Groundwater Quality and Quantity Annual Report 2022

Prepared to meet the Requirements of CRC231955

Christchurch City Council

July 2023

Christchurch City Council

Internal Document Review

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1 Introduction

Christchurch City Council (the Council) is required to review annual groundwater monitoring data from various sites within the territorial boundary of the Council. A combination of Council's hydrometric network data currently managed by NIWA (NIWA, 2022), and a selective Council's water supply wells results have been reviewed.

This work pertains to the groundwater aspect of the Comprehensive Stormwater Network Discharge Consent (CSNDC), CRC231955, issued by ECan to the Council on 20 December 2019. The work has been completed in accordance with the Christchurch City Council's Environmental Monitoring Programme (EMP).

1.1 Background

The CSNDC serves as a global consent enabling the Council to discharge water and contaminants to land and water from the stormwater network. A portion of this consent (conditions 49 – 55) requires the preparation and implementation of the EMP produced by the Council. The EMP serves to assess the effects of stormwater discharges from the Council stormwater network on the receiving environment. In particular, to groundwater, the purpose of the EMP is "to (1) measure whether stormwater discharges are causing adverse effects on groundwater quality and quantity, (2) determine compliance with the conditions of consent, and (3) inform stormwater mitigation."

Schedule 9 of the CSNDC sets the receiving environment objectives and attribute levels for groundwater and springs.

1.2 Objective

Section 3.4 of the EMP details the Council's annual groundwater reporting requirements. The objective of this report is to address the requirements specified in the EMP as follows:

- Groundwater level patterns in CCC water level monitoring wells;
- Groundwater quality patterns for copper, lead and zinc in ECan monitoring wells;
- *E. coli* detections in CCC water supply wells;
- Groundwater quality patterns for copper, lead and zinc from CCC water supply wells;
- Any information from spring monitoring that could be attributed to stormwater impacts on groundwater;
- Statistical analyses of change for *E. coli* (daily data from pumping stations) and electrical conductivity (quarterly data at ECan monitoring wells; used as an indicator of changes in metals levels) shall be undertaken using Time Trends or other robust analysis, using a statistical level of significance of 5% (i.e. $p \leq 0.05$);
    - A minimum of three years is required before trends analysis can be undertaken (NIWA, 2014);

    - Trends analysis shall be conducted on data since the beginning of the dataset.
- Any groundwater related issues that affect the performance of stormwater management systems; and
- An assessment as to whether the Receiving Environment Objectives and Attribute Target Levels specified in Schedule 9 (Groundwater and Springs) of the consent conditions are being met at each site for copper, lead and zinc.

2 Limitation of the report

In the past, the Council didn't have a routine monitoring program to focus on the sampling from the specific wells. It's important for the Council to establish a consistent plan for monitoring shallower aquifers (1 and 2). A well-defined monitoring strategy can provide information on the quality of data and help identify any potential issues or areas for improvement.

Currently the council is working on revising existing Environmental Monitoring Plan (EMP), once the EMP version is finalized, the Council will indeed have a clearer direction on the specific data quality requirements to focus on. With a finalized EMP version, the council can determine the key parameters and metric that need to be monitored in both aquifers. This will enable the Council to establish precise guidelines for data collection, analysis, and ongoing monitoring.

The summary presented in the report represents a collective analysis of data from reservoirs, pump stations, and wells at the different time of the year. While having specific well data at shallower aquifers would provide a more detailed understanding of quality of the drinking water, at this interim period, the analysis based on the existing data sources can still offer insights into the overall quality of drinking water at the source.

This report doesn't cover a trend analysis of change for electrical conductivity, copper, zinc and *E.coli*, because of inconsistent and insufficient data set from dedicated sampling points from the past three years to be able to conduct a trend analysis.

This report doesn't cover zinc, copper and lead results at source for the calendar year 2022 (except for one of the pump stations due to the site being isolated for contamination event management) as it was not required under the old Drinking Water Standards NZ 2005 (rev.2018) which were in force until 15 November 2022. The new sampling requirements at the source of the water supply is influenced by the introduction of new Drinking Water Quality Assurance Rules 2021 (DWQAR) prepared by Taumata Arowai in accordance with section 49 of the Water Services Act 2021. The new rules require the Council to monitor source water[1,2] with the following frequency (DWQAR - Table 16):

- *E. coli* and total coliforms: 2 times per month
- Copper and lead: annually

There is not a requirement to sample lead at source, but it will be added for year 2023 sampling plan.

3 Scope of work

In order to meet the objectives of this report, the Council undertook the following scope of work:

- Presented a summary of all groundwater level monitoring data from the Council Hydrometric Network currently managed by NIWA from 27 sites
- *E.coli* detection in the Council water supply wells
- Comparison of analytical results (Cu, Pb, Zn) to the attribute target levels from selective wells
- Summary of a detailed study to assess changes in groundwater level and groundwater quantity at three stormwater infiltration basins in Christchurch
- Summary of groundwater quality and quantity investigation projects

4 Methodology

4.1 Data Source: the Council Hydrometric Data

Groundwater level data was retrieved from the Council Annual Hydrometric Network Report as specified in Figure 1 of the EMP version 9.

5 Assessment Criteria

Groundwater data for copper, lead, zinc, electrical conductivity and *E. coli* have been compared to the attribute target levels specified in Schedule 9 of the CSNDC, in accordance with section 3.4 of the EMP. The attribute target levels are presented in Table 1.

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[1] *Samples may be collected either at the source abstraction point or at the treatment plant before any form of treatment, if water is from a single source. If multiple sources are used, samples must be collected from each source at points before any mixing of source water occurs.*

[2] *Where multiple bores access the same aquifer, one bore can be sampled to provide results that are representative of a number of bores if the water supplier can demonstrate that the bore that is sampled is representative of the bores that are not sampled. The representative nature of the sampled bore must be re-established every five years or after significant seismic activity.*

Table 1: Receiving Environment Objectives and Attribute Target Levels for Groundwater (Schedule 9, CRC231955)

Objective	Attribute	Attribute target Level
Protect drinking water quality	Copper, lead, zinc and *Escherichia coli concentrations* in drinking water	Concentrations to not exceed: Dissolved Copper: 0.5 mg/L Dissolved Lead: 0.0025 mg/L Dissolved Zinc: 0.375 mg/L No statistically significant increase in the concentration of *Escherichia coli* at drinking water supply wells
Avoid widespread adverse effects on shallow groundwater quality	Electrical conductivity in groundwater	No statistically significant increase in electrical conductivity

6 Results and Discussion

6.1 Groundwater level patterns in the Council water level monitoring sites

The Council groundwater network consists of a total of 27 sites operated by NIWA as at the end of 2022. The summary of the maximum, mean and minimum groundwater levels recorded during 2022.

All sites in the groundwater network are measured manually except for the Halswell Retention Basin (3255009), Dartford St (3246005) and Sumner (3257031) sites which are telemetered level sensors. At present the data from the telemetered sites is available up to the last hour.

Manual groundwater-levels are measured on either a weekly or fortnightly basis, depending on site status requirements. An additional requirement is that following rainfall of greater than 20 mm in a 24-hour period, groundwater measurements should be delayed by 2 days.

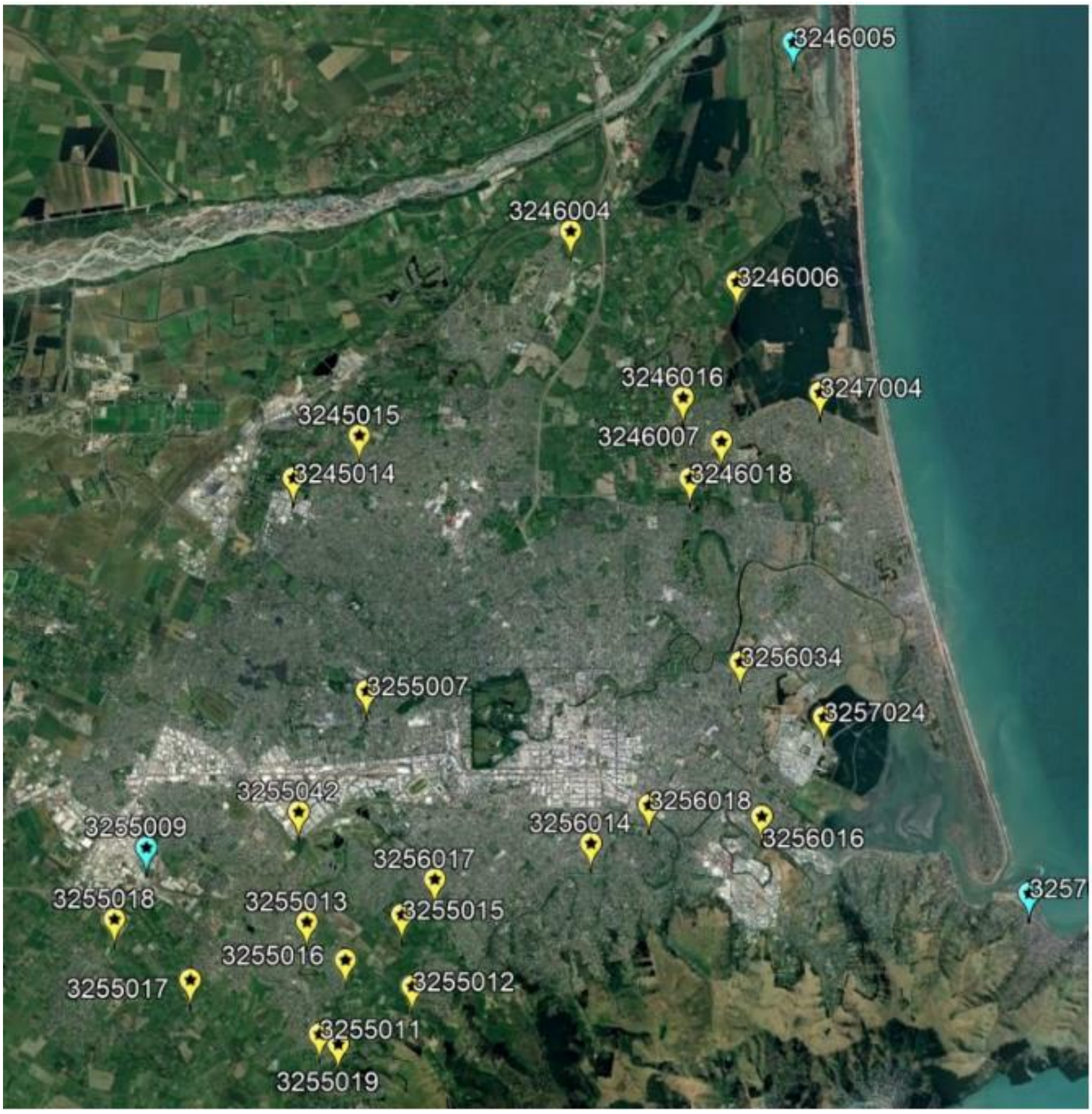

Figure 1: Location of the Council groundwater level sites during 2022. Telemetered sites are labelled with blue pins and manual sites with yellow pins.

6.2 *E. coli* detections in the Council Water supply wells

In total there were 6,359 *E. coli* samples taken from the various water supply wells, pump stations and reservoirs in the city in the 2022 calendar year. In total, there were 8 occasions where the guidelines were not met at Sockburn Pump Station (all from aquifer 2 dated 19 and 20 November 2022) and Estuary Pump station (aquifer information not known dated 21 and 24 November 2022). The exceedances at both of the pump stations were due to suction tank contaminations and not from the source water.

6.3 Copper in the Council Water supply wells

There were no exceedances recorded of the attribute target level for dissolved copper in the 2022 calendar year. There were three samples taken for dissolved copper analysis from Trafalgar Pump Station in the calendar year 2022.

6.4 Zinc in the Council Water Supply wells

There were no exceedances of the dissolved zinc target level in the 2022 calendar year. Similar to dissolved copper, there were 3 samples taken for the dissolved zinc analysis from Trafalgar pump station.

6.5 Lead in the Council Water Supply wells

There were no exceedances of the dissolved lead target level in the 2022 calendar year. Similar to dissolved copper, there were only 3 samples taken for the dissolved lead analysis from Trafalgar pump station.

7 Related research and ongoing groundwater investigation projects

Over the past two years, the Council has been working on various groundwater related research and monitoring projects related to Council's water supply assets to assess and manage risks to the safety of drinking water. Sections 7.1, 7.2 and 7.3 highlight the summary of some of the ongoing projects in groundwater space.

7.1 Stormwater basin environmental investigation project (AECOM, 2021)

The investigation was undertaken to satisfy CSNDC conditions. The objective is to assess localized changes in groundwater levels, and the flow and the quality of any nearby springs from the discharge of stormwater to three infiltration basin facilities (Awatea Basin, Kakapo Basin and Outlook Basin). The monitoring results will help understand the extent and magnitude of any effects on groundwater arising from the operation of the stormwater basins, with reference to the Attribute Target Limits in the CSNDC.

In total, seven groundwater monitoring wells were installed at three infiltration basins. Telemetry enabled data loggers were deployed in each of the seven monitoring wells to monitor standing water level and electrical conductivity for the monitoring period. The depth of the monitoring wells ranged from 0.05 to 0.15m below ground level (bgl) in a screened PVC standpipe. The standpipes were used to monitor the depth of stormwater in each basin to assist in the programming of the monthly monitoring events. Groundwater monitoring wells were monitored for 12 months (one per month) from

June 2021 to May 2022.

Findings:

Groundwater quality

The operation of the three infiltration basins in this investigation does not appear to have and adverse effect on the quality of shallow groundwater beneath the basins.

There were no exceedances of the attribute target levels for metals in groundwater during the 12 monthly sampling events.

Surface water samples collected from the basins did not report concentrations of analytes above the attribute target levels. While the attribute target levels are not applicable to surface water within the basin, the data provides some assurances that stormwater discharging into the basins is currently not resulting in deterioration of groundwater quality.

No statistically significant trends were reported for EC in groundwater beneath the basins.

Analysis of groundwater quality in upgradient and downgradient wells at each basin was not completed as groundwater flow direction art each basin could not be adequately inferred.

However, water quality and quantity between wells within each basin was broadly consistent.

Groundwater Quantity

Overall, there appears to be a good correlation between rainfall events and increased groundwater elevation at all three basins. This is expected as the infiltration basins are designed to capture surface water from the broader area and allow for rapid infiltration to ground.

Rainfall data plotted with both groundwater elevation and standing water levels in the basins reported a good correlation with rainfall events as low as 2-4mm correlating with standing water in the basins. The correlation indicates that the infiltration basins are operating as required with rainfall events resulting in water levels registered at the basin followed by rapid infiltration to groundwater which reports short term increases in groundwater elevation.

Effects on Electrical Conductivity and Springs

There does not appear to be any adverse effects on the water quality or quantity of nearby springs from the operation of infiltration basins at the three basins.

There were no statistically significant increasing trends in EC in groundwater beneath the three basins.

Future directions:

the Council is continuing the monitoring work with an intention to retrieve more quality data to be able to do trend analysis. The extension work will help further on the following:

- The correlation was established only between rainfall events and groundwater levels. In future, it would be interesting to compare the groundwater quality data with wet vs dry weather.
- A minimum of three years is recommended before trends analysis can be undertaken (NIWA, 2014); or interpreted, where possible, additional relevant data can be analyzed/compared from ECan/the Council hydrometric network in the future for reference.

7.2 Assessment of physico chemical monitoring requirements for the Council water supply wells (PDP, 2022)

The Christchurch City water supply is sourced from a network of wells distributed across the urban area. At the present time 138 wells are in service, ranging from 28 – 232 m deep. The wells supply water to 50 pumping stations, with 1 – 6 wells providing the supply to any particular pumping station. Christchurch City Council (the Council) in consultation with Taumata Arowai (TA) need to determine a source water chemistry monitoring schedule for this drinking-water network. The standard water chemistry monitoring requirements for water supply sources proposed by TA involves continuous, monthly, annual and 10-yearly sampling for different determinands. In the Council situation it is considered particularly onerous to require this proposed sampling regime at every well, particularly when many of the wells display similar water quality characteristics. In order to determine an appropriate monitoring regime, this report presents a review of the hydrogeologic setting for the Council water supply wells and reviews the information from recent water sampling over the last 10-years. The information is assessed relative to the Maximum Acceptable Values (MAVs) and Guideline Values (GVs) specified in the Drinking water Standards for New Zealand 2005 (Revised 2018) and subsequent modifications proposed by TA. It is important to note that bacterial sampling is outside the scope of this assessment.

The available hydrogeological information shows that the Council water supply wells abstract water from a vertical sequence of alluvially deposited gravel aquifers, referred to as Aquifers 1, 2, 3, 4 and 5. In the central and eastern areas of the city these aquifers are separated from each other, and from the land surface, by overlying low permeability silts and sands. To the west of the city the low permeability confining layers pinch out and aquifers in these western areas receive recharge from water infiltrating through the land surface, which has its greatest effect on shallower wells.

Two major sources of water provide recharge to the Christchurch aquifers:

Seepage flow from the Waimakariri River, which is a stable source of good quality water providing low chemical concentrations with little variation over time, and

rainfall recharge from the Canterbury Plains, which is more variable and shows the impacts of agricultural land use on water quality. Environment Canterbury (ECan) have defined a Christchurch Groundwater Protection Zone (GPZ) to define areas most affected by rainwater infiltrating through the land surface.

The different water quality effects from these two recharge sources are most evident in shallow wells to the west of the city.

This hydrogeological setting is well understood and provides a basis for classifying the Council water supply as being abstracted from 5 sources, defined as the 5 different aquifers (Aquifers 1 – 5). It will be appropriate for the two shallowest aquifers (Aquifers 1 and 2) to be split into two zones: a western zone where land surface effects could impact on wells (as defined by the Christchurch Groundwater Protection Zone in the Canterbury Land and Water Plan) and an eastern zone where the risk of surface effects is less due to the thickness of the overlying low permeability confining strata.

Consideration has been given to the relative merits of sampling individual wells or pumping stations (which represent the variable input of different combinations of wells at different times depending on the pumping configuration at the time of sampling). Whilst there has not been a large number of repeat samples from individual wells, the overall indication from the data review is that concentrations of dissolved chemicals are generally low and do not vary greatly. However, sampling of individual wells is generally considered better practice as it identifies the specific water quality at the well intake zone. This will be feasible for the Council provided the sampling load is distributed across all wells in a manageable manner. To achieve this, sampling of all the source water parameters specified by TA as 'annual' is proposed to be carried out by sampling 20% of the drinking-water wells each year on a regular rotational basis so that each individual well is sampled at least once every 5 years. This information will provide an understanding of the individual well contribution to each pumping station. It is recommended that the monitoring results should be reviewed as they are collected and if the results indicate exceedances of 50% of the MAV or parameters that breach the GVs, it would be prudent to then sample individual wells more frequently to better understand the source of those more elevated concentrations. That information could then contribute to management of the pumping pattern to lessen the risk that non-compliant water enters the water supply network.

Based on all this information, the following monitoring programme for physico-chemical parameters is set out in the **Table 2** below.

Table 2: Proposed monitoring schedule

Frequency	Determinands	Sampling Schedule
Continuous	Conductivity, pH Turbidity.	Any well where *E.coli* or Total coliforms have been detected over the last 3 years. A representative supply well from the shallowest aquifer where water has been assessed to be less than 1 year old.
Monthly	Nitrate-nitrogen and any determinand that exceeds 50% of a MAV or breaches a guideline value.	A representative shallow well from each pumping station that receives any water from Aquifer 1 & 2 wells in the Christchurch GPZ area. Any well where sampling has shown concentrations that exceed 50% of a MAV or breaches a GV
Annual	All parameters on the standard monitoring schedule proposed by Taumata Arowai (physico-chemical parameters in Table 16, TA 2022).	Within each year, 20% of all wells will be sampled, distributed evenly across all aquifers and pumping stations so that each well is sampled once every 5-years.
10-yearly	Gross alpha activity Gross beta activity Potassium	Within each year, 10% of all wells will be analyzed for these parameters, distributed evenly across all aquifers and pumping stations so that each well is sampled once every 10-years.

All monitoring data should be reviewed on an annual basis and adjustments made to the sampling regime to ensure it targets the most appropriate determinands, pumping stations and wells to assist in the safe management of the Christchurch water supply.

7.3 Drinking water supply security groundwater bore security modelling (Aqualinc Research Ltd, 2022)

Potable water for Christchurch city is extracted from the underlying Christchurch-West Melton groundwater system. This is a multi-layer system that extends from the Waimakariri River (north-west of the city) through to off-shore (east of the city) and merges into the greater Canterbury Plains aquifer system (west of the city). The city's water supply has historically been of high quality, and therefore has normally been supplied untreated.

The Drinking Water Standards of New Zealand (DWSNZ) 2005 (revised 2018) allowed for secure bore water to be supplied untreated if the following criteria are met:

- The bore water must not be directly affected by surface or climatic influences (i.e. the water is at least a year old, by which time any pathogens will have died);
- The well head must provide satisfactory protection to prevent contamination of the water supply; and
- *E. coli* must be absent in the bore water.

Christchurch City Council (the Council) have historically demonstrated Criteria 1 using a modelling approach. This model is required to be reassessed every five years. However, the last review (due in 2011) was significantly delayed due to the Canterbury earthquakes and the associated programme of water supply well infrastructure repairs and replacements. Furthermore, recent age dating has also been undertaken to supplement the Council's knowledge (including a set of approximately 70 wells during 2020/21). This enabled the Council to gain a more robust assessment of Criteria 1.

In addition, Environment Canterbury requires the Council to carry out an assessment to delineate the source protection zones of all of its wells, taking into account local hydrogeological conditions and potential contaminating activities. This work is required to include the one-year backward travel time predictions to estimate the zones needed for microbial protection and 50-year backward travel time predictions to estimate capture zones for protection of other contaminants.

the Council has engaged Aqualinc Research Ltd (Aqualinc) to predict the likely presence of water younger than one year in the Council's supply bores. These predictions are model-based and provide one of several lines of evidence that the Council will use to assess bore security for Criterion 1 and support any new criteria for protozoa protection.

This work has been supported and guided by an independent technical panel relating to DWSNZ compliance.

At the initiation of the project (January 2019), it was expected that the modelling work, and the Council's upgrades to bore headworks (post-earthquakes) and renewal programmes, would contribute to re-establishing compliance with the DWSNZ 2005 security Criteria 1 and 2 (along with continued monitoring for compliance with Criterion 3). However, this is no longer available to the Council. The regulator for drinking water is now Taumata Arowai. The DWSNZ were replaced in 2022 and the concept of secure groundwater is no longer included as an option. Taumata Arowai has released Drinking Water Quality Assurance Rules 2022 (DWQAR). These rules are intended to be a supporting document to the new drinking water standards, which consists of the determinands and their maximum allowable values only. Section 10.8.1 of the DWQAR include a definition of Class 1 water being:

Groundwater sources that draw from a depth of more than 30 metres…and via a sanitary bore head in which E.coli and total coliforms have not been detected over a period of three years….are not required to provide a protozoa barrier.

If it can be established that water younger than one year is very unlikely to be present in the abstracted water, then this is considered a robust alternative to microbial sampling.

Method

In undertaking the assessments, a numerical model (a modified version of the existing Canterbury Groundwater Model 3; Weir, 2018) has been used to identify bores that clearly comply with Criterion 1. Bores that failed these initial assessments were to be assessed in greater detail, if it was possible that more detailed analyses could alter the assessments. Other bores that were clearly non-compliant were also identified.

The assessments included the use of measured field data as a check on model representativeness. They consider how the aquifer system might respond under extreme, yet plausible, conditions (such as high pump rates, leaky aquitards, vertical flow within abandoned bores). An overriding principle of the method is that the model is applied in a way that results in predictions of travel times that are conservative (shorter travel times than actual). Therefore, if given these assessments, water less than one year old is not predicted to reach the bore, there is confidence that the risk of microbial contamination is acceptably low. If modelling suggests that some water reaching the bores may be younger than one year, then there is less confidence in the security of the bore, and more detailed (future) analyses may be needed. Alternatively, some bores cannot be classified as secure.

Multiple decision criteria have been applied to assess the likelihood of supply security for each supply bore. These are:

- The direction of any vertical hydraulic gradient (including pumping drawdown);
- Vertical hydraulic connections to overlying layers (as might be determined by aquifer tests); and
- One-year backward particle tracking under the following modelling scenarios:
    - Baseline (a modified version of the calibrated model with high-yet-plausible continuous pumping from all of the Council's supply bores);
    - Local aquitard punctures (such as might occur from seismic fractures, old lamp posts, building piles, old river incisions, local areas of higher (than elsewhere) vertical connection, etc.);

- Leaky bores (such as old unsealed or multi-screened bores that may vertically transmit water rapidly); and reduced spatial extent of the coastal confining layers.

A scoring system has been applied to the above criteria for assessing the supply security of each bore. A separate comparison of modelled water age has also been made against age estimates derived by GNS Science. However, interpreted age presents a snapshot at the time of sampling and can change between consecutive measurements. Therefore, geochemistry age has not been used as a formal assessment criteria. Rather, it has been presented as an approximate test of the model's groundwater age prediction and then act as a flag to indicate the need for further investigations if the geochemistry interpretations suggest age is younger than that predicted by the groundwater model.

Summary of Results

In total, 48 active well fields were modelled, comprising a total of 133 active bores. Overall, the conservative analyses have concluded that most bores met the DWSNZ 2005 Criterion 1; that is, it is very unlikely that water younger than one year is present in the abstracted water. This is largely due to the upward hydraulic gradients present at most locations, and the comparatively large depth of most bores. All bores either pass clearly or fail convincingly.

Of the 133 bores assessed:

- 124 are very unlikely to have young water; and
- are very likely to have young water.

Of the 48 well fields assessed:

- 46 have all bores that pass
- 2 have operational bores that fail:
  - Main Pumps - all 6 fail. However, water abstracted from this well field is currently treated with UV disinfection.
  - Dunbars - 3 bores fail, 1 pass

The 124 bores assessed as very unlikely to have young water should be considered as meeting Class 1 in the Drinking Water Quality Assurance Rules (if a sanitary bore head is proven) provided by Taumata Arowai.

The groundwater model has also been used to predict the total age of water reaching bores where age estimates have been made by GNS Science. Comparing the two predictions:

- The model almost always reports ages considerably younger than GNS, but this was expected due to the conservative nature of the modelling.
- Modelled minimum ages were older than 1 year for all bores except for the following:
- Both GNS and the modelling consistently predict that the Harewood bore (WELL-

01. M35/1653, abandoned) has a proportion of water younger than 1 year. This confirms that the applied methodology is sound.

- Modelled minimum ages for the following active bores were greater than 1 year, but only just, and therefore the results are uncertain: Main Pumps, WELL-03 (M36/1356) Redwood, WELL-01 (M35/5251)

8 Conclusions

An annual summary of the 2022 groundwater results and highlights of groundwater research projects have been presented. This report doesn't cover Zn, Cu and Pb sampling results at source for the calendar year 2022 (except for one of the pump stations due to the site being isolated for the contaminated work) due to the introduction of new drinking water rules at the end of 2022. This report doesn't include a trend analysis of change for electrical conductivity, copper, zinc and *E.coli*, due to inconsistent and insufficient data set from dedicated sampling points for the three years to be able to conduct a trend analysis.

This report serves as an interim report until the finalization of the Environmental Management Plan (chapter Three). As part of this process, the council will develop a monitoring schedule that aligns with the newly revised EMP. The results will be presented based on new monitoring regime. In addition, the summary of the groundwater- related research presented in this report will contribute valuable insights into the status of groundwater quality and provide crucial support to the revised EMP. It is anticipated that the comprehensive analysis and findings from the different groundwater related research projects outlined in this report will contribute significantly to the ongoing efforts in ensuring effective groundwater management and protection.

9 Recommendations

- Historical trend analysis are produced for the Council water level data.
- Development of the sampling plan once the revision of EMP chapter is complete.

10 References

- Christchurch City Council (August 2020). Environmental Monitoring Programme for Comprehensive Stormwater Network Discharge Consent for Ōtautahi/ Christchurch City and Te Pātaka o Rākaihautū/Banks Peninsula
- Environment Canterbury (20 December 2019). Resource Consent CRC190445, A DISCHARGE PERMIT (S15): to discharge water and contaminants to land and water from the stormwater network.

- Ministry of Health (2005, revised 2018). Drinking-water Standards for New Zealand. 19 December 2018.
- NIWA (2022). Christchurch City Council hydrometric network annual report: 1 January to 31 December 2021. April 2022.

Appendix A Groundwater site statistics summary 2021 comparison with full record

Station details			Full record			1-January-2021 - 31-December-2021		
Number	Name	Start of record	Minimum (m)	Maximum (m)	Mean (m)	Minimum (m)	Maximum (m)	Mean (m)
3245014	Roydvale Ave	06-Oct-77	26.195	29.795	27.588	26.195	27.673	26.861
3245015	Fairford St (opp Oldwood)	19-Dec-88	24.975	26.525	25.787	24.975	25.950	25.502
3246004	PS62, Tyrone Street	05-Jun-84	11.745	14.935	13.715	13.025	14.770	13.975
3246005	Dartford St, Brooklands	21-Jul-81	8.498	10.873	9.635	9.565	10.873	*9.802
3246006	Lower Styx Track Burwood Forest	11-Mar-91	10.400	12.775	11.051	10.635	11.240	10.897
3246007	Mairehau Rd, near Greenhaven	07-Mar-97	10.040	11.450	10.934	10.630	11.330	10.849
3246016	Marshland Domain	07-Mar-97	10.590	13.110	12.365	12.110	12.880	*12.286
3246018	QEII Drive (away) #2 Drain	24-May-99	10.750	12.214	11.103	10.994	11.524	11.119
3247004	No.134 Inwoods Road	12-Nov-84	11.320	12.990	12.235	12.090	12.650	12.326
3255007	Kirkwood Intermediate School	06-Jan-67	20.350	22.395	21.462	20.445	21.690	21.067
3255009	Halswell Ret.Basin, Halswell Jnt	11-Oct-77	23.701	29.585	25.588	23.821	25.524	*24.766
3255011	Cashmere/Kennedys Road	11-Sep-00	19.825	21.610	20.624	19.880	21.335	*20.543
3255012	Cashmere Road	11-Sep-00	15.665	19.360	17.803	16.945	19.096	18.221
3255013	Halswell Road PS	05-Jun-84	20.390	22.970	21.767	21.040	22.170	21.531
3255015	Hendersons Road	11-Sep-00	14.985	18.310	17.224	15.535	18.045	17.053
3255016	Milns/Sparks Road	13-Apr-92	18.700	20.940	19.552	19.320	20.033	19.642
3255017	Whincops Road	13-Apr-92	22.135	23.210	22.650	22.250	22.841	22.558
3255018	Hodgens Road	13-Apr-92	24.265	26.775	24.720	24.275	24.885	24.297
3255019	Quarry Carpark No.2	16-Jun-98	18.320	22.710	19.574	18.320	18.875	*18.600
3255042	Wigram Road near Haytons	10-Dec-13	23.836	25.146	24.457	24.026	24.871	24.503
3256014	Fisher Ave/Norwood Street	20-Apr-92	13.050	15.250	14.355	13.070	15.200	14.209
3256016	Gould Crescent, Woolston	07-Aug-78	8.145	10.145	9.455	9.055	9.685	9.310
3256017	PS42, Sparks Road	07-Jul-69	15.860	18.850	17.376	15.880	17.890	17.040
3256018	PS20, Locarno Street	03-Jun-59	15.860	18.850	17.371	15.880	18.080	17.134
3256034	PS1, Woodham Road	03-Jun-59	11.095	12.695	11.936	11.435	12.275	*11.598
3257024	Ruru Road, Bexley	10-Mar-86	7.635	12.380	11.098	10.980	11.520	11.193
3257031	Cnr Wakefield and Nayland, Sumner	08-Aug-19	12.520	13.835	13.130	13.190	13.820	13.377

Notes: * indicates gap percentage of 2.5% exceeded

Appendix B List of Council's wells in aquifers 1 and 2

List of all the Council wells that are in Aquifer 1

Pressure Zone	Pump Station Name	PS Number	Well	Well Number	Taumata Arowai Source Code	Ecan Well ID	Easting (NZTM X)	Northing (NZTM Y)	Depth [m]	Aquifer Number (Updated 30/1/2023)
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-01	WELL-01	G10865	M36/4591	1570814	5176669	29.5	1
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-02	WELL-02	G10866	M36/2828	1570885	5176727	29.4	1
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-03	WELL-03	G10867	M36/1356	1570904	5176630	28.4	1
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-04	WELL-04	G10868	M36/1363	1570795	5176815	29.3	1
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-05	WELL-05	G10869	M36/1195	1570841	5176807	28.9	1
Central	MAIN PUMPS	PS1024	MAIN PUMPS STN WELL-06	WELL-06	G10870	M36/0985	1570806	5176757	29.3	1
Central	MONTREAL	PS1027	MONTREAL STN WELL-02	WELL-02	G10871	M35/2325	1570119	5181180	31.7	1
Central	TANNER	PS1095	TANNER STN WELL-02	WELL-02	G10874	M36/1915	1574058	5177188	36	1
Central	TANNER	PS1095	TANNER STN WELL-03	WELL-03	G10875	M36/20729	1574068	5177173	37	1
Ferrymead	WOOLSTON	PS1065	WOOLSTON STN WELL-03	WELL-03	G10876	M36/1045	1574429	5178231	34.1	1

List of all the Council wells that are in Aquifer 2

Pressure Zone	Pump Station Name	PS Number	Well	Well Number	Taumata Arowai Source Code	Ecan Well ID	Easting (NZTM X)	Northing (NZTM Y)	Depth [m]	Aquifer Number (Updated 30/1/2023)
Central	AVERILL	PS1005	AVERILL STN WELL-03	WELL-03	G10878	M35/2403	1572530	5182195	86.00	2
Brooklands / Kainga	BROOKLANDS	PS1066	BROOKLANDS STN WELL-01	WELL-01	G10879	M35/7180	1575201	5193911	83.00	2
Rawhiti	CARTERS	PS1008	CARTERS STN WELL-02	WELL-02	G10881	M35/2790	1576178	5181306	95.00	2
West	DENTON	PS1099	DENTON STN WELL-05	WELL-05	G10882	M35/1864	1561623	5178520	72.80	2
West	DUNBARS	PS1102	DUNBARS STN WELL-01	WELL-01	G10883	M36/4053	1565341	5175645	54.00	2
West	DUNBARS	PS1102	DUNBARS STN WELL-02	WELL-02	G10884	M36/4052	1565086	5175757	54.30	2
West	DUNBARS	PS1102	DUNBARS STN WELL-03	WELL-03	G10885	M36/4333	1564865	5175859	52.60	2
Rawhiti	EFFINGHAM	PS1010	EFFINGHAM STN WELL-02	WELL-02	G10886	M35/1606	1577348	5184510	97.00	2
Rawhiti	EFFINGHAM	PS1010	EFFINGHAM STN WELL-03	WELL-03	G10887	M35/2609	1577352	5184527	96.20	2
Rawhiti	ESTUARY	PS1012	ESTUARY STN WELL-04	WELL-04	G10888	BX24/0412	1578629	5180019	98.00	2
Northwest	GRAMPIAN	PS1074	GRAMPIAN STN WELL-05	WELL-05	G10889	M35/8660	1568141	5185992	72.00	2
Central	HILLS	PS1017	HILLS STN WELL-05	WELL-05	G10918	M35/1035	1571817	5183698	116.10	2
Central	HILLS	PS1017	HILLS STN WELL-07	WELL-07	G10919	BX24/0350	1571823	5183693	82.00	2
Northwest	JEFFREYS	PS1076	JEFFREYS STN WELL-08	WELL-08	G10890	BX24/0532	1567080	5181950	80.00	2

Pressure Zone	Pump Station Name	PS Number	Well	Well Number	Taumata Arowai Source Code	Ecan Well ID	Easting (NZTM X)	Northing (NZTM Y)	Depth [m]	Aquifer Number (Updated 30/1/2023)
Brooklands / Kainga	KAINGA	PS1067	KAINGA STN WELL-01	WELL-01	G10891	M35/6213	1572414	5193066	92.00	2
Rawhiti	KEYES	PS1119	KEYES STN WELL-01	WELL-01	G10892	M35/18732	1577432	5182927	97.40	2
Rawhiti	KEYES	PS1119	KEYES STN WELL-03	WELL-03	G10893	M35/18734	1577566	5182999	104.00	2
Central	MAYS	PS1026	MAYS STN WELL-04	WELL-04	G10894	M35/2494	1569414	5183365	85.00	2
Parklands	PARKLANDS	PS1085	PARKLANDS STN WELL-02	WELL-02	G10895	M35/3128	1576257	5185730	92.60	2
Parklands	PARKLANDS	PS1085	PARKLANDS STN WELL-03	WELL-03	G10896	M35/7746	1576305	5185707	94.00	2
Riccarton	PICTON	PS1088	PICTON STN WELL-03	WELL-03	G10897	M35/8898	1568026	5179985	61.00	2
Parklands	PRESTONS	PS1123	PRESTONS STN WELL-01	WELL-01	G10898	BX24/0624	1572780	5186506	93.60	2
Parklands	PRESTONS	PS1123	PRESTONS STN WELL-04	WELL-04	G10899	BX24/0627	1572943	5186595	80.00	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-01	WELL-01	G10900	M35/1859	1564187	5179225	81.00	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-02	WELL-02	G10901	M35/1860	1564167	5179342	78.50	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-03	WELL-03	G10902	M35/2272	1564081	5179452	77.20	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-04	WELL-04	G10903	M35/2273	1564102	5179548	68.40	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-05	WELL-05	G10904	M35/2274	1564083	5179177	76.00	2
West	SOCKBURN	PS1109	SOCKBURN STN WELL-06	WELL-06	G10905	M35/2275	1563994	5179124	76.70	2
Central	SPREYDON	PS1030	SPREYDON STN WELL-06	WELL-06	G10906	M36/8288	1568822	5176420	58.00	2
Central	SYDENHAM	PS1031	SYDENHAM STN WELL-07	WELL-07	G10907	M36/20670	1570558	5178125	65.00	2