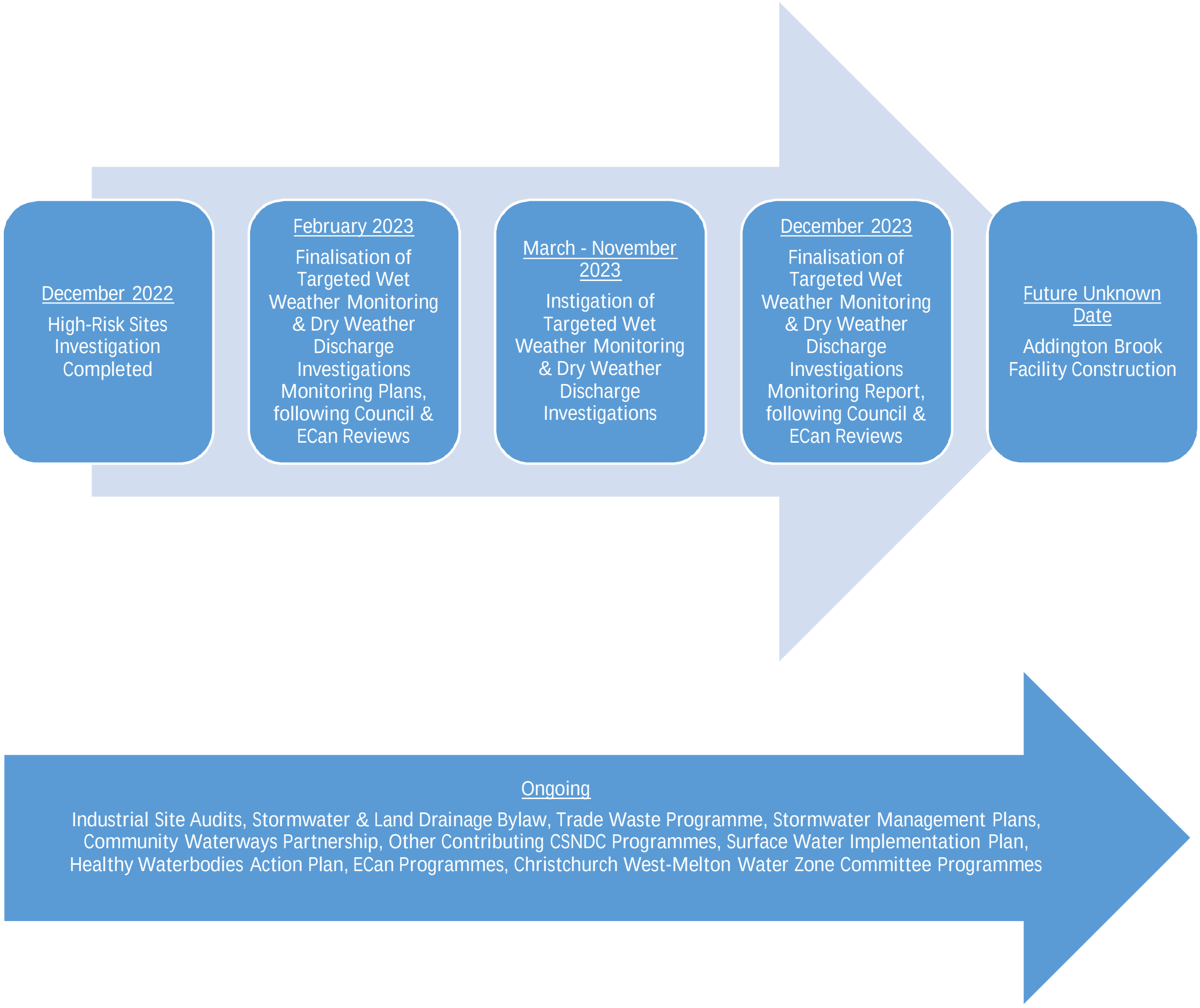



Figure 16. Timeline of remediation events to address surface water quality at the four sites prioritised under Condition 59

# 5. Conclusions

This is the first report in accordance with Condition 59 since the consent was granted in 2019. This report has identified that the copper, zinc, and TSS issues at the four priority sites for investigation (Ōpāwaho-Heathcote River at Ferry Road Bridge, Curlett Stream at Motorway, Addington Brook, and Nottingham Stream at Candys Road) are most likely due in part to stormwater discharges authorised under the CSNDC. However, there are also likely other illicit (e.g., dry-weather) discharges not authorised under the consent that may be impacting contaminant levels.

To address these impacts from stormwater, a number of remediation actions are proposed. This includes gathering more data on where contaminants are coming from by continuing targeted wet weather monitoring within the Curlett Stream catchment, and adding additional wet weather monitoring in the lower Ōpāwaho-Heathcote River and Nottingham Stream. Dry weather monitoring is also proposed within Curlett Stream and Addington Brook to identify non-stormwater illicit discharges. To treat stormwater contaminants before discharge to the waterways, it is proposed to construct Council stormwater treatment facilities within Addington Brook and Nottingham Stream. All these remediation options will be supplemented by existing work programmes under the CSNDC, such as Industrial Site Audits and other source control programmes, as well as ECan programmes.

Council considers work under this condition to be a long-term project. Each annual report will consider whether sites are regularly being prioritised for investigation, and the project as a whole will be iterative and adaptive, building on lessons learned in previous years.

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