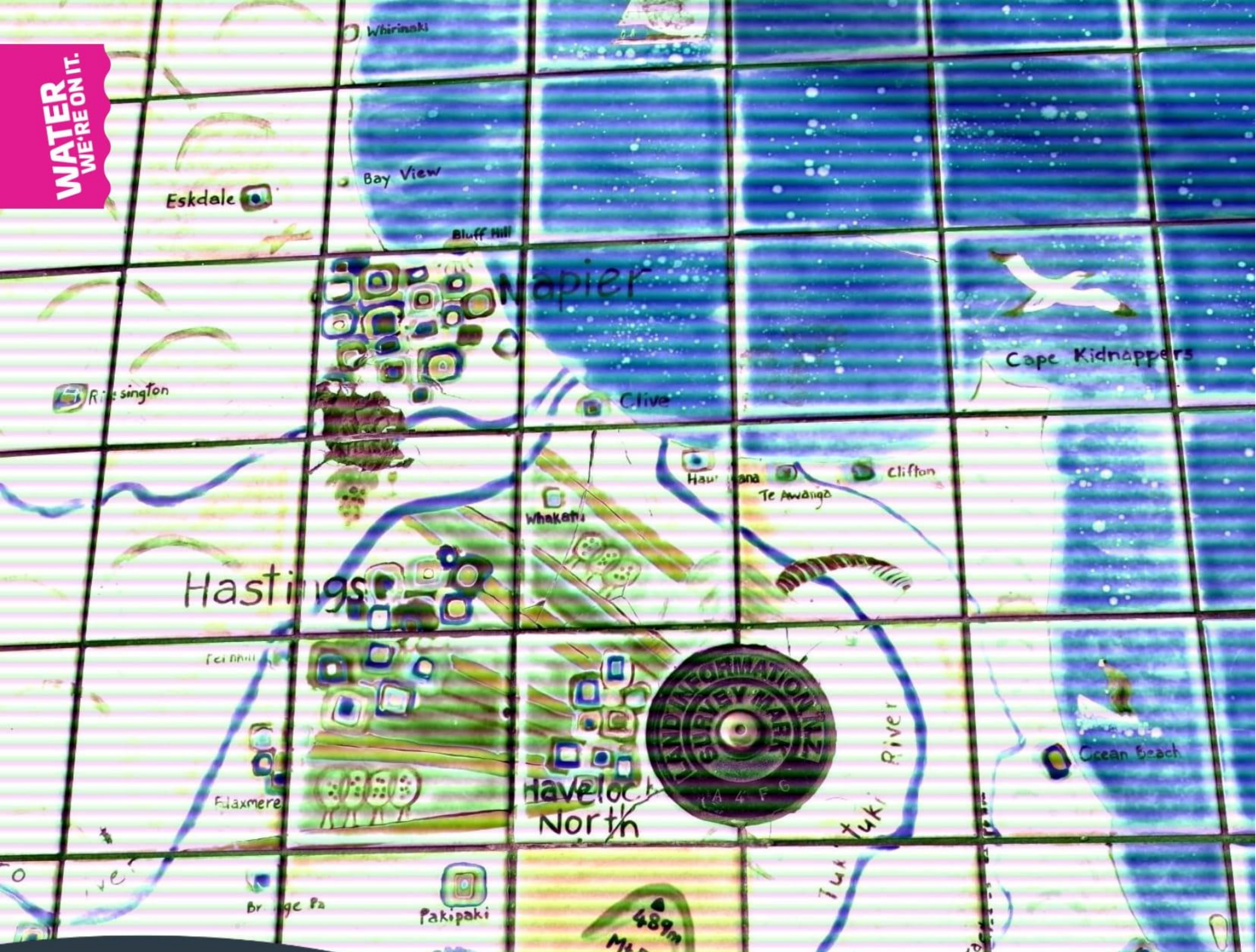
WATER WE'RE ON IT.



SOURCE WATER RISK MANAGEMENT PLAN

Napier drinking water supply (NAP001)

v1.0

NAPIER CITY COUNCIL
Te Kaunihera o Ahuriri

Version Control

Revision Number	DD/MM/YY	Infosource D#	Revision Details	Prepared by
v1.0	02/09/22	D#1447719	Document creation based on Tonkin+Taylor's Report on Napier drinking water supply - Source Water Risk Management Plan (Final draft): D#1474919	Anze Lencek (NCC)

Internal Document Review and Approval

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v1.0	02/09/22	Lance Groves (Water Planning Lead)	Russell Bond (Manager Water Strategy)	See signed pdf D#1592990

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Linked Documents

This SWRMP is linked to various documents that are stored in the InfoSource – NCC's document management system. The references are either supporting documents or the referred-to documents are an integral part of this SWRMP.

Document name	InfoSource D# or F#
Source Protection Zones for Public Supply Bores [T+T Report]	D#940928
Catchment Risk Assessment – Existing Public Water Supply Bores [T+T Report]	D#966713
Source Protection Zones For New Public Supply Bore Fields [T+T Report]	D#940987
Water Services Act 2021	D#1405898
Water Safety Plan	D#1447354
Water Safety Plan Improvement Plan	D#1445206
Heretaunga Aquifer Groundwater Model (Development Report) [HBRC Report]	D#1592168
TANK Catchments - State and Trend of River WQ and Ecology [HBRC Report]	D#1592171
Groundwater Quality State of Environment - State of Trends	D#1592174
Assessment of Bore Security (D#940977) [GHD Report]	D#940977
Groundwater Residence Time Assessment of Napier Water Supply Wells [GHD Report]	D#940980
Napier Water Safety Plan (WSP)	D#1447354
WSP Improvement Plan (IP)	D#1445206

Abbreviations Used

1080 - Sodium fluoroacetate

agl - Above Ground Level

bgl - Below Ground Level

CRA - Catchment Risk Assessment

DO - Dissolved Oxygen

DWA - Drinking Water Assessor

DWSNZ - Drinking water Standards for New Zealand

GNS - Institute of Geological and Nuclear Sciences

HBRC - Hawkes Bay Regional Council

ID - Infrastructure Data

IP – Improvement Plan

LAWA - Land, Air, Water Aotearoa

magl - Metres Above Ground Level

MAV - Maximum Acceptable Value

MCI - Macroinvertebrate Community Index

MRT - Mean Residence Time

MTT - Mean Transit Time

NCC - Napier City Council

NIWA - National Institute of Water and Atmospheric Research

NPS-FM - National Policy Statement for Freshwater Management 2014

OM - Organic Matter

PFAS - Perfluoralkyl and Polyfluoralkyl Substances

PFOA - Perfluorooctanoic acid

SOE - State of Environment

SPZ - Source Protection Zone

SWRMP - Source Water Risk Management Plan

T+T - Tonkin+Taylor

TA - Taumata Arowai

TANK – Tutaekuri, Ngaruroro, Karamu River, Ahuriri Estuary

TOC - Total Organic Carbon

WSA - Water Services Act 2021

WSP - Water Safety Plan

WTHB - Water Testing Hawkes Bay

WWTP - Wastewater Treatment Plant

1 Introduction

Napier City Council (NCC) has engaged Tonkin & Taylor Ltd (T+T) to assist with the preparation of a draft Source Water Risk Management Plan (SWRMP) as part of the NCC Contract with NCC for the Water Safety Plan (WSP) Rewrite. A final draft has been provided by T+T in June 2022 (D#1474919) and has been the basis for creation of this document.

1.1 Background

A Source Water Risk Management Plan (SWRMP) is a new requirement as part of the drinking water reforms that are being introduced by the Water Services Act 2021 (WSA). As it is currently worded, the WSA requires water suppliers to prepare a SWRMP and that the WSP must include a reference to this.

At the time when NCC awarded T+T to produce a draft SWRMP (in May 2021), there was no other guidance on preparation of SWRMP in New Zealand apart from the WSA which described the basic structure and intent of the SWRMP. In late May 2022 Taumata Arowai (TA) release further guidance for SWRMP (link), however the development of this SWRMP has not followed TA's guidance as it was published when T+T were expected to produce and share a final draft. An outstanding action to include a review of TA's guidance document and potentially fill in any missing gaps or considerations when undertaking the next full revision of this SWRMP has been added to the Water Safety Plan Improvement Plan as action OP85.

The SWRMP considers the management of potential risks across the broader groundwater supply source catchment rather than just considering the raw water quality at the point of abstraction. It provides a more holistic approach to managing drinking water quality than taken in the past and is in a way giving effect to Te Mana o Te Wai.

The WSA sets out a requirement for '*new arrangements that are based on a preventative risk management approach, alongside open flows of information between local authorities, drinking water suppliers and Taumata Arowai. Key measures for this approach include:*

- *Drinking water suppliers must prepare and implement a source water risk management plan, which identifies the hazards that relate to source water, assesses any risks that are associated with those hazards and identifies how those risks will be managed, controlled or eliminated, as part of a drinking water safety plan.*
- *Local authorities must contribute to source water risk management plans by sharing information about risks and undertaking actions to address them on behalf of a drinking water supplier.*
- *Drinking water suppliers must monitor source water quality, and regional councils must assess the effectiveness of regulatory and non-regulatory interventions relating to source water every 3 years.*
- *A new provision in the Resource Management Act 1991 to require consent authorities to have regard to risks, or potential risks, to source water when considering applications for resource consents.*'

The purpose of this SWRMP is to provide an overview of the source supply catchment and associated hazards, risks, and management for the Napier City urban water supplies. Source water is considered to cover the area within the wider capture zone defined by source protection zone (SPZ) 3.

2 Source catchment description

2.1 Overview

The groundwater source for the Napier City water supply is within the Heretaunga Plains which is host to the principal urban areas of Napier and Hastings in Hawke's Bay. The catchment is generally flat within the plains and is bounded on the west by the Huiarau, Kaweka, and Ruahine Ranges.

The catchment is approximately 3,400 km^2 based on the combined areas of the Ngaruroro River and the Tutaekuri River catchments which supply most of the recharge to the productive aquifer. The Tukituki River also provides recharge to the productive aquifer and has a large catchment of approximately 2,500 km^2. The Tukituki River is further south of the Ngaruroro River and the Tutaekuri River.

The predominant economic activity of the Heretaunga Plains is agriculture, either classified as 'Orchard, vineyard or other perennial crop' or 'Short-rotation Cropland'[1].

Napier City currently obtains its urban water supply from seven groundwater bores drilled into the Heretaunga Plains aquifer. There are 5 bores centred on the Taradale area (T2, T3, T5, T6 and T7) one bore off Coverdale Street (C1) and one in Awatoto (A1). Further bores are currently being installed at Awatoto but do not yet form part of the supply (commissioning and bringing online bores A2 and A3 planned for September 2022). Two Taradale bores (T1 and T4) do not form part of the supply as they were decommissioned at the end of May 2022.

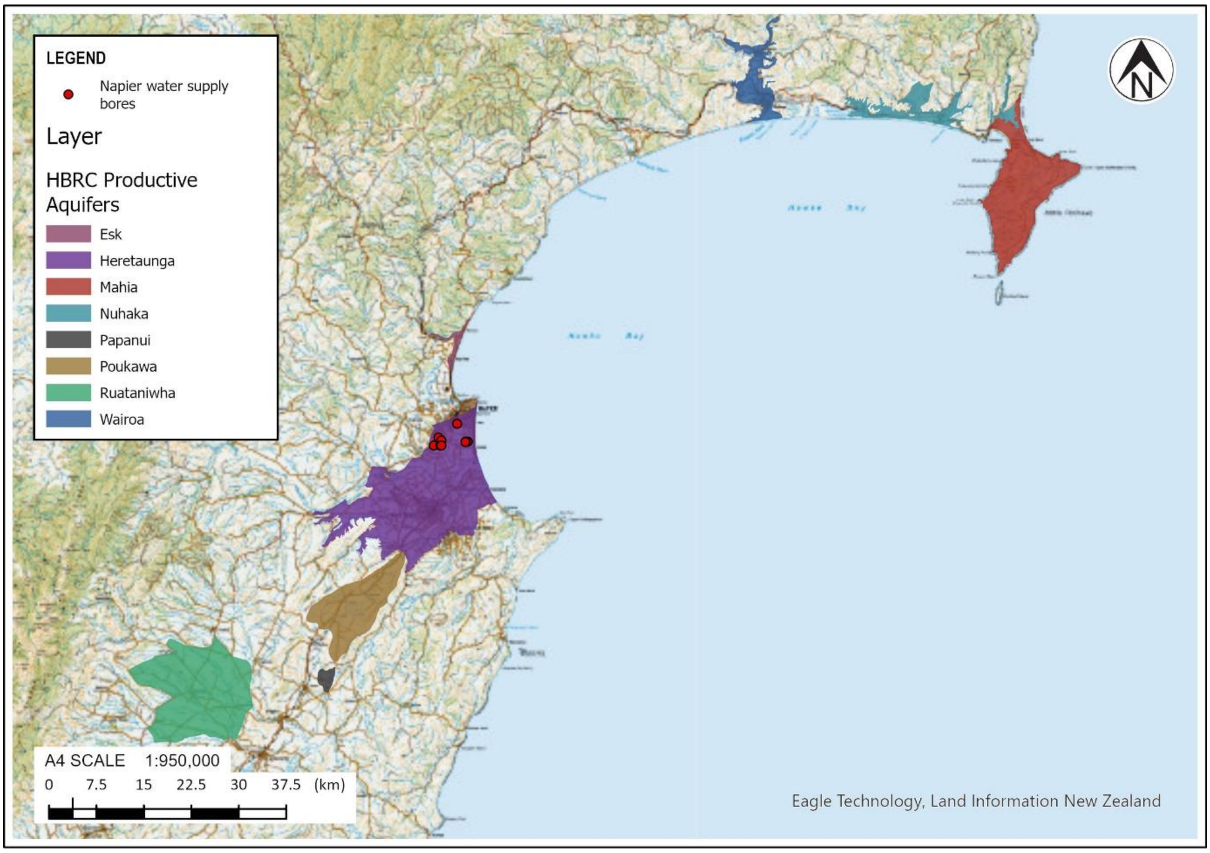

Figure 2.1: Heretaunga Plains Aquifers relative to Hawke's Bay.

[1] Land cover database v4 0 class orders. Ministry for the Environment. Accessed November 2021. https://data.mfe.govt.nz/layer/52764-land-cover-database-v4-0-class-orders/

2.2 Climate

The climate in this catchment is largely controlled by the mountain ranges to the west. During westerlies, the high country shelters the plains which can result in high temperatures with dry conditions. In southerlies or easterlies, the high country enhances rainfall as air masses are forced to ascend the ranges.

Rainfall patterns in the region are closely linked to elevation, with the lower elevations of the Heretaunga Plains averaging approximately 800 mm/year, whereas the adjacent ranges average approximately 1,000-1,500 mm/year (Figure 2.2).

The sheltered position of Hawke's Bay results in high sunshine hours and radiational cooling at night which gives rise to high daily fluctuations in temperature. The average summer temperature is approximately 17^{o}C and the average winter temperature is approximately 10^{o}C.

The climate in the Hawke's Bay is dominated by wet and dry climatic cycles, which means the annual rainfall data often masks the extremes experienced within one year. Major flooding in the Hawke's Bay area has been historically recorded due to heavy rainfall in the mountains, which is some of the highest recorded in New Zealand. In contrast, the region has been known to suffer droughts, with the worst recorded drought event, in both severity and duration from 1913 to 1916[2]. There is evidence of an overall drying since 1945 with fewer of the very wet years.

2.2.1 Climate change

Projections of climate change depend on various factors, which are uncertain. However, projected changes have been made for 2031-2050 and 2081-2100 compared to the climate of 1986-2005[3].

Rainfall is projected to decrease in the winter by 2 to 17 percent in Napier by 2090, and according to most recent projections, Hawke's Bay regions are not expected to experience a significant change in the frequency of extreme rainy days because of climate change. Temperatures are expected to increase by 0.7^{o}C to 3.1^{o}C.

[2] Dravid & Brown. 1997. Heretaunga Plains Groundwater Study. GNS. Volume 1: Findings.
[3] MfE https://environment.govt.nz/facts-and-science/climate-change/impacts-of-climate-change-per-region/projections-gisborne-hawkes-bay-region/

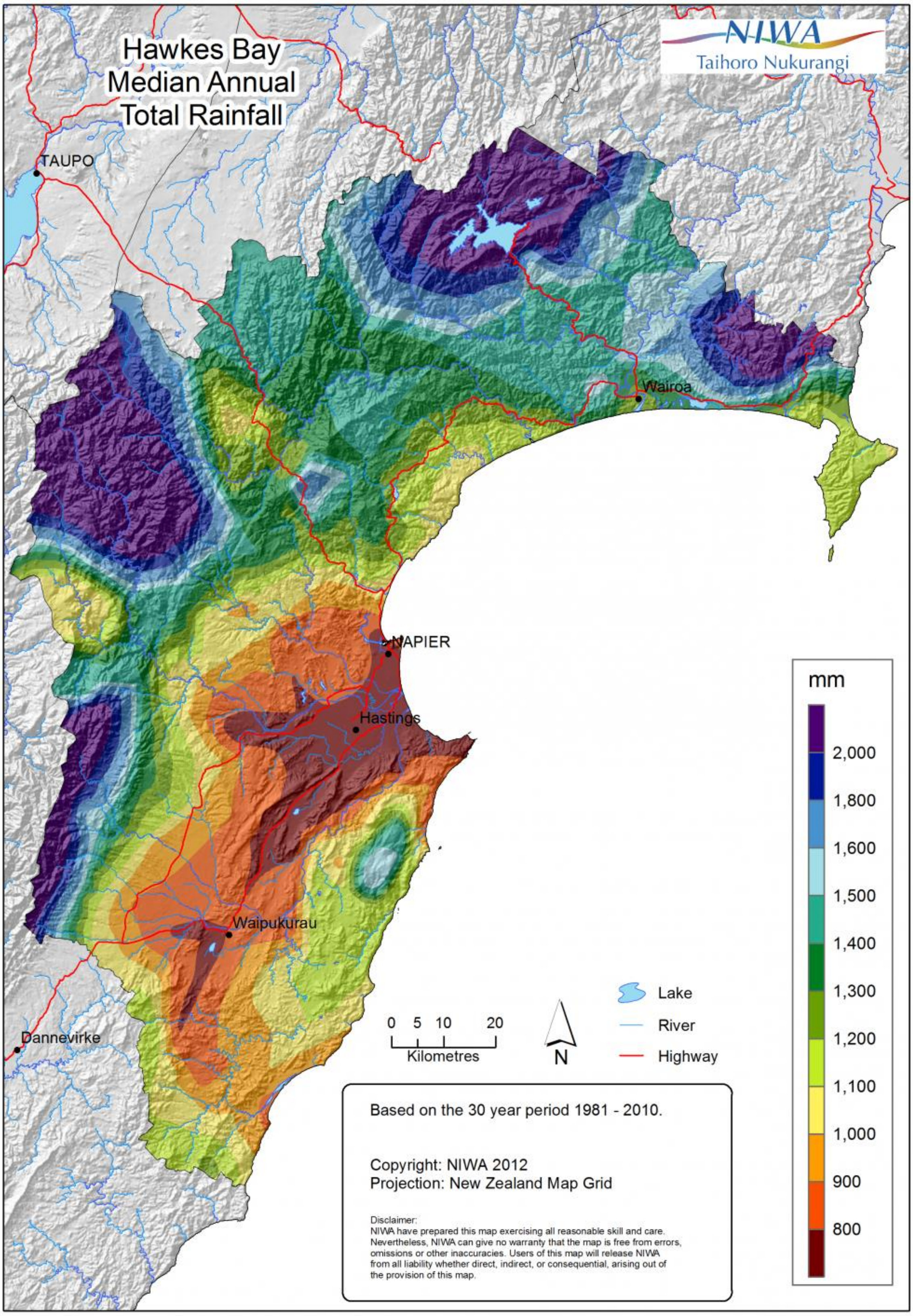

Figure 2.2: Median annual total rainfall for Napier and the greater catchment (from NIWA Regional climate maps).

2.3 Hydrology

There are three major Hawke's Bay rivers: Ngaruroro River, Tutaekuri River and the Tukituki River (refer Figure 2.3). T3 and T6 are just a few metres (100 m and 250 m respectively) from the Tutaekuri River, and approximately 4 km from the Ngaruroro River. Although the Tutaekuri River is closest to the bore fields, field investigations (refer Section 2.4) show that the Ngaruroro River likely contributes a significant volume of water to the aquifer. Whereas the Tutaekuri River is likely to be hydraulically connected to the shallow unconfined aquifer, it is likely not to have hydraulic connectivity with the confined aquifer in this area given the positive vertical upward hydraulic gradients from artesian conditions in the confined aquifer.

The Ngaruroro River has a catchment area of approximately 2,500 km^2. In 1867, the Ngaruroro River changed course after a major flooding event forced the river to break its banks, depositing 0.3-0.5 m of silt over most of the Heretaunga Plains area. Low flow measurements since 1957 indicate the Ngaruroro loses approximately half its flow to groundwater recharge. Water losses from the river have been observed between Maraekakaho and Fernhill[4].

The Ngaruroro River has very young water < 2 years mean transit time (MTT) along most of its length, which reflects the low permeability basement rocks near the surface or thin layer of gravels with short water retention times. The lower reaches have an MTT of c. 3 years which is likely to be backflow from the Heretaunga Plains groundwater system[5].

The Tutaekuri River has a catchment of 900 km^2 with its present river mouth near Clive, common to both the Ngaruroro River and the Tutaekuri River. The Tutaekuri River originally flowed into the Ahuriri Lagoon through Meeanee and Napier. Various diversion projects took place in the late 1800s to reclaim the Ahuriri Lagoon. Uplift associated with the 1931 Hawke's Bay earthquake added approximately 1,300 ha of land to the Heretaunga Plains from the former Ahuriri Lagoon and diverted the Tutaekuri to its present course. Flooding is a natural occurrence, both prior to and since the diversion. Low flow gauging has not indicated any losses between Puketapu and the coast, however losses have been measured upstream of Puketapu.

The Tutaekuri River drains water with an MTT of 8-12 years which indicates the presence of a considerable upstream groundwater reservoir, and active throughflow within its catchment[5].

[4] Dravid, & Brown. (1997). Heretaunga Plains Groundwater Study. 1908(January), 2–6.
[5] Morgenstern, U., Martindale, H., Knowling, M., Gordon, D., Toews, M., JG, B., Daughney, C., Trompetter, V., van der Raaij, R., Franzblau, R., Kaiser, J., Moreau, M., & Stewart, M. (2018). Heretaunga Plains Aquifers: Groundwater Dynamics, Source and Hydrochemical Processes as Inferred from Age, Chemistry, and Stable Isotope Tracer Data (Issue April). https://doi.org/10.21420/G2Q92G.U

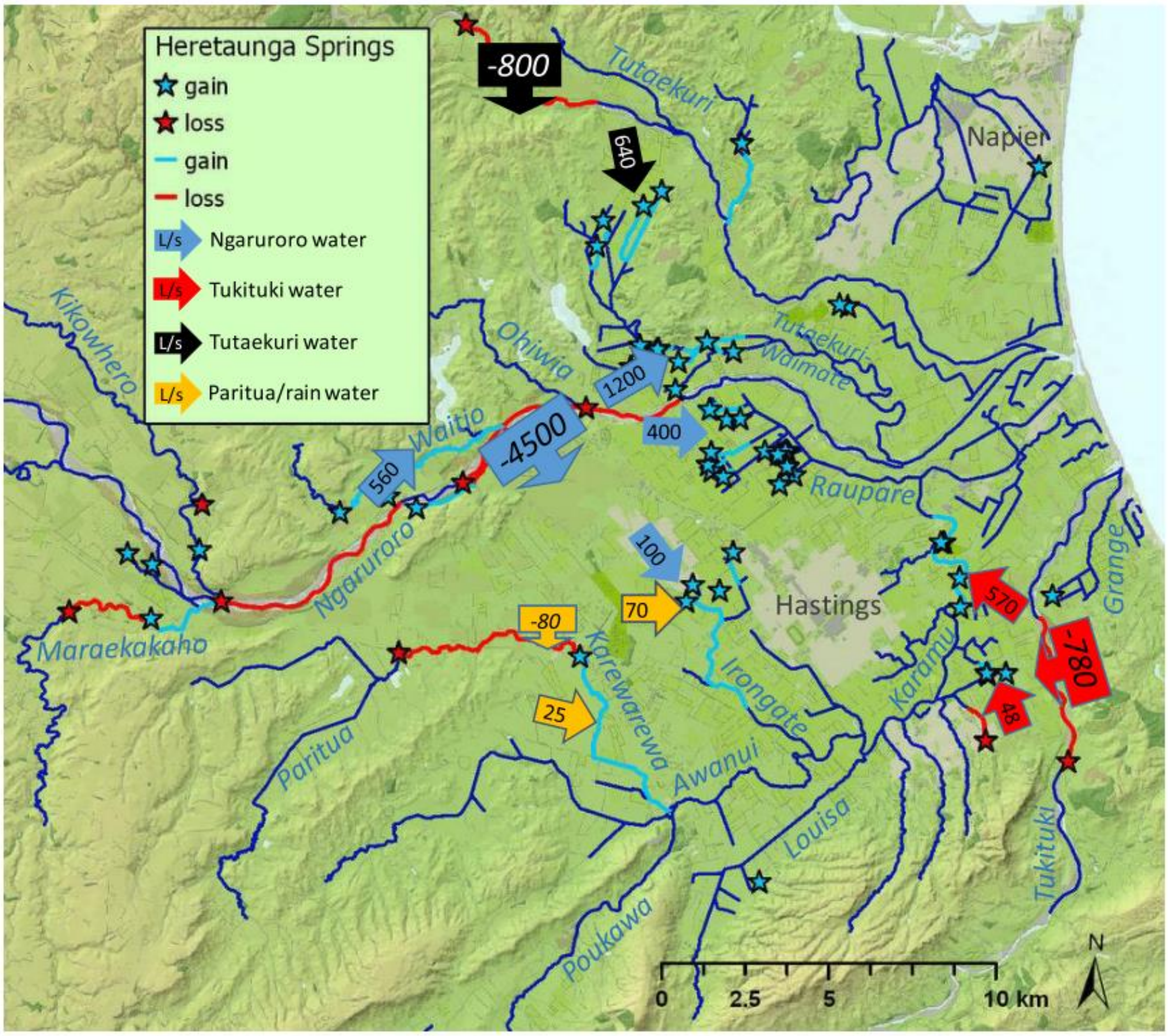

Figure 2.3: Flow gains and losses on the Heretaunga Plains. The various sub-catchments reported in the results. Stream reaches that lose flow to groundwater are represented as red lines, with gaining reaches mapped light blue.[6] (Figure from Wilding, 2018)

2.4 Hydrogeology

The Heretaunga Plains comprise at least five primary water-bearing units which were formed during the last 250,000 years. Sediments from the Tutaekuri, Ngaruroro, and Tukituki Rivers, together with coastal, lagoon, estuarine and embayment deposits, have formed both confined and unconfined aquifers. From the westernmost edge of the Plains near Maraekakaho to Hastings, the aquifer system is predominantly unconfined. Further east, the aquifer system becomes increasingly confined where the main aquifer is overlain by layers of clay and silt from post glacial transgressive and progradational marine deposition.

Dravid and Brown (1997) highlights some areas where there is a weaker confining seal due to postglacial deposition of overlapping river channels. This has resulted in the fine sediments of the confining layers being intercalated with permeable water bearing gravels, sand, and pumice. Overlap of the Tutaekuri River and the Ngaruroro River channels resulted in postglacial river reworking of the marine and marginal marine deposits that form the confining strata, and deposition of fluvial gravel channel deposits which form localised perched

[6] Wilding, T. (2018). Heretaunga Springs Gains and losses of stream flow to groundwater on the Heretaunga Plains Heretaunga Springs Gains and losses of stream flow to Iain Maxwell – Group Manager – Resource Management. June.

aquifers overlying the confined aquifer. HBRC completed aquifer vulnerability mapping[7,8] in 2010 which is illustrated in Figure 2.4. The mapping indicates that all the NCC bores are within relatively low vulnerability zones (2 -4) of surface contaminants, with 1 indicating the lowest vulnerability, and 13 indicating the highest vulnerability areas.

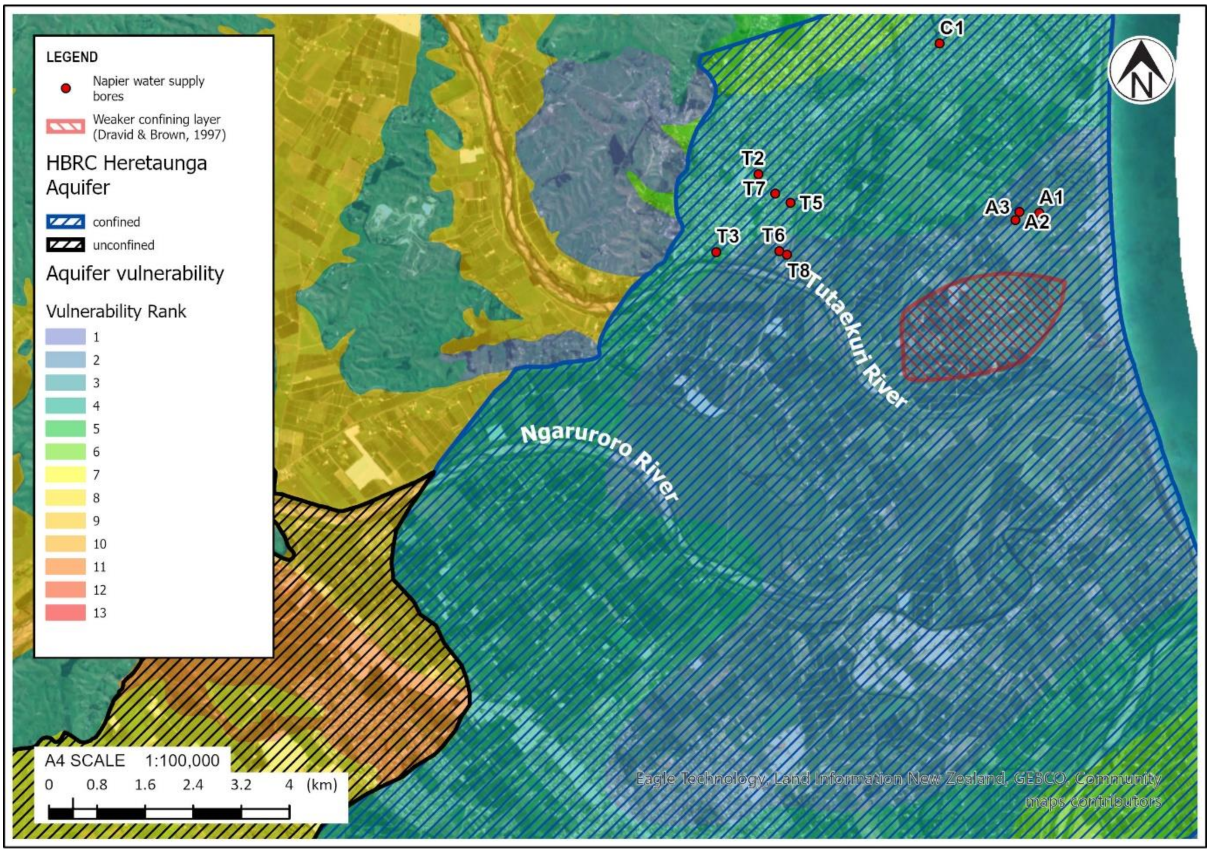

Figure 2.4: HBRC mapped aquifer vulnerability[7,8], aquifer delineations, and area of weaker confining layer closest to the NCC bores.

The confining marine clay layer (located east of a line formed through Fernhill, Hastings, and Bridge Pa) means aquifer piezometric heads are recorded as 8 m to 10 m above mean sea level at the coast. Regional groundwater flow directions are indicated from the west and north-west (from the Ngaruroro River) east towards the coast. In areas where large amounts of pumping occur, there can be little difference between heads measured in water-bearing units located at different depths, suggesting a connection between these units.

Most of the aquifer recharge in the Heretaunga Plains aquifer system is from river losses from the Ngaruroro, and land recharge from the unconfined/semi-confined area of the Heretaunga Plains. Some river losses to groundwater are noted along the Tutaekuri River in the Moteo Valley which contribute to the Tutaekuri-Waimate Stream flows and joins the Ngaruroro River upstream of Chesterhope Bridge. In addition, some recharge occurs from direct infiltration of rainfall to the unconfined area[2,5,6]. Most of the groundwater pressures around the water supply bores for Napier have positive artesian pressure, which means direct infiltration is less likely to recharge the underlying aquifer (Figure 2.5 and Figure 2.6).

The unconfined Holocene gravels of the Heretaunga Plains Aquifer system generally have relatively young MRT (mean residence times) of between 0-10 years. Along the groundwater flow path from the area of main river loss along the Ngaruroro River near Omahu (some 8 km from the Taradale bore field), the groundwater MRT

[7] Groundwater vulnerability (DRASTIC) mapping undertaken by HBRC. https://www.hbrc.govt.nz/assets/Document-Library/Plans/Regional-Resource-Management-Plan/Schedules-Maps/5.Schedule-5.pdf

[8] Baalousha, H., 2010. Assessment of a groundwater quality monitoring network using vulnerability mapping and geostatistics: a case study from Heretaunga Plains, New Zealand. Agricultural water management, 97(2), pp.240-246.

becomes progressively older towards the coast. The Taradale supply wells have an MRT of 20-40 years which is illustrated in Figure 2.5.

Based on hydrochemistry data from historical records through to 2017 (see Morgenstern at al 2018)[5], anoxic conditions have been observed in some parts of the Heretaunga Plains, which is seen through relationships with dissolved oxygen (DO) and organic matter (OM). In particular, the Coverdale bore in Napier, has been observed to have low DO which is thought to be associated with high OM, and has evolved to the stage of methane fermentation (~1-100 µmol/CH_4)[5].

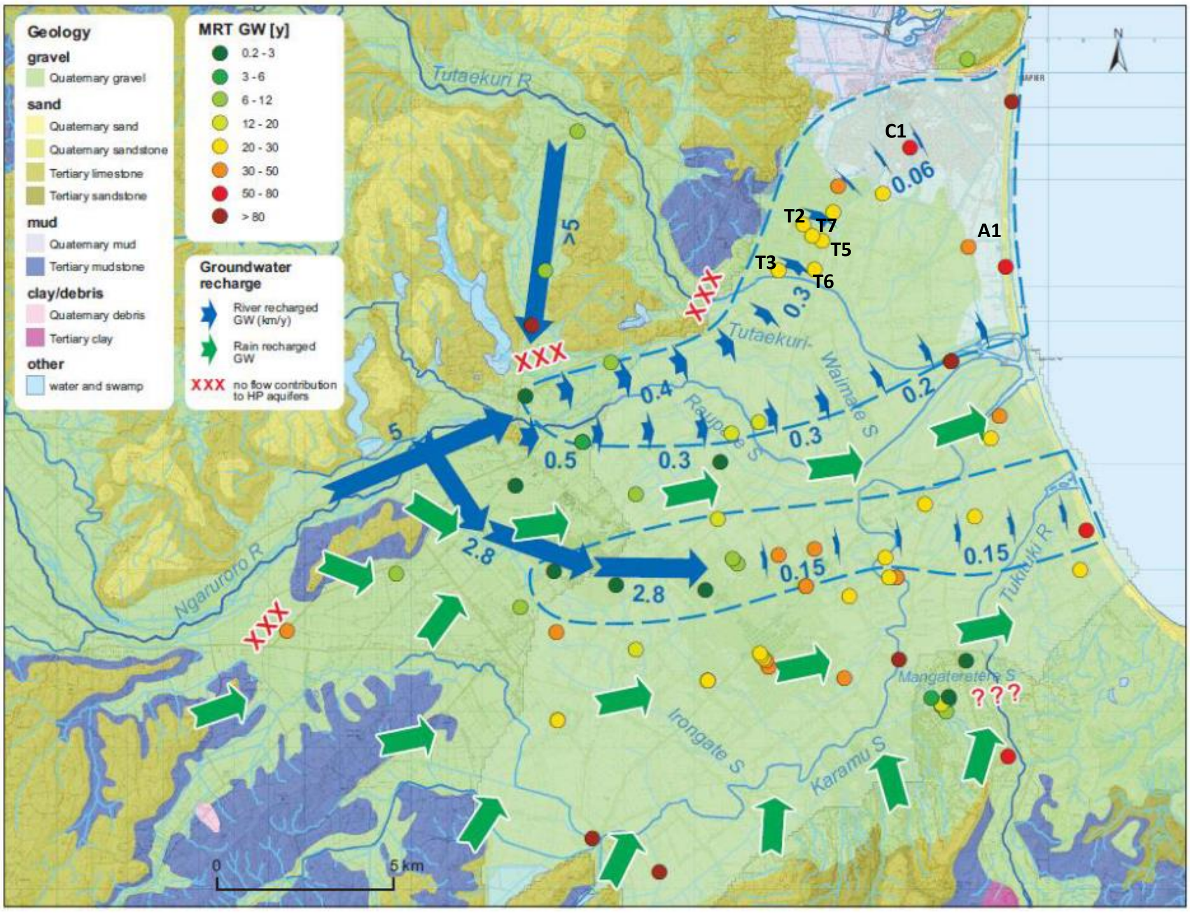

Figure 2.5: Water dynamics in the Heretaunga Plains hydrologic system inferred from groundwater ages (circles). Green arrows indicate rain recharged groundwater flow directions, red crosses indicate no connection of potentially lost surface water to the main aquifer. Red question marks indicate unknown contribution of the river to the main aquifer due to lack of data. The two areas indicated by blue dotted lines are the areas of clear Ngaruroro River-recharge signature (after Morgenstern et al., 2018). (Figure source: Rakowski et al, 2018)

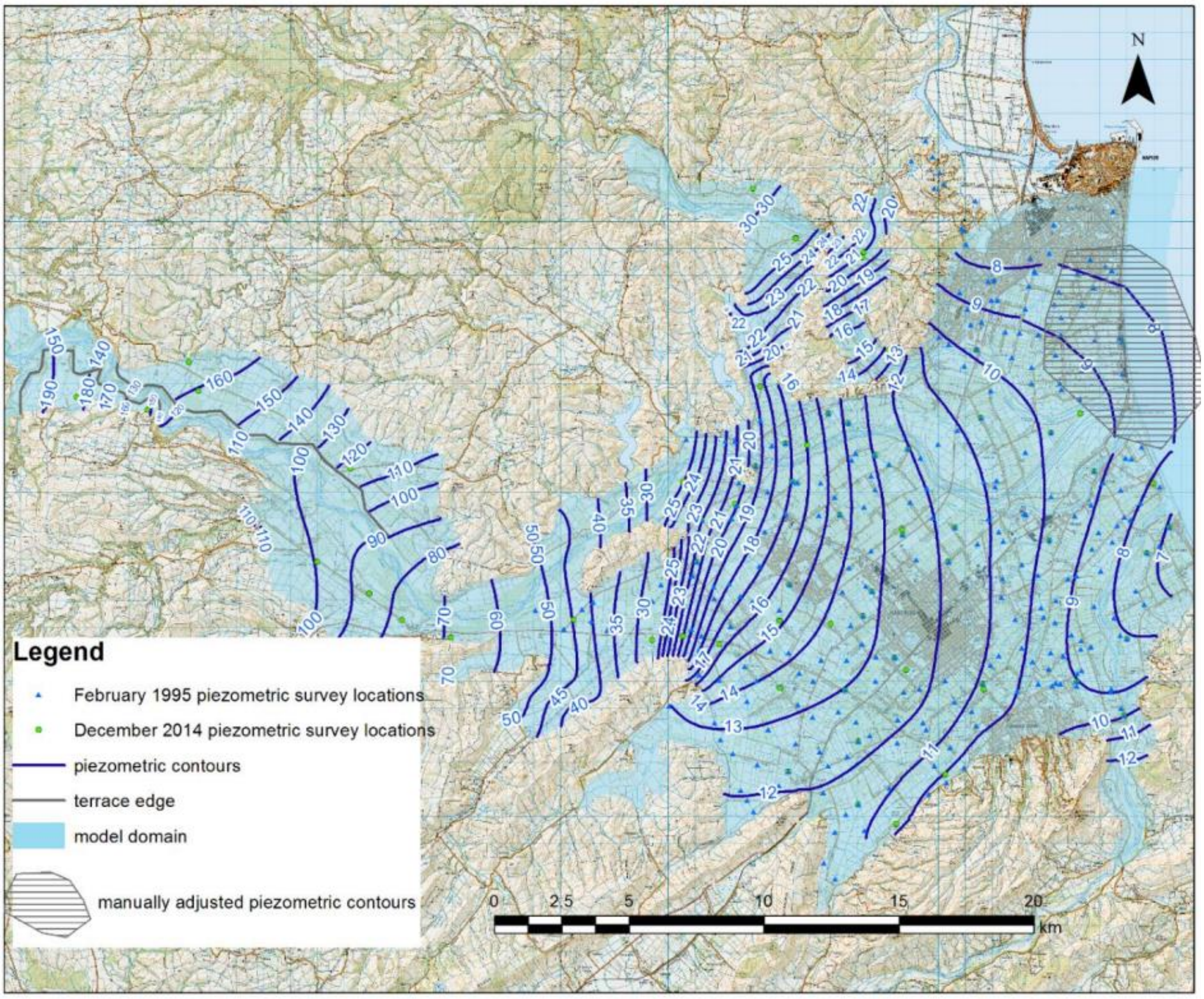

Figure 2.6: Piezometric map of the Heretaunga Aquifer systems during summer (from Rakowski and Knowling 2018). Contours were based on data recorded in February 1995 (Heretaunga Plains), December 2014 (Moteo Valley, Upper Ngaruroro Valley), and river elevations in the Upper Ngaruroro valley.[9]

2.5 Source catchment water quality

The following source have been referred to for this summary of water quality in the catchment and within proximity of the NCC bore fields:

- HBRC Ngaruroro, Tutaekuri, Karamu River and Ahuriri Estuary Catchments: State and Trends of River Water Quality and Ecology (July 2016)[10].

2.5.1 Surface water

Based on the information from the July 2016 state and trends of river water quality report the following has been summarised about the Ngaruroro River and Tutaekuri River.

The main stem of the Ngaruroro River was in excellent condition in the upper and middle catchment. There were some signs of minor enrichment and decrease in water clarity in the lower reaches. Based on water quality parameters, there was a minor decline in water quality from upstream to downstream, however, in general, the overall water quality and ecology of the Ngaruroro River main stem was healthy.

[9] HBRC, May 2018. Heretaunga Aquifer Groundwater Model (Development Report) (D#1592168)
[10] HBRC, July 2016. TANK Catchments - State and Trend of River WQ and Ecology (D#1592171)

The Tutaekuri main stem showed some enrichment in nutrients, particularly in phosphorus. The ecological parameters indicate a decrease in quality from upstream to downstream, with increasing periphyton biomass, and macroinvertebrate community index (MCI) values declining from excellent to fair towards the lower reaches.

The Tutaekuri tributaries and some of the Ngaruroro tributaries were enriched in nutrients, especially phosphorus, which was always above guideline levels. Particularly in the Mangatutu Stream, and low in the upper Mangaone, periphyton biomass was relatively high. The influence of the elevated nutrient loads in the tributaries had a minor effect on total water quality in the Ngaruroro due to the significant volumes of high-water quality from the upper catchment. However, the main stem of the Tutaekuri River was more influenced by these nutrient loads as there is a smaller volume of water coming from the pristine upper catchment and the dilution effect is lower than the Ngaruroro River.

Based on the SOE, toxicity effects on aquatic organisms from nitrate and ammonia were not an issue anywhere in the Ngaruroro and Tutaekuri catchments, as concentrations were always low. In the case of ammonia, concentrations were mostly below detection limit. *Escherichia coli* (*E. coli*) concentrations were very low in both catchments and were below the lowest guideline ('alert'-) level set out in the National Policy Statement for Freshwater Management 2014 (NPS-FM), based on 5-year median concentrations (/100 mL). The NPS-FM has since been amended to the NPS-FM 2020, which has 5 bands (A-E) as opposed to 4 bands (A-D). Based on the updated statement, the Ohiwa Stream and the Tutaekuri-Waimate Stream were in the D band (orange) based on elevated median annual values (> 130 and < 260 *E. coli* /100 mL).

2.5.2 Groundwater

The SOE groundwater quality monitoring programme commenced in 1997 and comprises forty-two sites of which forty sites have long term time series data used for state and trend analysis. Sites are sampled quarterly for analysis of major physico-chemical parameters, as well as microbiological indicators. All parameters are summarised in Table 4-1 HBRC SOE Monitoring Report (2016)[11].

The SOE report (2016) indicates most of the sites comply with the DWSNZ for the key chemical water quality parameters, except for naturally occurring manganese. Of the monitoring sites included in the SOE, 91% of sites comply with the MAV for manganese and 57% of sites comply with the aesthetic guideline value. However, most of the exceedances are associated with the deeper parts of the aquifer (> 50m) which is likely associated with longer MRT.

Nitrate levels within the Heretaunga Plains aquifer system comply with the DWSNZ MAV. In general, 74% of the sites had low nitrate-N (< 1.0 mg/L), 13% of sites had moderate levels of nitrate-N (1.0 to 5.65 mg/L) and 13% sites had high levels of nitrate-N (5.65 to 11.3 mg/L). The highest proportion of increasing nitrates recorded by HBRC occurs in the Ruataniwha aquifer, followed by the Mahia aquifer (Figure 2.1), and then in the Heretaunga aquifer. The increasing trend of nitrates for the Heretaunga aquifer is mainly concentrated in the eastern unconfined area, south of the Ngaruroro River.

The monitoring bores of well ID 611 (39 m deep, no info on screen) and 3781 (38 m deep, no info on screen) are the closest representative SOE bores to the bore fields of NCC, which have indicated a 94% (1 detect) and 100% DWSNZ compliance of E. coli, respectively. Based on the trend analysis for major physico-chemical parameters and microbiological indicators, most bores show no significant increasing or decreasing trends.

2.6 Future data discovery

HBRC is currently supporting a 3D aquifer mapping project, referred to on their website as airborne electromagnetic survey technology or SkyTEM. This technology will allow HBRC to understand more about the deep underground aquifers, in a way that has never been seen before. This understanding will improve the management of groundwater resources in the region.

The information will be shared by HBRC and will be publicly available after the target completion date of February 2023. At this time, the information should be reviewed and updates to this SWRMP considered by NCC.

[11] HBRC. September 2016. Groundwater Quality State of Environment - State of Trends (D#1592174)

3 Bore field description

The Napier reticulated water network consists of 488 km of mains, delivering approximately 1 billion litres of water annually. The water supply relies solely on groundwater, abstracting from seven bores into eleven reservoirs across the region (Figure 3.1). The current configuration of the bore fields will be optimised in the future and the SWRMP will require future updates to reflect the changes to the bore fields.

NCC holds a resource consent (AUTH-116128-04) to take water from ten wells for a combined cumulative rate of take (from all wells) of 784 L/s with a maximum 7-day volume take of 387,744 m^3.

The bore construction details and consented pumping rates for each of the production bores in use are summarised in Table 3.1.

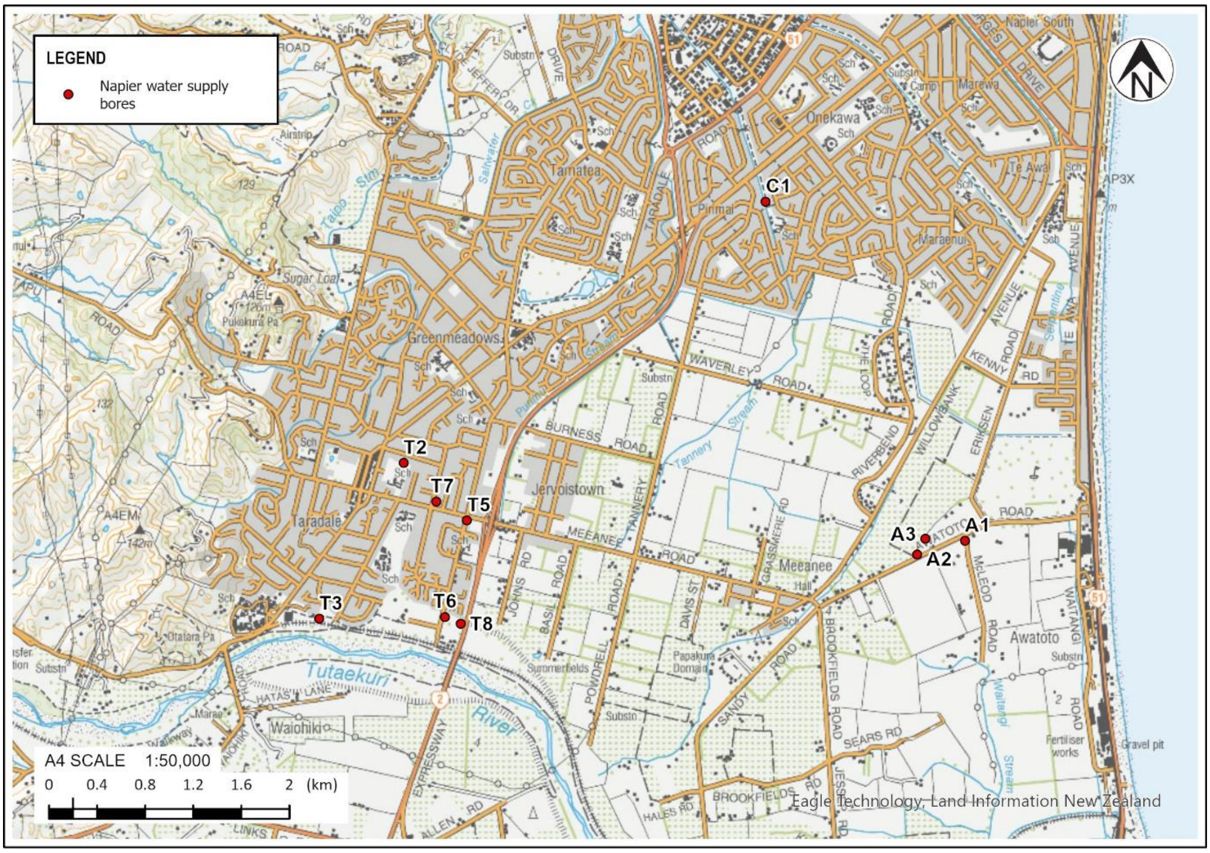

Figure 3.1: Locations of the current NCC bore fields.

Table 3.1: Bore field details

ID	Bore name	Well No.	Depth (m bgl)	Diameter (mm)	Screen depth (m bgl)	Maximum consented rate (L/s)	Maximum 7-day volume (m^3)
Awatoto bore							
A1	Cnr Awatoto & McLeod Rd	5913	90	300	74 – 76 78 – 84	125	75,600
A2	Awatoto Rd	16352	118	300	113 - 118	130	70,000
A3	Awatoto Rd	17215	**	400	**	130	70,000
Coverdale bore							
C1	Coverdale Street	4671	88.5	300	71.0 – 75.0 76.0 – 79.0	80	48,384
Taradale bore field							
T2	Bledisloe Park	480	41.76	250	35.97 – 41.76	100	58,060.8
T3	Riverside Park	872	42.85	300	36.85 – 42.85	70	36,288
T5	Guppy Rd	1998	51.2	300	39.9 – 49.4	120	69,552
T6	Guppy Rd	4144	74.5	300	60.0 – 72.35	130	69,552
T7	King St	4595	38.5	300	31 – 37	130	75,600
T8	Guppy Rd	17216	120	400	108.3 - 119	130	70,000

3.1 Awatoto

3.1.1 Location and description

The Awatoto bore field currently consists of one flowing artesian water supply bore (A1) located in the Awatoto rural area near the corner of McLeod and Awatoto Roads. The well head was modified in 2017 and is now an above-ground structure, with all fittings above the 100-year flood level.

The A2 bore was historically abandoned but is now being re-developed into the main supply along with bore A3. The A2 and A3 bores are expected to be online by the end of June 2022. When A2 is commissioned, A1 will be taken off-line, but maintained as a back-up supply.

3.1.2 Local hydrogeology

According to the GHD Hydrogeological Assessment and in relation to A1:

- *The bore is 90 m deep is drilled into an aquifer with strong artesian conditions (i.e. static water level of >5 m agl).*
- *The bore log identified six discrete clay layers, with the thickest of these located between approximately 23 m to 36 m below ground level. Based on the conceptual understanding of the groundwater system in this location the bore is considered to be screened in a confined aquifer.*

Geological logs in the vicinity of the Awatoto bore field show that the Awatoto public water supply aquifer is overlain by approximately 30 m of low permeability aquitard materials. Table 3.2 provides a summary of pumping test results for the existing Awatoto bore field. The pumping test results for the upgraded A2 and new A3 bore shall be added to Table 3.2 in future revisions of this SWRMP.

Aquifer vulnerability mapping undertaken by HBRC indicates that the vulnerability zones for the Awatoto A1 and A2 bore are rated as 2 and 4 out of a possible 13. Therefore, the A1 and A2 bores are assessed to have a low vulnerability to surface influences from the downward infiltration of surface water contaminants.

Table 3.2: Summary of aquifer test data results from pumping tests for the Awatoto bore field

Bore ID	Static water level (magl)	Transmissivity (m^2/d)	Storativity (-)	Source
A1	6.5	4,880	0.007	EAM (2009)
A2 (being redeveloped)	5.5	6,267-6,583	-	Lattey (2009)
A3 (under construction)	-	-	-	-

magl = metres above ground level

3.2 Coverdale

3.2.1 Location and description

The Coverdale bore field consists of one flowing artesian water supply bore (C1) located in Plantation Reserve, south of Kennedy Road and to the west of Coverdale Street. The bore wellhead is constructed in an underground sealed chamber with a removable concrete lid.

3.2.2 Local hydrogeology

According to the GHD Hydrogeological Assessment, the supply aquifer at C1 is strongly confined using the following lines of evidence:

- *A strong upwards vertical gradient, which is maintained throughout pumping. At the maximum pumping rate, the in-bore drawdown remained above 3.7 m agl (measured in May 2018).*
- *C1 is located within deep gravel units, with the screens being generally deeper than those of the Taradale Bores.*
- *C1 is located nearer to the shoreline, with alternating silts and clays reported from ground surface to 44 m depth.*
- *An aquitard comprising blue marine clay is present at this location, extending 37 m from the ground surface. This is notably thicker and forms a single clay unit compared to the other bore locations.*

Aquifer vulnerability mapping undertaken by HBRC indicates that the Coverdale SPZ2 covers an area with vulnerability zones rated as 4 and 6 out of a possible 13. This means that the aquifer is in the mid to lower end of vulnerability reducing the potential impact from surface influences.

3.3 Taradale

3.3.1 Location and description

The Taradale bore field comprises five flowing artesian water supply bores (T2, T3, T5, T6 and T7), which are distributed throughout central and south Taradale, situated within Napier's urban environment. T3 does experience periods when the artesian pressure is lower, and below a sampling tap that is located 1 m above ground.

Each bore is housed in a below-ground chamber, except for T2 and T6, which were altered in 2018 to reposition the headworks above ground. Additional bore construction details are provided in the GHD Hydrogeological Assessment[12].

In addition to the operating supply bores, two further bores, T1 and T4, were abandoned in 2018 and were decommissioned by the end of May 2022.

[12] GHD, June 2018. Assessment of Bore Security (D#940977)

3.3.2 Local hydrogeology

According to the GHD Hydrogeological Assessment:

- *The Taradale Bore field takes groundwater from a gravel aquifer within the wider Heretaunga Plains aquifer, referred to as the local Taradale supply aquifer. All Taradale bores (T2 to T7) are considered to be within the same aquifer between approximately 30 m and 75 m bgl.*
- *Water enters the Taradale supply aquifer system at the Ngaruroro River Loss Zone (the recharge zone), located between Roys Hill and Fernhill, approximately 15 km inland. The unconfined aquifer at this location comprises continuous gravel fan deposits, which are greater than 200 m in thickness.*
- *These gravels underlie the wider Heretaunga Plains and decrease in thickness towards the coast. The groundwater flow path for the Taradale supply aquifer from the recharge zone to Taradale is via a paleovalley of the Ngaruroro River. Along the groundwater flow path, there is a transition from unconfined gravels in the west (Fernhill), to confined aquifer conditions in the east (Taradale). This is associated with a transition from coarse river channel sediments inter -bedded river, estuarine and marine sediments with finer fractions.*
- *The Taradale supply aquifer itself is confined, which is indicated by several lines of evidence, including strong upward vertical gradients, low storativity values, near immediate response to pumping in bores 1.5 km away, no response to pumping from shallow monitoring wells and characteristics of the overlying aquitard units.*

Geological logs in the vicinity of the Taradale bore field show that the Taradale public water supply aquifer is overlain by approximately 20 to 30 m of low permeability aquitard materials, including interbedded lenses of silt, sand, and clay, with gravel inclusions. Table 3.3 provides a summary of the available pumping test results for the Taradale bore field.

Aquifer vulnerability mapping undertaken by HBRC indicates that the Taradale bores are within vulnerability zones rated as 2 and 4 out of a possible 13. This represents a relatively low vulnerability area of the aquifer and means the bore field is less likely to be affected by surface influences.

Table 3.3: Summary of aquifer test data results from pumping tests.

Bore ID	Static water level (magl)	Transmissivity (m^2/d)	Storativity (-)	Source
T2	5.0	11,347	9.5E-5	East Coast Environmental Associates Ltd (2001)
T3	1.0	-	-	Beca (1998)
T5	4.5 - 4.8	13,300 - 15,744	2.3E-4 – 3.0E-4	Beca (1998) & East Coast Environmental Associates Ltd (2001)
T6	No data	17,885 – 18,216	2.3E-4	Beca (1998) & East Coast Environmental Associates Ltd (2001)
T7	4.2	14,414	-	East Coast Environmental Associates Ltd (2001)

magl = metres above ground level

4 Source water monitoring and management

4.1 Overview

Source water monitoring and management is undertaken by NCC following several programmes. These programmes include raw water quality monitoring, resource consent reviews and casing pressure testing and are summarised in the following sub-sections of this SWRMP. The catchment risk assessment is described first because it has informed some of the decision making and monitoring and management programmes.

4.2 Catchment risk assessment

4.2.1 Summary

In December 2018 T+T developed source protection zones (SPZs; *Source Protection Zones for Public Supply Bores*, D#940928) in 2018 for the existing NCC public water supply bore fields located in the Taradale, Awatoto, and Coverdale areas. These delineated SPZs were used as outer perimeter boundaries for the catchment risk assessment (CRA; *Catchment Risk Assessment – Existing Public Water Supply Bores*, D#966713).

The purpose of a catchment risk assessment is to identify potential short- and long-term risks to raw water quality in the operational public water supply bores. These catchment risk assessments have been used for water safety planning purposes and to fulfil commitments made to NCC's assigned Drinking Water Assessor (DWA).

Information such as aquifer vulnerability mapping, discharge consents, bore permits, land use information, hazardous activities and industries list, and wastewater network data within each SPZ was collected. The data were used to undertake a qualitative assessment of risk considering the potential source-pathway-receptor relationship.

A simple matrix was used to identify the potential risks posed to the water supply bores. For each contaminant source identified, a qualitative risk rating was developed, based on the likelihood of a contaminant release into the environment and the chance of a contaminant following a pathway to the bore fields at concentrations that could be detrimental to the raw water quality.

In May 2019 T+T also produced Source Protection Zones For New Public Supply Bore Fields (D#940987) with the assumption that the two new bore fields will be developed in the vicinity of existing A1 and T6 bore respectively.

4.2.2 Catchment risk assessment summary of findings

Based on the CRA completed in 2019, confined conditions and artesian pressures at each of the bore fields reduces the risk of surface derived contamination entering the screened sections of the bores. Accordingly, most potential contaminant sources have been qualitatively assessed as low or very low. However, some potential contaminant sources were classified as moderate, high, or very high and these are highlighted in Section 4.4.1.

4.2.3 Catchment risk assessment gap analysis

A high-level gap analysis of the CRA has been undertaken to support preparation of this SWRMP. The original assessment was completed by T+T for NCC in 2019 based on a qualitative assessment of the likelihood of contaminants released at the surface and consequence of contamination within the delineated source protection zones (SPZs). SPZs were originally delineated by T+T in December 2018, with a full description of the delineated extent and method described in Source Protection Zones for Public Supply Bores report.

This previous CRA was scoped based on standard practice at that time and considers most of the high-level contaminant sources within the boundaries of the previously delineated SPZs (SPZ1 and SPZ2). However, the following improvements should be considered for future catchment risks assessments:

- A review of existing raw water quality to determine any correlations with identified hazardous activities and spatial trends.
- Evaluation of potential risks posed by cyanobacteria and protozoa.

- Further detailed investigation of wastewater infrastructure (undertaken in 2019) within proximity of the water supply bores (consideration of age and material of pipes). Diffuse leakage over time can present a potential significant risk to source water supply.
- Consideration for emerging organic contaminants and their potential source within the catchment (i.e. possible effluent discharge from wastewater treatment plants).
- Spatial mapping of natural hazards, such as flood and liquefaction zones which may increase the risk of a pathway to the receptor.
- Future consideration for detailed assessments or targeted monitoring that could form improvement items in the WSP.
- Further discussion on combined risk associated with contaminating activities and possible pathways through semi-qualitative analysis.
- Consider possible combined effect of catchment contaminants within the SPZ3.

4.3 Application of catchment risk assessment findings

Based on the findings of the CRA and the activities identified as medium to very high risk, NCC has implemented or are implementing the following items:

- Establishing a new two bore fields to optimise the use of the aquifer during pumping and to replace ageing bores. The new bore fields will also meet future demand. BECA consultants have produced a draft report in August 2022 outlining feasible options, work in progress to finalise.
- Increased microbiological testing at C1, A1, T5, T6 and T7 from fortnightly to weekly.
- Addition of PFAS/PFOA testing at T2 and C1 on a quarterly basis.
- Addition of 1080 testing at T6 on a 6-monthly basis.
- Extended total organic carbon and nitrate testing to all bores monthly.

4.4 Source risk management

4.4.1 Hazard identification

The following hazards have been identified from the CRA work and generally relate to those activities that pose a medium to very high risk to the bore fields. The assessment of risk using the risk matrix approach presented in the CRA assumes that contaminant pathways are complete. This often results in conservative assessments of risk.

The hydrogeological conditions of the source aquifer naturally provide greater protection by virtue of a confining aquitard and upward hydraulic gradients. These two naturally occurring features of the source aquifer reduce the likelihood of a complete contaminant pathway, which in turn reduces the risk to the source catchment.

Nonetheless, the following potential activities within the source catchments have been identified from the CRA report.

- The Taradale Fire Station located near to T2 and is considered to pose a very high potential PFAS/PFOA contamination risk to the bore given the up-gradient location and highly mobile nature of the contaminants:
  - Recommendation: The fire station poses a potential risk to the source water quality and should be monitored appropriately. This potential source of contamination is scheduled to be investigated further to assess the current PFAS/PFOA concentrations within the aquifer. A shallow bore MP17 (Northing 812763.93, Easting 415177.43; Bledisloe Park entrance, well depth of 11.82m) has been identified as appropriate location for PFAS sampling of shallow groundwater, with regular sampling to commence end of 2022.
- Livestock grazing adjacent to T5 is considered to present a medium microbial contamination risk because at the time livestock could access within 5 m of the bore. However, this potential risk has since been mitigated by the erection of a stock exclusion fence to > 5 m from the bore head.

Wastewater infrastructure is considered to represent a medium microbial contamination risk to T5, T6, T7, C1 and A1 because of the proximity to the bores. Wastewater pipes passing by T5 and T7 bores have been relined in 2018. The risk of wastewater pipes presence passing next to T6 is on the WSP IP OP88 to be assessed and appropriate actions taken to mitigate any potential adverse effects to water source. C1 and A1 bores will be put offline (and only to be used in emergency situations) once A2 and A3 are brought online to supply.

- An open drainage channel is considered to represent very high potential for microbial contamination risk to C1 because of the proximity to the bore. However, the risk is being mitigated by chlorine disinfection of the supply. C1 bore will be put offline once A2 and A3 are brought online to supply.
- The Onekawa Park closed landfill represents a medium potential for chemical contamination risk to Coverdale bore C1, largely associated with the potential for mobile chemical contaminants to reach the bore. C1 bore will be put offline once A2 and A3 are brought online to supply.

NCC currently mitigates some of the contaminating activities through chlorination at all bores.

4.4.2 Risk management

4.4.2.1 Awatoto

The Wastewater Treatment Plant (WWTP) was identified in the CRA as posing a low risk to source water quality.

Contingency against potential impacts of a spill at the WWTP is managed by water quality monitoring at the Awatoto bore with bi-monthly laboratory testing for Ammoniacal-nitrogen, in addition to weekly on-site testing of total coliforms and *E. coli.*

Currently there is a retention pond project underway at the WWTP to mitigate against overflow during peak flow events.

4.4.2.2 Coverdale

Source risks to the C1 bore include a range of potential contaminants such as organics, inorganics, metals, microbiological and PFAS/PFOA.

Source risk is currently managed through protection of the well head and chamber, annual compliance monitoring at the bore, monthly nitrate-N and TOC monitoring and PFAS monitoring every six months. C1 is also shutdown as a precautionary measure after heavy rainfall because of the elevated risk of contamination from potential sewage overflows into the open drainage channel close to the bore. C1 bore will be put offline once A2 and A3 are brought online to supply.

4.4.2.3 Taradale

The Taradale Fire Station was identified in the 2019 CRA as posing a very high potential risk to source water quality from PFAS/PFOA, particularly to T2 given the up-gradient location and proximity. Source risk to T2 is currently managed through raw water quality monitoring for PFAS on a six-monthly basis. This conservative consideration of risk should be re-assessed in later versions of this SWRMP after sufficient monitoring data has been collected.

Two expired discharge consents for pest control (1080 washdown) are associated with the HBRC works depot close to T6. Annual monitoring for 1080 in the raw water is undertaken at T6, for precautionary purposes.

Livestock grazing and the wastewater network pose a risk to the source water for T5, T6 and T7. Annual compliance monitoring at the bores, and weekly testing for total coliforms and *E.coli.* at T5, T6 and T7 is undertaken for source risk monitoring and management. Fortnightly monitoring is undertaken at T2 and T3. In addition, wastewater mains close to T5 and T7 were lined, and pressure tested in 2018 to provide confirmation of the integrity of the mains.

Future source risk management should consider the need to investigate the presence of PFAS/PFOA in the shallow groundwater down gradient of the fire station. If found, an appropriate management strategy should be developed, which may include installation of a sentinel well located between T2 and the fire station. This action is recorded within WSP Improvement Plan action OP85 to consider on the next SWRMP revision.

4.5 Abstraction infrastructure management

4.5.1 Bore security investigation

A bore security investigation was prompted when the Central North Island Drinking Water Assessment Unit (DWA) removed NCC's secure bore status in 2017. Criterion 2 of the DWSNZ 2005 (revised 2008) had to be reconfirmed before the secure status could be reinstated.

The bore security investigation was undertaken by GHD[13] and comprised a review of the well head security status for Taradale T2, T3, T6, T7 and Coverdale C1. These were assessed against Criterion 2 of the DWSNZ. GHD also assessed compliance with Criterion 1, for which the bore water must not be directly affected by surface or climatic influences. The report indicated a further application for interim secure status for T5 and A1 was expected in July/August 2018 once some remedial works had been completed.

GHD referred to the GNS groundwater residence time assessment[14] for consideration of compliance with Criterion 1. The GNS assessment indicated that all ten wells at the time were modelled to have less than 0.005% under one year old. They were inferred to satisfy the residence time criterion of the DWSNZ.

GHD confirmed that bore head protection works had been undertaken within the year prior to their assessment against Criterion 2. From their field inspections of the bore head works, GHD concluded that the selected bores (T2, T3, T6, T7 and C1) demonstrated compliance and interim secure status could be granted by the DWA.

Other tasks undertaken by GHD are described in the following sub-sections along with details of work undertaken since.

Since the bore security investigation report was published, all bores, including A1 and T5 have achieved secure status under the DWSNZ 2005. However, Bore Security Status is no longer recognised under the WSA 2021 nor Taumata Arowai legislative documents (such as Drinking Water Quality Assurance Rules).

4.5.2 Bore head sanitary inspections

No further bore head inspections have been undertaken following the work that was completed by GHD in 2018.

4.5.3 Bore casing integrity testing

GHD commissioned bore casing inspections by CCTV and casing pressure tests as part of their bore security investigation in 2018. The testing included A1, T2, T3, T5, T6, T7 and C1. GHD reported that all casing pressure tests were successful except for the pressure test undertaken at C1. The following were reported in relation to C1:

- There was no sign of casing imperfection.
- There was some sign of corrosion, which could have caused a loss of pressure.
- The extremely high artesian pressure (more than 3.6 m above ground) prevents ingress of surface water.
- The corrosion was observed at 26 m depth, within the thick clay aquitard layer.
- The clay aquitard provides a good seal against the casing stopping the potential for vertical leakage on the outside of the casing.

No further bore casing integrity testing has been undertaken since 2018. However, it is planned (improvement action OP89 in WSP) that testing will be undertaken on a regular cycle, with a frequency in the order of 5 years, but with consideration being given to the age of the bores when establishing appropriate frequency.

4.5.4 Ongoing maintenance and management

The GHD 2018 report provided recommendations to provide assurance of continuing bore security. These are summarised as follows because they are relevant to consider in this SWRMP:

[13] GHD, June 2018. Assessment of Bore Security (D#940977)
[14] GNS, March 2018. Groundwater Residence Time Assessment of Napier Water Supply Wells (D#940980)

- Regular testing of water age for each of the bores.
  - Taradale T5 and T6 are tested on a two-year cycle, next sampling event by GNS to be undertaken in spring 2022. This is because of the presence of young water in the water from these bores.
  - Remaining bores to be tested every five years.
- Regular testing of the casing integrity:
  - For bore T3 casing pressure testing should occur every five years because of screen and bore construction inefficiencies.
  - For bores where artesian pressures persist, the casing integrity can be monitored weekly using NCC's telemetry system that reads the existing casing pressure gauges (WSP IP action OP90). A drop in pressure may indicate the integrity of the casing has been compromised. T3, T5 and T7 have interlocks installed to shut down the plant should the hydraulic head fall below the conductor casing depth when the bore pump is running.
- Waterproof seals on the penetrations through the top of flanges.
  - For bore T3 these should be pressure tested each time work is carried out on the headworks and as a minimum every five years.
  - For the remaining bores, a pressure test shall be undertaken each time the pump is removed or following a pressure anomaly in the telemetry system (this outstanding requirement added to WSP IP OP12).
- Visual inspection of bore head.
  - Initiated for all dry chamber bores each time a high dry chamber water level is triggered.
  - Routine inspections are being undertaken monthly.

In addition to the above recommendations, a bore lifecycle plan or management plan should be prepared and attached in a later version of this SWRMP.

4.5.5 Aquifer pressure management and monitoring

Aquifer pressures are currently monitored at each of the supply bores through a telemetry system. The management and monitoring protocols are summarised as follows:

- Preparation of the SWRMP has also identified the possibility of adopting readily available information about groundwater levels in the deep confined aquifer through the HBRC open access portal[15]. The following three HBRC monitoring bores are closest to the Taradale and Awatoto bore fields and could be considered as a future means to monitor aquifer pressures. The open data portal contains five years of historical groundwater level monitoring data:
  - Well 222: Awatoto, 59 m deep and located along State Highway 51.
  - Well 1417: Awatoto, 53 m deep and located along Jessep Road.
  - Well 9068: Taradale, 44 m deep and located along state highway 50.

4.6 NCC raw water quality monitoring programme

NCC currently undertakes a broad water supply monitoring programme that consists of the following:

- Bores and treatment plants.
- Reticulation (distribution pipes).
- Reticulation (reservoirs).
- Reticulation (Dechlorinated Water Stations, Water Take Site)

[15] https://hbrcopendata-hbrc.opendata.arcgis.com/search?tags=OpenData_Environmental

This SWRMP presents the raw water supply monitoring associated with the supply bores only. Since June 2020, the monitoring programme has been updated regularly, with changes or modifications made only by approved NCC staff, which includes:

- The Drinking Water Quality Lead.
- The Manager Water Strategy.

Change to the monitoring programme before August 2022 was managed through a spreadsheet document (D#940031, *Napier (NAP001) – Monitoring Programme*) using the following process:

- A new tab was created in the spreadsheet, which was dated to reflect the monitoring requirements to be adopted from then on.
- An e-mail was sent to Water Testing Hawkes Bay (WTHB - Technical Manager, Sampling Lead) to them of the changes to the monitoring programme.
- An e-mail from WTHB was required to confirm receipt of change to the monitoring programme.

Starting 1 August 2022 NCC completely took over the responsibility for all sampling scheduling and the schedule is now managed by NCC using Lutra's Infrastructure Data (ID). Consultants from Waugh Infrastructure Management assisted with setting up and verification of schedules created in ID. Although the schedule is now fully set up in ID and provides input to laboratory's management system, a spreadsheet is still used as a masterplan (D#1464108, *Napier DW Sampling Master Schedule*) and is the basis for any changes to be made to ID schedules.

The monitoring programme that is undertaken for all online bores utilising grab samples is set out in Napier DW Sampling Master Schedule. NCC has a capital project underway to install online monitoring equipment at all bore sites to continuously measure below parameters:

- Turbidity (source water)
- Conductivity (source water)
- pH (source water)
- Temperature (source water)
- Free Available Chlorine (water leaving the treatment plants)

Data from online instruments will be pulled into the ID, monitored and trended.

4.7 Raw water quality monitoring results

NCC has provided raw water quality for source water from each bore from 2018 to 2021. The data provide results from sampling undertaken on daily, sub-weekly, and weekly frequencies (as described in Section 4.6). Physical and microbiological parameters monitored include temperature, pH, electrical conductivity, total dissolved solids (TDS), turbidity, total coliforms, and *E.coli*. In addition, a larger suite of determinands is monitored and managed for DWSNZ compliance based on monthly testing since early 2019. More sporadic testing of the larger suite of determinands has been undertaken annually since 2014.

The following sub-sections provide a high-level review of the raw water quality recorded at each of the bore fields.

4.7.1 Awatoto

The following raw water quality data is available from Awatoto bore A1:

- Historical annual raw water quality results from 2014, 2016, 2018-2021 for a full suite of determinands.
- Since 2019, pH, turbidity, electrical conductivity, dissolved and total iron, dissolved and total manganese, ammoniacal-N, and total organic carbon have been tested monthly/bi-monthly.
- From January 2018, total coliform, and *E. coli* have been tested weekly.
- From January 2018, temperature, pH, turbidity, and conductivity have been tested daily.

The data indicate the Awatoto bore A1 has had no *E. coli* detected above the DWSNZ maximum acceptable value (MAV). At times, other contaminants including total coliforms, total iron and turbidity have been detected above their respective guideline values, but these have generally coincided with shutdown periods.

4.7.2 Coverdale

The following raw water quality data is available from Coverdale bore C1:

- Historical annual raw water quality results from 2014, 2016, 2018-2021 for a full suite of determinands.
- Since 2019, nitrate-N and total organic carbon have been tested monthly/bi-monthly.
- From January 2018, total coliform, and *E. coli* have been tested weekly.
- From January 2018, temperature, pH, turbidity, and conductivity have been tested daily.

The data indicate, the Coverdale bore C1 has had no *E. coli* detected above the MAV. Total coliform has been historically detected on two occurrences between November 2017 and June 2021. There is no observed significant trend with the turbidity results. No other parameters exceeded the DWSNZ MAV.

4.7.3 Taradale

The following raw water quality data is available from bores T1, T2, T3, T4, T5, T6, and T7:

- Historical annual raw water quality results from 2014, 2016, 2018-2021 for a full suite of determinands.
- Sub-annual testing at some bores for dissolved iron and manganese, total ammoniacal-N, nitrate-N, and total organic carbon.
- From January 2018, total coliform/*E.coli* have been tested weekly.
- From January 2018, temperature, pH, turbidity, and conductivity have been tested daily.

Based on the readily available data, bores T1 and T7 have historically detected *E. coli* in the raw water. Figure 4.1 illustrates the number of detectable concentrations of *E. coli* and total coliform per month since January 2018. Total coliforms have been historically detected on seventy-four occasions between November 2017 and June 2021 at bores T1, T2, T4, T5, T6, and T7. There have been no historical detections of *E. coli* in the raw water at T3, therefore the data have not been included in the summary charts.

In April 2018 following a period where bore T7 was offline due to maintenance, T7 was forced offline for almost three weeks following several *E.coli* detects (1 - 8.7 cfu/100 ml) above MAV (> 1 cfu /100 ml). In June 2018, bore T6 had several elevated detects of total coliform (> 200 cfu/100ml) during a period of maintenance. Elevated levels of turbidity were noted on most days which also had total coliforms or *E.coli* detects.

Based on the results from the NCC raw water quality there are no additional historical exceedances.

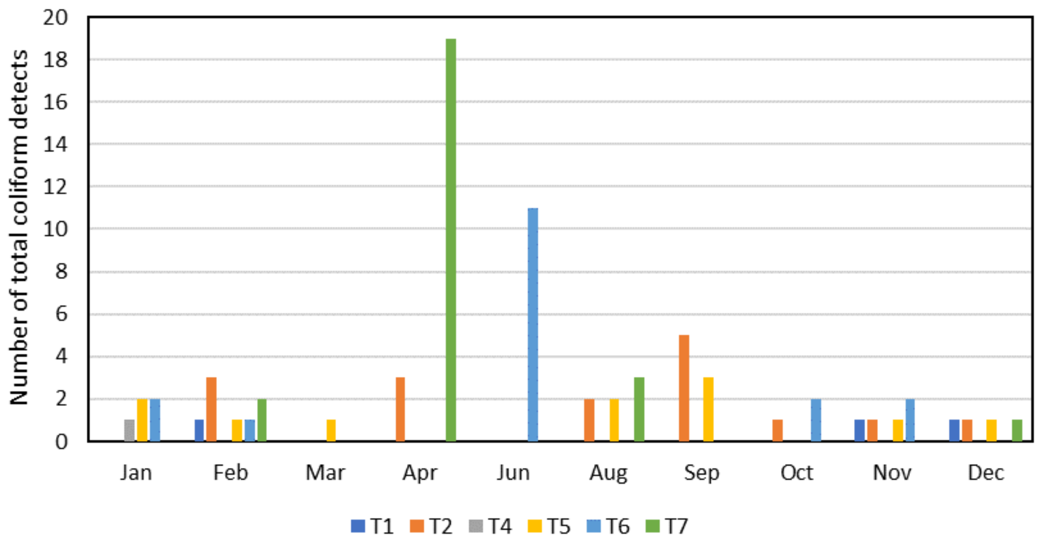

Figure 4.1: Number of total coliform detects from all Taradale bores since 1/11/2017. Bore T3 had no recorded total coliform detects.

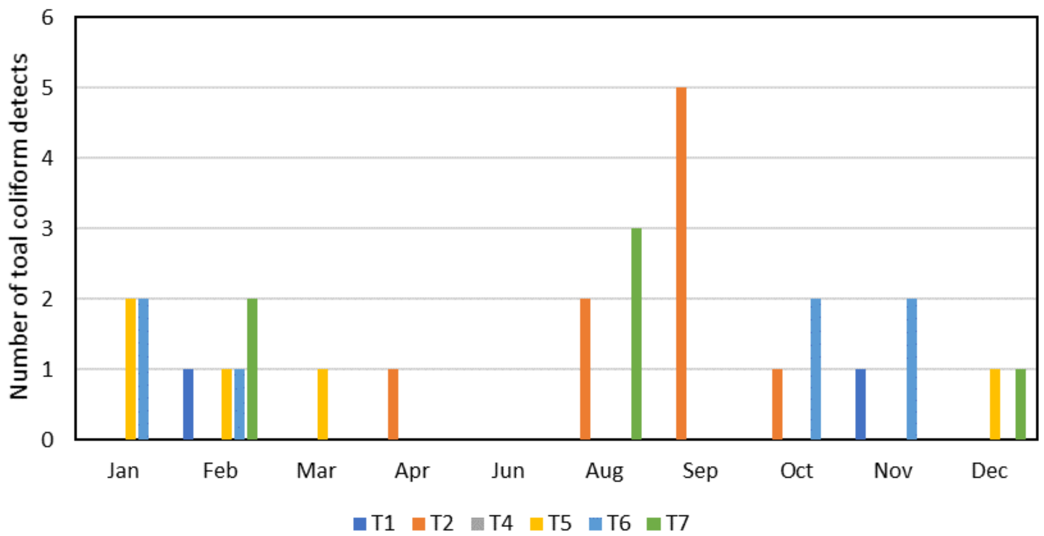

Figure 4.2: Number of total coliform detects from all Taradale bores while active since 1/11/2017. Bore T3 had no recorded total coliform detects.

4.7.4 Summary of raw water quality

Based on the readily available data, raw water quality from the supply bores appears to supply good quality groundwater. This conclusion is supported by various factors such as:

- Previous aquifer vulnerability mapping[7] which indicated the aquifer is at relatively low risk from vertical percolation of contaminants from the surface.
- Artesian conditions observed at all bore fields, which indicate an upward hydraulic gradient between the confined aquifer and the unconfined aquifer.
- Aquifer age dating/chemical analysis which suggests sufficiently long mean residence times of groundwater.

When parameters such as total coliforms and total iron have been recorded above drinking water standards, this has generally coincided with bore shutdown periods and an increase in within the bore casing.

Changes to the current data capture and storage to further enable subsequent analyses of the water quality data are being currently addressed. On 1 August 2022 all samples scheduling is set up within ID and all laboratory results are pushed back to ID. Creation of dashboards, batch reports and forms in ID is work in progress as well is data transfer of at least 2.5 years of Water Testing Hawkes Bay's water testing results.

4.8 Review process for HBRC resource consents

NCC and HBRC have an established relationship and have an informal arrangement that provides NCC with the opportunity to review resource consent applications (i.e., discharge consents or new bores) submitted to HBRC that are in the SPZs. The following process is currently followed:

- HBRC e-mails NCC with a regular weekly summary of resource consent applications received in a spreadsheet format.
- HBRC e-mails NCC, on a case-by-case basis, the details of resource consents that are situated within the SPZs.
- NCC reviews the resource consent applications and provides HBRC with comments and queries for consideration or action.

5 Ongoing monitoring and management

5.1 Overview

The purpose the SWRMP is to establish a coordinated approach to the ongoing monitoring and management of the source aquifer for the Napier water supply. It draws on existing approaches and information described in preceding sections to develop the ongoing measures to protect the source aquifer.

5.2 Bore fields

Bore field management and monitoring is an important aspect of source risk management. Monitoring at the bores will provide information about groundwater level changes, which will provide information about the direction of flow of groundwater, downwards or upwards (i.e. aquifer pressure). If the bores are allowed to degrade sufficiently, they can provide a pathway for shallower groundwater to enter the bore and hence to enter the water supply.

5.2.1 Vertical groundwater flow controls

Groundwater across the Napier bore fields is generally under artesian pressure. This means that the groundwater in the source aquifer wants to flow upward through the overlying aquitard. This upward flow reduces the ability of contaminants to travel downward into the aquifer. Maintaining the upward flow is an important part of source protection and that is why it requires management and monitoring.

These upward flows are currently monitored as groundwater pressure in each of the operational production bores. A telemetry system is in place that relays data to the Council office and is alarmed to alert the relevant operators. Table 5.1 details the control levels for each of the operational bores as required by this SWRMP.

Table 5.1: Control level for groundwater pressures

Bore ID	Control level	Vulnerability to drawdown related contamination risk
A1	Conductor casing at 12 mbgl (estimate)	Artesian pressure.
A2	Conductor casing at 12 mbgl (estimate)	Artesian pressure.
A3	Conductor casing at 12.0 mbgl	Artesian pressure.
C1	Conductor casing at 12.1 mbgl	Artesian pressure.
T2	Conductor casing at 15 mbgl	Artesian pressure.
T3	If well pressure falls below 11 mbgl then the bore shuts down. An interlock device requires on-site inspection and re-start.	Artesian pressure (on occasion, the artesian pressure reduces and is closer to the ground surface). Unlikely to drawdown to control level.
T5	Casing at 11.3 mbgl Control level 6 mbgl If well pressure falls below 11 mbgl then the bore shuts down. An interlock device requires on-site inspection and re-start.	Artesian pressure. Unlikely to drawdown to control level, but has occurred in the past. 1986 pumping test at 82 L/s resulted in approximately 3.5 m drawdown.
T6	Conductor casing at 12.1 mbgl	Artesian pressure.

Bore ID	Control level	Vulnerability to drawdown related contamination risk
T7	Casing at 28.8 mbgl Control level 11 mbgl If well pressure falls below 11 mbgl then the bore shuts down. An interlock device requires on-site inspection and re-start.	Artesian pressure. Unlikely to drawdown to control level, but has occurred in the past. 2001 pumping test at 130 L/s resulted in approximately 4 m drawdown.

5.2.2 Management

NCC does not operate a formal system for the management of the bore fields. Bore lifecycle plans for each of the new and existing bores will be developed to ensure the bores undergo regular maintenance and monitoring. The plans will be prepared for future versions of this SWRMP and attached as an appendix to this plan or as part of the overarching asset management plan. As a minimum, the bore lifecycle plan should include, but not be limited to:

- Bore description including date of installation and construction details.
- Pressure/integrity testing schedule to check for potential casing defects.
- Downhole camera inspections to check for potential casing defects.
- Replacement/repair costs.

5.3 Source water quality monitoring

5.3.1 General

Source water quality monitoring could be used to provide early detection of potential changes in the source water chemistry across the bore field. Potential monitoring bores comprise a combination of HBRC SOE wells and privately owned wells (yet to be identified – included in WSP IP OP85) and have been selected based on their location and depth.

The proposed monitoring bores (some negotiation may be required for private bores) are located within the current source water catchments, either:

- Close to known potential sources of contamination set out in the CRA.
- Spread to provide general coverage to identify more diffuse changes to groundwater chemistry from land use activities.

Depth of wells is important because they need to provide chemistry information for the deep source aquifer. Chemistry information from the shallow groundwater is also important because this body of water is subject to surface influence and helps with early detection and potential future effects on the deep source aquifer.

The deep source aquifer is protected by the low permeability aquitard that underlies the bore field and the upward artesian flow of groundwater as described above.

Although there are very high-risk activities situated within the catchments for the bore fields, as listed below, specific sentinel bores to target potential high-risk sources of contamination are not considered necessary:

- The Taradale Fire Station was assessed as posing a very high risk to the Taradale T2 bore as a potential source of PFOS/PFOA. T2 will be decommissioned when the new bores are installed and operating. For this reason, no sentinel bores are required. Existing monitoring for PFOS/PFOA at T2 is sufficient to manage the risk until decommissioning.
- The open drainage channel close to C1 was originally assessed as posing a very high risk for microbial contamination. This risk rating has been reassessed by T+T as presenting a medium risk[16]. Given the

[16] The original risk rating considered a ‘significant’ consequence and an ‘almost certain’ likelihood. The ‘almost certain’ likelihood assumed that the confining layer and integrity of the bore that are protecting the source can become compromised in the future. Current raw water quality monitoring data suggest that these have not been compromised and ‘moderate’ or ‘unlikely’ likelihood is more appropriate.

proximity of the channel to C1, a sentinel bore is not required, instead the ongoing monitoring of the raw water at C1, in compliance with the DWSNZ (until replaced by the new rules from Taumata Arowai), is considered sufficient to manage the risk.

5.3.2 Source water monitoring bores

The register of source water quality monitoring bores along with the sample schedule is set out in Table 5.2. This register will be updated in the future if, for example, suitable monitoring bores become available or new bores are added to the existing bore field.

Several monitoring bores selected are used by HBRC for SOE reporting and have long term time series data that can be used for trend analysis. These data and analysis have recently been published as part of a nationwide database created by LAWA[17].

Table 5.2: Register of source water quality monitoring bores

Bore ID	Depth (m)	Screened interval (m)	Address (Coordinates)	Sample frequency	Sample parameters
611	39	-	Guppy Road Depot, Taradale (1931424E, 5615293N)	Quarterly HBRC	Appendix A
3781	38	-	131 York Ave, Anderson Park, Greenmeadows (1932019E 5618065N)	Quarterly HBRC	Appendix A
Private bores	To be confirmed				

5.4 Source catchment inspections/observations

5.4.1 Source catchment - bore head surrounds

The immediate area within 100 m of the bore heads shall be inspected on a quarterly basis for the following purposes. The objective of the inspections/observations is to help inform any changes to this SWRMP:

- To record and report on any significant changes in land use in the surrounding area.
- To observe existing activities of concern, for example the open drainage channel close to C1.

Bore head inspections are undertaken and required as part of the water safety plan and so are not included here.

5.4.2 Source catchment – wider surrounds

The source catchments for the bore fields have been defined in the source protection zone report[18]. SPZ1 is based on the immediate surrounds of each bore (5 m set back), SPZ2 is a microbial protection zone and is based on a one-year travel time, and SPZ3 is based on a ten-year travel time. The source catchment shall be inspected annually to observe high risk activities identified in the CRA as well as the more moderate risk activities also identified in the CRA (recorded as an improvement action OP87 in WSP IP).

[17] https://www.lawa.org.nz/explore-data/hawkes-bay-region/groundwater-quality/heretaunga-aquifer-system

[18] T+T, December 2018. Source Protection Zones for Public Supply Bores (D#940928)

In addition, land use change activities identified throughout the year as well as other activities identified through communications with HBRC (i.e. discharge consents) shall also be included in the inspections/observations.

This SWRMP shall be updated with additional management, monitoring or mitigation as required.

6 Risk communication plan

This risk communication plan is critical to guide how decisions are made to determine how information is transferred between NCC and HBRC and other stakeholders. It is also important to identify stakeholder engagement methods and tools that are appropriate and applicable for targeted stakeholders and site-specific characteristics.

The objective is to ensure there is two-way communication between NCC and HBRC (and other stakeholders, i.e. public views) so that the SWRMP is kept up to date so that new potential contamination sources can be identified and evolving knowledge about the source catchment can be readily captured and shared.

The risk communication plan is set out in Table 6.1.

Table 6.1: Risk communication plan

Reason for communication	Communications activity	Communication method	Audience	Frequency of communication	Owner	Comments
Exceedance of MAVs at source catchment monitoring location	NCC or HBRC	E-mail Future dashboard	NCC HBRC	Within 24 hours of receiving laboratory results	NCC	-
In bore water level falling below the control level	NCC	Internal e-mail Telemetered dashboard	NCC HBRC	Immediately following alert	NCC	-
To collect SOE monitoring data throughout the year rather than on the annual cycle	SOE monitoring results for wells: 611 3781	e-mail Excel	NCC HBRC	Monthly	HBRC	-
To receive timely inputs into proposed discharge consents within the defined SPZs	Discharge consents	E-mail	NCC HBRC	Within one week of receiving an application for discharge consents	HBRC	-

Appendix A: List of determinands

State of environment groundwater quality monitoring parameters	
pH [/]	Chloride [mg/L]
E. coli	Total Ammoniacal-N [mg/L]
Total Alkalinity [mg/L as $CaCO_3$]	Nitrite-N [mg/L]
Total Hardness [mg/L as $CaCO_3$]	Nitrate-N [mg/L]
Calcium Hardness [mg/L as $CaCO_3$]	Dissolved Reactive Phosphorus [mg/L]
Magnesium Hardness [mg/L as $CaCO_3$]	Reactive Silica [mg/L as SiO_2]
Electrical Conductivity [µS/cm]	Sulphate [mg/L]
Total Dissolved Solids [mg/L]	
Dissolved Iron [mg/L]	
Dissolved Manganese [mg/L]	
Dissolved Potassium [mg/L]	
Dissolved Sodium [mg/L]	