Mahaanui Kurataiao Ltd

Ōtākaro Cultural Monitoring Report

June 2024

Executive Summary

This report details cultural monitoring undertaken to assess mana whenua values in the Ōtākaro catchment as required under the conditions of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC231955) held by Christchurch City Council (CCC).

Mahaanui Kurataiao Ltd undertook cultural monitoring over four days between 29 February and 8 March 2024 at thirteen sites within the Ōtākaro catchment using the State of Takiwā and Cultural Health Assessment methods.

Overall, this monitoring indicated that cultural health values throughout the catchment varied from poor to moderate. The Attribute Target Level for Mana Whenua Values of 5 (i.e., very good) was not met by the 2024 survey results.

A previous State of Takiwā monitoring was undertaken by mana whenua in 2012.

The results of the 2024 survey showed a slight improvement in the overall health scores recorded in comparison to the 2012 survey, but this improvement is not significant. High *E. coli* levels (i.e. above the recreational use limit of 550 MPN/100 mL in the Canterbury Land and Water Plan) were detected at four of the seven sites where water quality samples were taken.

Many of the concerns outlined in previous State of Takiwā reports were also noted in the 2024 survey including; a lack of indigenous riparian planting and/or indigenous vegetation in general, concerns around direct untreated stormwater discharges from residential houses, and unsafe mahinga kai practice/harvest.

Throughout the 2024 State of Takiwā survey it was noted by monitors that although many sites had sufficient access for mahinga kai, they themselves would not harvest any mahinga kai due to the lack of abundance and quality of the water/stream bed. Recommendations have been made in this report based on the results of the 2024 survey.

Acknowledgements

Mahaanui Kurataiao Ltd would like to thank the project Cultural Monitors, Cherie Williams and Frankie Williams.

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1 Introduction

This report details monitoring undertaken to assess mana whenua values in the Ōtākaro catchment as required under the conditions of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC231955) held by Christchurch City Council (CCC).

Mahaanui Kurataiao Ltd undertook cultural monitoring in February/March of 2024 at thirteen sites within the Ōtākaro catchment. Five of these sites were subject to previous monitoring and are listed in the CCC Environmental Monitoring Programme for the CSNDC. Eight of the monitoring sites were requested by the Kaitiaki of Te Ngāi Tūāhuriri Rūnanga.

1.1 Monitoring sites

Under the CSNDC, catchments are monitored on a five-yearly rotation to assess the efficacy of actions undertaken to mitigate the impact of stormwater discharges on the receiving environment. Mahaanui Kurataiao Ltd undertook cultural monitoring at thirteen sites within the Ōtākaro catchment (Table 1). The monitored site locations are shown in Figure 1. Five of these sites (Sites 7, 8, 9, 11, and 12) have been previously monitored and are listed in the CCC Environmental Monitoring Programme for the CSNDC. As such, monitoring of these sites were required as part of compliance with the conditions of the consent (particularly the Environmental Monitoring Programme or EMP). Eight of the remaining sites were requested by the Kaitiaki of Te Ngāi Tūāhuriri Rūnanga during consultation prior to monitoring. A short summary of the significance of each site to Te Ngāi Tūāhuriri Rūnanga is included in Table 1. The monitoring and results presented in this report are a snapshot of the cultural and water quality health of the river at the time of recording. Many of the monitored aspects require further and/or continuous monitoring to determine trends in the data.

Table 1. Monitoring sites for the Ōtākaro catchment in 2024.

Site No.	Site Name/Water Body	Location	Significance	Land Use	Coordinates (NZTM X, Y)	CCC EMP monitoring site code
1	Avonhead / Waimairi Tributary	Russley Road	Western most source of the Ōtākaro and Waimairi Tributary.	Industrial	1562841, 5183149	None
2	Waimairi Stream	Burnside Park	Source of West Burn Tributary flowing into Waimairi and significant recreational area – rugby, soccer and cricket.	Urban / Park	1564642, 5182934	None
3	Dudley Creek	Dudley Creek	Source of Dudley Creek, northern most tributary of the Ōtākaro.	Urban	1566933, 5184256	None
4	Wairārapa Stream	Jellie Park	Near source of Hewlings Stream and Wairārapa Stream, including spring fed lake and significant recreational area within urban park – public pool, skatepark.	Urban / Park	1566333, 5182660	None
5	Waimairi Stream	Royds Reserve	Mid-catchment reference (ease of access).	Urban	1567963, 5181231	None
6	Ilam Stream	Athol Terrace	Source of Ilam Stream tributary.	Urban	1565374, 5180865	None
7	Ilam Stream	Pūtarikamotu /Deans Bush	Traditional settlement and food gathering site, remaining native forest remnant, protected reserve.	Urban / Reserve	1567428, 5180681	AVON24
8	Ōtākaro	Waipapa / Little Hagley Park	Traditional settlement and food gathering site, upper most main channel site.	Urban / Park	1571109, 5180591	AVON20
9	Ōtākaro	Ōtautahi	Traditional settlement and food gathering site.	Urban	1571063, 5180582	AVON16
10	Kerrs Reach	Kerrs Reach	Contemporary recreational site – rowing/waka ama and complimentary sample site.	Urban / Park	1574217, 5181669	None
11	Te Oranga	Te Oranga / Horseshoe Lake	Traditional settlement and food gathering site, significant urban drainage sink and native/natural wetland/spring remnant.	Urban / Park / Reserve	1574035, 5183994	AVON15

12	Ōruapaeroa	Ōruapaeroa / Travis Wetland	Traditional settlement and food gathering site, significant urban/rural drainage sink and native/natural wetland remnant.	Urban and Rural / Reserve	1575535, 5185269	AVON14
13	Ōtākaro	Owles Terrace	Contemporary recreational area – waka ama, former public works site and lower most Avon river site.	Urban / Park	1577863, 5182323	None

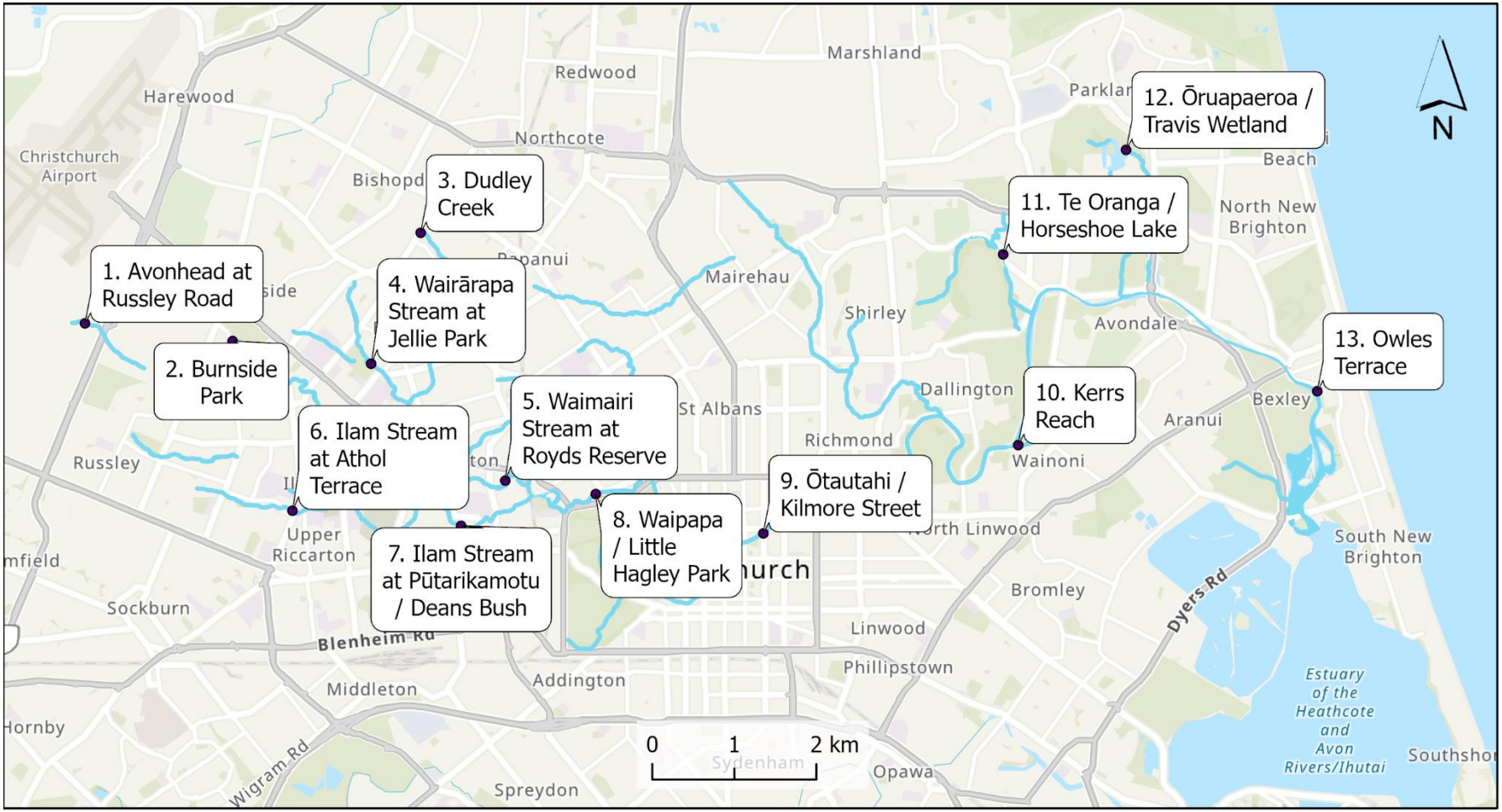

Figure 1. Monitoring site map.

1.2 Methodology

The survey in 2024 utilised the State of Takiwā and Cultural Health Assessment to undertake the monitoring of mana whenua values within the catchment. These methods incorporate vegetation, bird and fish surveys, and water quality methods from the NIWA Stream Health and Macroinvertebrate Assessment Kit or SHMAK (Biggs, Kilroy, & Mulcock, 1998). Water quality parameters were recorded using a Hanna multiparameter probe and water samples from suitable sites were sent to Hills Laboratory for analysis. The following sections provide a summary overview of these methods.

1.2.1 State of Takiwā

State of Takiwā (SOT) is an established tool used as part of other waterway monitoring in Canterbury and was developed by Te Rūnanga o Ngāi Tahu as part of their Ki Uta Ki Tai - Mountains to the Sea Natural Resource Management framework (Pauling, 2004) and outlined in the tribal vision, Ngāi Tahu 2025 (Te Rūnanga o Ngāi Tahu, 2003). SOT combines mātauranga māori and western science practices to give a holistic view of catchment health by assessing a range of waterway health indicators. This method involves acquiring information based on the following forms: site definition, site visit, site assessment, cultural stream assessment, and SHMAK. The programme is designed to facilitate tangata whenua to record information, assess the data and produce reports that reflect the environmental and cultural health of relevant natural resources. The SOT also uses a standard data form, which is completed based on shared background information or research and in-field observation.

The site visit form includes meteorological data, identified site pressures and archaeological observations, as well as any recent land disturbances. This helps contextualise the information gathered on the day of monitoring and can help identify trends (e.g., seasonal patterns, wet weather events, maramataka/lunar cycles). The main part of the SOT assessment is the site assessment forms, which identifies and scores site pressures, the degree of modification, the suitability and access restrictions for mahinga kai practices.

The final components of the SOT assessment are based on the SHMAK method to allow iwi, landowners, and community groups to assess stream habitat and stream-bed life. The components for assessing stream habitat include an assessment of habitat quality, composition of stream bed, bank vegetation and deposits. Components for assessing stream-bed life include assessments of invertebrates and periphyton (on exposed surfaces). Velocity was measured using the methodology outlined in the SHMAK manual. Water clarity was

measured using a clarity tube, or where clarity was higher (over the 1 metre length of the clarity tube) a black disc viewer (Biggs, Kilroy, & Mulcock, 1998). Further details on the level of testing that was conducted at each site are outlined in sections below.

1.2.2 Cultural Health Assessment

The Cultural Health Assessment/Index (CHA) for streams and waterways (Tipa & Teirney, 2003) was developed in conjunction with three Ngāi Tahu Rūnanga (Arowhenua, Ōtākou and Moeraki Rūnanga) in the South Island and Ngāti Kahungunu in the North Island. The CHA is made up of three components: site status (traditional significance), mahinga kai values assessment, and cultural stream health. The site status component describes the significance of the site to Māori; whether it is a traditional or contemporary site and the likelihood that mana whenua will return to this site. The mahinga kai values assessment identifies mahinga kai species present at each site and then compares this with historical abundance. Site access is also assessed as it can be a barrier to mana whenua undertaking cultural practices. Lastly, the cultural stream health measure uses a 1-5 score (1 = poor quality/low values to 5 = high quality/values) for eight individual indicators: water quality, water clarity, flow and habitat variety, catchment land use, riparian vegetation cover, riverbed condition or sediment, use of the riparian margin and degree of channel modification. Scores from these eight indicators are combined to provide a cultural stream health measure. The questions used in this 2024 study were provided by Gail Tipa as part of training with Mahaanui Kurataiao Ltd staff in January 2023. The form is filled out individually by each attending mana whenua monitor.

1.2.3 Indigenous vegetation and bird surveys

The qualitative observational survey of indigenous and introduced vegetation involves an in-field identification within a 100-metre radius of each site. The species were noted for each site surveyed. The percentage of indigenous cover was estimated to the nearest 5%. Bird species were identified on day of the in-field recording and were also noted for each site surveyed.

1.2.4 Fish survey

In addition to the data gathered from in-field observations, the method for fish survey involves using trapping methods appropriate to different stream conditions. Electric fishing was not undertaken as part of the 2024 survey. Trapping methods used in the 2024 survey included hīnaki (fyke nets), and gee minnow traps, with both nets and traps left overnight. No traps were baited as part of the 2024 survey. Hīnaki capture larger aquatic species (e.g., tuna/eels),

and gee minnow capture smaller species (e.g., bullies and elvers). Small aquatic species were retrieved from the traps and placed in buckets filled with water from the waterway. They were held for long enough to identify type and count numbers. Tuna were placed in water with a mild sedative (clove oil) to identify species and measure the size. All sedated animals were placed in fresh water until recovered prior to return to the waterway.

1.2.1 Water quality testing

Water quality parameters were recorded using a Hanna multiparameter probe. This can measure fluid pH, oxidation reduction potential (ORP), electrical conductivity, turbidity, dissolved oxygen (DO), and temperature. Water samples were collected from the CCC EMP sites (7, 8, 9, 11, and 12) and sites 4 and 5 by monitors using the testing kits provided by Hill Laboratories Limited. The collected water samples were sent to Hill Labs for analysis of dissolved metals and other common contaminants (listed in Appendix C).

2 Background and traditional associations[1]

Tai ki uta; Ihu tai maroro

From the nose of the tide back to the land;
To where the sea sinks down (on the continental shelf).

Te Ihutai is an area of immense cultural and historical importance to Tangata Whenua within the Christchurch and wider Canterbury area. The estuary not only provided vital access to waterways stretching from Te Waihora (Lake Ellesmere) to the Kowai River, and to the fishing grounds of Te Tai o Maha-a-nui (Pegasus Bay), but was a place of significant settlement and food gathering for Waitaha, Ngāti Mamoe and Ngāi Tahu for over 600 years. The food and resources taken from the estuary were also part of an important trade and social network between hapū and whānau throughout Te Waipounamu (the South Island) (Christchurch City Libraries 2006; Tau, Goodall, Palmer & Tau 1990).

The first settlers of Te Ihutai were Waitaha who lived in two principle kaika (villages) around the estuary, located at Te Raekura (near Redcliffs) and Te Kai a Te Karoro (near Jellicoe Park). This was followed by Ngāti Māmoe who occupied a settlement near the Estuary on Tauhinu Korokio (Mt Pleasant) during the 1500s. About one hundred years after this, Ngāi Tahu, under the chief Turakautahi, established Kaiapoi pā north of the Waimakariri, along with the settlement of Rāpaki in Whakaraupo, Lyttelton Harbour under, Te Rakiwhakaputa. While Ngāi Tahu did not live alongside the estuary itself, people from both Kaiapoi and Rāpaki visited and used the area extensively as a mahinga kai in a similar way to their predecessors (Christchurch City Libraries 2006; Tau et al 1990).

During these times the estuary was known to support tuna (eels), kanakana (lamprey), inaka (whitebait), patiki (flounder) and pipi. Kumara and aruhe (edible fern root) were grown in the sandy soils at the mouth of the Ōtākaro / Avon River. Manuka weirs were built around the mouth of the rivers during the eel migrations and patiki were abundant in the mudflats across the middle of the estuary, an area called Waipatiki (Christchurch City Libraries 2006; Tau et al 1990).

[1] This section was largely taken from the State of Takiwā Te Āhutanga o Te Ihutai report by Pauling et. al. (2007)

While the estuary itself provided an abundance of valuable food resources, equally important was the estuary's catchment, which was made up of an extensive network of springs, waterways, swamps, grasslands and lowland podocarp forests. The extent of this network, much of which was still present at the time of European arrival, was captured on the 1856 'Black Map', as well as numerous written and visual records from this period (Christchurch City Council 2007; CCL 2007).

Both the Ōtākaro (Avon River) and Ōpāwaho (Heathcote River) were highly regarded as mahinga kai by Waitaha, Ngāti Mamoe and Ngāi Tahu, who maintained a number of settlement and mahinga kai sites along these rivers. These included Puari (Inner city/High Court/Victoria Square area), Pūtarikamotu (Deans Bush), Ōtautahi (Kilmore/Barbados St), Te Oranga (Horseshoe Lake) and Ōpāwaho (Opawa) (Tau et al 1990).

The importance of the Ihutai catchment and the mahinga kai it contained was highlighted by the claims of Hakopa Te Ata o Tu, Pita te Hori and others of Ngāi Tūāhuriri to the Native Land Court in 1868. They attempted to have traditionally significant sites put aside as mahinga kai reserves but were unsuccessful. This action effectively shut Ngāi Tahu out of the development of the city and ultimately, the subsequent management of the Ihutai catchment (Tau et al 1990; Tau 2000; Matunga 2000; Pauling 2006).

The taking of the Te Ihutai Māori Reserve in 1956 under the Public Works Act as part of the Christchurch sewage works development and the subsequent discharge of human effluent into the estuary further compounded the situation. So important were the sites and the integrity of the mahinga kai found there, that the owners of the reserve would not accept the money offered as compensation, because they believed that only an area of land having similar characteristics to that which was taken would be adequate recompense (Tau et al 1990).

A number of catchment sites were also recorded as significant sites by Ngāi Tahu elders in information gathered by H.K Taiaroa during the time of the 1879 Smith-Nairn Commission. This information is particularly important as it included lists of the flora and fauna taken as mahinga kai at the specific sites. As Tau (2006, p12) states "these lists are critical because they are the earliest written records from Ngāi Tahu elders that allow us to construct a picture of what the landscape was like". Traditional species recorded from these lists for the Ihutai catchment include:

- **Freshwater Fish:** Tuna (eels), Kanakana (lampreys), Kokopū, Inaka (whitebait), Waikoura (freshwater crayfish), pipiki and hao (eel).
- **Plants:** Aruhe (fernroot), Whinau (hinau), Pōkākā, Matai, Kahikatea, Kōrari (flowering flax stalks), Kāuru (cabbage tree root), Tutu, Kumara.
- **Birds:** Kererū (wood pigeon), Kākā, Kōkō (tui), Koparapara (bellbird), Mohotatai (banded rail), Parera (grey duck), Pūtakitaki (paradise duck), Rāipo (scaup), Pāteke (brown teal), Tataa (spoonbill duck).
- **Other:** Kiore (rat) (Taiaroa 1880).

From the literature review, a list of traditionally significant sites within the Ōtākaro catchment and the types of mahinga kai species traditionally found there are shown in Table 2 below.

Table 2. Traditionally significant sites and mahinga kai species within the Ōtākaro catchment.

Name	Location	Significance	Mahinga Kai	Reference
Ō-Rakipāoa	Upper Riccarton, Fendalton	A settlement and food gathering site.	Tuna, Aruhe, Hīnau, Pōkākā, Kanakana, Korari	Tau 2006 CCL 2007 Tau et al 1990
Motu-iti	Locality in Bryndwyr	A settlement and food production site.	Kāuru, Aruhe, Inaka, Tuna, Kiore	Tau 1994 Taiaroa 1880
Wairārapa	Ilam	A settlement and food production site.	Kāuru, Aruhe, Inaka, Tuna, Kiore	Tau 1994 Taiaroa 1880
Hereora	Locality in Harewood	A settlement and food production site.	Kāuru, Aruhe, Inaka, Tuna, Kiore	Tau 1994 Taiaroa 1880
Pū-tarika-motu	Deans Bush, Riccarton	A settlement and food gathering site.	Tuna, Kanakana, Aruhe, Hīnau, Matai, Pōkākā, Kahikatea, Kererū, Kākā, Kōkō, Koparapara, Mohotatai	Tau 2006 CCL 2007 Tau et al 1990
Puari	On the banks of the Avon River from modern day Carlton Mill Corner, past Victoria Square to the loop in the Avon near Lichfield Street	Waitaha pā with associated urupā. Ngāi Tahu mahinga kai site. Market (Victoria) Square used by Ngāi Tūāhuriri to sell produce grown at Tuahiwi to early settlers.	Tuna, Inaka, Kokopū, Kokopara, Parera, Pūtakitaki	CCL 2007 Taylor 1950
Waipapa	Little Hagley Park (between Harper Avenue and Carlton Mill corner)	A temporary whare site used on journeys between Kaiapoi and Banks Peninsula and during the operation of Market Square.		CCL 2007 Tau et al 1990 Taylor 1950

Ō-Tautahi	Between Barbados and Kilmore Streets	The pā of Te Potiki Tautahi of Koukourarata.	Tuna, Inaka, Kōkopu, Kūmara, Aruhe, Pārera, Rāipo Pūtakitaki, Pāteke, Tataa	Beattie 1945 Tau et al 1990 CCL 2007
Waikākāriki	Horseshoe Lake	The site of a significant settlement called Te Oranga.		Tau et al 1990 CCL 2007

2.1 Archaeological sites

The significance of Ōtākaro to the tūpuna is highlighted by the number of archaeological sites, wāhi tapu and wāhi taonga that are located along and in the vicinity of the waterway. Archaeological sites include ovens and artefacts to the immediate west of the central city, urupā/burials and pā sites within the city centre, and artefacts, midden and urupā/burials along the eastern reaches of the awa. Many of these sites were recorded in the 19th and 20th centuries, especially in the city centre during the modification of the natural landscape into the planned colonial settlement, as well as later mass infrastructure projects. Given the prominence of the area to various iwi (beginning with Waitaha) it is unclear how many other archaeological sites went unreported during this time. Areas such as the Puari Pā Urupā along Cambridge Terrace and Tautahi Pā along Kilmore Street and Oxford Terrace are identified wāhi tapu. Similarly, wāhi taonga sites include Waikākāriki and Travis wetlands. Figure 2 below gives an indication of these patterns based on current records (ArchSite, 2024).

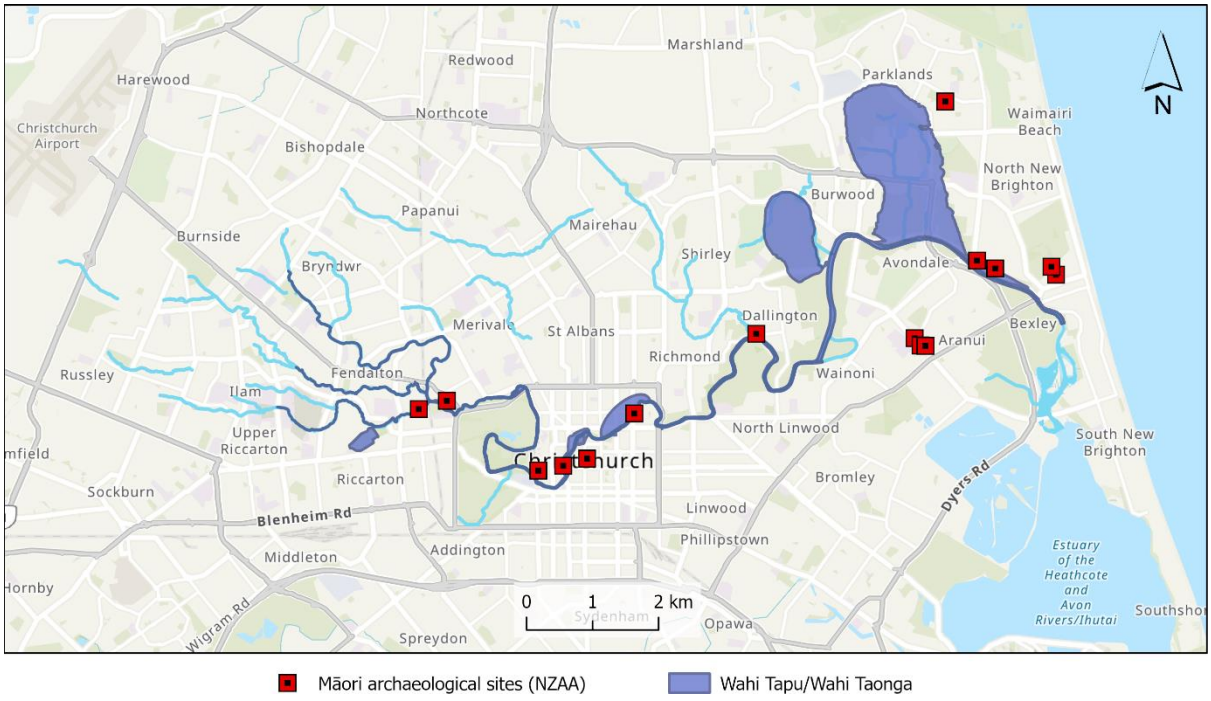

Figure 2. Māori archaeological sites currently recorded within the vicinity of Ōtākaro within the database of archaeological sites (ArchSite 2024). Wāhi tapu and wāhi taonga sites are also shown.

2.2 Environmental background

The Ōtākaro catchment is approximately 8,900 ha in area. The Ōtākaro extends for approximately 26 kilometres from its spring-fed source in Avonhead to its mouth at Te Ihutai.

The Ōtākaro / Avon River originates from several spring-fed streams in the upper catchment, including the Wairārapa, Waimairi and Ōrakipaoa that combine at Mona Vale to create the main stem of the Ōtākaro/Avon River. The main downstream tributaries (St Albans Creek, Dudley Creek, Shirley Stream and Waikākāriki / Horseshoe Lake) contribute to the Ōtākaro / Avon River in the lower reaches below Fitzgerald Avenue.

In addition to spring-fed tributaries there are 74 kilometres of stormwater drains that contribute to both the quality and quantity of water the tributaries and river receives.

The catchment is a highly modified environment that has undergone dramatic change in the last 160 years, particularly with regard to the loss of mahinga kai, natural areas and indigenous habitats and ecosystems, and the decline of water quality.

Ongoing development and extensive settlement within the catchment over the last two centuries, combined with the more recent earthquakes of 2010/2011 has seen a degradation

of catchment values including reduced water quality due to pollution and siltation, reduced hydraulic capacity, loss of terrestrial vegetative cover and decreased in-stream habitat for fish and invertebrates.

2.3 Previous monitoring

A SOT or CHA of the Ōtākaro and the Ihutai catchment was undertaken in 2007 (Pauling et al., 2007) and 2012 (Orchard et. al., 2012). A summary of key monitoring findings is provided in Table 3. A total of 13 sites were selected for monitoring throughout the Ōtākaro catchment. The sites were selected to maintain a Ki Uta Ki Tai approach, based on consultation with representatives from Te Ngāi Tūāhuriri Rūnanga. The sites had a range of traditional purposes and significance including waipuna, reserves, mahinga kai, and confluence sites.

Table 3. Summary of key findings from Pauling et al. (2007) and Orchard et al. (2012) in relation to the Ōtākaro catchment.

	Pauling et al. (2007)	**Orchard et al. (2012)**
SOT	The scores ranged from very poor to moderate across all sites.	The scores ranged from very poor to moderate across all sites.
CHA	The stream health and mahinga kai scores ranged from very poor to moderate.	The cultural stream health assessment score averaged 1.9 (“poor”) across Ōtākaro sites.
SHMAK	The highest scoring site was Waipapa (Little Hagley Park), followed by Pūtarikamotu. Jellie Park had the highest stream habitat score.	The highest scoring site was Royds Reserve and the lowest scoring site was Owles Terrace.
E. coli	Five out of thirteen sites exceeded the recreational alert level of 260 *E. coli*/100 ml. All sites fell below the shellfish/food gathering standard of 4-14 *E. coli*/100 ml. *E. coli* at three out of thirteen sites showed resistance to Ampicillin antibiotic, indicating human faecal contamination.	Eleven out of thirteen sites exceeded the recreational alert level of 260 *E. coli*/100 ml. Four sites reached the upper testing limit of 2,420 *E. coli*/100 ml. *E. coli* at six out of thirteen sites showed resistance to antibiotic, indicating human faecal contamination, agricultural and wildfowl contamination.
Indigenous species	Most sites (7 out of 13) had very poor native species abundance (i.e., the abundance of native plant, bird and fish species minus the abundance of exotic species).	The sites with the highest indigenous vegetation richness are Jellie Park, Royds Reserve, and Waikākāriki. The overall abundance of indigenous bird species was low. The sites with the highest indigenous bird species richness are Jellie Park, Waimairi and Ōruapaeroa.

		The site with the most diverse fish species was Ōtautahi.
Issues or factors associated with lower scores	The influence of untreated stormwater inputs or wastewater discharges (e.g., Travis Wetland and Horseshoe Lake). Land drainage and thick sedimentation, particularly in the lower and tidal zones (e.g., Ōtautahi, Kerrs Reach, Owles Terrace). Loss of native vegetation cover. Loss of visible springs and water quantity, e.g., Avonhead, Burnside Park, Dudley Creek. The upper areas of all Avon tributaries were completely dry.	The absence of flowing water (e.g., Avonhead and Burnside Park). Degraded and/or heavily urbanised areas. Limited vegetation and/or the presence of exotic vegetation. Poor water clarity and/or high sedimentation. Highly modified river channels. Lack of indigenous species and mahinga kai species. Detection of human sewerage. Mahinga kai would not be conducted at most sites. There are concerns around water quality, degraded riparian areas, habitat degradation (e.g., erosion and presence of weeds and pests). Degradation of habitats for indigenous species—restoration of riparian and in-stream habitat is a priority. Encroachment of urban development on waterways.
Factors associated with higher scores	Presence and restoration of native vegetation. The influence of freshwater springs (e.g., Jellie Park). The separation of the site from intensive urban or rural land use (e.g., Travis Wetland).	Native restoration and/or remnant vegetation. The presence and abundance of indigenous species, particularly mahinga kai species. High water quality including water clarity. Natural flow patterns. Natural stream bed channel and composition (e.g., absence of silt). Presence of natural springs or other taonga in good condition.
Recommen-dations	Implement shellfish/food gathering standards for all waterways. Development, protection, and enhancement of native riparian buffer	Recommendations in addition to those in Pauling et al. (2007): Elimination of contaminants including from the wastewater network and stormwater runoff and rural land uses.

	zones and spring sites (including Avonhead). Development of stormwater treatment systems. Stop stormwater and drainage inputs into Horseshoe Lake. Support restoration efforts and develop a native fish kohanga area in Travis Wetland. Regular monitoring including cultural assessments of catchment management.	Restoring water quality to enable safe mahinga kai harvest. Investigation of *E. coli* sources. Enquiry into heavily degraded sites and remediation. Protection and enhancement of all known springs. Restore and protect indigenous riparian vegetation, particularly on public land. Incentives to encourage the restoration of riparian areas on private land. Urban development must not encroach on waterways and prevent riparian restoration. Regular cultural monitoring and reporting.
Comparison	The 2012 condition of the catchment remains poor—comparable to 2007 results. Large *E. coli* increases were recorded at Dudley Creek, Athol Terrace, Pūtraikamotu and Waipapa. Waterway health issues worsened by the earthquakes. Issues that persist from 2007 include: the presence of contaminants from stormwater and wastewater discharges, sedimentation, unnatural flow patterns (including absence of water).	

3 Summary of sites and monitoring undertaken

The monitoring team comprised staff from Mahaanui Kurataiao Ltd (Matt Walcott and Irene Setiawan) and two whānau members of Te Ngāi Tūāhuriri Rūnanga; Cherie Williams and Frankie Williams. The fish survey, the water quality testing, and the SHMAK field work, particularly invertebrates and periphyton sections, were conducted on 29 February and 1 March 2024 (i.e., one week prior to the cultural health monitoring) by Mahaanui Kurataiao Ltd staff due to the anticipation of a rainfall event. Invertebrates and periphyton can be impacted by significant rainfall events that cause high river flows and flushing effects. The completion of the SOT forms was undertaken on 7 to 8 March 2024. *See Section 3.1 for more information.*

As part of the SOT forms, information on the site locations and weather was recorded to provide context for the collected data. Due to the catchment location, all sites were characterised as urban. Recorded ecosystems were all river or streams, except for Site 11 Te Oranga / Horseshoe Lake and Site 12 Travis Wetland classified as lake or wetland. Site 13 Owles Terrace was the only site that was tidally influenced and classified as both river or stream and estuary or lagoon. Monitoring at Site 13 Owles Terrace occurred during low tide to enable the recording of invertebrates and periphyton safely. Most monitored sites were in council-owned reserves, except for Site 1 Avonhead and Site 3 Dudley Creek, which were within private land.

The weather during the monitoring periods was mainly clear, clear, or partly cloudy with temperatures ranging from 15 to 25 °C and no precipitation. Winds were minimal to light (between 13 to 18 km/hour). The monitoring on 29 February to 1 March 2024 took place during the waning gibbous moon phase and the monitoring on 7 to 8 March 2024 took place during the waning crescent moon phase. All sites had stable flow in the past two weeks prior to monitoring.

3.1 Constraints and limitations

Some rainfall was forecasted on 2 and 3 March, therefore, we did the in-stream invertebrate and periphyton investigation prior to the CHA monitoring on 29 Feb to 1 Mar. The cultural health aspects (SOT and CHA) were completed on 7 to 8 March.

Two monitoring sites were partially located within private land, therefore monitors were limited to where they could conduct their SOT and CHA surveys. For Site 1 Avonhead, access was

arranged prior to monitoring days between MKT and the relevant landowners. For Site 3 Dudley Creek, no access was arranged prior as part of the stream could be observed safely from a public footpath.

During the fish survey MKT staff were unable to set a hīnaki/fyke net or gee minnow trap at some monitoring sites due to low water depth and safety concerns. One hīnaki/fyke net was originally planned to be installed at Site 9 Ōtautahi Kilmore Street, however during the monitoring period the water depth in the river was too deep to install the net. There was also a significant amount of instream vegetation at this site which would have made it difficult to suitably place the hīnaki/fyke net in open space within the water. MKT staff had also planned to set one hīnaki/fyke net and one gee minnow trap at Site 12 Ōruapaeroa Travis Wetland, however during the monitoring period the water depth at this site was too shallow to install both of these.

4 Results

The following sections cover the results for each of the survey sections or questions in the SOT and CHA, parts of the SHMAK, the fish, bird and vegetation surveys, and the water quality testing. Where there were overlaps in recorded information in the CHA and SOT surveys (for example for observed vegetation and bird species) these have been combined in the results and raw data tables. In this section, the sites have been presented in geographic order, starting with the westernmost site on the left (Site 1 - upstream) and heading east/downstream along the catchment.

4.1 State of the Takiwā

Observational survey of the following categories was undertaken: site pressures, degree of modification, access for mahinga kai, suitability for harvesting and overall health. Each category was scored on a scale of 1 – 5, with 1 = poor quality/low values and 5 = high quality/values. The recorded score for each category has been presented by site in Figure 3 below.

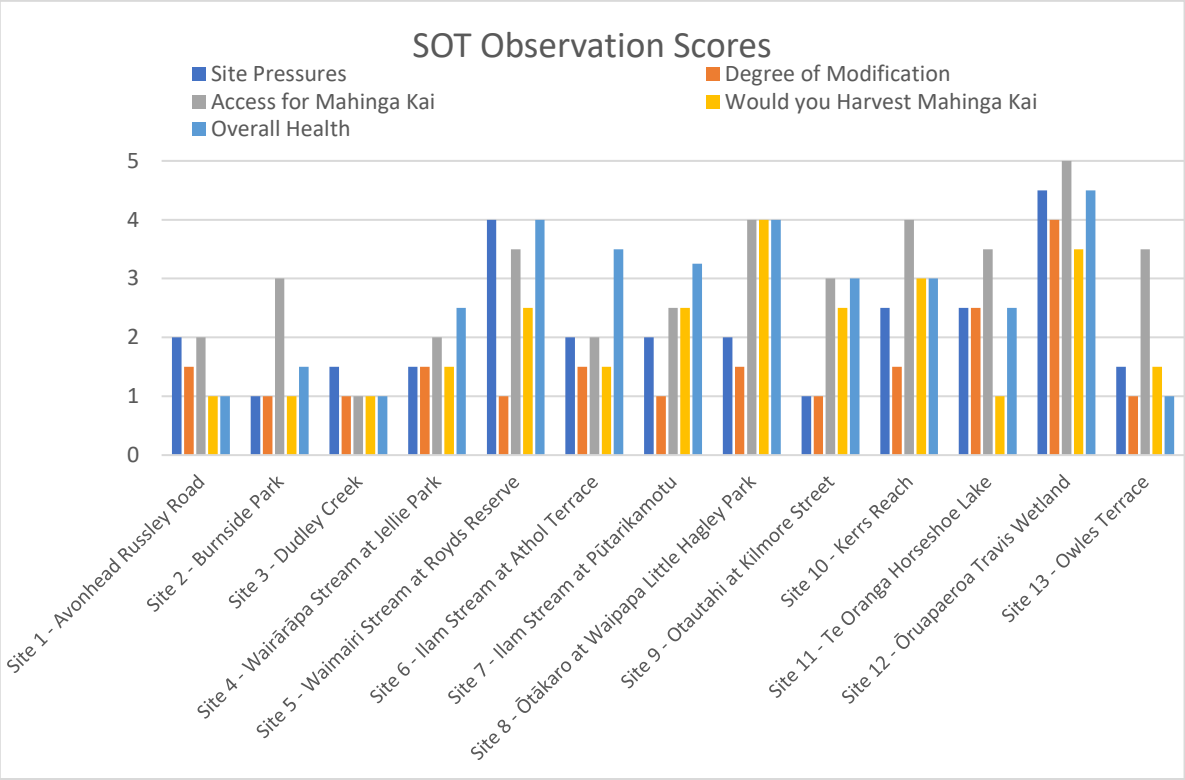

Figure 3. The scores for each category in the SOT for each surveyed site.

Overall, 75% of the total number of observational scores ranged from 1 (very poor) to 3 (moderate) for each category and site. The three sites with no water flow scored the lowest,

which were Site 1 Avonhead at Russley Road, Site 2 Burnside Park, and Site 3 Dudley Creek. Two other sites scored very low on average, these were Site 4 Wairārāpa Stream at Jellie Park and Site 13 Owles Terrace. Lower scores at these sites were mainly reflected in site pressures, degree of modification, and mahinga kai harvest. Monitors noted the immense site pressures at both of these sites, predominately from the residential dwellings that are located along one side of the stream at Jellie Park and the discharges that come from these, as well as the large amount of contaminant discharges at Owles Terrace. Monitors visited Site 12 Owles Terrace during low tide and observed very thick and soft riverbed conditions, which was predominately made up of mud or silt, and a lot of algae cover across the river banks. These all factored into their scores when answering whether they would harvest mahinga kai. Site 12 Ōruapaeroa Travis Wetland was the only site which scored a 4 or better in most of the categories. Monitors scored it a 4.5 on average for overall health and it was the only site which scored a 5 (very good) for mahinga kai access, meaning there were no restrictions with regards to access to this site for harvesting mahinga kai.

Figure 4 below shows the average score for each category of the site assessment section of the State of Takiwā survey. These scores give an overall indication of health across the Ōtākaro catchment. The average scores for each category were all under 3 (moderate values), with the highest being a 3 for site access across the catchment for mahinga kai harvest, and the lowest being 1.5 (low value) for the degree of modification/change at each site.

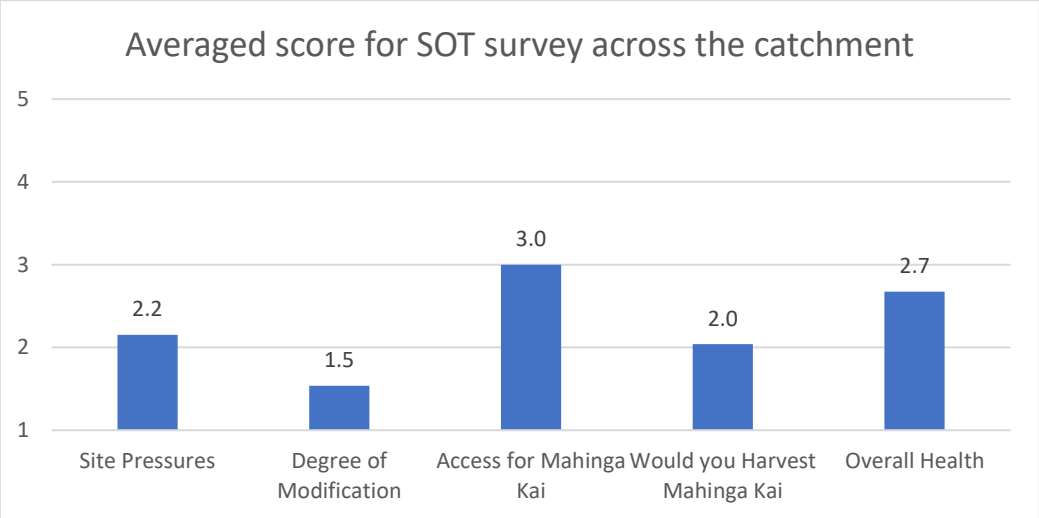

Figure 4. The averaged scores for the SOT survey for each category across the catchment.

4.2 Cultural Health Assessment (CHA)

The graphed results for every question or category of the CHA can be found in Appendix A. The averaged[2] scores for the overall health for each site are indicative of the most common scoring recorded during the assessment and have therefore been included in this section.

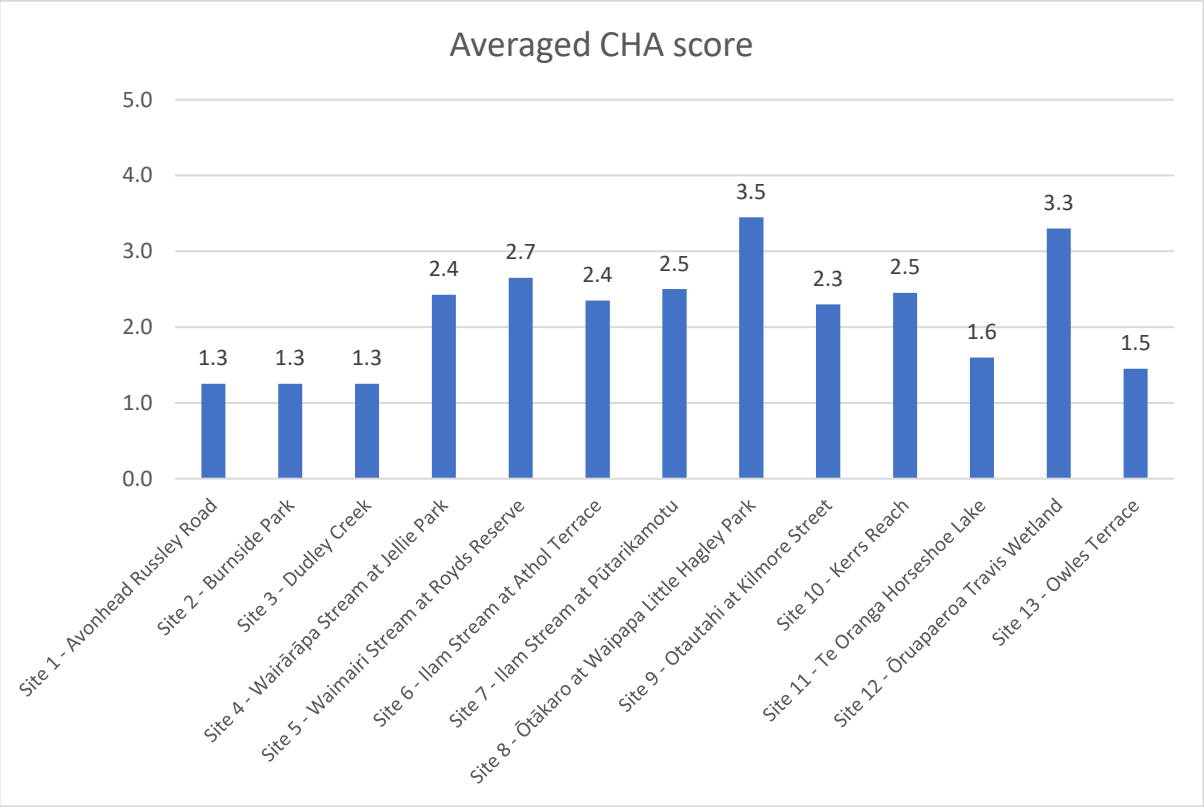

Figure 5. The averaged CHA score for overall health across the catchment.

The overall results show most of the sites scored between 2 and 3 across all questions or categories. The two highest average scoring sites were Site 8 Ōtākaro at Waipapa Little Hagley Park, and Site 12 Ōruapaeroa Travis Wetland, with average scores of 3.5 and 3.3 respectively. Five sites scored on average between 1.3 and 1.6, indicating a very poor trend for cultural stream health. Three of these sites had no water flow within the stream itself, whereas at the other two sites monitors noted unhealthy characteristics such as discoloured water with low to no flow, extensive weed and silt build up along the stream bed as well as other debris and discharges evident at the sites.

[2] Calculated by adding all of the individual scores recorded by the monitors and dividing by the count of those numbers (2 – comprising of two whānau monitors).

In addition to the State of Takiwā questions, whānau monitors were asked to answer a select set of questions as a separate assessment of cultural impacts for each site. These questions included identifying anything that was of concern at the site, and what needed to be done at each site to restore it as a mahinga kai. The comments from the monitors have been summarised into broad categories and are detailed in the tables below (Tables 4-5).

Table 4. Summary of the concerns identified in the responses to the Cultural Health Assessment for each site.

Identified concern	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Untreated stormwater run-off from roads and/or residential dwellings			✔	✔	✔	✔	✔	✔
Direct discharge (i.e., stormwater pipes directed into waterways)		✔	✔	✔	✔			
Steep modified banks and/or stream edges						✔		
Human rubbish in water (i.e., plastics)			✔			✔	✔	✔
Silt, sediment, debris (i.e. dead wood) build up in stream						✔	✔	
Lack of native vegetation					✔			✔
Lack of access to stream itself	✔				✔			
Structures close to stream (i.e., houses, decks)				✔				
Weeds and plant overgrowth instream and/or along banks	✔			✔		✔		
No water present – dry springs	✔	✔	✔					
Overtaken by introduced vegetation	✔	✔						
Lack of instream rooted vegetation					✔			

Table 5. Summay of the concerns identified in the responses to the Cultural Health Assessment for each site.

Identified concern	Site 9	Site 10	Site 11	Site 12	Site 13
Contaminant discharge			✔		
Untreated stormwater run-off from roads and/or residential dwellings	✔		✔		✔
Direct discharge (i.e. stormwater pipes directed into waterways)					✔
Toxic algae blooms					✔
Pollution from birds (i.e. bird poo)				✔	
Human rubbish in water (i.e., plastics)	✔	✔			
Silt, sediment, debris (i.e., dead wood) build up		✔		✔	
Weeds and plant overgrowth instream and/or along banks	✔	✔			
Discoloured water		✔		✔	

There were a range of concerns identified across all sites throughout the Ōtākaro catchment. The more frequent concerns identified by monitors include: untreated stormwater runoff from roads and residential dwellings, human rubbish in waterways, overgrowth of weeds and plants instream and/or along banks, and the direct discharges of stormwater into the stream (i.e., stormwater pipes from residential dwellings discharging directly into stream). Some of the concerns identified by monitors were directly related to the geographical location of particular sites, and therefore were not consistent issues throughout the catchment. For example the three upstream sites located near the headwaters of Ōtākaro have no water flow present as springs have dried up. These three sites are the only sites throughout the catchment where this was identified as an issue. Another example is pollution from birds (i.e., bird poo) was only identified as an issue at one site, Site 12 Ōruapaeroa Travis Wetland. This site is a natural wetlands with a large variety of bird species present, which also creates other issues such as pollution caused by the birds themselves.

There were also some positive comments from monitors with regards to the wide range of native vegetation and bird species present at Site 12 Ōruapaeroa Travis Wetland, noting the restoration works that have been undertaken to naturalise this site. Additional comments made

by monitors with regards to what actions were needed at each site to restore it as a mahinga kai have been summarised and outlined in Tables 6 and 7 below.

It was noted that at every site monitored additional native vegetation planting was listed as one of the actions required to help restore mahinga kai. Only one site throughout the catchment (Site 12 Ōruapaeroa Travis Wetland) was identified as having a good abundance of native vegetation, however it was also noted that there was a lot of room throughout the site for additional planting to be undertaken. All other sites monitored had a distinct lack of native vegetation. Other frequently identified actions include riparian planting of native species, installing rubbish bins and removing existing rubbish in and around the stream, and monitoring/maintaining weeds or other overgrown plants. Many sites had overgrown weeds throughout the stream itself which hindered water flow. This was also noted by monitors.

Table 6. Summary of the identified actions to restore mahinga kai in the responses to the Cultural Health Assessment for each site.

Identified action to restore mahinga kai	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Riparian planting (native species)	✔			✔	✔	✔	✔	✔
Installing rubbish bins. Remove rubbish that's present at site					✔	✔	✔	✔
Controlling discharge (stopping direct discharge into rivers)								
Monitor/maintain weeds and other plantings. Clear weeds instream	✔	✔		✔			✔	
Reactivate springs		✔						
Native vegetation planting	✔	✔	✔	✔	✔	✔	✔	✔
Improved access			✔					
Remove sediment and/or silt						✔	✔	
Less modification			✔					
Investigate discharge source[3]			✔	✔				

[3] During monitoring at Sites 3 and 4 monitors noted a number of stormwater pipes directly discharging to the stream/river. It is not 100% known where these pipes originate from, or the level of contaminants that may also be discharging from these pipes resulting in the comments regarding an action to investigate the source of the discharge.

Table 7. Summary of the identified actions to restore mahinga kai in the responses to the Cultural Health Assessment for each site.

Identified action to restore mahinga kai	Site 9	Site 10	Site 11	Site 12	Site 13
Riparian planting (native species)	✔	✔			✔
Installing rubbish bins. Remove rubbish that's present at site	✔	✔	✔		✔
Controlling discharge (stopping direct discharge into rivers)					✔
Monitor/maintain weeds and other plantings. Clear weeds instream	✔		✔	✔	✔
Native vegetation planting	✔	✔	✔	✔	✔
Protection from road runoff (i.e., install roadside kerbs)			✔		

Some of the actions listed in the above tables were only specific to one site or a small part of the catchment as a whole. For example, the neighbouring road at Site 11 Te Oranga Horseshoe Lake did not have any roadside kerbs along the lake side of the road to catch any stormwater, so during high rainfall events any excess stormwater will flow into the grass bank alongside the road. Stormwater will either be soaked into ground or flow directly into Te Oranga Horseshoe Lake. Monitors identified this as a potential issue and felt installing roadside kerbs at this site would help maintain stormwater flows and direct it into specialised containment areas. Tables 4 to 7 should be considered together in this report as many of the identified actions to restore mahinga kai are directly related to identified concerns by whānau monitors and in most cases would have a positive impact on overall health throughout the catchment. Other general actions for the catchment noted in the SOT survey included: better management by landowner, interpretation/signage, restoration of native species, protection/access arrangement for significant sites with landowner, and pest/weed control.

4.3 Vegetation Survey

4.3.1 Traditional

The Ōtākaro catchment was traditionally a significant source of mahinga kai, and thus is of vital importance to manawhenua, who in the past utilised the abundant food and natural resources that could be harvested from the springs, waterways, wetlands and grasslands that once flourished in this area.

The catchment has changed significantly with European settlement. Prior to this the surrounding catchment was dominated by low shrubs and grasses, along with native wetland

vegetation such as raupō and harakeke occupying the banks. With increased human development throughout the catchment exotic vegetation such as willows and European grasses have become more dominant.

4.3.2 Assessment

The full list of observed species can be found in Appendix B. Figure 6 below shows the number of native and introduced plant species observed and identified during the survey by site. Across the catchment, 47% of the recorded vegetation is native and 53% is introduced.

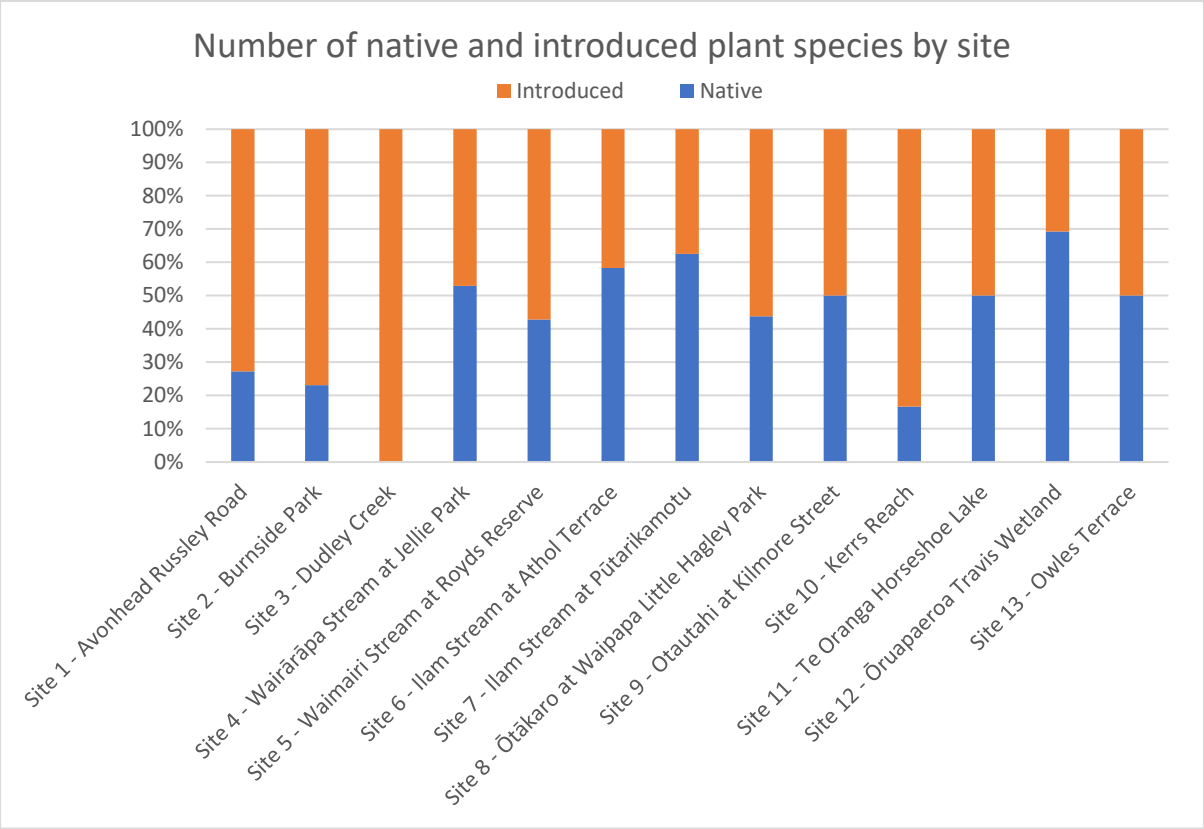

Figure 6. The number of identified native and introduced plants species by site recorded in the vegetation survey.

There was a much higher abundance of introduced vegetation observed compared with native species at the three sites furthest upstream (Site 1 Avonhead, Site 2 Burnside Park, and Site 3 Dudley Creek). Monitors also noted that 100% of the vegetation observed at Site 3 were introduced species. Site 10 Kerrs Reach also had a much higher abundance of introduced vegetation species in comparison to native vegetation. In contrast there were some sites which recorded higher percentages of native vegetation cover compared to introduced species.

These sites were Site 4 Wairārāpa Stream at Jellie Park, Site 6 Ilam stream at Athol Terrace, Site 7 Ilam Stream at Pūtarikamotu, and Site 12 Ōruapaeroa Travis Wetland. Site 12 had the highest percentage cover of native vegetation throughout the total catchment area, with it having approximately 69% native vegetation throughout the site. Introduced species recorded throughout the catchment included (but not limited to) willow, gorse, poplar, pine, oak, maple, magnolia, silver birch, elderberry, grasses and weeds. Recorded native species throughout the catchment included tī kouka, manuka, kōwhai, harakeke, totara, punga, mingimingi, pātiti (carrex), bracken fern, tarata (lemonwood), toi toi, raupō, kahikatea, and koromiko. As mentioned earlier Site 12 Ōruapaeroa Travis Wetland had the highest percentage cover of native vegetation throughout the Ōtākaro catchment. These numbers reflect the amount of restoration work that has been undertaken at this site over past years.

4.4 Bird Survey

4.4.1 Traditional

Traditional species recorded throughout the catchment include kererū (wood pigeon), kākā, kōkō (tui), koparapara (bellbird), mohotatai (branded rail), parera (grey duck), pūtakitaki (paradise duck), rāipo (scaup), pāteke (brown teal), tata (spoonbill duck). This information was gathered by H.K Taiaroa during the time of the 1879 Smith-Nairn Commission (Pauling et al., 2007). This is not an exhaustive list.

4.4.2 Assessment

Figure 7 below shows the number of observed species of bird by site. The highest number of bird species observed was nine. This was recorded at Site 10 and Site 12. Species recorded here included pigeon, manu pango (blackbird), paradise duck, mallard duck, grey duck, Pāpango (black teal duck), pīwakawaka, pūkeko, bellbird, magpie, canadian geese, black swan, unidentified gulls, and sparrow. These species were also among the most common species recorded across the catchment. Figure 7 below also highlights a trend of very little to no bird species observed in the upper catchment areas and a higher number of species being recorded in the middle to lower catchment sites. This could reflect the type of vegetation that is present at each site, as well as the water quality and the types of activities that are undertaken at each site.

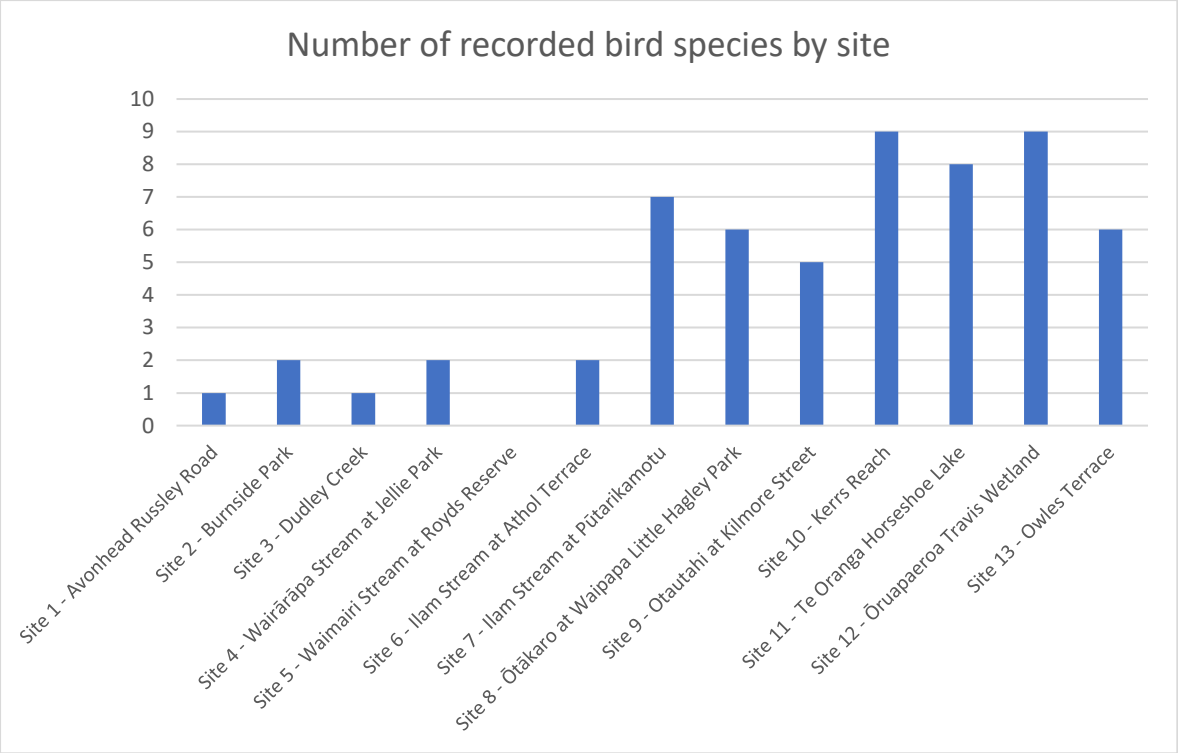

Figure 7. Numbers of bird species recorded at each site.

4.5 Fish Survey

4.5.1 Traditional

Based on mātauranga māori and previous surveys, fish species present throughout the Ōtākaro catchment included tuna (eels), kanakana (lamprey), inanga (whitebait), kokopu, waikoura (freshwater crayfish), pipiki and hao (eel) (Pauling et al., 2007). This is not an exhaustive list.

4.5.2 Assessment

The fish survey was conducted separately to the CHA monitoring due to time constraints with whānau monitor availability and forecasted heavy rainfall over the days CHA monitoring was to be conducted. MKT staff visited all sites that were deemed suitable for the fish survey during the week prior to CHA monitoring and set at least one gee minnow trap to survey smaller species. The water depth at Site 12 Ōruapaeroa Travis Wetland was too shallow for a gee minnow trap to be set. One additional gee minnow trap was set at Site 13 Owles Terrace to broaden the fish survey at the site. Prior to conducting the fish survey, MKT staff identified four monitoring sites that were deemed suitable for a hīnaki (fyke net) to be installed overnight. These were Site 8 Waipapa Little Hagley Park, Site 9 Ōtautahi Kilmore Street, Site 11 Te

Oranga Horseshoe Lake, and Site 12 Ōruapaeroa Travis Wetland. Upon visiting these sites on the first day of monitoring for the fish survey, the water depth at Site 9 was well above the waist height of both MKT staff and a hīnaki could not be installed safely. Other factors which made this site unsuitable were the abundance of instream vegetation around the entrance point of the river and the recreational users of the river during the time of visit. While setting up fish traps at this site MKT staff observed others paddling a waka, travelling up and down the river approximately 100m downstream of the monitoring site. Aside from safety concerns with the depth of the river, it was feared the recreational users may damage either their waka or the hīnaki itself if they were to paddle further upstream. When MKT staff visited Site 12 during the first day of the fish survey monitoring, it was discovered that water depth throughout the extent of the wetlands was too shallow for a hīnaki to be installed. There were no safety issues or other constraints with installing hīnaki at either of the remaining two sites (Site 8 and Site 11). Site 1, Site 2, and Site 3 were completely dry and had no water present in stream, therefore no fish traps were installed here.

Figure 8 below shows the variety of fish species and abundance caught at each site where fish traps were installed. The only site where no fish species were caught was Site 6 Ilam Stream at Athol Terrace. Most sites that were surveyed only had one species of fish that were caught. The highest number of species caught at a particular site was 4. These were observed at Site 11 and Site 13, which are two of the three most downstream sites. The most common species of fish observed throughout the catchment were common bullies, which were caught at seven out of nine sites. The number of common bullies caught ranged from eight to twenty six, and ranged in size from approximately 20mm to 110mm. Tuna (shortfin and longfin) were also caught and observed at four sites, ranging in size from approximately 170mm to 850mm. The smallest tuna species observed were unidentified baby eels at Site 13 Owles Terrace, and the largest species were observed at Site 8 Waipapa Little Hagley Park and Site 11 Te Oranga Horseshoe Lake. These were both longfin tuna. Other species that were caught were shortfin tuna and giant bullies. One unidentified fish was caught and observed at one site, as well as two unidentified baby tuna. Two unidentified deceased fish were also caught and observed at one site.

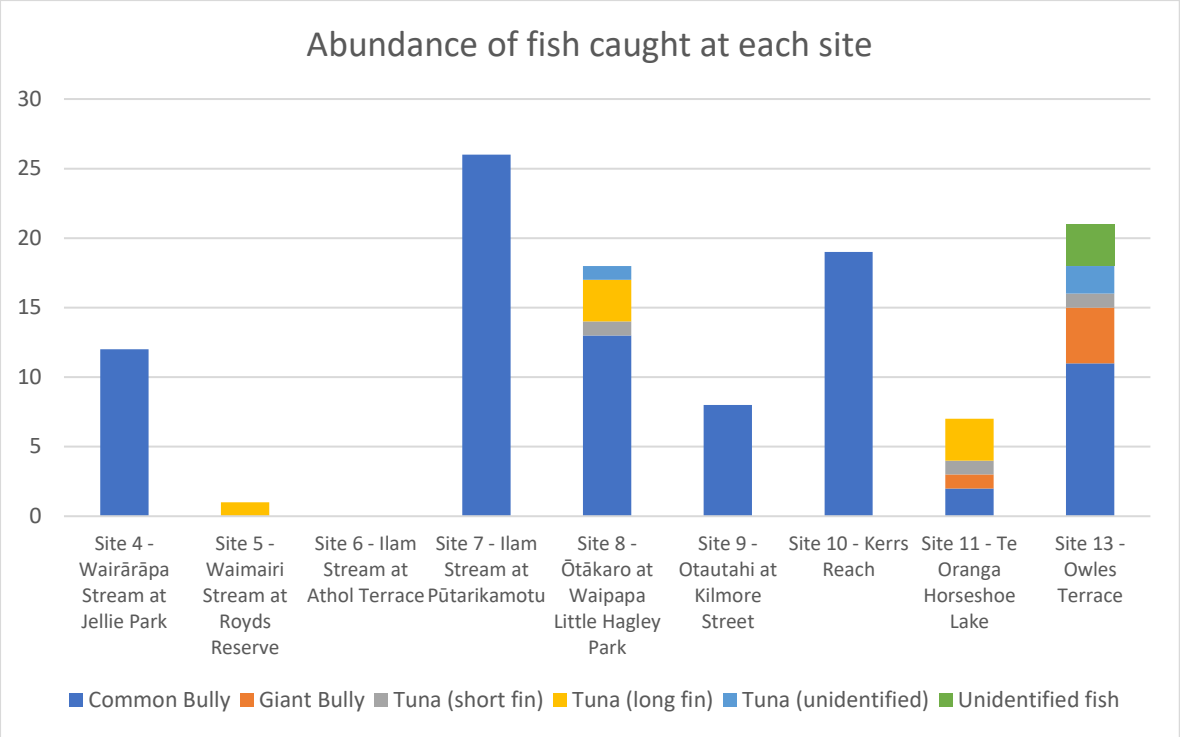

Figure 8. Abundance of fish species recorded at each site.

Recorded species variety across the Ōtākaro catchment was low, with the average number of species recorded per site being 1.8. This does not include the three unidentified fish species caught at Site 13. Abundance of fish caught across the catchment was varied, with upstream sites recording lower abundance values on average than those further downstream. As mentioned earlier there were no fish caught at Site 6, meaning this site had the lowest abundance of fish species throughout the catchment. Site 7 had the highest abundance of fish observed, with a total of twenty six common bullies caught in one gee minnow trap.

4.6 Stream Health and Macroinvertebrate Assessment Kit

In order to provide further data on the health of the stream, records of velocity, pH, temperature, electrical conductivity and clarity were recorded during monitoring in March 2024 (Table 7). However, it should be noted that to accurately determine data trends requires making a standard set of measurements and observations at regular intervals over time.

Table 7. Results from records of the SHMAK testing (using the multiparameter probe). The pH and temperature recorded meet LWRP standards.

Site Code	Time/ Date	Velocity (m/s)	pH	Water temperature (°C)	Electrical conductivity (µS/cm)	Water clarity (cm)	Dissolved oxygen (mg/L)	Dissolved oxygen (% saturation)
Site 1	07/03/21 08.34am	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Site 2	07/03/24 09.32am	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Site 3	07/03/24 10.26am	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Site 4	07/03/24 11.22am	0.06m/s	6.51	12.6	170	76.3cm	10.7	100.7
Site 5	07/03/24 03.14pm	0.31m/s	6.64	14.6	177.6	91.3cm	8.7	85.8
Site 6	07/03/24 12.58pm	0.07m/s	6.42	13.9	219	79.87cm	8.28	80
Site 7	07/03/24 02.02pm	0.21m/s	6.65	15	192.6	92.6cm	9.69	96.1
Site 8	08/03/24 08.32am	0.28m/s	6.86	13.8	181.7	79.43cm	9.27	90
Site 9	08/03/24 09.23am	N/A	7.05	14.2	184.7	N/A	7.39	72.6
Site 10	08/03/24 10.10am	N/A	6.96	16	199.6	N/A	7.13	73
Site 11	08/03/24 02.12pm	0.15m/s	7.12	16.3	166.2	68.87	8.15	84.5
Site 12	08/03/24 12.53pm	N/A	8.09	20.7	495	4.87	9.38	106.6
Site 13	08/03/24 11.27am	N/A	7.6	16.3	916	74.53	9.74	99.9

Velocity rates were only recorded at six out of thirteen sites due to stream accessibility and stagnant flows at other locations. The three sites furthest upstream also had no water present in stream, therefore most of the SHMAK tests were unable to be undertaken.

The measured pH at all sites were within the range of 6.42 and 8.09, consistent with the receiving water standards set out in the Canterbury Land and Water Regional Plan (LWRP) (Environment Canterbury, 2023). In addition, water temperatures across all of the river sites were below the maximum temperature of 20 °C set out in the LWRP (freshwater outcomes for Canterbury rivers). Water temperature at Site 12 Ōruapaeroa Travis Wetland was recorded at being 20.7°C during the time of visit, however this site is classified as a wetland as opposed to a river.

The electrical conductivity was highest at Site 13 Owles Terrace due to the saltwater present at this location. It should also be noted that during the time MKT staff conducted SHMAK testing at this site it was low tide throughout the catchment, based off tide information for Lyttelton, New Zealand. This meant river water levels were at or very close to their lowest levels for any 24 hour period, and water was likely starting to flow upstream from the Ihutai estuary outflow.

Clarity ranged on average between 4.87cm to 92.6cm across all measured sites. Water clarity was not able to be measured at some sites due to stream access issues and lack of water in stream itself. The lowest water clarity result was measured at Site 12 Ōruapaeroa Travis Wetland. Turbidity was much higher at this site than others due to the high amounts of sediment throughout the wetlands, and the extensive number of bird species present. Site 7 Ilam Stream at Pūtarikamotu Deans Bush had the best water clarity measurement, which was 92.6cm on average. This result reflects the quality of water within the Ōtākaro catchment at this location, with a number of springs located less than 3km upstream of this site (Canterbury Maps, 2024).

Dissolved oxygen concentration levels were measured at all sites with flowing water. DO concentrations throughout all sites measured ranged between 7.13mg/L to 10.7mg/L and between 72.6% and 106.6% for minimum saturation cover. These results were consistent with the receiving water standards set out in the Canterbury Land and Water Regional Plan (LWRP) (Environment Canterbury, 2023).

Table 8. Results from records of the SHMAK testing (observation based).

Site Code	Bed Composition	Bank Vegetation True Left	Bank Vegetation True Right	Deposits
Site 1	N/A – stream dry, historic streambed	2% native trees, 98% pasture	75% introduced trees, 25% pasture	N/A

	overgrown with weeds and vegetation.	grasses and weeds.	grasses and weeds.	
Site 2	N/A – stream dry, overgrown with pasture grasses.	1% native trees, 69% introduced trees, 30% pasture grasses and weeds.	1% native trees, 69% introduced trees, 15% pasture grasses and weeds, 15% bare ground, roads, buildings.	N/A
Site 3	Although site was dry when monitors visited, water is present during rainfall events and increased stormwater runoff. 20% large cobbles, 50% small cobbles, 30% mud or silt. It was noted that grasses and weeds were present in stream bed.	10% introduced trees, 90% pasture grasses and weeds.	1% wetland vegetation, 49% pasture grasses and weeds, 50% bare ground, roads, buildings.	N/A
Site 4	5% large cobbles, 40% small cobbles, 25% gravels, 20% mud or silt, 10% woody debris.	15% native trees, 5% introduced trees, 30% pasture grasses and weeds, 50% bare ground, roads, buildings.	25% native trees, 30% wetland vegetation, 10% introduced trees, 35% bare ground, roads, buildings.	>5mm
Site 5	10% large cobbles, 70% sand, 20% water plants rooted in stream bed.	5% native trees, 5% wetland vegetation, 10% other introduced trees (conifers), 80% bare ground, roads, buildings, grass.	35% native trees, 30% wetland vegetation, 10% other introduced trees (conifers), 25% bare ground, roads, buildings, grass.	>5mm
Site 6	50% mud or silt, 10% man-made (e.g. Concrete), 40% woody debris.	30% native trees, 40% wetland vegetation, 10% other introduced trees (conifers), 20% bare ground, roads, buildings.	30% native trees, 30% wetland vegetation, 40% bare ground, roads, buildings.	>5mm
Site 7	5% small cobbles, 5% gravels, 25% sand, 25% mud or silt, 5% man-made (e.g. concrete), 10% woody debris, 25% water plants rooted in stream bed.	15% native trees, 10% wetland vegetation, 75% bare ground, roads, buildings.	25% native trees, 30% wetland vegetation, 5% pasture grasses and weeds, 40% bare ground, roads, buildings.	>5mm

Site 8	5% large cobbles, 40% small cobbles, 25% gravels, 20% mud or silt, 10% woody debris.	15% native trees, 5% introduced trees, 30% pasture grasses and weeds, 50% bare ground, roads, buildings.	25% native trees, 30% wetland vegetation, 10% introduced trees, 35% bare ground, roads, buildings.	>5mm
Site 9	8% gravels, 2% woody debris, 90% water plants rooted in stream bed.	50% wetland vegetation, 10% introduced trees, 25% pasture grasses and weeds, 15% bare ground, roads, buildings.	50% wetland vegetation, 10% introduced trees, 20% pasture grasses and weeds, 20% bare ground, roads, buildings.	N/A – not assessed due to water depth.
Site 10	5% mud or silt, 95% water plants rooted in stream bed.	5% wetland vegetation, 5% introduced trees, 90% pasture grasses and weeds.	5% wetland vegetation, 95% pasture grasses and weeds.	N/A – not assessed due to water depth.
Site 11	90% mud or silt, 5% large cobbles, 5% small cobbles.	5% wetland vegetation, 5% introduced trees, 5% native trees, 85% pasture grasses and weeds.	5% wetland vegetation, 50% pasture grasses and weeds, 45% introduced trees.	>5mm
Site 12	100% mud or silt.	80% wetland vegetation, 8% native trees, 2% introduced trees, 10% pasture grasses and weeds.	100% wetland vegetation.	>5mm
Site 13	3% large cobbles, 2% small cobbles, 80% mud or silt, 15% water plants rooted in stream bed.	1% wetland vegetation, 80% pasture grasses and weeds, 19% bare ground, roads, buildings.	1% wetland vegetation, 5% scrub, 74% pasture grasses and weeds, 20% bare ground, roads, buildings.	>5mm

Mud or silt was the predominant composition of the stream bed throughout all monitoring sites, although gravels and cobbles of varied sizes were noted as well. Water plants rooted in the stream bed also accounted for high percentages of some sites, in particular at Site 9 and Site 10. The bank vegetation is based on an observed percentage estimation of specified categories in the SOT: native trees, wetland vegetation, tall tussock grassland, introduced trees (willow, polar), other introduced trees (conifers), scrub, rock/gravels, short tussock grassland, pasture grasses/weeds and bare ground/roads/buildings. More detail on the identified plant species recorded is shown in Section 4.3 and in Appendix B. Loose deposited

material on the stream bed was estimated to be >5mm at all sites that were monitored. It should be noted that deposits could not be measured at 5 sites due to stream bed access and suitability (i.e. no water was present at 3 sites).

4.7 Water Quality Testing

Seven sites were selected for water sampling on the 28th of February 2024. These were: Site 4 Wairārapā Stream at Jellie Park, Site 5 Waimairi Stream at Royds Reserve, Site 7 Pūtarikamotu Ilam Stream at Deans Bush, Site 8 Waipapa Little Hagley Park, Site 9 Ōtautahi Kilmore Street, Site 11 Te Oranga Horseshoe Lake, and Site 12 Ōruapaeroa Travis Wetland (Tables 9 and 10). The water samples were sent to Hill Laboratories for testing. The results of the levels of contaminants recorded tests are covered in the table below and in Appendix C. It should be noted that typical monitoring of contamination requires repeated testing at regular intervals over time.

Table 9. Results from the water sample testing provided by Hill Laboratories. Values in red bold do not comply with the relevant LWRP freshwater outcomes and receiving water standards (i.e., 90% species level protection). Values in blue bold do not comply with the 99% species level protection based on ANZECC (2000).

Site	Site 4 – Wairārapā Stream at Jellie Park	Site 5 – Waimairi Stream at Royds Reserve	Site 7 – Pūtarikamotu Ilam Stream at Deans Bush	Site 8 – Waipapa / Little Hagley Park
pH (pH Units)	7.3	7.5	7.5	7.7
Electrical Conductivity (EC) (mS/m)	17.3	18.0	19.4	18.4
Total Suspended Solids (g/m^3)	< 3	< 3	< 3	< 3
Dissolved Copper (g/m^3)	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead (g/m^3)	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Zinc (g/m^3)	**0.0016**	0.0015	**0.0059**	**0.0039**
Total Nitrogen (g/m^3)	1.43	2.4	3.1	2.0
Total Ammoniacal-N (g/m^3)	0.039	< 0.010	0.010	< 0.010
Nitrite-N (g/m^3)	0.006	< 0.002	0.002	0.003
Nitrate-N (g/m^3)	1.33	2.4	3.0	1.98
Nitrate-N + Nitrite-N (g/m^3)	1.33	2.4	3.0	1.98
Total Kjeldahl Nitrogen (TKN) (g/m^3)	0.10	< 0.10	< 0.10	< 0.10
Dissolved Reactive Phosphorus (g/m^3)	< 0.004	0.005	< 0.004	< 0.004
Total Phosphorus (g/m^3)	0.006	0.006	0.006	0.007
Escherichia coli (MPN / 100mL)	770	86	308	461
Chlorophyll a (g/m^3)	0.0009	< 0.0002	0.0003	0.0007

The water quality results in Table 7 were compared against the freshwater outcomes and receiving water standards for spring-fed plains urban rivers (i.e., 90% species level protection) set out in the LWRP. Four water samples taken were above the 550 MPN / 100mL limit for *E. coli*, with Site 12 recording the highest level of *E. coli* throughout the catchment. It should be noted that Hill Laboratory analyst's stated the water samples were >24 hours old before they

were able to commence water quality testing, which may have affected these microbiological results.

Table 10. Results from the water sample testing provided by Hill Laboratories. Values in red bold do not comply with the relevant LWRP freshwater outcomes and receiving water standards (i.e., 90% species level protection). Values in blue bold do not comply with the 99% species level protection based on ANZECC (2000).

Site	Site 9 – Ōtautahi Kilmore Street	Site 11 – Te Oranga Horseshoe Lake	Site 12 – Ōruapaeroa Travis Wetland
pH (pH Units)	7.7	7.7	8.3
Electrical Conductivity (EC) (mS/m)	18.7	18.5	48.3
Total Suspended Solids (g/m^3)	3	< 3	60
Dissolved Copper (g/m^3)	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead (g/m^3)	0.00010	< 0.00010	0.00019
Dissolved Zinc (g/m^3)	**0.0049**	< 0.0010	< 0.0010
Total Nitrogen (g/m^3)	1.74	0.48	3.4
Total Ammoniacal-N (g/m^3)	0.058	0.046	< 0.010
Nitrite-N (g/m^3)	0.007	0.007	< 0.02 #2
Nitrate-N (g/m^3)	1.60	0.193	< 0.02
Nitrate-N + Nitrite-N (g/m^3)	1.60	0.20	< 0.02 #2
Total Kjeldahl Nitrogen (TKN) (g/m^3)	0.13	0.28	3.4
Dissolved Reactive Phosphorus (g/m^3)	**0.017**	**0.048**	**0.032**
Total Phosphorus (g/m^3)	0.019	0.081	0.61
Escherichia coli (MPN / 100mL)	579	770	> 2,420
Chlorophyll a (g/m^3)	0.0011	0.0015	0.076

The measured concentrations of metals and metalloids (copper, lead and zinc) were lower than the aforementioned standards set out in the LWRP at all but one of the monitored sites. The only exception was Site 4 where the measured concentration of zinc was 0.0016g/m$^{3.}$ It should be noted the limit for zinc under the 90% species level protection threshold within spring-fed plains urban water quality class is 0.0015g/m^3. The water sample taken from Site 5

also measured 0.0015g/m^3 for zinc. In addition, the annual median concentration for nitrate-nitrogen set out in Schedule 8 (region-wide water quality limits) of the LWRP is 3.8 g/m^3 for the spring-fed plains urban management unit. The measured nitrate-nitrogen concentrations across all sites were below this annual median concentration.

The water quality results were also compared with the 99% species level protection trigger values (ANZECC, 2000) for copper, lead, and zinc. Three sites exceeded the trigger value for total zinc concentrations of 0.0024 g/m3. These sites were Site 7, Site 8, and Site 9. The concentrations of total copper and lead were below their respective trigger values. Caution is required during the interpretation of test results against trigger values (including those set out in the LWRP), as the measured concentration is total, i.e., not dissolved as measured in the water sample analysis from Hill Laboratories.

As mentioned above, under the Canterbury LWRP a limit of 550 MPN/100 mL of *E. coli* for 95% of samples is set for spring fed lower basin, plain and urban streams. Site 5, Site 7, and Site 8 were below the accepted limit, however; the results at Site 7 and Site 8 were still above 'alert' trigger level of 260 MPN/100mL, which indicates an increased risk of illness from swimming, but still within an acceptable range. All sites should be monitored further for additional comparisons.

4.8 Attribute Target Levels for Mana Whenua Values

Condition 54 of the CSNDC requires Attribute Target Levels to be developed in collaboration with Papatipu Rūnanga. The relevant target levels are based on the Waterway Cultural Health Index and SOT models, with a 1 to 5 scale from very poor to very good. As of 2022, the six Papatipu Rūnanga represented by Mahaanui Kurataiao Ltd determined that the target level for all waterway classifications should be set at 5 (very good).

For the Ōtākaro catchment, the average score of overall health from the SOT survey of the monitored sites was 2.7. The average score from the Cultural Health Assessment survey (based on the score for overall health) for all sites was 2.5. These scores do not meet the set target level of 5 for Mana whenua values. The average scores by site are shown below in Figure 9. This graph shows that while some sites have a score of 4 or better, there are others that are significantly less and in some cases are scored a 1. These results show that there is still much work to be done throughout the Ōtākaro catchment to improve the cultural health of each site, as well as the catchment overall.

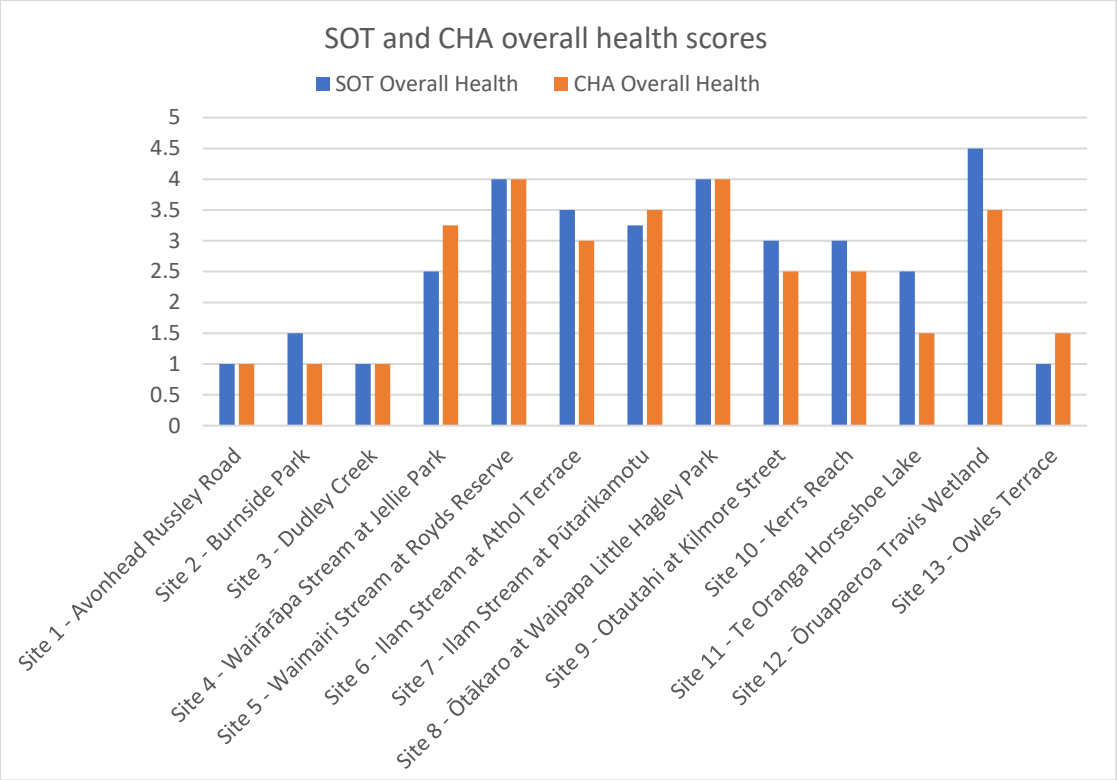

Figure 9. The SOT and CHA scores for overall health by site.

5 Discussion

5.1 Overview of the catchment

The overall averaged score for the catchment from the SOT and CHA monitoring was 2.3 and 2.2 respectively. The overall averaged score for the catchment from the most recent SOT monitoring conducted in 2012 was 1.7. This shows there was a slight improvement throughout the catchment on average, however many of the issues that were raised from the 2012 SOT were also mentioned in the 2024 SOT. Key factors that were associated with lower cultural health scores from both the 2012 SOT and 2024 SOT monitoring were the absence of flowing water (i.e., at Site 1 Avonhead at Russley Road, Site 2 Waimairi Stream at Burnside Park, and Site 3 Dudley Creek), limited vegetation and/or the presence of exotic vegetation, lack of indigenous species and mahinga kai species, and poor water clarity and/or high sedimentation. Another issue raised by monitors from the 2024 SOT was concern around the various untreated stormwater runoff and discharges directly into the waterway at many of the monitoring sites within the Ōtākaro catchment. These discharges came from either roadside stormwater pipes or directly from individual residential dwellings. The major concern related to the direct discharges of stormwater was the unknown level of contaminants that may also be discharged into the waterways. Pollution and contamination issues were noted at other sites with regards to the appearance of water, sediment and silt levels on the stream bed, and toxic algae growth. In the 2012 SOT survey, all but two sites exceeded the contact recreational standard of 260 MPN/100mL for *E. coli*, and four sites recorded a value of at least 2,420 MPN/100mL. These sites were Site 3 Dudley creek, Site 6 Ilam Stream at Athol Terrace, Site 7 Ilam Stream at Pūtarikamotu Deans Bush, and Site 8 Waipapa Little Hagley Park. It was also noted that these sites were surveyed directly after rainfall events, which is known to influence *E. coli* values. Nevertheless, these results indicate that *E. coli* levels in the Ōtākaro catchment are high relative to the Contact Recreation Alert level, with many sites exceeding that level. In comparison only one of the seven sites sampled was below the Contact Recreation Alert level for *E. coli*, this being Site 5 Waimairi Stream at Royds Reserve. As mentioned earlier Site 12 was the only site that recorded a value of at least 2,420 MPN/100mL. Five of the seven sites sampled recorded lower values of *E. coli* when compared to the 2012 SOT survey. The two sites with higher *E. coli* values were Site 11 Te Oranga Horseshoe Lake and Site 12 Ōruapaeroa Travis Wetland.

CHA scores throughout the catchment ranged on average between 1.3 (poor values) to 3.5 (moderate to high values). The average CHA score was 2.2. In the 2012 SOT survey CHI Stream Health Assessment scores (which are the equivalent to CHA) ranged from 1.0 to 2.5 across the Ōtākaro catchment, scoring 1.9 on average. These results show that there was a slight improvement throughout the catchment with regards to cultural stream health, however this is only a very minimal improvement. Monitors noted a variety of actions required to restore mahinga kai, and some of the more common actions included: removal of exotic species along bank margins and within the stream, planting of native vegetation and increasing riparian planting, monitoring and maintenance of weeds and other plants that require maintenance (i.e., harakeke), removal of rubbish from within the stream and surrounding area, and removal of silt and sediment in streams. Some other actions that were noted by monitors were more site specific, such as investigating sources of direct discharges into the water way and improving site access where this was found to be an issue.

During the 2012 SOT monitoring the percentage of indigenous vegetation traditionally present at each site typically ranged between 10% and 40%. The sites that had the highest indigenous vegetation richness were Site 4 Wairarapa at Jellie Park, Site 5 Waimairi Stream at Royds Reserve, and Site 11 Te Oranga Horseshoe Lake. For comparison during the 2024 SOT monitoring the sites with the highest percentage of indigenous vegetation were Site 7 Ilam Stream at Pūtarikamotu / Deans bush, Site 11 Te Oranga Horseshoe Lake, and Site 12 Ōruapaeroa Travis Wetland. The number of recorded fish species varied across all 13 sites during the 2024 SOT survey, ranging between 0 and 4 different species. These results were similar to the most recent SOT survey in 2012, although Site 9 Otautahi at Kilmore Street was the most diverse with regards to number of fish species caught, which was 6.

5.1.1 1 – Avonhead at Russley Road

The SOT scores for Site 1 were poor on average. Monitors scored the site a 2 for site pressures, 1.5 for degree of modification, 2 for access for harvesting, 1 for mahinga kai harvest, and 1 for overall health. These scores were heavily influenced by factors such as site accessibility, the abundance of overgrown exotic vegetation and weeds, lack of indigenous vegetation, and lack of water instream. CHI scores for this site were very poor on average, with most CHI categories scoring a 1 (very poor). The only exception for this was for vegetation cover along banks and margins, where this was 3.5. Monitors noted however that this score referred to the abundance of weeds and exotic vegetation, as opposed to indigenous,

therefore it could be interpreted incorrectly with regards to cultural stream health. Actions to restore mahinga kai at this site include: clearing all weeds and exotic vegetation from the historic stream channel and along bank margins, planting native vegetation, and restoring water flow.

Figure 10. Looking west at the historic site for the Ōtākaro headwaters.

5.1.2 2 – Waimairi Stream at Burnside Park

The SOT scores for Site 2 were mostly consistent with most categories scoring a 1. The only exceptions were access for harvesting which was scored a 3 and overall health which was scored a 1.5. Monitors noted that although there were no obvious issues with accessing for harvesting at this site, the site itself had no mahinga kai present and therefore nothing available to harvest. All monitors noted the following actions required to improve health at this site: better management by landowner, restoration of native species, pest/weed control, and better interpretation/signage throughout the site. CHI scores were also very consistent throughout all categories, with most scoring a 1. Vegetation on banks and margins was scored a 2 and riverbed conditions was scored a 2.5. There was no water flow present at this site and

it was noted that it appeared to have been dry for quite some time. Historic stream channel has been turned into a walking track which is used by a range of recreational users, including runners, dog walkers, and mountain bike riders.

Figure 11. Picture of historic Waimairi Stream channel, looking east (downstream).

5.1.3 3 – Dudley Creek

The SOT scores for Site 3 were very poor on average. All categories were scored a 1 apart from site pressures, which scored a 1.5. The waterway has been heavily urbanised at this site, with very minimal set backs from neighbouring residential dwellings on either side. No water flow was present during the time of monitoring, however it was noted that this waterway is

heavily influenced by stormwater runoff during rainfall events. Stormwater is discharged from the main road (Greers Road) which travels across Dudley Creek, as well as other individual dwellings which have direct stormwater discharge outlets into the waterway. Monitors also noted that every individual discharge point from residential dwellings needed to be addressed and improved in order for the site health to improve. Stormwater runoff from existing dwellings is currently untreated and allowed to discharge directly into the waterway. During heavy rainfall events this has a significant impact as potential contaminants such as heavy metals are discharged directly into Dudley Creek which is a tributary of Ōtākaro. These contaminants would have adverse ecological effects. CHI scores were similar to SOT, with most categories scoring a 1. Riverbed conditions was scored a 2.5 and vegetation on banks and margins was scored a 1.5. There was no native vegetation present and only some exotic plants and trees. The streambed itself had some grasses and weeds present, but was predominately made up of small and large cobbles, and mud or silt. Some rubbish was also present in the waterway during the time of monitoring, and this was identified as an issue which would stop monitors using this site. Other identified issues included instream weeds and grasses that were not maintained, and the surrounding land use and stormwater runoff from the main road.

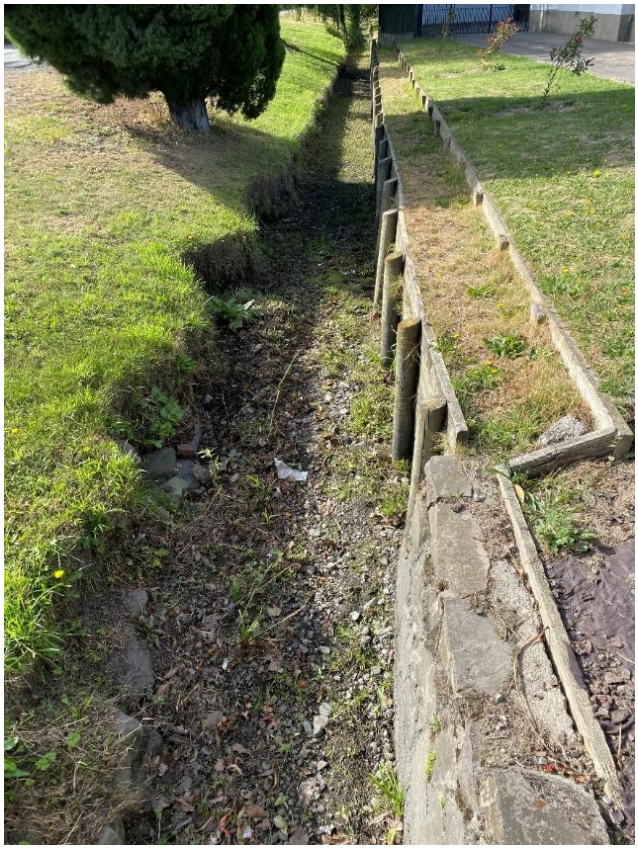

Figure 12: Photo looking downstream of Dudley Creek, standing next to Greers Road.

5.1.4 4 – Wairārapa Stream at Jellie Park

SOT scores for Site 4 were slightly better than scores from the previous 3 sites, however they were still poor values on average. Scores ranged from 1.5 to 2.5 across all categories, with overall health being scored a 2.5. There were some positive aspects to this site, such as some of the native vegetation planting that has been undertaken recently along the true right side of the stream bank. There were also some negative aspects, with the most notable being the very short set backs from neighbouring residential dwellings along the true left side of the stream. Many dwellings had fences and decking built within the waterway setback, as well as some stormwater discharge points directly into the waterway from their properties. These all had considerable impacts on SOT and CHI scores, in particular with mahinga kai harvest. CHI scores were better at this site as well, with most categories scoring between 3 and 3.5. There were still some very poor scores at this site, including the use of riverbanks and margins and changes to the river channel, which were both scored 1. This was directly related to the neighbouring residential dwellings along the true left side of the waterway and the level of intrusions within the waterway setbacks. One gee minnow trap was set along the true left bank of the stream and caught 12 common bullies. Fish were juvenile and ranged between 20mm and 35mm in size.

Figure 13. Photo of Wairārapa Stream looking north.

5.1.5 5 – Waimairi Stream at Royds Reserve

SOT scores for Site 5 were varied across all categories. Scores ranged from 1 to 4, with overall health being scored a 4. The degree of modification at this site was extreme, with monitors noting neighbouring residential dwellings along both sides of the waterway, stormwater discharge pipes directed into the waterway, wood and stone lined retaining walls, and straightening. Although water appeared very clear and free of contaminants, monitors noted that there was a high degree of sediment build up throughout the stream bed. CHI scores for water clarity and water quality were both very good, with both scoring 4.5. Overall health was scored a 4, with concerns around the lack of native vegetation, instream vegetation, and lack of riparian planting all impacting overall scores. One gee minnow trap was set along the true right bank and left overnight. One small longfin tuna was caught and observed by monitors. It was measured as approximately 530mm in length.

Figure 14. Photo of Waimairi Stream looking north (downstream).

5.1.6 6 – Ilam Stream at Athol Terrace

SOT scores for Site 6 were consistent, with most categories scoring between 1.5 and 2. Overall health at this site was scored a 3.5, which was a moderate value. Concerns at this site included the surrounding land uses, neighbouring residential dwellings and the extent of their waterway setback intrusion, stormwater runoff from the residential dwellings, and the silt/sediment build up instream. CHI scores were more varied, with scores ranging from 1 to 4. Use of riverbanks/margins and changes to river channel both scored a 1 while water clarity was scored a 4. It was noted that there are natural springs mapped near this site (upstream) which may have an impact on water quality and clarity for this stream. One gee minnow trap was set along the true right bank of this waterway; however no fish species were caught overnight.

Figure 125. Photo of Ilam Stream looking east (downstream).

5.1.7 7 – Ilam Stream at Pūtarikamotu

SOT scores at Site 7 were only marginally better than Site 6, across most categories. Degree of modification scored the lowest, being a 1. Monitors noted this was due to factors such as

bridges, culverts, and retaining walls in the surrounding area, as well as what appears to be stormwater discharge outlets from neighbouring residential dwellings which discharge directly into the waterway. Overall health was scored 3.25 on average, with aspects such as level of silt and sediment build up along the stream bed, human rubbish within the waterway, and level of riparian planting all impacting the scores. CHI scores were similar, with most categories scoring between 2 and 3.5. Use of riverbanks/margins and changes to river channel were both scored a 1, while water clarity was scored a 4.5. Monitors identified the following actions required to restore this site as a mahinga kai: native planting (in particular riparian planting to increase fish and bird habitat), removal of trash and silt within the waterway, and improving signage in the site that explains the historic importance of this site for Māori, as monitors stated that there was once a pā site within Pūtarikamotu Deans Bush. One gee minnow trap was set along the true left bank and caught a total of 26 common bullies overnight. This was the highest abundance of common bullies caught across all monitoring sites, with the same number of fish also being caught at Site 11 – Te Oranga Horseshoe Lake. The common bullies that were caught ranged in size from approximately 25mm to 65mm.

Figure 16: Photo of Ilam Stream looking east (downstream).

5.1.8 8 – Ōtākaro at Waipapa Little Hagley Park

SOT scores at Site 8 were a mixture of good and poor results. This site scored poorly for site pressures and degree of modification, both scoring 2 and 1.5 respectively. Access for

harvesting and mahinga kai harvest both scored a 4 overall, with monitors indicating that site was accessible with easy access to the waterway from the jetty, and that they would come back to harvest mahinga kai with a variety of indigenous vegetation and fish species available. The site was scored a 4 for overall health. Monitors noticed some rubbish floating in the waterway which impacted this score, and also noted an increase in native riparian planting would increase the overall health of this site. CHI scores were mostly consistent, with many of the categories scoring a 4 or 4.5. The fish survey conducted at this site included setting one gee minnow trap and one hīnaki (fyke net) along the true left bank, which were both left overnight. In total 13 common bullies were caught along with 5 tuna. The common bullies ranged in size from 25mm to 60mm. While monitors were observing the tuna one managed to escape back into the waterway before it could be accurately identified and measured. It was estimated that this tuna was approximately 730mm in length. After this tuna had escaped the monitors then used a small amount of clove oil to sedate the fish so they could be measured and identified more accurately. Of the remaining tuna, one was identified as shortfin while the other three were identified as longfin. The 3 longfin tuna were measured at approximately 600mm, 650mm, and 850mm. The one remaining shortfin tuna was measured at approximately 650mm. Once fish were identified and measured they were transferred to a recovery bucket of water before being transferred back into the waterway once they had regained consciousness. An electric air pump was also used in the recovery bucket to increase oxygen levels for the fish.

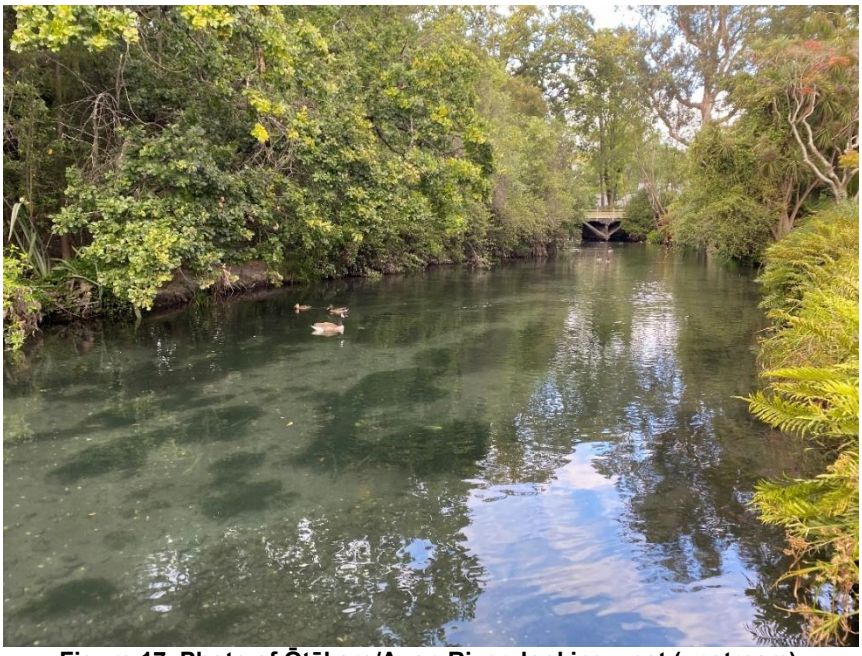

Figure 17. Photo of Ōtākaro/Avon River, looking west (upstream).

5.1.9 9 – Ōtākaro at Ōtautahi

SOT scores at Site 9 were varied, ranging from 1 to 3 across all categories. Although there were no extensive barriers identified with site access, there were a number of issues noted that impacted overall health. These were site pressures from the surrounding land use (for example the intensive housing on one side of the river and the urban park on the other), and the various stormwater runoff from surrounding roads and footpaths. Overall health for SOT was scored a 3 on average with rubbish and weeds within the waterway being identified as the main influencers for this. CHI scores were typically between 2-3 for most categories. Riverbed conditions were scored a 1 due to the abundance of weeds instream. Only one gee minnow trap was set at this site for the purpose of conducting a fish survey. Monitors had originally planned to set one hīnaki however stream depth was too deep to safely install a net. The abundance of weeds as well as other recreational users of the river were also factors in preventing a hīnaki being installed at this site. Eight common bullies were caught overnight in the gee minnow trap, ranging in sizes from approximately 65mm to 105mm. No other fish species were caught at this site.

Figure 18: Photo of Ōtākaro River facing north.

5.1.10 10 – Kerrs Reach

The SOT scores for Site 10 varied from 1.5 for degree of modification to 4 for site access for harvesting. Actions such as restoration of native species, increasing native riparian planting, and pest/weed control were identified by monitors to improve site health. This site is within Christchurch's Residential Red Zone where land has been identified as unsuitable for buildings. This has resulted in the surrounding landscape becoming very bare since the 2010/2011 Christchurch earthquakes with all residential housing being demolished. The only buildings that remain at the site are the rowing club and facilities. The surrounding land use at this site is predominately recreational, with mainly rowers and fisherman using the river. Other recreational users include kayakers, runners and dog walkers. CHI scores were similar, with scores ranging from 1.5 to 4 across the categories, with overall health scoring a 2.5. Monitors noted that more native vegetation planting and native riparian planting was needed to help restore this site as a mahinga kai. One gee minnow trap was set along the true right bank as part of the fish survey for this site. In total there were 18 common bullies caught overnight, ranging from approximately 50mm to 100mm in length. One deceased common bully was also found in the gee minnow trap, which was approximately 20mm in length.

Figure 19: Photo of Ōtākaro river at Kerrs Reach, looking west across the river.

5.1.11 11 – Te Oranga Horseshoe Lake

SOT scores for Site 11 were varied, ranging from 1 to 3.5. Mahinga kai harvest was the lowest scored category, as the site was observed as being too polluted from bird excrement. CHI scores were lower on average, with most categories scoring either a 1 or 1.5 on average. Water clarity was very poor at this site, with lakebed conditions being very soft and predominantly made up of silt and mud. There are also multiple stormwater discharge points from nearby residential dwellings and roads which discharge untreated stormwater directly into the waterbody. This would have a significant impact on water quality within Horseshoe Lake, in particular during heavy rainfall events. One gee minnow trap and one hīnaki were set along the true left bank and left overnight for the purpose of conducting a fish survey. In total two common bullies, one giant bully, one shortfin tuna and three longfin tuna were caught. The two common bullies were estimated to be between 25mm and 30mm in length. The giant bully was measured at approximately 120mm in length. The three longfin tuna were approximately between 600mm and 850mm in length, and the one shortfin tuna was approximately 650mm in length.

Figure 20: Photo of Te Oranga Horseshoe Lake, looking south (downstream).

5.1.12 12 – Ōruapaeroa Travis Wetland

SOT scores at Site 12 were much more positive than from previous sites. Scores ranged from 3.5 to 5. Monitors scored access for harvesting a 5 (very good) as they felt there were no restrictions to accessing mahinga kai to harvest. Overall health was scored a 4.5, with monitors stating the contaminants from the high abundance of bird species would have a negative impact on water quality here. CHI category scores varied from 1 (variety of habitats) to 4.5 (catchment landuse). Variety of habitats scored very poorly due to the waterbody not having any current or depth variability. It was noted with monitors however that the site was a natural wetlands, which can make it difficult to assess against SOT and CHI assessment questions as they are designed for assessing streams and waterways. The majority of questions from the SOT and CHI however are still relevant for this site and provide important information. Monitors noted that there were no major concerns observed at this site, and how beautiful the natural wetlands are. The only concerns raised by monitors were regarding the potential contamination from the abundance of bird species throughout the site. Continuing to plant more native vegetation at this site was noted as an action that monitors would like to see happen in the future, to continue restoration and enhancement of this site as a mahinga kai. Monitors were unable to conduct a fish survey at this site due to the low depth of water throughout the wetlands during the time of monitoring.

Figure 21: Photo of Ōruapaeroa Travis Wetlands, looking southwest from monitoring location.

5.1.13 13 – Owles Terrace

SOT scores at Site 13 were mostly poor, with scores of 1 to 1.5 for all but one category. Access for harvesting was the exception which scored 3.5. Reasons for poor scores were the level of discharge that was occurring at this site, the degree of modification that has occurred such as the bridges and stopbanks that have been built up, and the amount of toxic algae that is present in and around the water. CHI scores were consistent, with all categories being scored between 1 and 2 on average. Riverbed conditions were very poor, with a lot of sediment, silt, and mud build up with minimal plants rooted in the riverbed. Water clarity was also poor, and in most places monitors were unable to see the bottom of the riverbed. Due to the level of discharge occurring at this site monitors indicated they would not harvest any mahinga kai that may be present. Two gee minnow traps were set along the true left bank of the waterway and left overnight to conduct a fish survey. In total there were 11 common bullies, 4 giant bullies, 1 shortfin eel, 2 unidentified baby eels, and 2 unidentified deceased fish caught in both gee minnow traps. Common bullies ranged between approximately 55mm to 110mm in length, while giant bullies were measured at approximately 70mm to 80mm in length. The shortfin eel was measured at approximately 660mm in length and the unidentified baby eels were approximately 170mm to 220mm in length.

Figure 22: Photo of Ōtākaro looking downstream (south).

6 Conclusion and recommendations

Mahaanui Kurataiao Ltd undertook cultural monitoring in February and March of 2024 at thirteen sites within the Ōtākaro catchment using the SOT and CHA methods. The average health score for both SOT and CHA assessments were 2.3 and 2.2 respectively, indicating below average health. The Attribute Target Level for Mana Whenua Values of 5 (very good health) was therefore not met by the survey results. The average overall health scores from the 2024 survey had improved slightly in comparison to the most recent SOT survey for the Ōtākaro catchment conducted in 2012, however many of the issues and concerns raised in 2012 were also discussed in the 2024 survey. Concerns raised that negatively influenced catchment health scores included the absence of flowing water (i.e., Site 1 Avonhead and Site 2 Burnside Park), little to no vegetation and the presence of exotic vegetation and weeds, poor water clarity, high volumes of sediment instream, and a lack of indigenous vegetation and/or mahinga kai species. Additional concerns were raised around human rubbish found within waterways and bank vegetation, lack of easy waterway access in some sites, lack of native riparian planting, unidentified direct stormwater discharges into waterways, and toxic algae blooms.

6.1 Recommendations

The following recommendations have been provided as a result from the 2024 survey. Where issues have been identified and persist from the 2012 survey, the recommendations from that report have been replicated here.

- A catchment-based planting plan must be developed that ensures riparian margins are protected and enhanced while also providing sufficient habitat for taonga species. This should include removal of exotic pest species (e.g., blackberry, clematis, willows) to prevent indigenous planting being choked. It should also include appropriate maintenance of species such as harakeke, in conjunction with best practice and tikanga advice from mana whenua. These works must have stringent erosion and sediment controls in place during works to protect the awa.
- Overgrown weeds must be regularly monitored and maintained throughout the Ōtākaro catchment. In particular along waterway banks, margins and instream.
- *E. coli* levels within the catchment must be monitored regularly and the sources of this contamination be identified as soon as possible.

- Pending results of the *E. coli* investigation, appropriate measures must be implemented to reduce levels of contamination within the catchment. Further information on the source of the *E. coli* contamination and measures to reduce contamination must be discussed with rūnanga through appropriate channels.
- Sediment sources must be investigated throughout the catchment, and specific plans for planting be developed and enacted to mitigate erosion impacts in these areas. Plans to control and remove excess sediment must also be developed and enacted to improve stream health and habitat. As mentioned above, any plantation works must have stringent erosion and sediment controls to protect the awa.
- Mahinga kai sites should be developed throughout the catchment in conjunction with mana whenua.
- All future urban development must have appropriate setbacks from waterways that are consistent with policies outlined in the Mahaanui Iwi Management Plan 2013 (refer to policy **WM12.5**).
- Appropriate rubbish bin facilities must be installed within public spaces to help prevent litter. Public spaces should be regularly monitored to identify fly-tipping activity and keep walkways tidy.
- Methods to protect the river from road runoff, particularly on high vehicle use roadways, should be investigated and implemented.

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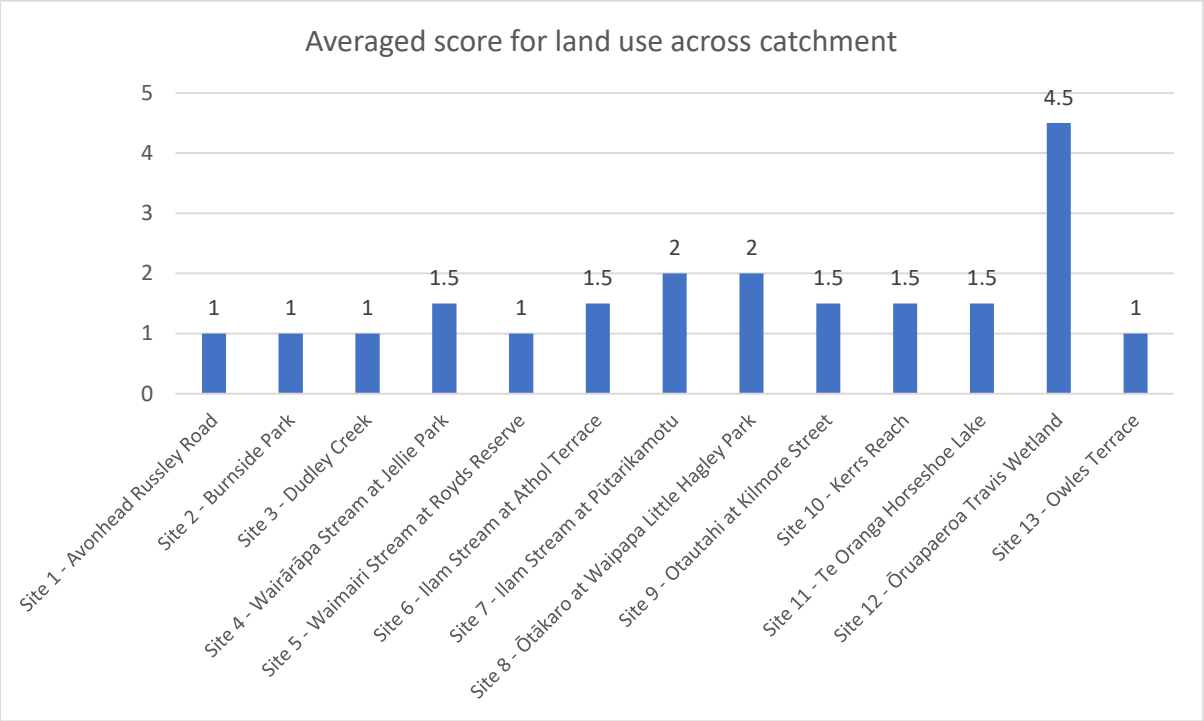
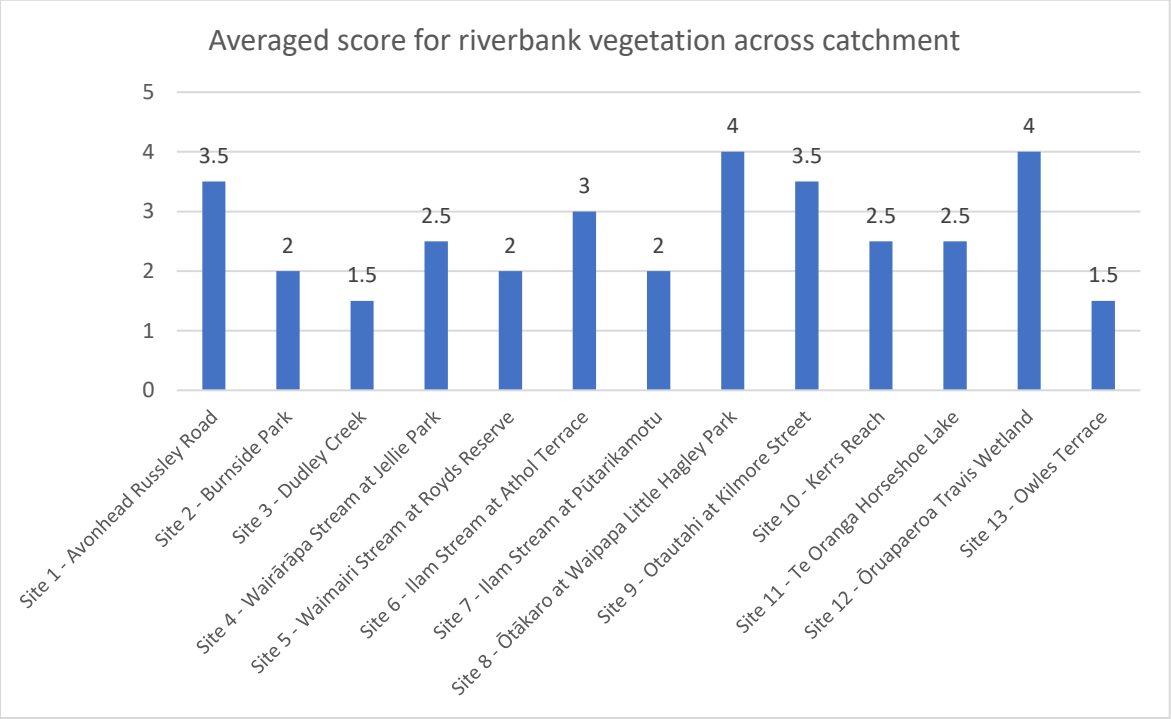
8 Appendix

8.1 Appendix A: Graphed results from Cultural Stream Health Assessment.

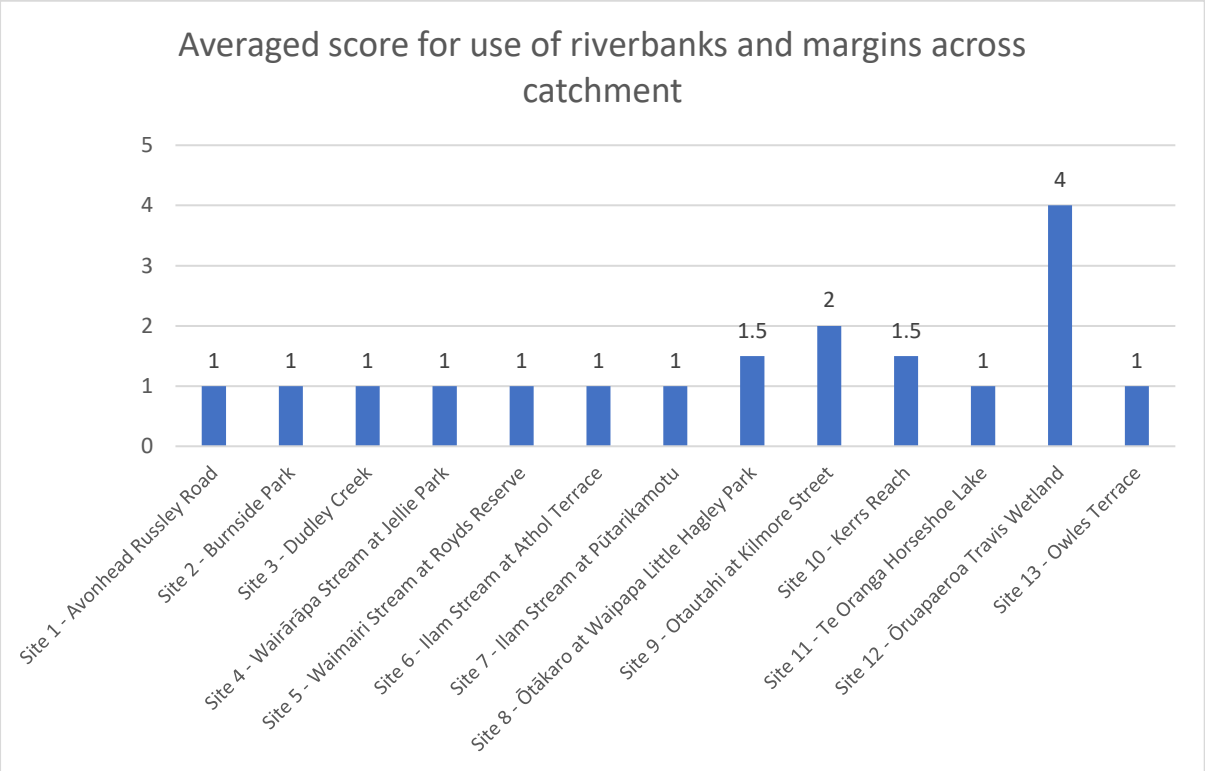
8.1.1 Observation of catchment land use.



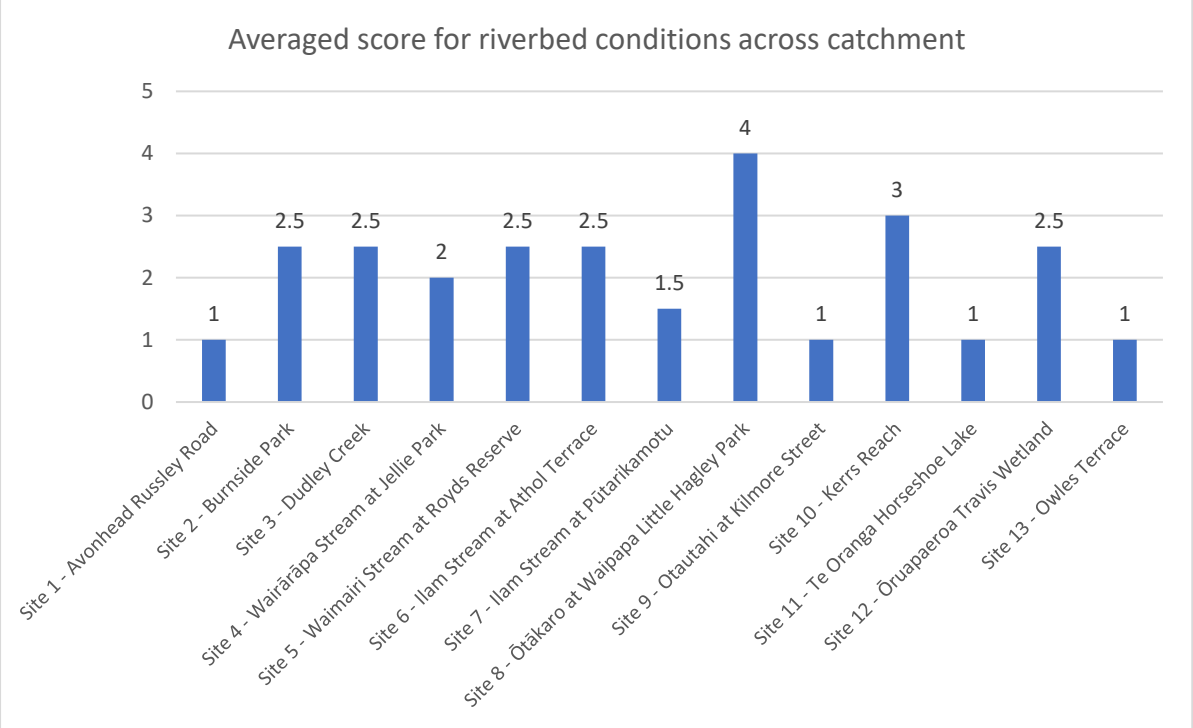
8.1.2 Assessment of vegetation cover along banks and margins (100m either side).



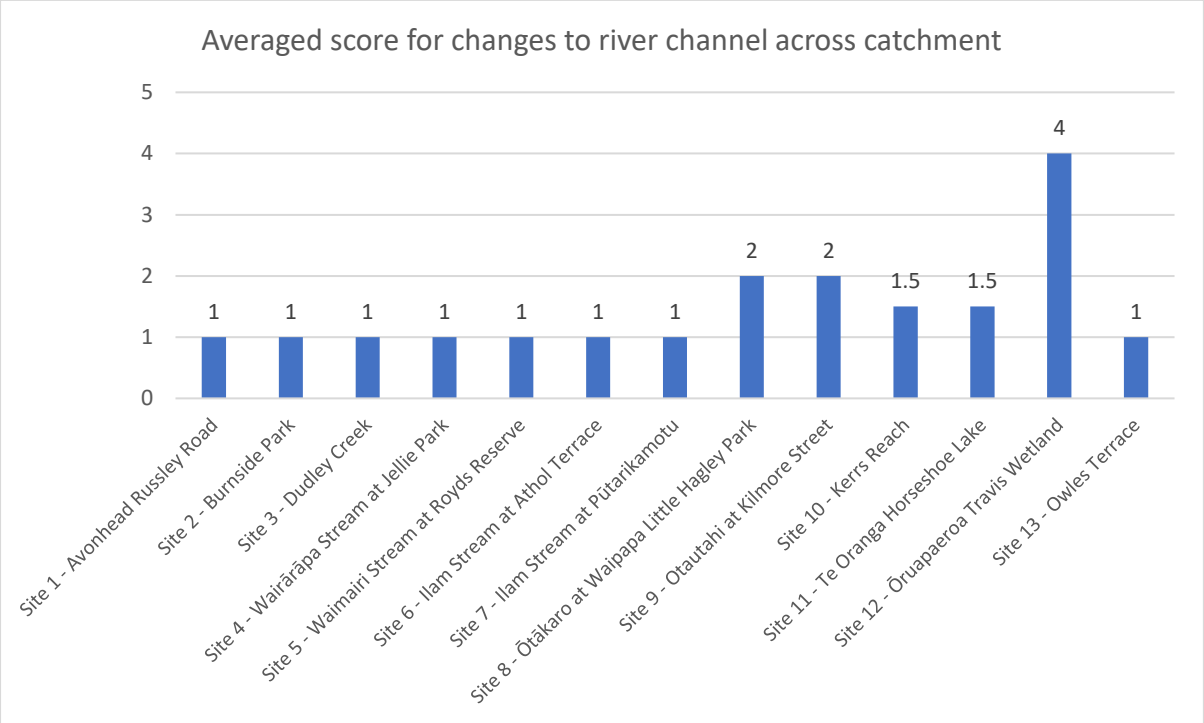
8.1.3 Use of the river banks and margins (100m either side).



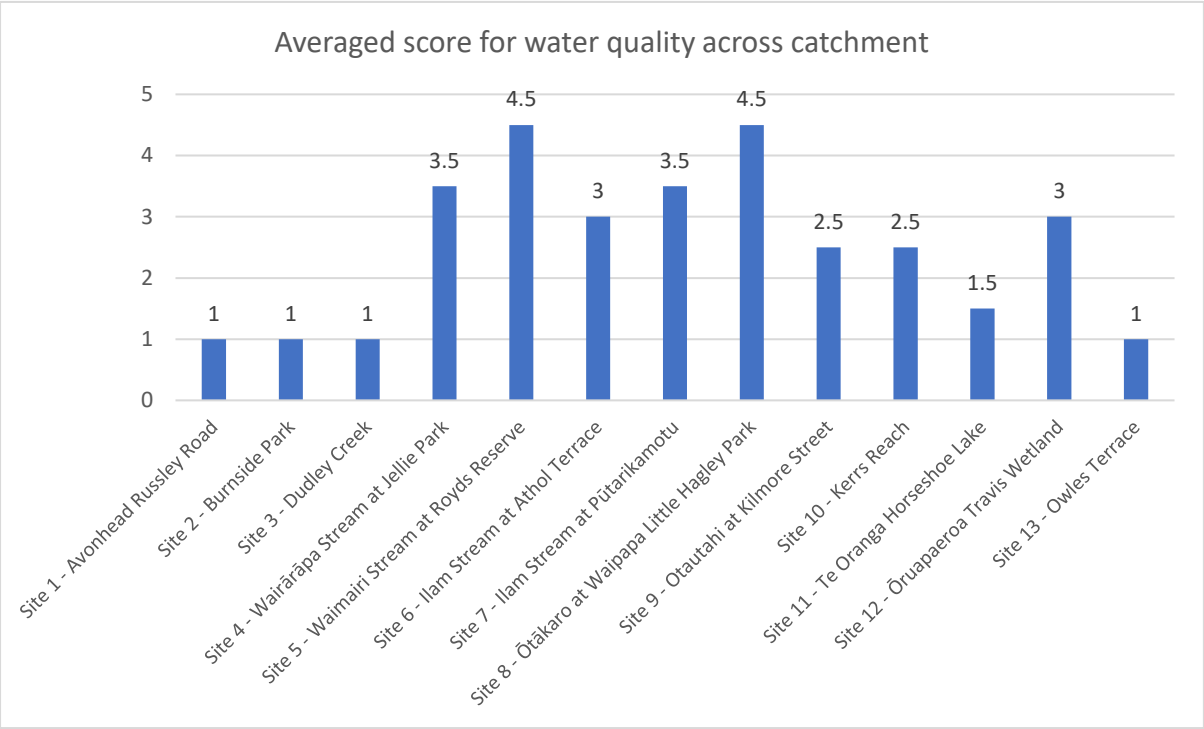
8.1.4 Assessment of riverbed conditions.



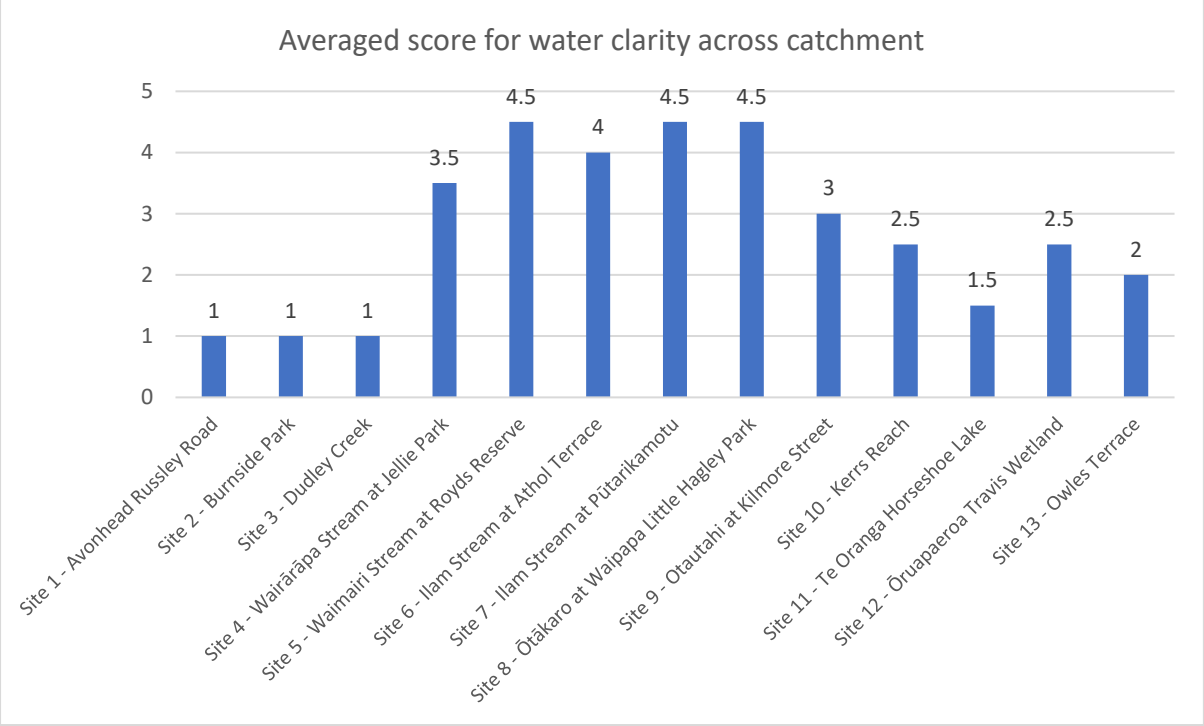
8.1.5 Changes to river channel.



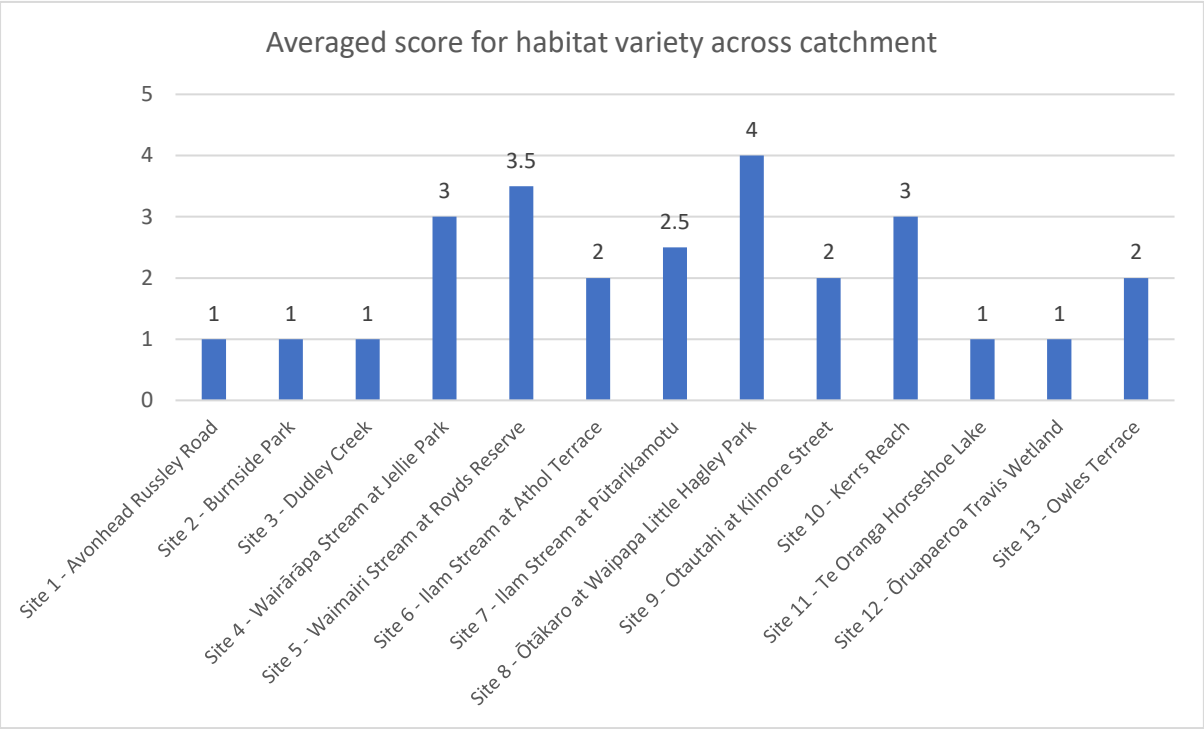
8.1.6 Assessment of water quality.



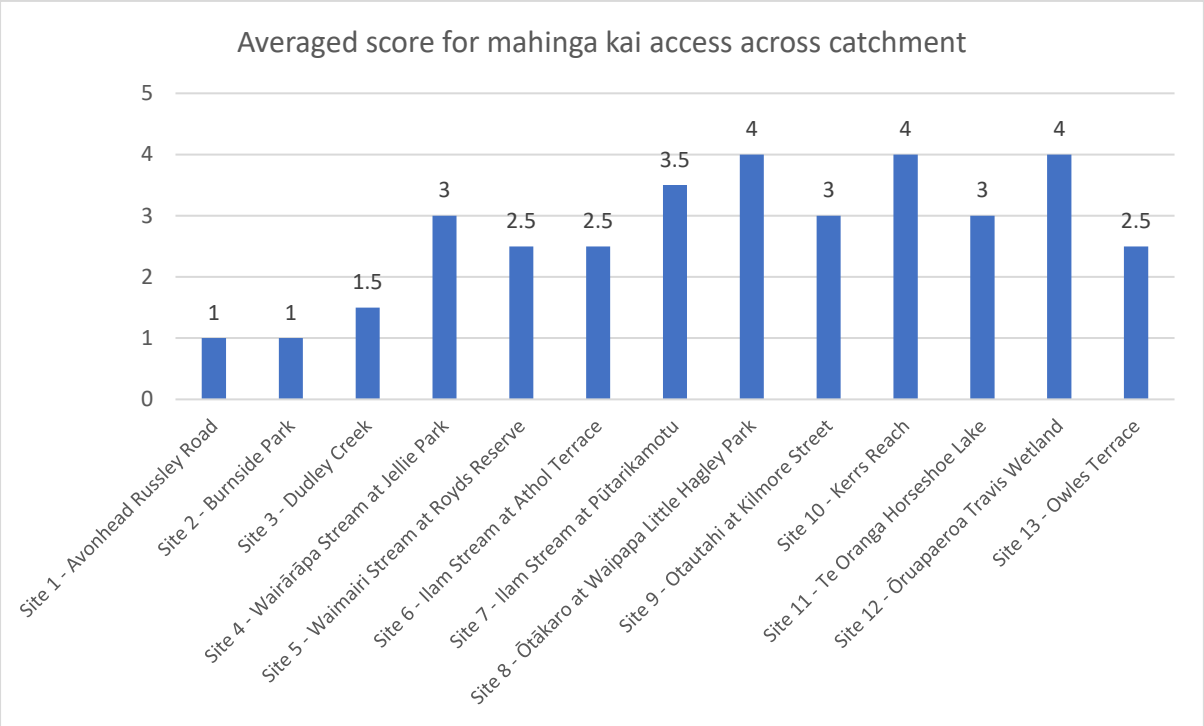
8.1.7 Assessment of water clarity.



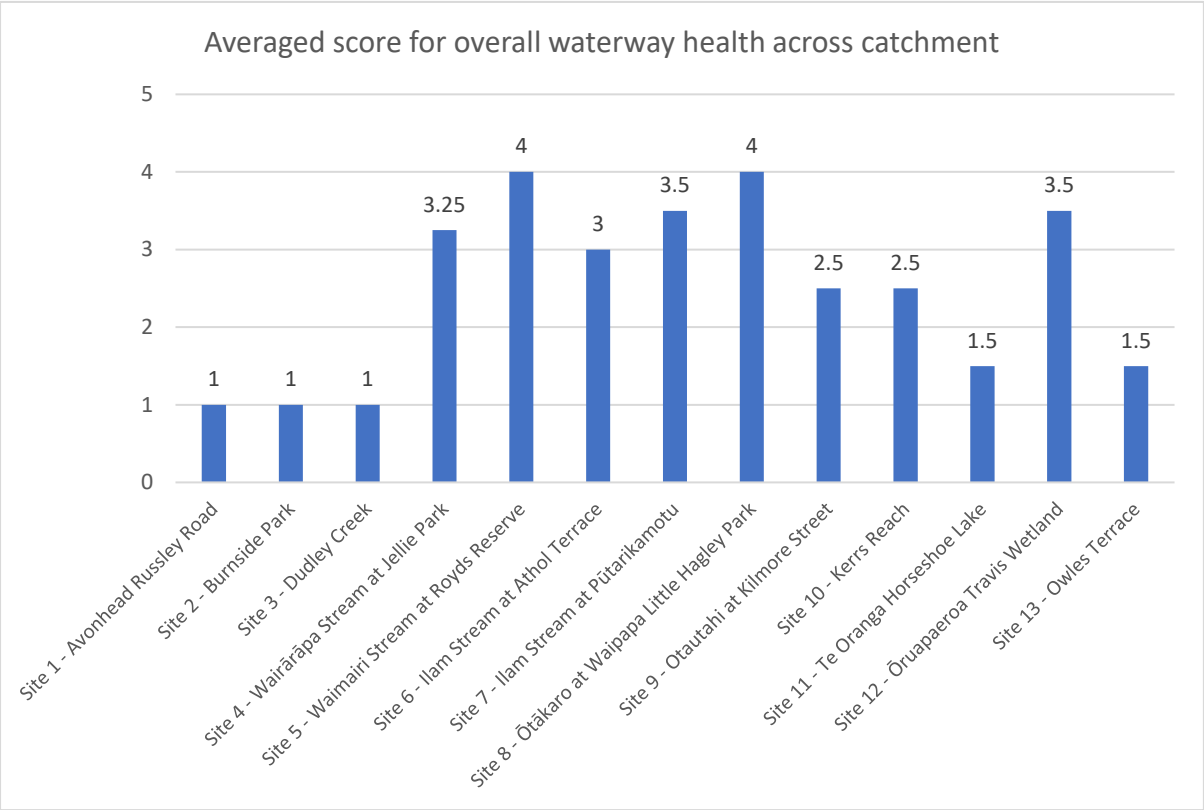
8.1.8 Assessment of habitat variety.



8.1.9 Do you consider site access is sufficient to harvest mahinga kai?



8.1.10 Overall health of waterway at each site.



8.2 Appendix B: Raw Data for vegetation, fish and bird surveys.

8.2.1 Plant Species

Site Code	Site Name	Plant Species (as recorded in survey)	Native/Introduced	Abundance
Site 1	Avonhead at Russley Road	Tī Kōuka	Native	Few
Site 1	Avonhead at Russley Road	Manuka	Native	Few
Site 1	Avonhead at Russley Road	Lemonwood	Native	Few
Site 1	Avonhead at Russley Road	Weeds	Introduced	Lots
Site 1	Avonhead at Russley Road	Blue gum trees	Introduced	Some
Site 1	Avonhead at Russley Road	Elderberry	Introduced	Lots
Site 1	Avonhead at Russley Road	Fennel	Introduced	Lots
Site 1	Avonhead at Russley Road	Black berry	Introduced	Lots
Site 1	Avonhead at Russley Road	Gorse	Introduced	Not recorded
Site 1	Avonhead at Russley Road	Dock plant	Introduced	Some
Site 1	Avonhead at Russley Road	Willow	Introduced	Not recorded
Site 2	Burnside Park	Tī Kōuka	Native	Some
Site 2	Burnside Park	Kōwhai	Native	Few
Site 2	Burnside Park	Ferns	Native	Few
Site 2	Burnside Park	Hollyhocks	Introduced	Few
Site 2	Burnside Park	Oak Tree	Introduced	Few
Site 2	Burnside Park	Elderberry	Introduced	Few
Site 2	Burnside Park	Ivy	Introduced	Lots

Site 2	Burnside Park	Dock plants	Introduced	Few
Site 2	Burnside Park	Willow	Introduced	Few
Site 2	Burnside Park	Black nightshade	Introduced	Few
Site 2	Burnside Park	Poplar	Introduced	Not recorded
Site 2	Burnside Park	Grasses and Weeds	Introduced	Not recorded
Site 2	Burnside Park	Maple	Introduced	Not recorded
Site 3	Dudley Creek	Swamp weed	Introduced	Few
Site 3	Dudley Creek	Dock plant	Introduced	Few
Site 3	Dudley Creek	Common grasses/weeds	Introduced	Few
Site 4	Wairārāpa Stream at Jellie Park	Lemonwood	Native	Some
Site 4	Wairārāpa Stream at Jellie Park	Kōwhai	Native	Some
Site 4	Wairārāpa Stream at Jellie Park	Tī Kōuka	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Harakeke	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Manuka	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Mingimingi	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Carex Plants	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Bracken Fern	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Native grasses	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Toetoe	Native	Few
Site 4	Wairārāpa Stream at Jellie Park	Elderberry	Introduced	Few
Site 4	Wairārāpa Stream at Jellie Park	Swamp plant	Introduced	Few

Site 4	Wairārāpa Stream at Jellie Park	Willow	Introduced	Few
Site 4	Wairārāpa Stream at Jellie Park	Silverbirch	Introduced	Few
Site 4	Wairārāpa Stream at Jellie Park	Douglas fur	Introduced	Few
Site 4	Wairārāpa Stream at Jellie Park	Weeds	Introduced	Not recorded
Site 4	Wairārāpa Stream at Jellie Park	Introduced grasses	Introduced	Few
Site 5	Waimairi Stream at Royds Reserve	Fern	Native	Few
Site 5	Waimairi Stream at Royds Reserve	Harakeke	Native	Some
Site 5	Waimairi Stream at Royds Reserve	Tī Kōuka	Native	Few
Site 5	Waimairi Stream at Royds Reserve	Totara	Native	Few
Site 5	Waimairi Stream at Royds Reserve	Punga	Native	Few
Site 5	Waimairi Stream at Royds Reserve	Lemonwood	Native	Not recorded
Site 5	Waimairi Stream at Royds Reserve	Carex	Native	Not recorded
Site 5	Waimairi Stream at Royds Reserve	Toetoe	Native	Few
Site 5	Waimairi Stream at Royds Reserve	Maple Trees	Introduced	Some
Site 5	Waimairi Stream at Royds Reserve	Common grasses	Introduced	Some
Site 5	Waimairi Stream at Royds Reserve	Magnolia	Introduced	Some
Site 5	Waimairi Stream at Royds Reserve	Swamp grasses	Introduced	Few
Site 5	Waimairi Stream at Royds Reserve	Oak tree	Introduced	Some
Site 5	Waimairi Stream at Royds Reserve	Yew trees	Introduced	Few
Site 6	Ilam Stream at Athol Terrace	Harakeke	Native	Some

Site 6	Ilam Stream at Athol Terrace	Toetoe	Native	Few
Site 6	Ilam Stream at Athol Terrace	Tī Kōuka	Native	Some
Site 6	Ilam Stream at Athol Terrace	Punga	Native	Few
Site 6	Ilam Stream at Athol Terrace	Totara	Native	Few
Site 6	Ilam Stream at Athol Terrace	Carex	Native	Few
Site 6	Ilam Stream at Athol Terrace	Willow	Introduced	Some
Site 6	Ilam Stream at Athol Terrace	Common grasses	Introduced	Few
Site 6	Ilam Stream at Athol Terrace	Iris plants	Introduced	Few
Site 6	Ilam Stream at Athol Terrace	Yellow buttercup	Introduced	Few
Site 6	Ilam Stream at Athol Terrace	Black nightshade	Introduced	Few
Site 6	Ilam Stream at Athol Terrace	Ivy	Introduced	Lots
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Harakeke	Native	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Tī Kōuka	Native	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Punga	Native	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Golden totara tree	Native	Not recorded
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Kahiketea trees	Native	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Blue Gum	Introduced	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Magnolia	Introduced	Few
Site 7	Ilam Stream at Pūtarikamotu / Deans Bush	Maple Tree	Introduced	Few
Site 8	Ōtākaro at Waipapa Little Hagley Park	Toetoe	Native	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Pungas	Native	Some

Site 8	Ōtākaro at Waipapa Little Hagley Park	Carrex	Native	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Mingimingi	Native	Few
Site 8	Ōtākaro at Waipapa Little Hagley Park	Tī Kōuka	Native	Few
Site 8	Ōtākaro at Waipapa Little Hagley Park	Bracken Fern	Native	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Golden Totara	Native	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Oak trees	Introduced	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Swamp trees	Introduced	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Buttercups	Introduced	Few
Site 8	Ōtākaro at Waipapa Little Hagley Park	Red Wood	Introduced	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Magnolias	Introduced	Some
Site 8	Ōtākaro at Waipapa Little Hagley Park	Wisteria	Introduced	Few
Site 8	Ōtākaro at Waipapa Little Hagley Park	Blue Gum Trees	Introduced	Some
Site 9	Otautahi at Kilmore Street	Harakeke	Native	Some
Site 9	Otautahi at Kilmore Street	Carrex	Native	Few
Site 9	Otautahi at Kilmore Street	Ferns	Native	Some
Site 9	Otautahi at Kilmore Street	Tī Kōuka Trees	Native	Some
Site 9	Otautahi at Kilmore Street	Native grasses	Native	Few
Site 9	Otautahi at Kilmore Street	Toetoe	Native	Few
Site 9	Otautahi at Kilmore Street	Poplar trees	Introduced	Some
Site 9	Otautahi at Kilmore Street	Swamp plants	Introduced	Some
Site 9	Otautahi at Kilmore Street	Dock plants	Introduced	Few

Site 9	Otautahi at Kilmore Street	Willow	Introduced	Not recorded
Site 10	Kerrs Reach	Harakeke	Native	Few
Site 10	Kerrs Reach	Willow	Introduced	Lots
Site 10	Kerrs Reach	Poplar trees	Introduced	Some
Site 10	Kerrs Reach	Pine trees	Introduced	Some
Site 10	Kerrs Reach	Evergreen magnolias	Introduced	Not recorded
Site 10	Kerrs Reach	Swamp weed	Introduced	Not recorded
Site 11	Te Oranga Horseshoe Lake	Harakeke	Native	Some
Site 11	Te Oranga Horseshoe Lake	Toetoe	Native	Few
Site 11	Te Oranga Horseshoe Lake	Native grasses	Native	Few
Site 11	Te Oranga Horseshoe Lake	Tī Kōuka	Native	Few
Site 11	Te Oranga Horseshoe Lake	Willow	Introduced	Lots
Site 11	Te Oranga Horseshoe Lake	Poplar	Introduced	Some
Site 11	Te Oranga Horseshoe Lake	Blackberry	Introduced	Few
Site 11	Te Oranga Horseshoe Lake	Silver birch	Introduced	Few
Site 12	Ōruapaeroa Travis Wetland	Harakeke	Native	Lots
Site 12	Ōruapaeroa Travis Wetland	Raupō	Native	Lots
Site 12	Ōruapaeroa Travis Wetland	Native grasses	Native	Lots
Site 12	Ōruapaeroa Travis Wetland	Manuka	Native	Some
Site 12	Ōruapaeroa Travis Wetland	Tī Kōuka	Native	Some
Site 12	Ōruapaeroa Travis Wetland	Toetoe	Native	Lots
Site 12	Ōruapaeroa Travis Wetland	Koromiko	Native	Some

Site 12	Ōruapaeroa Travis Wetland	Carex	Native	Lots
Site 12	Ōruapaeroa Travis Wetland	Mingimingi	Native	Some
Site 12	Ōruapaeroa Travis Wetland	Butter Cups	Introduced	Not recorded
Site 12	Ōruapaeroa Travis Wetland	Willow	Introduced	Some
Site 12	Ōruapaeroa Travis Wetland	Gorse	Introduced	Few
Site 12	Ōruapaeroa Travis Wetland	Poplar trees	Introduced	Some
Site 13	Owles Terrace	Toetoe	Native	Few
Site 13	Owles Terrace	Tī Kōuka	Native	Few
Site 13	Owles Terrace	Harakeke	Native	Few
Site 13	Owles Terrace	Pine tree	Introduced	Some
Site 13	Owles Terrace	Nurfolk Pine	Introduced	Few
Site 13	Owles Terrace	Common grasses	Introduced	Some

8.2.2 Fish Species

Site Code	Date	Site Name	Fish Species	Native/ Introduced	Method	Abundance	Size range
Site 4	March 2024	Wairārāpa Stream at Jellie Park	Tīpokopoko (Common Bully)	Native	Gee Minow	12	20mm – 35mm
Site 5	March 2024	Waimairi Stream at Royds Reserve	Longfin Tuna	Native	Gee Minow	1	530mm
Site 7	March 2024	Ilam Stream at Pūtarikamotu / Deans Bush	Tīpokopoko (Common Bully)	Native	Gee Minow	26	25mm – 65mm
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Tuna – Unidentified (escaped)	Native	Hīnaki	1	730mm

Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Shortfin Tuna	Native	Hīnaki	1	650mm
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Longfin Tuna	Native	Hīnaki	3	600mm – 850mm
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Tīpokopoko (Common Bully)	Native	Gee Minnow	13	25mm – 60mm
Site 9	March 2024	Otautahi at Kilmore Street	Tīpokopoko (Common Bully)	Native	Gee Minnow	8	65mm – 105mm
Site 10	March 2024	Kerrs Reach	Tīpokopoko (Common Bully)	Native	Gee Minnow	18	50mm – 100mm
Site 10	March 2024	Kerrs Reach	Tīpokopoko (Common Bully) – deceased	Native	Gee Minnow	1	20mm
Site 11	March 2024	Te Oranga Horseshoe Lake	Longfin Tuna	Native	Hīnaki	3	600mm – 850mm
Site 11	March 2024	Te Oranga Horseshoe Lake	Shortfin Tuna	Native	Hīnaki	1	650mm
Site 11	March 2024	Te Oranga Horseshoe Lake	Giant Bully	Native	Hīnaki	1	120mm
Site 11	March 2024	Te Oranga Horseshoe Lake	Tīpokopoko (Common Bully)	Native	Gee Minow	2	25mm – 30mm
Site 13	March 2024	Owles Terrace	Shortfin Tuna	Native	Gee Minow	1	660mm
Site 13	March 2024	Owles Terrace	Tīpokopoko (Common Bully)	Native	Gee Minow	11	55mm – 110mm
Site 13	March 2024	Owles Terrace	Giant Bully	Native	Gee Minow	4	70mm – 80mm

Site 13	March 2024	Owles Terrace	Baby Tuna (unidentified)	Native	Gee Minow	2	170mm – 220mm
Site 13	March 2024	Owles Terrace	Unidentified fish (deceased)	Unknown	Gee Minow	2	60mm
Site 13	March 2024	Owles Terrace	Unidentified fish	Unknown	Gee Minow	1	60mm

8.2.3 Bird Species

Site Code	Date	Site Name	Bird Species
Site 1	March 2024	Avonhead at Russley Road	Pūkeko
Site 2	March 2024	Burnside Park	Blackbird
Site 2	March 2024	Burnside Park	Pigeon
Site 3	March 2024	Dudley Creek	Blackbird
Site 4	March 2024	Wairārāpa Stream at Jellie Park	Unidentified ducks
Site 4	March 2024	Wairārāpa Stream at Jellie Park	Pīwakawaka
Site 6	March 2024	Ilam Stream at Athol Terrace	Pīwakawaka
Site 6	March 2024	Ilam Stream at Athol Terrace	Mallard duck
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Mallard duck
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Pigeon
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Paradise duck
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Blackbird
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Sparrow
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Unidentified sea gull
Site 7	March 2024	Ilam Stream at Pūtarikamotu	Pīwakawaka
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Pīwakawaka

Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Canadian geese
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Blackbird
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Pigeon
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Mallard duck
Site 8	March 2024	Ōtākaro at Waipapa Little Hagley Park	Grey duck
Site 9	March 2024	Otautahi at Kilmore Street	Pigeon
Site 9	March 2024	Otautahi at Kilmore Street	Pāpango / Black teal duck
Site 9	March 2024	Otautahi at Kilmore Street	Canadian geese
Site 9	March 2024	Otautahi at Kilmore Street	Unidentified sea gulls
Site 9	March 2024	Otautahi at Kilmore Street	Sparrow
Site 10	March 2024	Kerrs Reach	Pāpango / Black teal duck
Site 10	March 2024	Kerrs Reach	Canadian geese
Site 10	March 2024	Kerrs Reach	Black swan
Site 10	March 2024	Kerrs Reach	Grey duck
Site 10	March 2024	Kerrs Reach	Mallard duck
Site 10	March 2024	Kerrs Reach	Magpie
Site 10	March 2024	Kerrs Reach	Blackbird
Site 10	March 2024	Kerrs Reach	Sparrows
Site 10	March 2024	Kerrs Reach	Unidentified sea gulls
Site 11	March 2024	Te Oranga Horseshoe Lake	Pūkeko
Site 11	March 2024	Te Oranga Horseshoe Lake	Paradise duck
Site 11	March 2024	Te Oranga Horseshoe Lake	Unidentified sea gulls

Site 11	March 2024	Te Oranga Horseshoe Lake	Blackbird
Site 11	March 2024	Te Oranga Horseshoe Lake	Sparrow
Site 11	March 2024	Te Oranga Horseshoe Lake	Canadian geese
Site 11	March 2024	Te Oranga Horseshoe Lake	Grey duck
Site 11	March 2024	Te Oranga Horseshoe Lake	Pāpango / Black teal duck
Site 12	March 2024	Ōruapaeroa Travis Wetland	Pūkeko
Site 12	March 2024	Ōruapaeroa Travis Wetland	Bellbird
Site 12	March 2024	Ōruapaeroa Travis Wetland	Pāpango / Black teal duck
Site 12	March 2024	Ōruapaeroa Travis Wetland	Paradise duck
Site 12	March 2024	Ōruapaeroa Travis Wetland	Canadian geese
Site 12	March 2024	Ōruapaeroa Travis Wetland	Unidentified sea gulls
Site 12	March 2024	Ōruapaeroa Travis Wetland	Blackbird
Site 12	March 2024	Ōruapaeroa Travis Wetland	Sparrow
Site 12	March 2024	Ōruapaeroa Travis Wetland	Pīwakawaka
Site 13	March 2024	Owles Terrace	Black swan
Site 13	March 2024	Owles Terrace	Pīwakawaka
Site 13	March 2024	Owles Terrace	Unidentified sea gulls
Site 13	March 2024	Owles Terrace	Grey duck
Site 13	March 2024	Owles Terrace	Mallard duck
Site 13	March 2024	Owles Terrace	Blackbird

8.3 Appendix C: Water Quality testing results

See below for results table from water sample analysis as provided by Hills Laboratory.

Hill Labs
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
0508 HILL LAB (44 555 22)
+64 7 858 2000
mail@hill-labs.co.nz
www.hill-labs.co.nz

Certificate of Analysis Page 1 of 3

Client:	Mahaanui Kurataiao Limited	Lab No:	3482272	SPv1
Contact:	Irene Setiawan	Date Received:	29-Feb-2024	
	C/- Mahaanui Kurataiao Limited	Date Reported:	08-Mar-2024	
	226 Antigua Street	Quote No:	128949	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Irene Setiawan	

Sample Type: Aqueous

Sample Name:		Site 4 28-Feb-2024 9:15 am	Site 5 28-Feb-2024 9:55 am	Site 7 28-Feb-2024 11:35 am	Site 8 28-Feb-2024 12:40 pm	Site 9 28-Feb-2024 1:24 pm
Lab Number:		3482272.1	3482272.2	3482272.3	3482272.4	3482272.5
pH	pH Units	7.3	7.5	7.5	7.7	7.7
Electrical Conductivity (EC)	mS/m	17.3	18.0	19.4	18.4	18.7
Total Suspended Solids	g/m³	< 3	< 3	< 3	< 3	3
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00010
Dissolved Zinc	g/m³	0.0016	0.0015	0.0059	0.0039	0.0049
Total Nitrogen	g/m³	1.43	2.4	3.1	2.0	1.74
Total Ammoniacal-N	g/m³	0.039	< 0.010	0.010	< 0.010	0.058
Nitrite-N	g/m³	0.006	< 0.002	0.002	0.003	0.007
Nitrate-N	g/m³	1.33	2.4	3.0	1.98	1.60
Nitrate-N + Nitrite-N	g/m³	1.33	2.4	3.0	1.98	1.60
Total Kjeldahl Nitrogen (TKN)	g/m³	0.10	< 0.10	< 0.10	< 0.10	0.13
Dissolved Reactive Phosphorus	g/m³	< 0.004	0.005	< 0.004	< 0.004	0.017
Total Phosphorus	g/m³	0.006	0.006	0.006	0.007	0.019
Escherichia coli	MPN / 100mL	770 #1	86 #1	308 #1	461 #1	579 #1
Chlorophyll a	g/m³	0.0009	< 0.0002	0.0003	0.0007	0.0011

Sample Name:		Site 11 28-Feb-2024 2:15 pm	Site 12 28-Feb-2024 2:50 pm
Lab Number:		3482272.6	3482272.7
pH	pH Units	7.7	8.3
Electrical Conductivity (EC)	mS/m	18.5	48.3
Total Suspended Solids	g/m³	< 3	60
Dissolved Copper	g/m³	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	0.00019
Dissolved Zinc	g/m³	< 0.0010	< 0.0010
Total Nitrogen	g/m³	0.48	3.4
Total Ammoniacal-N	g/m³	0.046	< 0.010
Nitrite-N	g/m³	0.007	< 0.02 #2
Nitrate-N	g/m³	0.193	< 0.02
Nitrate-N + Nitrite-N	g/m³	0.20	< 0.02 #2
Total Kjeldahl Nitrogen (TKN)	g/m³	0.28	3.4
Dissolved Reactive Phosphorus	g/m³	0.048	0.032
Total Phosphorus	g/m³	0.081	0.61
Escherichia coli	MPN / 100mL	770 #1	> 2,420 #1
Chlorophyll a	g/m³	0.0015	0.076

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Mahaanui Kurataiao Ltd

Te Pātaka o Rākaihautū

Cultural Monitoring Report

October 2025

Executive Summary

This report details cultural monitoring undertaken to assess mana whenua values in Te Pātaka o Rākaihautū / Banks Peninsula catchment as required under the conditions of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC252424) held by Christchurch City Council (CCC).

Mahaanui Kurataiao Ltd undertook cultural monitoring within the takiwā of Wairewa Rūnanga and Te Hapū o Ngāti Wheke (Rāpaki) Rūnanga over two separate days during March and April 2025 using the State of Takiwā and Cultural Health Assessment methods. Cultural monitors from Ōnuku Rūnanga and Te Rūnanga o Koukourarata were unavailable during the set monitoring period outlined in the CCC Environmental Monitoring Programme, therefore no cultural monitoring was able to be conducted. It is proposed that cultural monitoring will be undertaken during the next summer with both Rūnanga.

Overall, this monitoring indicated that cultural health values throughout the catchment varied from poor to very good in a range of cultural health categories. The Attribute Target Level for Mana Whenua Values of 5 (i.e., very good) was not met by the 2025 survey results.

The results of the 2025 surveys showed wide ranging values of cultural health parameters, with some aspects of monitoring sites scoring well, but most scoring poorly to moderately. High *E. coli* levels (i.e. above the recreational use limit of 550 MPN/100 mL in the Canterbury Land and Water Plan) were detected at all but one of the monitoring sites where water quality samples were taken throughout the Whakaraupō and Te Roto o Wairewa catchments.

Concerns outlined by cultural monitors during both State of Takiwā monitoring surveys for Wairewa Rūnanga and Te Hapū o Ngāti Wheke included a high abundance of exotic vegetation (i.e., willow) in some parts of the catchment, significant modification in streams and rivers (e.g., stream bank modifications and man-made structures such as culverts), and noticeable stream/lake health issues such as algal blooms and thick patches of sediment along stream beds. Recommendations have been included in this report based on the results of the 2025 surveys.

Acknowledgements

Mahaanui Kurataiao Ltd would like to thank the cultural monitors, Ana Gray, Matiu Prebble, Iaean Cranwell, and Aaria Rolleston from Wairewa Rūnanga, and Tayla Nelson-Tuhuru and Nadia Green from Te Hapū o Ngāti Wheke (Rāpaki) Rūnanga.

Contents

1 Introduction

This report details monitoring undertaken to assess mana whenua values in Te Pātaka o Rākaihautū / Banks Peninsula catchment as required under the conditions of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC252424) held by Christchurch City Council (CCC).

Mahaanui Kurataiao Ltd undertook cultural monitoring in March and April of 2025 throughout the Whakaraupō and Te Roto o Wairewa catchments. Twelve monitoring sites were surveyed across both catchments. Three of these sites were subject to previous aquatic ecology and water quality monitoring and are listed in the CCC Environmental Monitoring Programme for the CSNDC. The other nine monitoring sites were requested by the Kaitiaki of Wairewa Rūnanga and Te Hapū o Ngāti Wheke Rūnanga.

1.1 Monitoring sites

Under the CSNDC, catchments are monitored on a five-yearly rotation to assess the efficacy of actions undertaken to mitigate the impact of stormwater discharges on the receiving environment. Mahaanui Kurataiao Ltd undertook cultural monitoring at five sites throughout the Te Roto o Wairewa catchment with cultural monitors from Wairewa Rūnanga, and seven sites throughout the Whakaraupō catchment with cultural monitors from Te Hapū o Ngāti Wheke Rūnanga. All twelve monitoring sites are outlined in Tables 1 and 2, while site locations are shown in Figures 1 and 2. No sites have been previously monitored for Mana Whenua Values under the CSNDC, however three sites within the Whakaraupō catchment are monitored monthly for water quality, and one of these sites is also monitored annually for aquatic ecology as part of the Environmental Monitoring Programme (EMP) for the CSNDC. The remaining nine monitoring sites were requested by the Kaitiaki of Wairewa Rūnanga and Te Hapū o Ngāti Wheke Rūnanga during consultation prior to monitoring. A short summary of the significance of each site to both Rūnanga is included in Table 1 and 2. The monitoring and results presented in this report are a snapshot of the cultural and water quality health of the river at the time of recording. Many of the monitored aspects require further and/or continuous monitoring to determine trends in the data.

Table 1. Monitoring sites for Whakaraupō sub catchment, as part of monitoring for Te Pātaka o Rākaihautū / Banks Peninsula catchment in 2025.

Site No.	Water Body	Location	Significance	Land Use	Coordinates (NZTM X, Y)	CCC EMP monitoring site code
1	Whakaraupō / Lyttelton Harbour	Te Ana Marina	Te Tai o Mahaanui (Selwyn-Banks Peninsula Coastal Marine Area) Coastal Statutory Acknowledgement Area.	Urban / Special Purpose Lyttelton Port Zone	1576799, 5171979	CW02
2	Cass Bay Drain	Cass Bay Walkway	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1575113, 5171881	CW03
3	Stream Reserve Drain	Māori Gardens Track, Governors Bay	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1572032, 5170198	BP01
4	Ohinetahi / Allandale Outlet	Allandale Domain	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1571751, 5167960	None
5	Te Rapu Outlet	Governors Bay Teddington Road	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1572643, 5164920	None
6	Te Wharau Stream	Marine Drive	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1575995, 5166492	None
7	Purau Stream	Purau Recreation Ground	Wāhi taonga. Traditional mahinga kai site.	Urban / Recreation	1579853, 5168148	None

Table 2. Monitoring sites for Te Roto o Wairewa sub catchment, as part of monitoring for Te Pātaka o Rākaihautū / Banks Peninsula catchment in 2025.

Site No.	Water Body	Location	Significance	Land Use	Coordinates (NZTM X, Y)	CCC EMP monitoring site code
1	Hukahuka Turoa Stream	Western Valley Road	Traditional mahinga kai site. Key tributary of Te Roto o Wairewa.	Rural	1583656, 5155986	None
2	Ōkana River	Awa-iti / Little River Domain	Traditional mahinga kai site. Wāhi tapu. Significant recreational area – recreational sport and local school grounds.	Urban / Park	1583649, 5154234	None
3	Ōkana River	Kinloch Road	Traditional mahinga kai site. Wāhi tapu. Significant recreational area – Christchurch Akaroa Rail Trail along true right of awa.	Rural	1583030, 5153152	None
4	Okuti River	Kinloch Road	Traditional mahinga kai site – historic kanakana spawning site upstream.	Rural	1583548, 5151716	None
5	Te Roto o Wairewa / Lake Forsyth	Catons Bay	Statutory Acknowledgement site. Culturally significant mahinga kai site.	Rural	1580548, 5151398	None

Figure 1.Whakaraupō catchment monitoring site map as part of Te Hapū o Ngāti Wheke Rūnanga State of Takiwā monitoring.

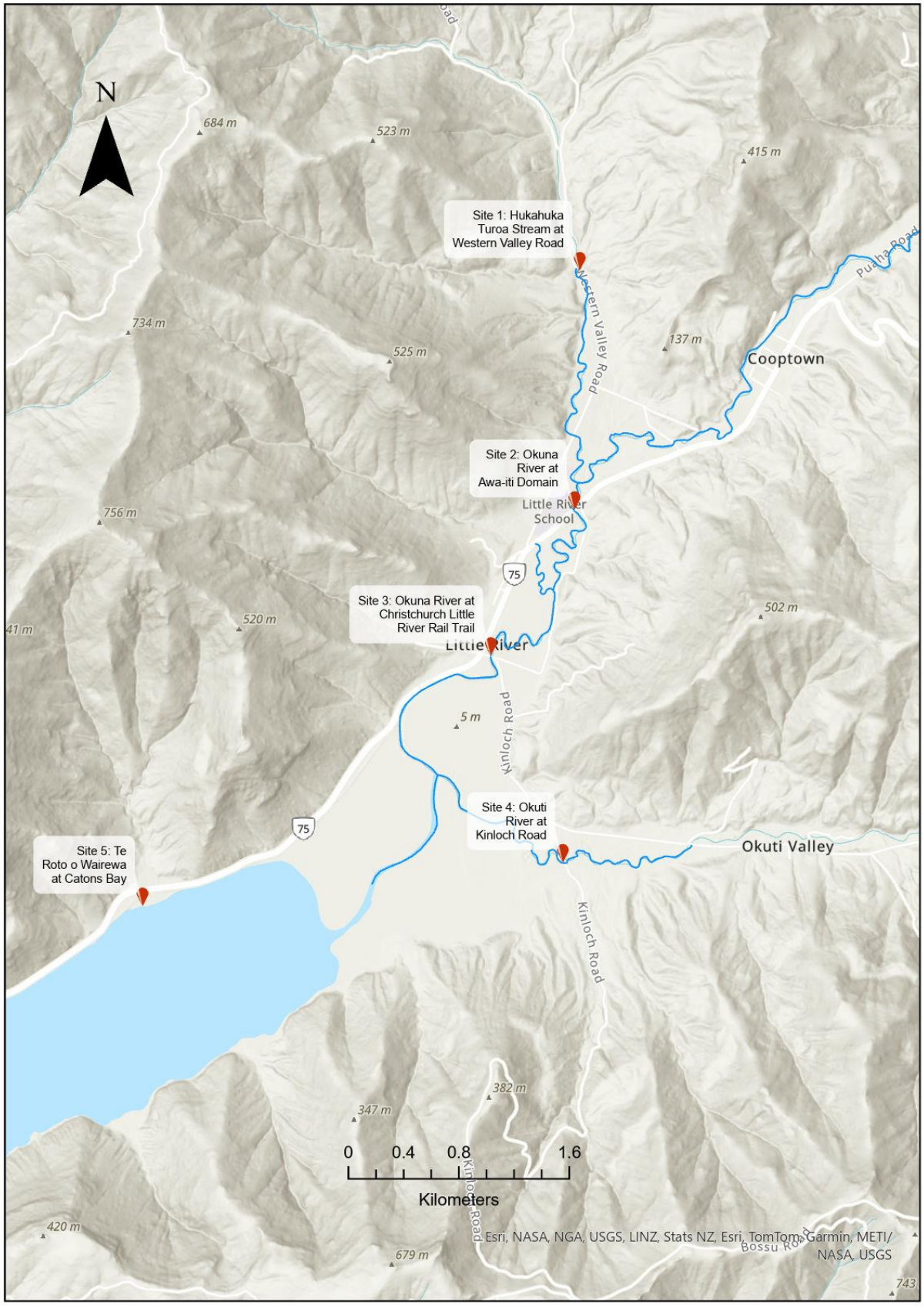

Figure 2: Te Roto o Wairewa catchment monitoring site map as part of Wairewa Rūnanga State of Takiwā monitoring

1.2 Methodology

The surveys in 2025 utilised the State of Takiwā and Cultural Health Assessment to undertake the monitoring of mana whenua values within the catchment. These methods incorporate vegetation, bird and fish surveys, and water quality methods from the NIWA Stream Health and Macroinvertebrate Assessment Kit or SHMAK (Biggs, Kilroy, & Mulcock, 1998). Water quality parameters were recorded using a Hanna multiparameter probe and water samples from suitable sites were sent to Hills Laboratory for analysis. The following sections provide a summary overview of these methods.

1.2.1 State of Takiwā

State of Takiwā (SOT) is an established tool used as part of other waterway monitoring in Canterbury and was developed by Te Rūnanga o Ngāi Tahu as part of their Ki uta ki tai - Mountains to the Sea Natural Resource Management framework (Pauling, 2004) and outlined in the tribal vision, Ngāi Tahu 2025 (Te Rūnanga o Ngāi Tahu, 2003). SOT combines mātauranga māori and western science practices to give a holistic view of catchment health by assessing a range of waterway health indicators. This method involves acquiring information based on the following forms: site definition, site visit, site assessment, cultural stream assessment, and SHMAK. The programme is designed to facilitate tangata whenua to record information, assess the data and produce reports that reflect the environmental and cultural health of relevant natural resources. The SOT also uses a standard data form, which is completed based on shared background information or research and in-field observation.

The site visit form includes meteorological data, identified site pressures and archaeological observations, as well as any recent land disturbances. This helps contextualise the information gathered on the day of monitoring and can help identify trends (e.g., seasonal patterns, wet weather events, maramataka/lunar cycles). The main part of the SOT assessment is the site assessment forms, which identifies and scores site pressures, the degree of modification, the suitability and access restrictions for mahinga kai practices.

The final components of the SOT assessment are based on the SHMAK method to allow iwi, landowners, and community groups to assess stream habitat and stream-bed life. The components for assessing stream habitat include an assessment of habitat quality, composition of stream bed, bank vegetation and deposits. Components for assessing stream-bed life include assessments of invertebrates and periphyton (on exposed surfaces). Velocity was measured using the methodology outlined in the SHMAK manual. Water clarity was measured using a clarity tube, or where clarity was higher (over the 1 metre length of the

clarity tube) a black disc viewer (Biggs, Kilroy, & Mulcock, 1998). Further details on the level of testing that was conducted at each site are outlined in sections below.

1.2.2 Cultural Health Assessment

The Cultural Health Assessment/Index (CHA) for streams and waterways (Tipa & Teirney, 2003) was developed in conjunction with three Ngāi Tahu Rūnanga (Arowhenua, Ōtākou and Moeraki Rūnanga) in the South Island and Ngāti Kahungunu in the North Island. The CHA is made up of three components: site status (traditional significance), mahinga kai values assessment, and cultural stream health. The site status component describes the significance of the site to Māori; whether it is a traditional or contemporary site and the likelihood that mana whenua will return to this site. The mahinga kai values assessment identifies mahinga kai species present at each site and then compares this with historical abundance. Site access is also assessed as it can be a barrier to mana whenua undertaking cultural practices. Lastly, the cultural stream health measure uses a 1-5 score (1 = poor quality/low values to 5 = high quality/values) for eight individual indicators: water quality, water clarity, flow and habitat variety, catchment land use, riparian vegetation cover, riverbed condition or sediment, use of the riparian margin and degree of channel modification. Scores from these eight indicators are combined to provide a cultural stream health measure. The questions used in the 2025 surveys were provided by Gail Tipa as part of training with Mahaanui Kurataiao Ltd staff in January 2023. The form is filled out individually by each attending mana whenua monitor.

1.2.3 Indigenous vegetation and bird surveys

The qualitative observational survey of indigenous and introduced vegetation involves an in-field identification within a 100-metre radius of each site. The species were noted for each site surveyed. The percentage of indigenous cover was estimated to the nearest 5%. Bird species were identified on day of the in-field recording and were also noted for each site surveyed.

1.2.4 Fish survey

In addition to the data gathered from in-field observations, the State of Takiwā method for fish survey involves using trapping methods appropriate to different stream conditions. Trapping methods typically used in the State of Takiwā survey methodology include hīnaki (fyke nets), and gee minnow traps, with both nets and traps left overnight. Hīnaki capture larger aquatic species (e.g., tuna/eels), and gee minnow capture smaller species (e.g., bullies and elvers). Due to limited MKT staff and cultural monitor availability, and stream conditions, monitors were

unable to set fish traps in the awa overnight. Many of the streams monitored had low flows and stream depth, making them unsuitable for gee minnow traps and hīnaki. Others were unsafe to enter and set fish traps and nets. Data from the New Zealand Freshwater Fish Database (NZFFD) was gathered for all available monitoring sites to help support State of Takiwā survey data.

1.2.5 Water quality testing

Water quality parameters were recorded using a Hanna multiparameter probe. This can measure fluid pH, oxidation reduction potential (ORP), electrical conductivity, turbidity, dissolved oxygen (DO), and temperature. Water samples were collected from the CCC EMP sites (Site 2 - Cass Bay Drain, Cass Bay and Site 3 - Stream Reserve Drain, Governors Bay) as well as sites 4, 6 and 7 from Te Hapū o Ngāti Wheke monitoring. Water samples were also collected as part of the Wairewa Rūnanga monitoring at Site 1 – Hukahuka Turoa Stream, Site 2 – Okana River at Awa-iti Domain, and Site 3 – Okana River at Christchurch Little River Rail Trail. Water samples were collected by monitors using testing kits provided by Hill Laboratories Limited. The collected water samples were sent to Hill Labs for analysis of dissolved metals and other common contaminants (listed in Appendix C).

2 Background and traditional associations

Te Pātaka o Rākaihautū / Banks Peninsula is culturally significant landscape of immense importance to Ngāi Tahu Whānui. The bays, coast and lands of this catchment are part of the rich history and identity of Ngāi Tahu and reflect the relationship between tāngata whenua and the environment. The numerous pā sites, kāinga, mahinga kai areas, wāhi taonga and wāhi tapu sites throughout Te Pātaka o Rākaihautū hold the stories of Ngāi Tahu migration, settlement and resource use.

Given the richness of cultural and landscape heritage values associated with Te Pātaka o Rākaihautū, a cultural landscape approach is the most appropriate way to manage and protect significant sites. Silent files are an important indicator of cultural landscape values, and there are numerous silent files throughout this catchment.

Manawhenua – Ngāi Tahu Papatipu Rūnanga

The three tribal groupings of Waitaha, Ngāti Mamoe and Ngāi Tahu are today collectively known as Ngāi Tahu Whānui – the iwi recognised as holding mana whenua over the majority of Te Waipounamu, including Te Pātaka o Rākaihautū. There are four Ngāi Tahu hapū / Papatipu Rūnanga located on Te Pātaka o Rākaihautū, including:

Te Hapū o Ngāti Wheke (Rāpaki) Rūnanga

- *Te Hapū o Ngāti Wheke (Rāpaki) is the modern-day representative of the hapū Ngāti Wheke. The takiwā of Te Hapū o Ngāti Wheke centres on Rāpaki and includes the catchment of Whakaraupō and Te Kaituna. The Port Cooper Deed of 1849 (English translation) describes the takiwā as follows: "The inland boundary commences at the mouth of the Ōpawa thence along [the Halswell River] to Waihora; the outer boundary commences at Kaitara [Port Levy], thence by Te Pohue [Monument], thence by the Ahupatiki [Mt Herbert] ridge to Waihora following the line of the said mountain to Kuhakawariwari."*
- *Whakaraupō has a rich history of Ngāi Tahu land use and occupancy, and a strong tradition of mahinga kai. The harbour was named after the raupō reeds that were once plentiful at Ōhinetahi at the head of the harbour. Kaimoana such as pātiki, pātiki rori, pīoki, hoka, aua, pāpaki, koiro and hokarari provided an abundant and reliable supply of mahinga kai for tāngata whenua and their manuhiri. The restoration of kaimoana*

values and cultural health of Whakaraupō is a priority objective for tāngata whenua. During the lifetime of Rāpaki tāua and pōua, pollution of Whakaraupō has resulted in the inability of Rāpaki residents and their visitors to eat kaimoana gathered from the area. Historically there were abundant supplies of ika to provide regular food for those living at Rāpaki, however this is no longer the case. The Whakaraupō catchment also holds significant recreational values for the community. Ngāi Tahu use of Whakaraupō also includes waka, including waka ama (ouotrigger canoes), waka taua (traditional canoes), and waka unua (sailing canoes). Ngāi Tahu have used waka on Whakaraupō for generations, for mahinga kai, travel and trade.

Te Rūnanga o Koukourarata

- *The takiwā of Te Rūnanga o Koukourarata centres on Koukourarata and extends from Pōhatu Pā to the shores of Te Waihora including Te Kaituna. The takiwā reflects traditional concepts of Māori land tenure, following the routes and events of the makawhiua waka and Ngāi Tuhaitara war party, and enforced again in 1849 by Pukenui during the Port Levy Deed negotiations, when he declared the rights to Kaituna, Waihora and Waikakahi Pā.*
- *The catchment of Te Ara Whānui o Makawhiua (Koukourarata) has an extensive history of Ngāi Tahu settlement. Three pā once existed around the bay: Kaitara, Koukourarata, and Puāri. After the fall of Kaiapoi Pā, Koukourarata and Puāri became the main centres of Ngāi Tahu activity in the Canterbury region. Koukourarata and the surrounding catchment is a rich mahinga kai resource and increasing pressures on these resources is an ongoing management challenge for tāngata whenua. The health of kaimoana is integral to Ngāi Tahu culture and identity.*

Ōnuku Rūnanga

- *Ōnuku Rūnanga is the modern-day representative of the hapū Ngāi Tarewa and Ngāti Irakēhu at Ōnuku, on the shores of Akaroa Harbour. The takiwā of Ōnuku Rūnanga centres on Ōnuku and the hills and coasts of Akaroa to the adjoining takiwā of Te Rūnanga o Koukourarata and Wairewa Rūnanga. Karaweko, a rangatira of the Ngāi Tarewa people of Ōnuku, set out the takiwā of Ōnuku as from the hill top of Pōhatu to the hilltop of Te Ruahine [point at the entrance of Akaroa Harbour] then to Timutimu*

Head on the west, but that the roadways between the inner and outer bays should always be left open, so other hapū could come and go for mahinga kai and hui.

- *Ngāi Tarewa and Ngāti Irakēhu hold kaitiaki responsibilities to ensure sustainable management of Akaroa Harbour, including protection of taonga and mahinga kai for future generations. Today, mana whenua-led social and environmental projects, businesses, mana whenua-manageed taiāpure, co-governance of Takapūneke Reserve, and other activities and contributions to the wider community continue to build the contemporary story of Ngāi Tarawa and Ngāti Irakēhu within their takiwā. All of this is guided by the tribal whakatauākī.*

Wairewa Rūnanga

- *Wairewa Rūnanga is the modern-day administrative council and representative of the hapū of Kāti Irakehu and Kāti Makō who hold manawhenua over the Wairewa takiwā.The takiwā of Wairewa Rūnanga centres on Wairewa and the catchment of Te Roto o Wairewa / Lake Forsyth and the hills and coast to the adjoining takiwā of Koukourarata, Ōnuku and Taumutu Rūnanga.*
- *Te Roto o Wairewa is a culturally significant mahinga kai site for Wairewa Rūnanga and Ngāi Tahu. Tangata whenua all have cultural, spiritual, historic and traditional associations to the lake. The waterways in the Te Roto o Wairewa catchment flow from maunga to lake, ki uta ki tai. The cultural health of the lake directly reflects the cultural health of the surrounding waterways and catchment.*

2.1 Archaeological sites

There are many culturally significant landscapes, archaeological sites, wāhi tapu and wāhi taonga, and silent file areas throughout Te Pātaka o Rākaihautū which highlight the significance of the catchment to the tupuna. Most of these sites of significance are located in coastal areas and along waterways which discharge into Te Tai o Mahaanui. Archaeological sites mostly include pā sites, ovens and artefacts, and urupā/burials. Figure 3 below shows the spatial patterns of these sites of significance based on current records (ArchSite, 2025). Māori archaeological sites are represented by yellow squares, while silent file areas are indicated by light blue circles and rectangles. Rūnanga sensitive areas are shown as larger more transparent shaded blue areas.

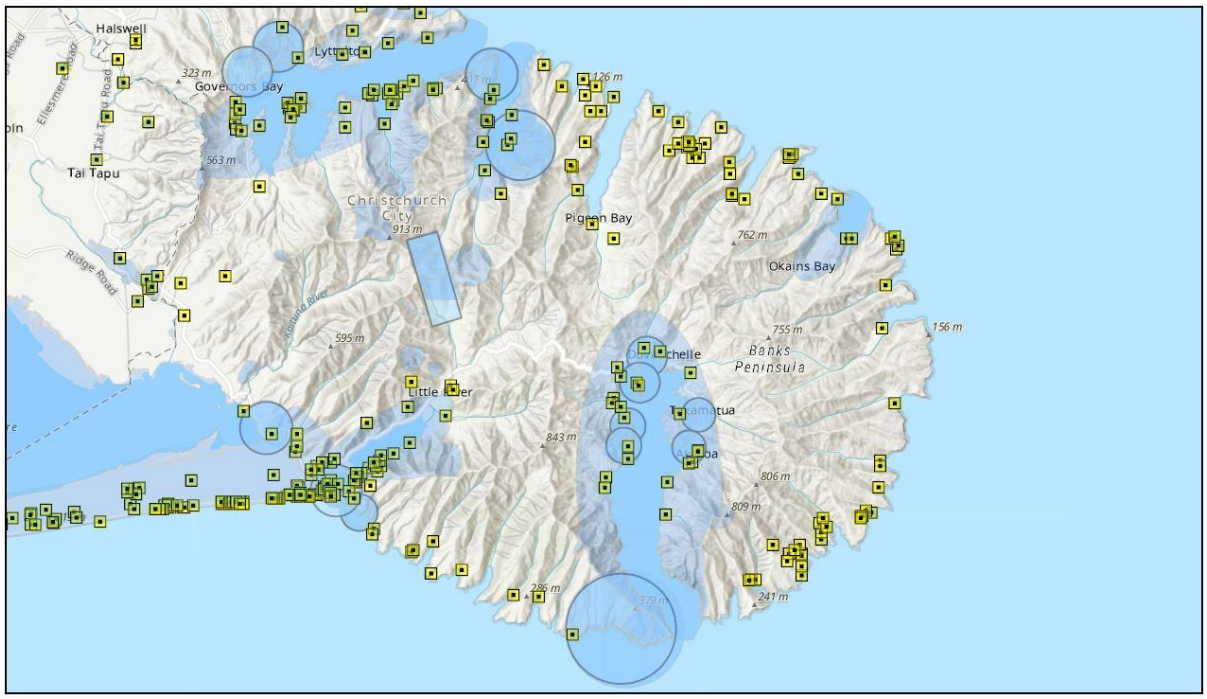

Figure 3: Māori archaeological sites, silent file areas and Rūnanga sensitive areas currently recorded on Te Pātaka o Rākaihautū (Source: ArchSite, 2025).

2.2 Environmental background

Te Pātaka o Rākaihautū / Banks Peninsula catchment is approximately 116,000 ha in area. The peninsula contains over 100 streams where the catchments are relatively short (less than 10 km long) and very steep, with lowland stream reaches generally only measuring a few kilometres long. All streams on the peninsula have high ecological values and a diverse native fish population. Native fish species include threatened species such as longfin tuna (eel) and lamprey, īnanga spawning sites, and two of only four known redfinned bully habitats in

Canterbury (ECAN, 2025). The majority of these streams reflect the Ngāi Tahu resource management philosophy of ki uta ki tai – mountains to sea.

Prior to European settlement, Te Pātaka o Rākaihautū was almost entirely covered in native forest. Only very steep and exposed areas were an exception to this, including areas too swampy to support native trees. Widespread deforestation occurred between 1860 and 1890 when majority of land on the peninsula was converted to agricultural and pastoral land use. This has resulted in significant resource management issues throughout the catchment, including freshwater and coastal water management.

Flow in streams throughout Te Pātaka o Rākaihautū is dependent on rainfall, with flash flooding occurring frequently during high rainfall events on the peninsula. During extended dry periods, many streams either stop flowing or become reliant on seepages or springs to maintian limited flow. Most streams flow directly into the harbours and sea, with the exception of Te Roto o Wairewa (Lake Forsyth). Some waterways between Lansdowne and Kaituna Valleys flow into Te Waihora, however this sits outside the Te Pātaka o Rākaihautū SMP boundary.

Stormwater infrastructure varies throughout the peninsula and reflects population densities and urban settlements. The largest settlement Lyttelton has a fully constructed stormwater network where its eight hillside waterways are fully piped. Diamond Harbour and Governors Bay are the next largest settlements and stormwater typically discharges into ephemeral valleys from multiple short lengths of pipe. There are also some private stormwater discharges within both settlements, which discharge onto hillsides causing some erosion in places. The three other larger settlements of Akaroa, Duvauchelle and Little River have short lengths of stormwater pipes that discharge into streams flowing through the settlements. These streams usually have consistent base flow and discharge into Akaroa Harbour. In smaller settlements, roadside drains and culverts make up the majority of the stormwater network and convey stormwater for shorter distances before discharging it into streams or watercourses.

Stormwater treatment is minimal throughout the peninsula. Some treatment devices have been installed in key settlements such as Diamond Harbour and Governors Bay to help mitigate the effects of development. The majority of stormwater is either discharged directly to land or to streams and watercourses which then discharge into the harbours.

Te Pātaka o Rākaihautū waterways differ to waterways throughout Christchurch City as they have distinct and important ecological values including high native fish populations. Most streams have steep catchments and limited area available for new infrastructure to treat stormwater contaminants. Because of this, typical stormwater treatment methods such as treatment wetlands or increased setbacks are not practiable, and alternative methods that also take into account the high ecological values of these streams must be considered.

Council monitors water quality at three long-term sites on the peninsula. These sites have a water quality index (WQI) score which indicate the overall health of water at each site (Dhakal et al., 2025). The WQI score is used to consolidate data from 11 individual water quality parameters into a single index value that ranges from 0 to 100, with 100 representing high water quality. Banks Peninsula waterways had the lowest average WQI score compared with all CSNDC monitoring sites, indiciating the worst water quality of all catchments. This is partly due to the stricter water quality standards that apply to protect ecological values, compared to the waterways within Chrsitchurch City (Dhakal et al., 2025).

As part of the CSNDC EMP, total suspended solids (TSS), copper, lead, and zinc are measured and assessed against the consent Objectives and Attribute Target Levels (ATLs). All three Council monitored waterway sites on Te Pātaka o Rākaihautu failed multiple ATLs.

2.2.1 New Zealand Freshwater Fish Database

At the time of writing, data in the New Zealand Freshwater Fish Database (NZFFD) has been recorded from the Te Pātaka o Rākaihautū catchment from 1960 to 2022. Sampling was undertaken through electric fishing, observation, hīnaki/fyke nets and traps. The range of species recorded in the database is presented in Tables 3 and 4 below.

Table 3. List of aquatic species from NZFFD recorded from the Whakaraupō catchment.

Year of recording	Recorded taxon
1960-1969	*Gobiomorphus hubbsi* – Bluegill bully
	Cheimarrichthys fosteri – Torrentfish
	Galaxias maculatus – Īnanga
	Anguilla australis – Shortfin eel
	Anguilla dieffenbachii – Longfin eel
	Gobiomorphus cotidianus – Common bully
	Gobiomorphus gobioides – Giant bully
	Galaxias fasciatus – Banded kokopu
	Galaxias – Unidentified galaxiid
	Aldrichetta forsteri – Yelloweye mullet
	Marine – Marine species
	Retropinna retropinna – Common smelt

	Galaxias brevipinnis – Koaro
	Anguilla dieffenbachii – Longfin eel
1970-1979	*Galaxias maculatus* – Īnanga
	Galaxias brevipinnis – Koaro
	Anguilla dieffenbachii – Longfin eel
	Cheimarrichthys fosteri – Torrentfish
	Gobiomorphus hubbsi – Bluegill bully
	Galaxias fasciatus – Banded kokopu
1980-1989	*Galaxias maculatus* – Īnanga
	Galaxias fasciatus – Banded kokopu
	Anguilla dieffenbachii – Longfin eel
	Cheimarrichthys fosteri – Torrentfish
	Gobiomorphus cotidianus – Common bully
	Gobiomorphus gobioides – Giant bully
	Anguilla – Unidentified eel
	Anguilla australis – Shortfin eel
	Gobiomorphus huttoni – Redfin bully
	Gobiomorphus hubbsi – Bluegill bully
1990-1999	*Galaxias maculatus* – Īnanga
2000-2009	*Galaxias fasciatus* – Banded kokopu
	Gobiomorphus hubbsi – Bluegill bully
	Gobiomorphus gobioides – Giant bully
	Gobiomorphus cotidianus – Common bully
	Cheimarrichthys fosteri – Torrentfish
	Anguilla australis – Shortfin eel
	Gobiomorphus huttoni – Redfin bully
	Anguilla – Unidentified eel
	Galaxias maculatus – Īnanga
	Anguilla dieffenbachii – Longfin eel
2010-2019	*Gobiomorphus gobioides* – Giant bully
	Gobiomorphus cotidianus – Common bully
	Gobiomorphus huttoni – Redfin bully
	Cheimarrichthys fosteri – Torrentfish
	Galaxias maculatus – Īnanga
	Anguilla – Unidentified eel
	Cheimarrichthys fosteri – Torrentfish
	Galaxias fasciatus – Banded kokopu
	Galaxias – Unidentified galaxiid
	Anguilla dieffenbachii – Longfin eel
2020-2022	*Galaxias fasciatus* – Banded kokopu
	Gobiomorphus cotidianus – Common bully
	Galaxias – Unidentified galaxiid
	Anguilla australis – Shortfin eel
	Galaxias brevipinnis – Koaro
	Anguilla – Unidentified eel
	Gobiomorphus huttoni – Redfin bully
	Galaxias maculatus – Īnanga

Table 4. List of aquatic species from NZFFD recorded from the Te Roto o Wairewa catchment.

Year of recording	**Recorded taxon**
1964	*Gobiomorphus cotidianus* – Common bully
	Anguilla australis – Shortfin eel
	Perca fluviatilis – Perch
	Anguilla dieffenbachii – Longfin eel
	Gobiomorphus breviceps – Upland bully

	Retropinna retropinna – Common smelt
1979	*Salmo trutta* – Brown trout
	Perca fluviatilis – Perch
	Gobiomorphus cotidianus – Common bully
	Geotria australis – Lamprey
	Anguilla dieffenbachii – Longfin eel
	Rhombosolea – Unidentified flounder
	Aldrichetta forsteri – Yelloweye mullet
	Rhombosolea retiaria – Black flounder
	Retropinna retropinna – Common smelt
	Gobiomorphus gobioides – Giant bully
	Gobiomorphus breviceps – Upland bully
1985	*Geotria australis* – Lamprey
	Gobiomorphus breviceps – Upland bully
1992-1998	*Galaxias* – Unidentified galaxiid
	Anguilla dieffenbachii – Longfin eel
	Salmo trutta – Brown trout
	Gobiomorphus breviceps – Upland bully
	Rhombosolea retiaria – Black flounder
	Galaxias maculatus – Īnanga
	Anguilla australis – Shortfin eel
	Gobiomorphus cotidianus – Common bully
	Geotria australis – Lamprey
	Retropinna retropinna – Common smelt
2001-2009	*Galaxias brevipinnis* – Koaro
	Anguilla dieffenbachii – Longfin eel
	Salmo trutta – Brown trout
	Gobiomorphus cotidianus – Common bully
	Anguilla australis – Shortfin eel
	Rhombosolea retiaria – Black flounder
	Perca fluviatilis – Perch
	Salmo – Unidentified salmonid
	Scardinius erythrophthalmus – Rudd
	Tinca tinca – Tench
	Galaxias maculatus – Īnanga
	Anguilla – Unidentified eel
	Retropinna retropinna – Common smelt
	Geotria australis – Lamprey
	Gobiomorphus breviceps – Upland bully
	Gobiomorphus – Unidentified bully
	Anguilla – Unidentified eel
2017-2021	*Geotria australis* – Lamprey
	Anguilla australis – Shortfin eel
	Gobiomorphus breviceps – Upland bully
	Perca fluviatilis – Perch
	Gobiomorphus cotidianus – Common bully
	Salmo trutta – Brown trout
	Anguilla dieffenbachii – Longfin eel
	Gobiomorphus – Unidentified bully
	Anguilla – Unidentified eel
	Galaxias brevipinnis – Koaro
	Galaxias – Unidentified galaxiid

2.3 Previous monitoring/Current state

Te Roto o Wairewa Catchment

A State of the Takiwā assessment undertaken in 2005 and 2006 showed that land use was having a marked effect on water quality and biodiversity. This was particularly evident in the mid-lower catchment where there was a noticeable loss of cultural health as you travel from upper to lower catchment – source to sink. The degraded cultural health of Te Roto o Wairewa and its tributaries is the most significant issue in this catchment. Sedimentation and the concentration of nutrients in the sediment of the lakebed are key contributors to degraded cultural health. There is over 1 metre of sedimentation in the lake, equating to approximately 5,000,000 m^3 of topsoil which has eroded from the catchment.

Te Roto o Wairewa has little protection from the effects of land use on its margins. Historically, lake margin wetlands acted as a nutrient and sediment filter which helped maintain water quality. However, very few wetlands remain on the landscape today.

Whakaraupō Catchment

The hills and lowlands of Whakaraupō features numerous streams, both permanent and ephemeral, which travel through key urban areas where the majority of residents live such as Lyttelton, Governors Bay, Charteris Bay, Diamond Harbour and Purau. Erosion, particularly from roadside cuttings, is a key issue of concern for Rūnanga as rainfall often carries sediment onto roads and into waterways. Stormwater from the built environment contains pollutants including sediment, heavy metals and nutrients which negatively impacts cultural values of the waterways. Native vegetation is scarce and mainly found in steep or isolated areas. While stream headwaters are generally clean, water quality declines closer to the harbour due to the presence of sediment, nutrients, *E. coli*, and nitrogen. In farmland, many lowland streams lack planting and fencing, allowing livestock to pollute them. Urban areas contribute additional runoff from roads, roofs, septic tanks, and stormwater systems.

3 Summary of sites and monitoring undertaken

The monitoring team comprised staff from Mahaanui Kurataiao Ltd (Matt Walcott and Tama Hamilton-Morrison) and whānau members from Wairewa Rūnanga (Ana Gray, Matiu Prebble, Iaean Cranwell, and Aaria Rolleston) and Te Hapū o Ngāti Wheke Rūnanga (Tayla Nelson-Tuhuru and Nadia Green). Monitors were unable to conduct the fish survey for both sub-catchments due to time constraints. Data was gathered from the New Zealand Freshwater Fish Database to support these results. The water quality testing for cultural monitoring undertaken with Te Hapū o Ngāti Wheke was conducted the day after the infield survey due to a delay in receiving the water sample kits. State of Takiwā observations, Cultural Stream Assessment and SHMAK field work were conducted on the day of monitoring with cultural monitors. *See Section 3.1 for more information.*

As part of the SOT forms, information on the site locations and weather was recorded to provide context for the collected data. Site locations were characterised as a mixture of urban and rural. Recorded ecosystems were all mostly rivers or streams, with the exceptions for Site 1 - Lyttelton Port within the Whakaraupō catchment and Site 5 - Te Roto o Wairewa within the Wairewa catchment. These sites were classified as marine and lake respectively. Most monitored sites were in Council-owned reserves or public spaces therefore access was not an issue. Two sites within the Wairewa catchment were surrounded by private farmland (Site 1 – Hukahuka Turow Stream and Site 4 – Okuti River at Kinloch Road).

The weather was cold and windy during mana whenua values monitoring with Te Hapū o Ngāti Wheke. Light rainfall began in the morning and became persistent by the afternoon. Strong southwest winds became consistent throughout the afternoon, and temperatures ranged between 14 to 18 °C. During monitoring with Wairewa Rūnanga weather was clear, with minimal wind and no rain. Temperatures ranged from 15 to 18 °C. The monitoring with Te Hapū o Ngāti Wheke on 17 March 2025 took place during the waning gibbous moon phase and the monitoring with Wairewa Rūnanga on 11 April 2025 took place during the waxing gibbous moon phase. All sites had stable flow prior to and during monitoring.

3.1 Constraints and limitations

Cultural monitoring with Koukourarata and Ōnuku Rūnanga could not be conducted within the timeframes set in the CSNDC Environmental Monitoring Programme due to cultural monitor availability. As per the Environmental Monitoring Programme for the CSNDC, monitoring for Mana Whenua Values is to be undertaken concurrently with aquatic ecology surveys, during March, to ensure no biases due to sampling during different seasons and this being the preferred time for ecological monitoring generally. Unfortunately, no cultural monitors were available during this timeframe to conduct cultural monitoring within the takiwā for Koukourarata and Ōnuku. It is proposed that monitoring with both Rūnanga will be conducted during March 2026.

Whakaraupō sub-catchment

Monitors did not undertake the fish survey due to time constraints and site suitability. Most monitoring sites had very low flows and stream depth, which made it unsuitable to install gee minnow traps and hīnaki / fyke nets. Site 1 – Lyttelton Port and Site 6 – Te Wharau Stream were unsafe to enter for monitors due to high water depth and flows, therefore no fish traps could be installed. Site 7 – Purau Stream was assessed as the only site that was suitable for conducting a fish survey, however due to time constraints with staff availability this fish survey could not be conducted during the time of monitoring. Data from the New Zealand Freshwater Fish Database was used to help provide further context around fish populations within the catchment.

Monitors were unable to undertake invertebrate and periphyton sampling at most monitoring sites due to site suitability. Only Site 7 – Purau Stream was determined as being suitable for conducting invertebrate and periphyton sampling.

There was persistent rainfall during the day of monitoring with Te Hapū o Ngāti Wheke which may have influenced some results. Rainfall was recorded as light to moderate for most of the day, becoming heavy by the time monitors completed their surveys at the final monitoring site. Cultural monitors were able to complete all parts of the State of Takiwā observations and Cultural Stream Assessment for all monitoring sites. Water samples for the Ngāti Wheke State of Takiwā survey were taken the following day when rainfall had subsided. The volume of rainfall throughout Te Pātaka o Rākaihautū on 17 March contributed to the skewed water sample quality results. Most notably the high E. coli levels in all samples were a result of high

rainfall volumes carrying contaminants from upper catchment farmland into hillside streams, which then flushed downstream and into the harbour.

Te Roto o Wairewa sub-catchment

Time constraints with cultural monitor availability during the day of monitoring meant MKT staff could not conduct the fish survey. Data from the New Zealand Freshwater Fish Database was used to help provide further context around fish populations within the catchment.

Due to health and safety concerns with water quality, no SHMAK testing was conducted in the lake at Site 5 - Te Roto o Wairewa at Catons Bay. Cultural monitors were still able to complete all observational based surveys for the State of Takiwā and Cultural Stream Assessment questions.

Figure 4. Photo of Stream Reserve Drain looking upstream.

4 Results

The following sections cover the results for each of the survey sections or questions in the SOT and CHA, parts of the SHMAK, the bird and vegetation surveys, and the water quality testing. Where there were overlaps in recorded information in the CHA and SOT surveys (for example for observed vegetation and bird species) these have been combined in the results and raw data tables. In this section, the sites within the Whakaraupō sub-catchment have been listed in geographic order, starting with Site 1 in Lyttelton Port and travelling around the harbour to the furthest point (Site 7 – Purau Stream). For Te Roto o Wairewa sub-catchment, sites are listed in geographic order, starting with the most upstream point (Site 1 – Hukahuka Turoa Stream) and heading south/downstream through the catchment.

4.1 State of the Takiwā

Observational survey of the following categories was undertaken: site pressures, degree of modification, access for mahinga kai, suitability for harvesting mahinga kai and overall health. Each category was scored on a scale of 1 – 5, with 1 = poor quality/low values and 5 = high quality/values. The recorded score for each category has been presented by site for each sub-catchment in Figures 4 and 5 below.

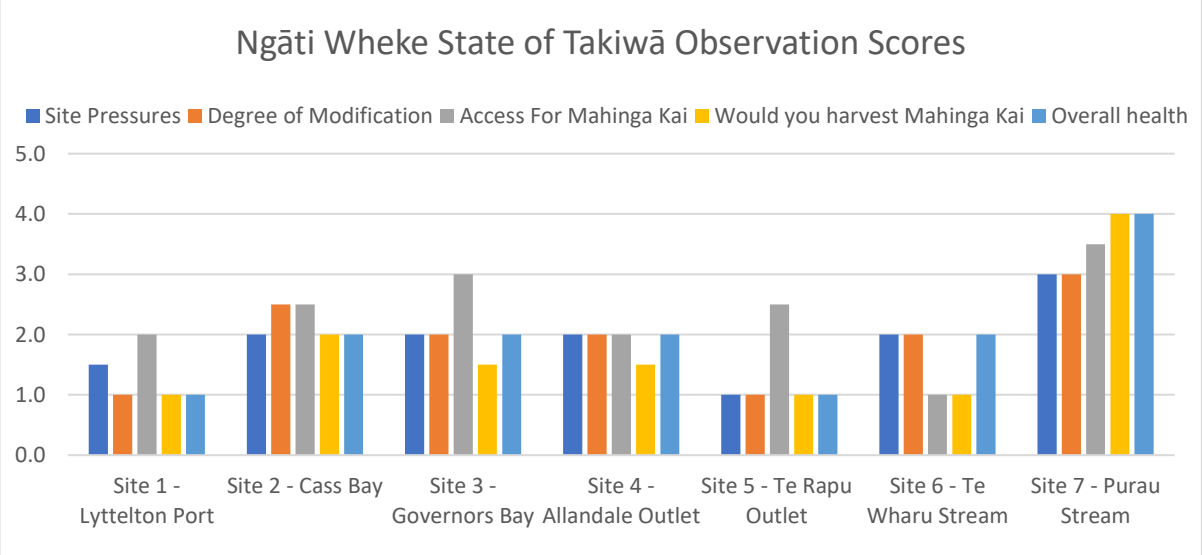

Figure 5. The scores for each category in the Ngāti Wheke SOT for each surveyed site.

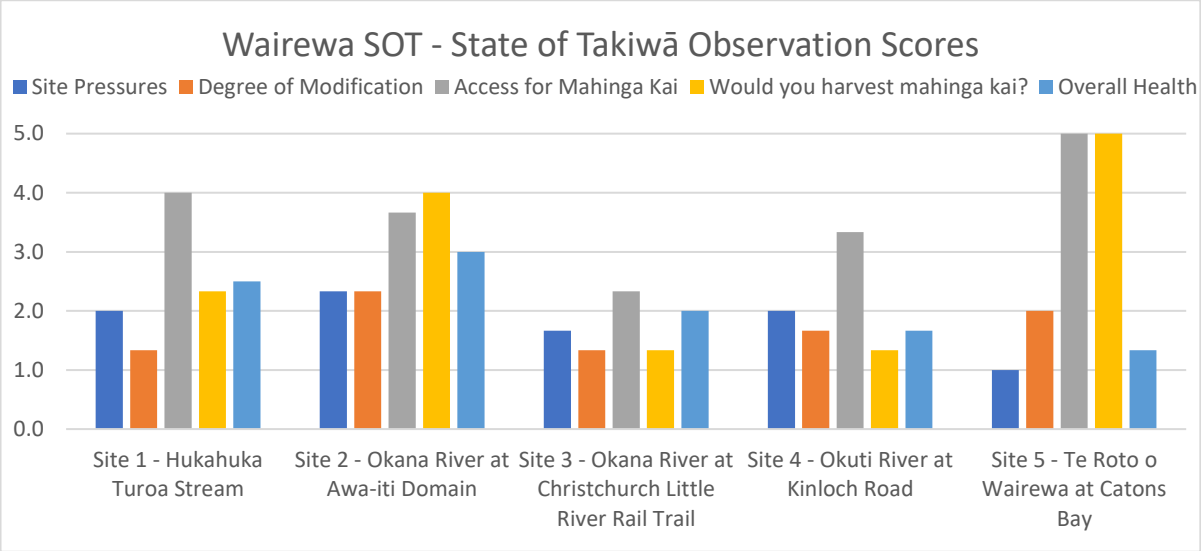

Figure 6. The scores for each category in Wairewa SOT for each surveyed site.

State of Takiwā results were similar between Ngāti Wheke and Wairewa surveys, with average scores assessed as 'poor to moderate': Ngāti Wheke averaged 2.0 and Wairewa 2.4. The average CHA scores for each monitoring site in the Ngāti Wheke survey ranged between 1.1 to 3.1, meanwhile for the Wairewa survey average scores ranged between 1.5 to 2.8. Four sites in the Ngāti Wheke SOT scored very poorly on average (scores below 2.0). These were Site 1 – Lyttelton Port, Site 4 – Allandale Outlet, Site 5 – Te Rapu Outlet, and Site 6 – Te Wharau Stream. Site 3 – Ōkana River at Christchurch Little River Rail Trail was the only site in the Wairewa SOT to score below 2.0 on average. Lower scores were reflected in site pressures and modification, low willingness to harvest mahinga kai, low stream flows, habitat loss, and contaminants. Ngāti Wheke cultural monitors noted significant pressures from residential port activity (Site 1), and infrastructure and land use at Site 5. Wairewa cultural monitors reported similar pressures at Site 3 and noted land use impacts from farms, forestry, and stormwater runoff. Despite notable pressures at Site 5 (Te Roto o Wairewa), its cultural importance maintained higher SOT scores, particularly relating to mahinga kai harvest.

Figures 6 and 7 show average category scores from the SOT survey, mostly below 3, indicating moderate cultural health. The highest score was for mahinga kai access in the Wairewa survey (3.7), while the lowest (1.7) was for willingness to harvest (Ngāti Wheke) and degree of modification (Wairewa).

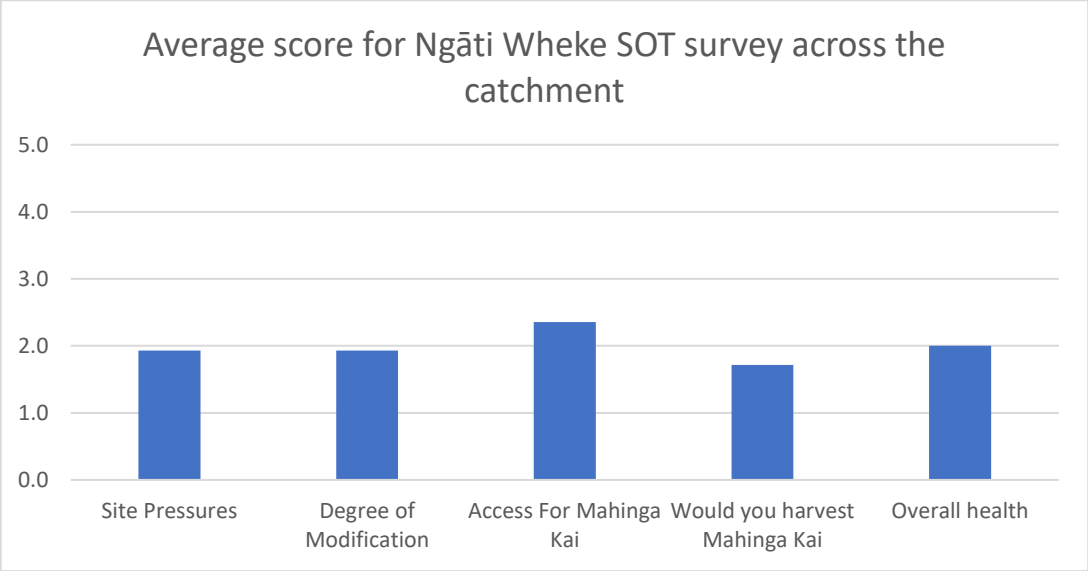

Figure 7. Averaged Ngāti Wheke SOT survey scores for each category across the catchment.

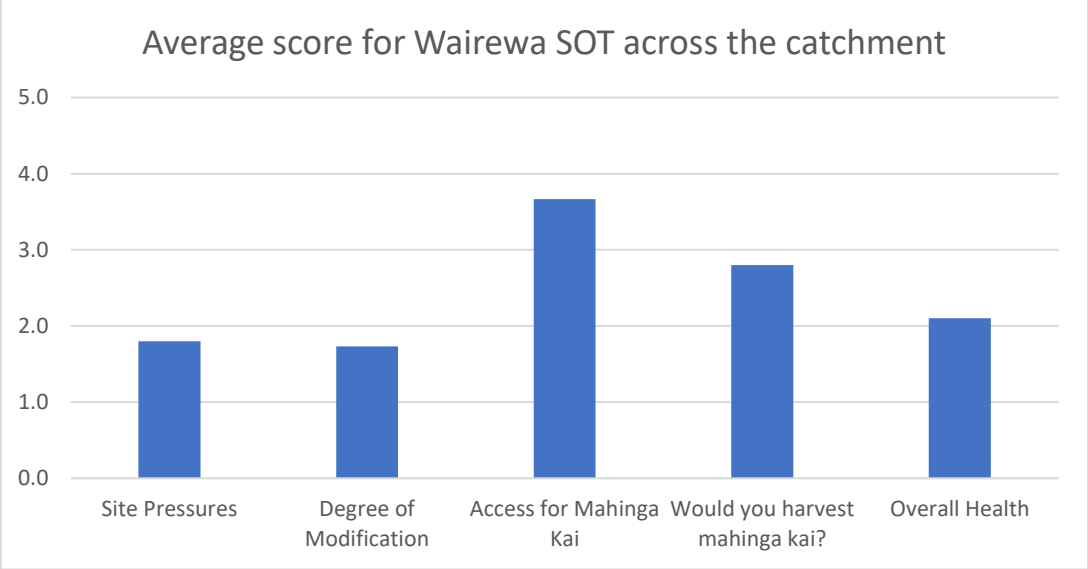

Figure 8. Averaged Wairewa SOT survey scores for each category across the catchment.

4.2 Cultural Health Assessment (CHA)

The graphed results for every question or category of the CHA for both surveys can be found in Appendix A. The averaged[1] scores for the overall health for each site and catchment are indicative of the most common scoring recorded during the assessment and have therefore been included in this section. Cultural monitors did not answer the overall health assessment for Site 1 – Lyttelton Port, therefore the bar chart below shows no data for this site.

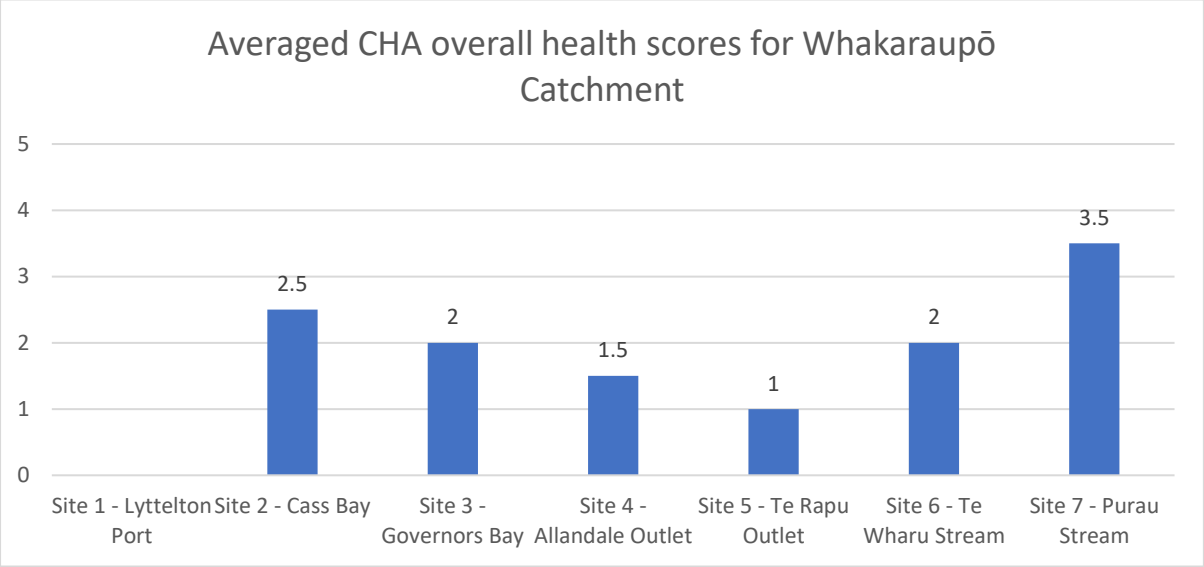

Figure 9. The averaged Overall Health CHA score for the Whakaraupō catchment.

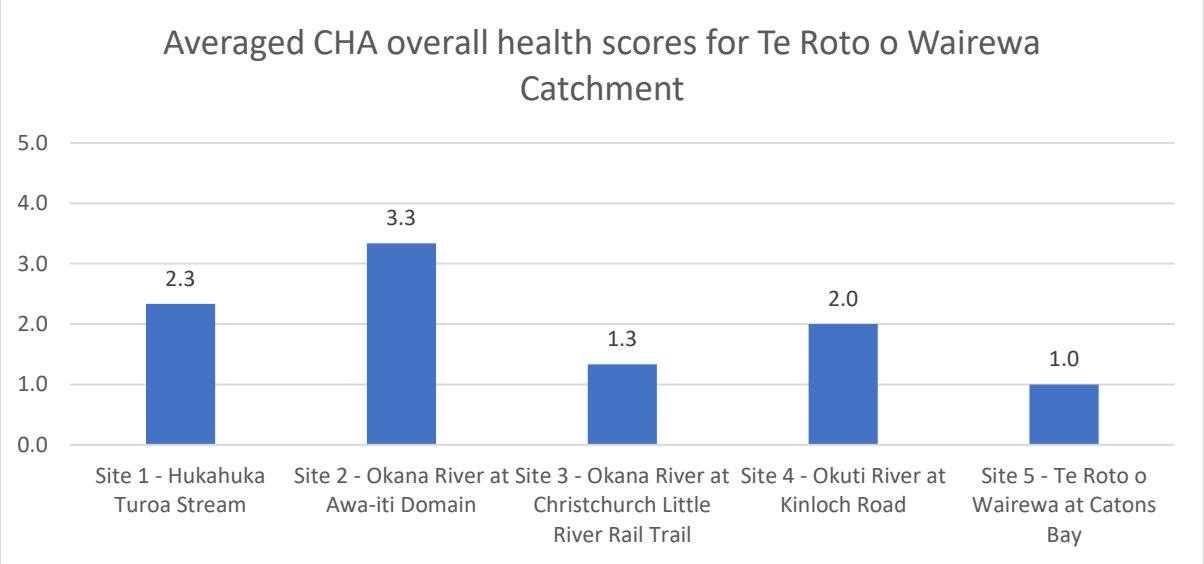

Figure 10: The averaged CHA score for Te Roto o Wairewa catchment

[1] Calculated by adding all the individual scores recorded by the monitors and dividing by the count of those numbers.

Cultural monitoring results show most sites scored between 1 and 3 for overall health, indicating poor cultural stream health across both sub-catchments. Only two sites scored above 3 on average: Site 2 (Ōkana River at Awa-iti Domain, Wairewa) and Site 7 (Purau Stream, Whakaraupō). Key factors influencing scores included vegetation health, stream clarity and flow, streambed conditions, and water quality. Site 1 (Lyttelton Port, Whakaraupō) was not assessed for overall health, likely due to the wording of the SOT survey question referring specifically to rivers, which this site is not.

Whānau monitors also answered separate questions on cultural impacts, including site concerns and actions needed to restore mahinga kai. Their responses have been summarised in Tables 5-6.

Table 5. Summary of the concerns identified in the responses to the Cultural Health Assessment for Te Hapū o Ngāti Wheke.

Identified concern	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Water quality issues – visually polluted (i.e., foams, slimy surface).	✔	✔	✔				
Minimal native vegetation cover.	✔	✔		✔	✔		
Modified landscape	✔	✔					
Modified streams and banks (i.e., straightening, man-made structures).		✔	✔				
High sediment cover along stream bed.				✔	✔	✔	
High abundance of exotic vegetation.						✔	✔
High abundance of weeds – instream and along stream banks.						✔	✔
Direct stormwater discharges from private dwellings.		✔	✔				
Slash and/or rubbish within waterway.						✔	
Contaminated land near monitoring site.				✔			
Minimal setbacks from private properties and busy roads.		✔	✔	✔	✔	✔	✔

Table 6. Summay of the concerns identified in the responses to the Cultural Health Assessment for Wairewa Rūnanga.

Identified concern	Site 1	Site 2	Site 3	Site 4	Site 5
High abundance of exotic vegetation.	✔	✔	✔	✔	
Modified streams and banks (i.e., straightening, man-made structures).	✔	✔			
Water quality issues – visually polluted (i.e., foams, slimy surface).		✔	✔		✔
Bank erosion along rivers and waterbodies		✔	✔		
Flooding issues		✔	✔		
Inappropriate land use contributing to poor river / lake quality.			✔	✔	✔

Cultural monitors raised concerns about the lack of native vegetation and the spread of exotic species like willows, as well as stormwater discharges from urban areas, particularly in places like Cass Bay and Governors Bay. These discharges contribute to pollution and flooding. Site-specific issues, such as historical deforestation around Te Roto o Wairewa, have led to erosion and nutrient buildup in the lake. Some positive comments by cultural monitors included good access for mahinga kai at some sites, and areas with abundant native vegetation which corelated to higher cultural health scores due to better habitat quality and resource availability.

Table 7. Summary of the actions identified to restore mahinga kai in the responses to the Cultural Health Assessment for Te Hapū o Ngāti Wheke.

Identified action to restore mahinga kai	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Increase monitoring in key contaminant source areas.	✔						
Increase native vegetation.		✔	✔	✔	✔	✔	✔
Improve riparian zones with native vegetation and larger setbacks.				✔	✔		
Removal of weeds and invasive species.		✔	✔			✔	✔
Removal of exotic trees.						✔	
Improve stormwater treatment in urban areas (i.e., filtration, treatment devices).	✔	✔	✔				
Better erosion and sediment control in upper catchment areas.				✔			
Renaturalise streams.					✔		

Improve access for mahinga kai.						✔	✔
Improve fencing within private land for stock exclusion.				✔	✔		✔
Indigenous habitat restoration (i.e., īnanga spawning areas).						✔	

Table 8. Summary of the actions identified to restore mahinga kai in the responses to the Cultural Health Assessment for Wairewa Rūnanga.

Identified action to restore mahinga kai	Site 1	Site 2	Site 3	Site 4	Site 5
Increase native vegetation.	✔	✔			✔
Improve riparian zones with native vegetation and larger setbacks.	✔	✔	✔		✔
Improve pest and weed control.					✔
Improve access to awa		✔			
Better erosion and sedimentation control		✔	✔		✔

Cultural monitors recommended similar restoration actions across both catchments to support mahinga kai, such as increasing native vegetation, improving riparian zones, and controlling pests and weeds. Some actions were site-specific, like stream naturalisation at Te Rapu Outlet and increased monitoring in Lyttelton, suggested by Te Hapū o Ngāti Wheke Rūnanga. These actions align with concerns raised by whānau and will help improve cultural health by mitigating negative impacts from stormwater discharges.

4.3 Vegetation Survey

4.3.1 Traditional

Majority of land throughout Te Pātaka o Rākaihautū is classified as rural and open space. Traditionally, Te Pātaka o Rākaihautū was extensively covered in dense indigenous forest. Mixed stands of predominantly large podocarps (totara, matai, rimu, and kahikatea) dominated the higher elevations, while broadleaved angiosperms dominated the lower elevations (Burrows 1994). The present-day environment across Te Pātaka o Rākaihautū has been heavily modified due to human settlement and agricultural development. Deforestation occurred extensively throughout the catchment during the late 1800's, as much of the peninsula was converted to agricultural and pastoral land use. In parts of the peninsula, up to 30% cover of indigenous vegetation remains, while for the rest of the peninsula, indigenous vegetation cover ranges from <10% to 20% (Figure 11). As a result, there are significant

resource management issues throughout the environment, including climate change fresh water and coastal management, land-use intensification, and indigenous biodiversity protection and restoration. The entire landscape of Te Pātaka o Rākaihautū (including the Port Hills) is identified as Outstanding Natural Landscape.

Te Roto o Wairewa and its catchment were regarded as one of the central food baskets of the Ngāi Tahu and the Waitaha region. The waterways in the Te Roto o Wairewa catchment flow from maunga to lake, Ki uta ki tai. This means the cultural health of the lake is directly related to the cultural health of wayerways. Water quality and quantity in the catchments waterways has decreased significantly in the memory of the people of Wairewa. This has had significant impacts on mahinga kai sourced from the lake.

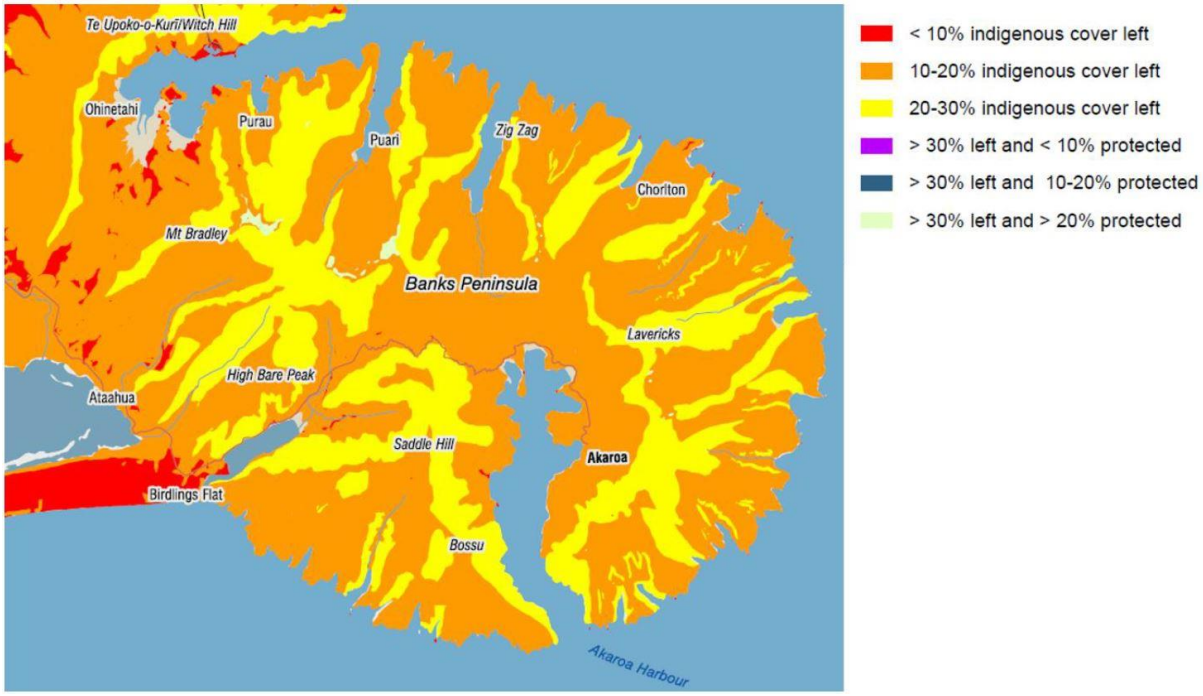

Figure 11. Percentage cover of indigenous vegetation remaining on Te Pātaka o Rākaihautū. (Source: Manaaki Whenua).

4.3.2 Assessment

The full list of observed species is provided in Appendix B. Figures 11 and 12 below show the ratio of native to introduced plant species recorded during State of Takiwā surveys. Whakaraupō showed greater variation, with native vegetation coverage ranging from 20% to 100% across sites. Most sites in Te Roto o Wairewa recorded approximately 90% native vegetation coverage. No native vegetation was recorded at Site 4 (Okuti River). Native vegetation was generally more abundant in rural areas than urban. An exception was the Lyttelton Port area, where no introduced species were recorded despite its urban setting. Only one native species (hebe) was noted during the site visit, though many others are present in the area, planted during the 2018 development of Te Ana Marina. These include Ngāio, Ribbonwood, Tī kouka, Kawakawa, and others (Lyttelton Port Company).

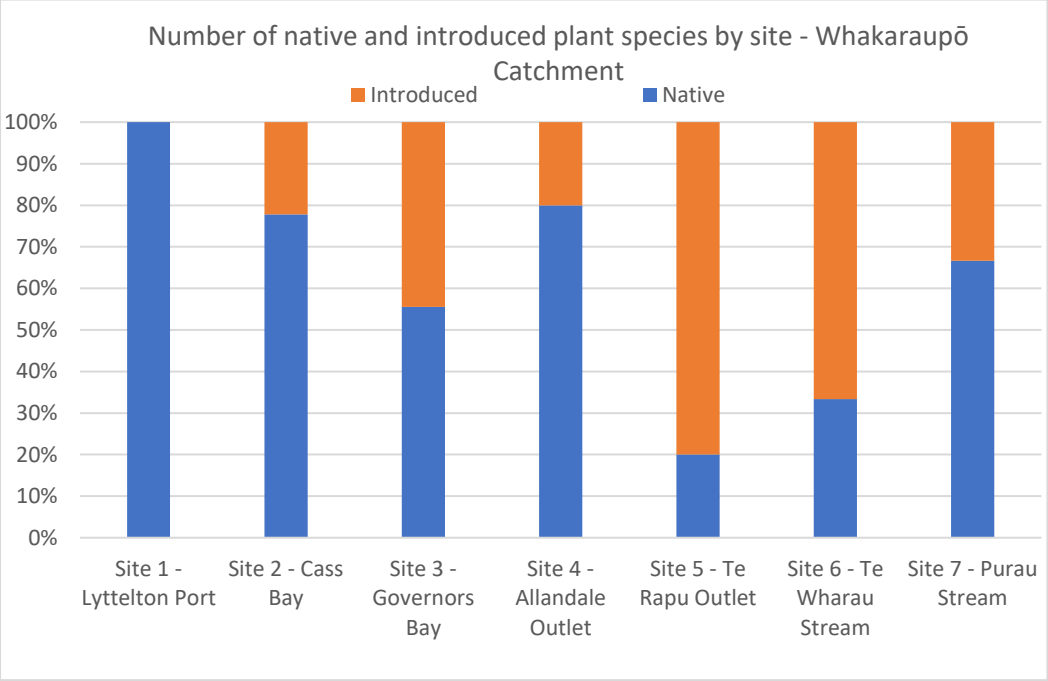

Figure 12. The percentage of identified native and introduced plant species by site recorded in the Ngāti Wheke State of Takiwā survey.

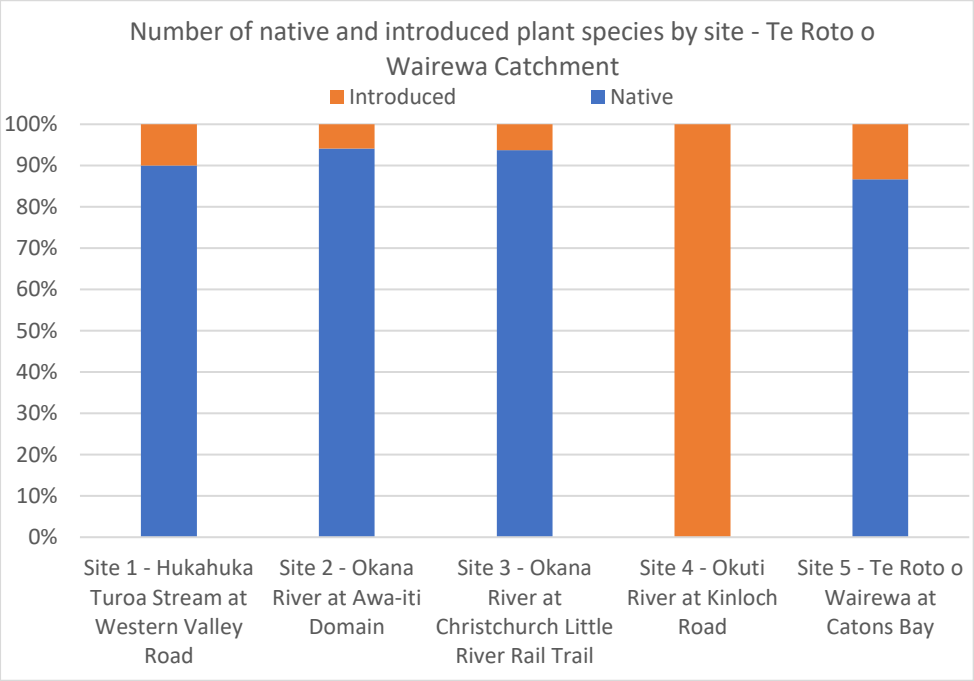

Figure 13. The percentage of identified native and introduced plant species by site recorded in the Wairewa State of Takiwā survey.

Monitoring sites in the Te Roto o Wairewa catchment recorded a higher average number of native plant species (over 10 per site) compared to Whakaraupō. The highest count was 16 species at Site 2 (Ōkana River at Awa-iti Domain).

Introduced species in Whakaraupō included willow, periwinkle, ivy, mahoe, fennel, wattle, grasses, and weeds. Native species recorded included hebe, kamahi, ngaio, karamu, tarata, tī kouka, taupata, whauwhaupaku, ahrakeke, kānuka, akeake, and tōtara, though many others were present but unrecorded. Te Roto o Wairewa's higher native plant abundance reflects recent replanting efforts in public reserves. Restoring native vegetation is a key kaupapa for tāngata whenua, addressing impacts from historic deforestation and urban settlement that reduced native rakau and manu populations, while also strengthening cultural connections to the whenua.

4.4 Bird Survey

4.4.1 Traditional

The Christchurch, Te Waihora and Te Pātaka o Rākaihautū catchments once held one of the most diverse populations of bird species throughout Aotearoa. The pre-human avian diversity is thought to have included many flightless birds (e.g., moa, adzebill and buff weka); coastal birds (e.g., white-flippered penguin, crested penguin and mottled petrel); and some large predatory birds (e.g., Haast's eagle, the worlds largest known eagle, and Laughing Owl – both of which are now extinct).

Waterway, wetland and coastal birds were particularly abundant in the Whakaraupō and Te Roto o Wairewa catchments. Some species were endemic to New Zealand, while others such as red-necked avocet and pied stilt colonised from Australia (CCC Biodiversity Strategy 2008-2035). Forest birds were abundant on the Port Hills and Banks Peninsula as well as in native forest on the plains.

Te Roto o Wairewa and its surrounding catchment have been dramatically modified over the last two centuries which has had significant impacts on mahinga kai values. Significant ecological changes occurred during human settlement along with the introduction of exotic predators. The use of fire also modified habitats and depleted native forest cover. Colonisation by European settlers in the 1850's resulted in the rapid destruction of biodiversity due to habitat destruction, introduction of mammalian predators, hunting, and avian disease caught from introduced birds. By 1890 the majority of forest cover had been removed to allow for agricultural and pastoral land use. This resulted in massive reductions in native birds.

4.4.2 Assessment

Figures 13 and 14 below show the number of observed bird species at each monitoring site. Seven different bird species were observed by Ngāti Wheke cultural monitors at Site 7 – Purau Stream, the highest number for any site. Bird observations were low in the Wairewa survey, with three of five sites recording only one species and a maximum of three at any site. Pīwakawaka was the most common native bird observed across both surveys, while sparrows and blackbirds were the most frequently observed overall.

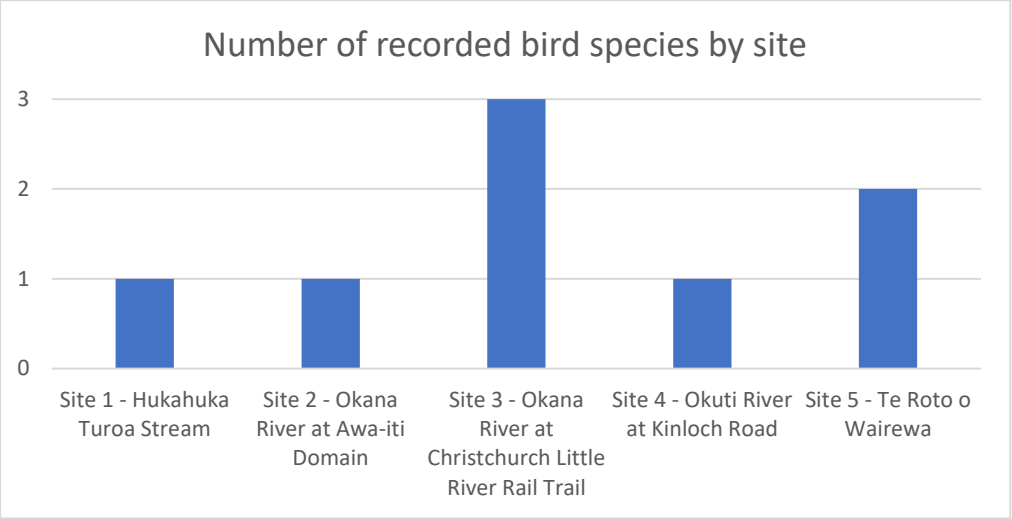

Figure 14. Number of bird species recorded at each site during the Te Hapū o Ngāti Wheke State of Takiwā survey.

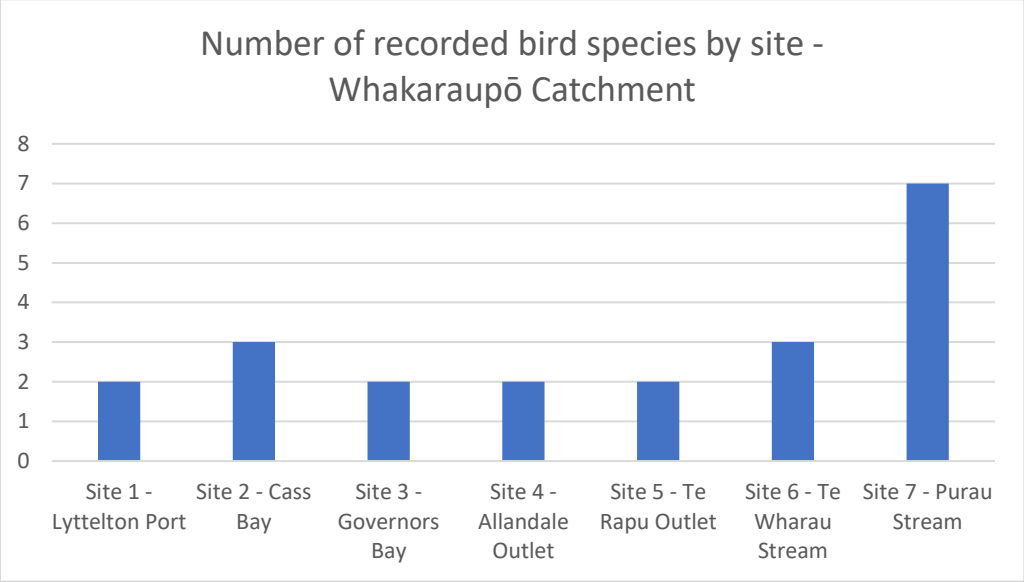

Figure 15. Number of bird species recorded at each site during the Wairewa State of Takiwā survey.

4.5 Fish Survey

4.5.1 Traditional

Present day – Te Pātaka o Rākaihautū awa support a high native fish diversity, including two threatened species (longfin tuna and lamprey), īnanga spawning sites, and two of only four known redfinned bully habitats in Waitaha. Several streams have high ecological and biodiversity values for the entire catchment and must be managed with a Ki uta ki tai approach – source to sea.

There are no complete records of the fish species for Ōtautahi and Te Pātaka o Rākaihautū roto, awa, and repo. During a recent survey across Akaroa Harbour and Little River streams, a total of 12 species were recorded of which 11 were identified as native species and 1 introduced species (Green, 2024). Of the 11 native fish species, one is Threatened – Nationally Vulnerable (pouched lamprey: *Geotria australis*), three At Risk – Declining (longfin tuna: *Anguilla dieffenbachia*, īnanga: *Galaxias maculatus* and bluegilled bully: *Gobiomorphus hubbsi*) and one At Risk – Naturally Uncommon (giant bully: *Gobiomorphus gobioides*).

4.5.2 Assessment

No in field fish surveys were conducted by monitors during the Ngāti Wheke and Wairewa Rūnanga State of Takiwā surveys due to time constraints and staff shortages. Instead, the most recent NZFFD data was used to support findings and provide context for streams and rivers in the Whakaraupō and Te Roto o Wairewa catchments. Figure 16 shows the number of fish species recorded at each monitoring site in the Whakaraupō catchment. Site 6 (Te Wharau Stream) recorded the highest number of indigenous species, including torrentfish, longfin tuna, shortfin tuna and īnanga.

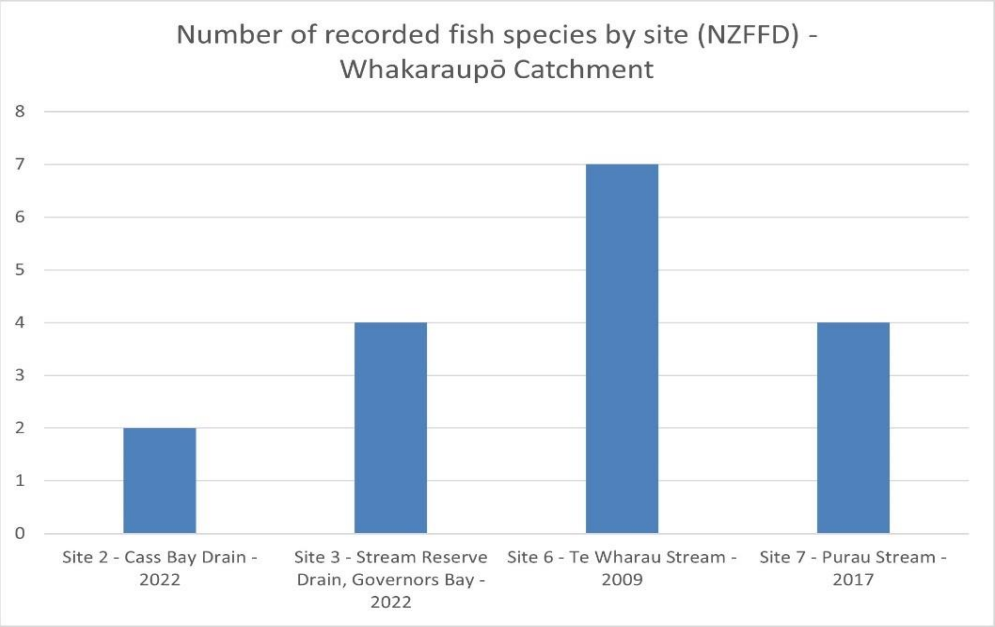

Figure 16. Number of fish species recorded in Whakaraupō catchment (Source: NZFFD).

Fish species data from Te Roto o Wairewa catchment show high numbers of both indigenous and non-native species. Four monitoring sites had fish data available, shown in Figure 17 below. Longfin tuna and brown trout were the most common species, recorded at four and

three sites respectively. Other fish species recorded in the catchment were upland bully, common bully, perch, lamprey, shortfin tuna, rudd, and common smelt.

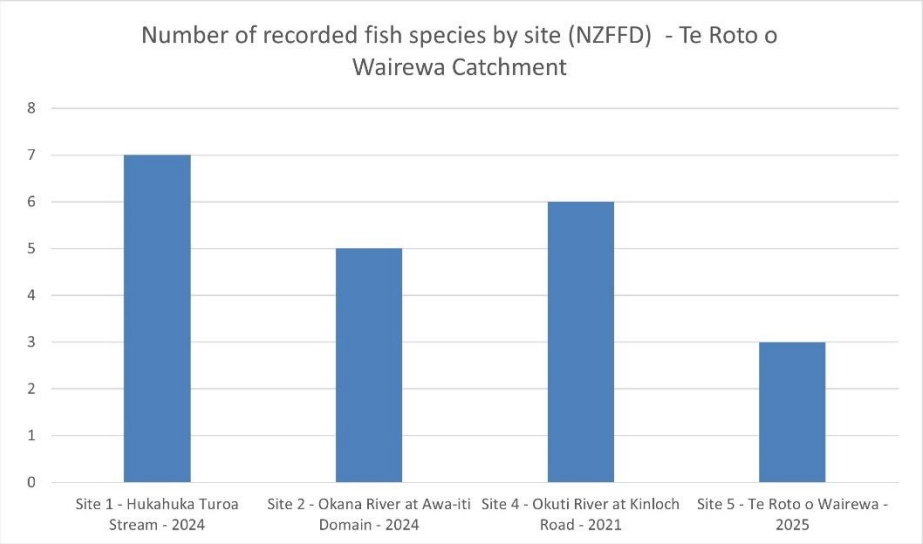

Figure 17. Number of fish species recorded in Te Roto o Wairewa catchment (Source: NZFFD)

Ecological Values and Fish Populations

As previously noted, the awa of Te Pātaka o Rākaihautū hold high ecological values, supporting diverse native fish and sensitive species. Īnanga spawn in tidal vegetation during autumn, with key sites at Allandale, Charteris Bay, Purau Bay, Koukourarata, Pigeon Bay, Okains Bay, Le Bons Bay, Takamatua Bay, Robinsons Bay, Duvauchelle Bay, Barrys Bay and French Farm (Canterbury Maps, 2025). Additional spawning sites exist outside the SMP scope. Other native species found in bush-clad streams include banded kokopu and koaro. Longfin and shortfin tuna, once widespread, have declined due to habitat loss and commercial fishing. Adult piharau (lamprey) are also present in some awa, including those flowing into Te Roto o Wairewa, despite spending most of their lives at sea. Introduced species include brown trout and, occasionally, chinook salmon.

Water Quality and Habitat Pressures

Water quality is the most significant threat to fish populations. Sedimentation from development, erosion, deforestation, and agriculture has degraded stream health by smothering invertebrates, which has contributed to reduced water clarity, and impacting plant growth and food sources for fish. Urban development across the Peninsula introduces contaminants through stormwater runoff, with monitoring showing rising levels of heavy metals

and other pollutants. Inadequate management of development – such as reduced riparian margins, bridges, and culverts – can alter stream flow, hinder fish passage, and increase flood risk.

4.6 Stream Health and Macroinvertebrate Assessment Kit

In order to provide further data on the health of the stream, records of velocity, pH, temperature, electrical conductivity and clarity were recorded during Te Hapū o Ngāti Wheke and Wairewa Rūnanga monitoring (Table 9). However, it should be noted that to accurately determine data trends requires making a standard set of measurements and observations at regular intervals over time.

Table 9. Results from records of the SHMAK testing. The pH and temperature recorded meet LWRP standards.

Te Hapū o Ngāti Wheke Rūnanga monitoring								
Site Code	**Time/ Date**	**Velocity (m/s)**	**pH**	**Water temperature (°C)**	**Electrical conductivity (µS/cm)**	**Water clarity (cm)**	**Dissolved oxygen (mg/L)**	**Dissolved oxygen (% saturation)**
Site 1	9.46am 18/03/2025	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Site 2	10.18am 18/03/2025	N/A	7.6	17	175.1	N/A	8.71	88.50
Site 3	11.10am 18/03/2025	N/A	7.15	15	228.8	N/A	7.47	74.10
Site 4	11.44am 18/03/2025	N/A	7.6	15.5	391.7	N/A	8.04	80.90
Site 5	14.28pm 18/03/2025	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Site 6	14.05pm 18/03/2025	N/A	7.58	15.2	135.8	N/A	9.6	96.50
Site 7	13.13pm 18/03/2025	N/A	7.57	15.4	106	75	9.73	97.30
Wairewa Rūnanga monitoring								
Site 1	09.30am 11/04/2025	0.177[2]	7.52	9.7	128.5	55	13.71	120.60
Site 2	10.50am 11/04/2025	N/A	7.36	9.9	145.9	62	13.44	119.30
Site 3	11.30am 11/04/2025	N/A	7.25	9.7	148.8	N/A	11.85	104.20

[2] Data sourced from ECan/NIWA

Site 4	12.07pm 11/04/2025	N/A	7.24	10.5	129.5	72	12.31	110.80
Site 5	12.40pm 11/04/2025	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Stream velocity was mostly unmeasured due to safety, access issues, stagnant flows, and low depths. Fluid pH and water temperature at all sites met Canterbury Land and Water Regional Plan (LWRP) standards. Dissolved oxygen (DO) concentrations were measured at most sites with flowing water. Most results met the 90% minimum saturation requirement under the LWRP. Three sites in the Whakaraupō catchment measured below the 90% limit while higher concentrations of DO were recorded throughout the Te Roto o Wairewa catchment. Conductivity was consistent across sites, with the highest reading at Site 4 (Allandale Outlet), reflecting coastal influence in Whakaraupō. It should be noted that no relevant guidelines currently exist for conductivity. Water clarity was only measured at one Whakaraupō site and three Te Roto o Wairewa sites, all showing average to moderate clarity impacted by rural sediment runoff. Some sites were not tested due to safety and contamination risks.

Site and stream observations made as part of the SHMAK assessment are represented in Table 10 below.

Table 10. Monitoring site and stream observation results from SHMAK testing (observation based).

Te Hapū o Ngāti Wheke Rūnanga monitoring				
Site Code	**Bed Composition**	**Bank Vegetation True Left**	**Bank Vegetation True Right**	**Deposits**
Site 1	N/A	N/A	N/A	N/A
Site 2	40% boulders, 10% large cobbles, 30% man-made, e.g. concrete, 20% mud or silt.	10% native trees, 5% wetland vegetation, 15% rock, gravels, 70% bare ground, roads, buildings.	10% native trees, 5% wetland vegetation, 15% rock, gravels, 70% bare ground, roads, buildings.	3 – 5 mm
Site 3	5% boulders, 15% large cobbles, 10% man-made, e.g., concrete, 10% woody debris, 60% mud or silt.	10% native trees, 10% introduced trees, 10% scrub, 70% bare ground, roads, buildings.	10% native trees, 10% introduced trees, 10% scrub, 70% bare ground, roads, buildings.	3 – 5 mm
Site 4	100% mud or silt.	10% native trees, 5% wetland vegetation, 10% other introduced trees, 10% rock, gravels, 50% pasture grasses and weeds,	10% native trees, 5% wetland vegetation, 10% other introduced trees, 10% rock, gravels, 50% pasture grasses and weeds,	> 5 mm

		15% bare ground, roads, buildings.	15% bare ground, roads, buildings.	
Site 5	5% large cobbles, 10% man-made, e.g., concrete, 85% mud or silt.	25% tall tussock grassland, not improved, 25% rock, gravels, 50% pasture grasses and weeds.	5% wetland vegetation, 25% rock, gravels, 50% pasture grasses and weeds, 20% bare ground, roads, buildings.	> 5 mm
Site 6	N/A	60% introduced trees, 25% pasture grasses and weeds, 15% bare ground, roads, buildings.	60% introduced trees, 25% pasture grasses and weeds, 15% bare ground, roads, buildings.	N/A
Site 7	45% large cobbles, 5% boulders, 40% mud or silt, 10% gravels.	10% native trees,10% introduced trees, 40% pasture grasses and weeds, 40% bare ground, roads, buildings.	10% native trees, 10% introduced trees, 40% pasture grasses and weeds, 40% bare ground, roads, buildings.	1 – 3 mm
Wairewa Rūnanga monitoring				
Site 1	10% boulders, 25% large cobbles, 30% small cobbles, 25% gravels, 5% man-made, e.g., concrete, 5% mud or silt.	40% pasture grasses and weeds, 30% native trees, 20% introduced trees, 10% bare ground, roads, buildings.	50% pasture grasses and weeds, 25% native trees, 15% introduced trees, 10% bare ground, roads, buildings.	< 1 mm
Site 2	2% boulders, 30% large cobbles, 60% small cobbles, 5% woody debris, 3% water plants, rooted in stream bed.	20% native trees, 40% wetland vegetation, 10% other introduced trees, 20% pasture grasses and weeds, 10% bare ground, roads, buildings.	30% native trees, 45% wetland vegetation, 10% other introduced trees, 15% bare ground, roads, buildings.	< 1 mm
Site 3	N/A	10% introduced trees, 80% pasture grasses and weeds, 10% bare ground, roads, buildings.	50% native trees, 10% wetland vegetation, 10% bare ground, roads, buildings, 30% pasture grasses and weeds.	> 5 mm
Site 4	20% boulders, 60% large cobbles, 15% small cobbles, 5% woody debris.	10% wetland vegetation, 20% introduced trees, 20% other introduced trees, 10% rock, gravels, 10% bare ground, roads, buildings, 30% pasture grasses and weeds.	20% introduced trees, 50% pasture grasses and weeds, 10% rock, gravels, 20% bare ground, roads, buildings.	1 – 3 mm

Site 5	100% mud or silt.	10% introduced trees, 90% pasture grasses and weeds.	5% native trees, 5% wetland vegetation, 5% introduced trees, 40% rock, gravels, 30% pasture grasses and weeds, 15% bare ground, roads, buildings.	> 5 mm

Streambed composition could not be assessed at three monitoring sites due to access and safety concerns. Most assessed sites had high mud or silt coverage, with Sites 4 and 5 in the Whakaraupō catchment recording 100% composition of mud or silt. Upstream sites in Te Roto o Wairewa catchment showed healthier, more varied habitats. Bank vegetation at most sites reflected a rural environment.

Figure 18: Monitors conducting SHMAK testing in Okana River at Awa-iti Domain.

4.7 Water Quality Testing

Five sites were selected for water sampling as part of the Te Hapū o Ngāti Wheke monitoring while three sites were sampled during the Wairewa monitoring. Water samples were taken on 19 March 2025 for Te Hapū o Ngāti Wheke and 11 April 2025 for Wairewa. All water samples were sent to Hill Laboratories for analysis. The results of the levels of contaminants recorded from water samples are shown in Tables 9 and 10 below and have been included in Appendix C. It should be noted that typical monitoring of contamination requires repeated testing at regular intervals over time. These water sample results represent a snapshot in time to support results from cultural monitoring surveys.

Table 11. Water sample analysis results from Te Hapū o Ngāti Wheke Monitoring.

Site	Site 2 – Cass Bay Stream	Site 3 – Stream Reserve Drain, Governors Bay	Site 4 – Allandale Outlet	Site 6 – Te Wharau Stream	Site 7 – Purau Stream
pH (pH Units)	7.9	7.6	7.7	7.5	7.4
Electrical Conductivity (EC) (mS/m)	24.8	19.1	18.9	12.2	9.2
Total Suspended Solids (g/m^3)	9	8	25	15	11
Dissolved Copper (g/m^3)	0.0040	0.0026	0.0016	0.0010	0.0008
Dissolved Lead (g/m^3)	0.00036	0.00040	0.00026	< 0.00010	< 0.00010
Dissolved Zinc (g/m^3)	0.0149	0.0070	0.0020	< 0.0010	< 0.0010
Total Nitrogen (g/m^3)	1.35	1.09	1.37	1.62	0.64
Total Ammoniacal-N (g/m^3)	0.026	< 0.010	0.012	< 0.010	< 0.010
Nitrite-N (g/m^3)	0.006	0.007	0.007	0.005	0.002
Nitrate-N (g/m^3)	0.55	0.148	0.35	1.11	0.162
Nitrate-N + Nitrite-N (g/m^3)	0.565	0.155	0.35	1.11	0.164
Total Kjeldahl Nitrogen (TKN) (g/m^3)	0.79	0.94	1.02	0.51	0.48
Dissolved Reactive Phosphorus (g/m^3)	0.112	0.040	0.030	0.022	0.015
Total Phosphorus (g/m^3)	0.21	0.129	0.125	0.087	0.053
Escherichia coli (MPN / 100mL)	> 2, 420	1, 733	> 2, 420	1, 733	> 2, 420
Chlorophyll a (g/m^3)	0.0020	0.0005	0.0010	0.0014	0.0008

Table 12. Water sample analysis results from Wairewa Monitoring.

Site	Site 1 – Hukahuka Turoa Stream	Site 2 – Okana River at Awa – Iti Domain	Site 3 – Okana River at Christchurch Little River Rail Trail
pH (pH Units)	7.6	7.7	7.6
Electrical Conductivity (EC) (mS/m)	12.9	14.6	15.0
Total Suspended Solids (g/m^3)	5	3	< 3
Dissolved Copper (g/m^3)	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead (g/m^3)	< 0.00010	< 0.00010	< 0.00010
Dissolved Zinc (g/m^3)	< 0.0010	< 0.0010	< 0.0010
Total Nitrogen (g/m^3)	0.30	0.31	0.30
Total Ammoniacal-N (g/m^3)	< 0.010	< 0.010	< 0.010
Nitrite-N (g/m^3)	< 0.002	< 0.002	< 0.002
Nitrate-N (g/m^3)	0.166	0.123	0.133
Nitrate-N + Nitrite-N (g/m^3)	0.167	0.123	0.134
Total Kjeldahl Nitrogen (TKN) (g/m^3)	0.13	0.19	0.16
Dissolved Reactive Phosphorus (g/m^3)	0.021	0.023	0.023
Total Phosphorus (g/m^3)	0.041	0.046	0.046
Escherichia coli (MPN / 100mL)	461	866	687
Chlorophyll a (g/m^3)	0.0004	0.0008	0.0004

The water quality results from Ngāti Wheke and Wairewa Rūnanga monitoring were compared against the freshwater outcomes and receiving water standards for Banks Peninsula rivers and streams (i.e., 99% species level protection) set out in the LWRP. Two water samples for Wairewa Rūnanga monitoring exceeded the 550 MPN per 100 mL limit for *E. coli*, while all five water samples taken for Ngāti Wheke Monitoring exceeded the limit for *E. coli.* Three of the five water samples taken for Ngāti Wheke Monitoring also exceeded the limit for dissolved reactive phosphorus (DRP). DRP concentrations are an indication of a waterbody's ability to support algae and plant growth. Higher concentrations of DRP in a stream, river or lake can cause rapid weed growth or algal blooms which can degrade the health of the waterbody. The measured concentrations of metals and metalloids (copper, lead and zinc) were lower than the standards set out in the LWRP for all water samples.

Water sampling for Te Hapū o Ngāti Wheke monitoring was conducted after a rainfall event which resulted in very high readings of *E. coli*. This was likely due to increased runoff from farmland in the upper catchment.

All sites should be monitored further for additional comparisons.

4.8 Attribute Target Levels for Mana Whenua Values

Condition 54 of the CSNDC requires Attribute Target Levels to be developed in collaboration with Papatipu Rūnanga. The relevant target levels are based on the Waterway Cultural Health Index and SOT models, with a 1 to 5 scale from very poor to very good. As of 2022, the six Papatipu Rūnanga represented by Mahaanui Kurataiao Ltd determined that the target level for all waterway classifications should be set at 5 (very good).

For Te Pātaka o Rākaihautū, two separate SOT monitoring surveys were conducted in the Whakaraupō and Te Roto o Wairewa catchments. Overall, this monitoring indicated that the catchment has 'poor' to 'moderate' cultural health values. For the Whakaraupō catchment, the average score for the SOT survey was 2.0. For Te Roto o Wairewa catchment, the average SOT score was 2.4. The average CHI score for both surveys was 2.1. These scores did not meet the set target level of 5 (Figure 19 and 20), indicating that significant work is required throughout the catchment to improve the cultural health of all monitoring sites, as well as the catchment overall.

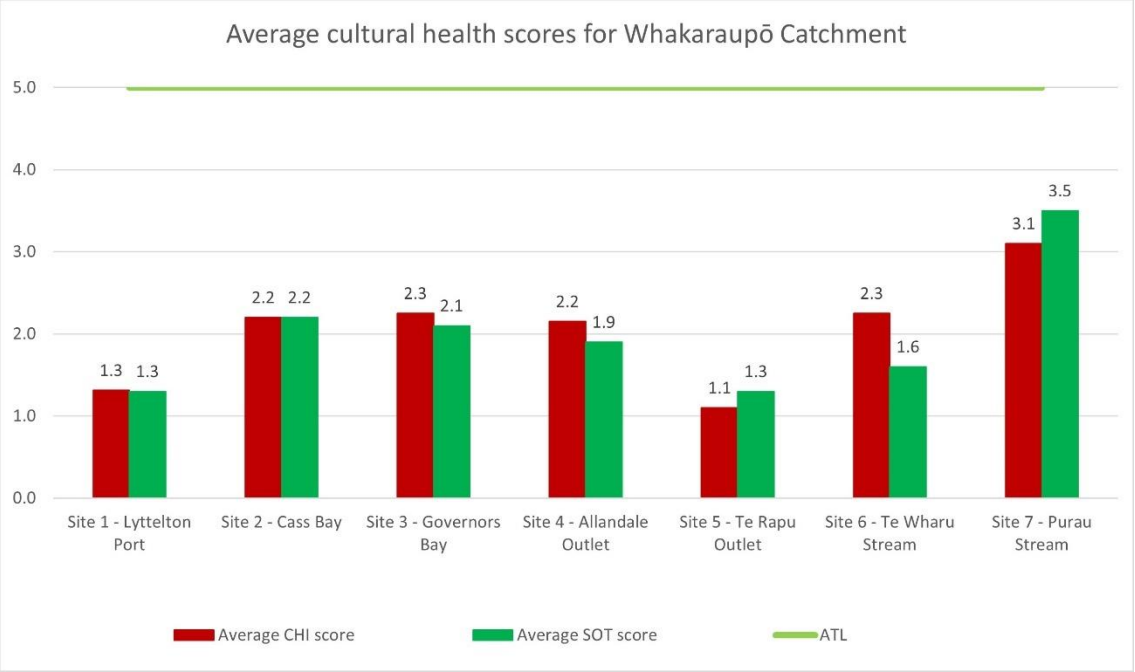

Figure 19. The SOT and CHI scores for overall health by site (Whakaraupō catchment).

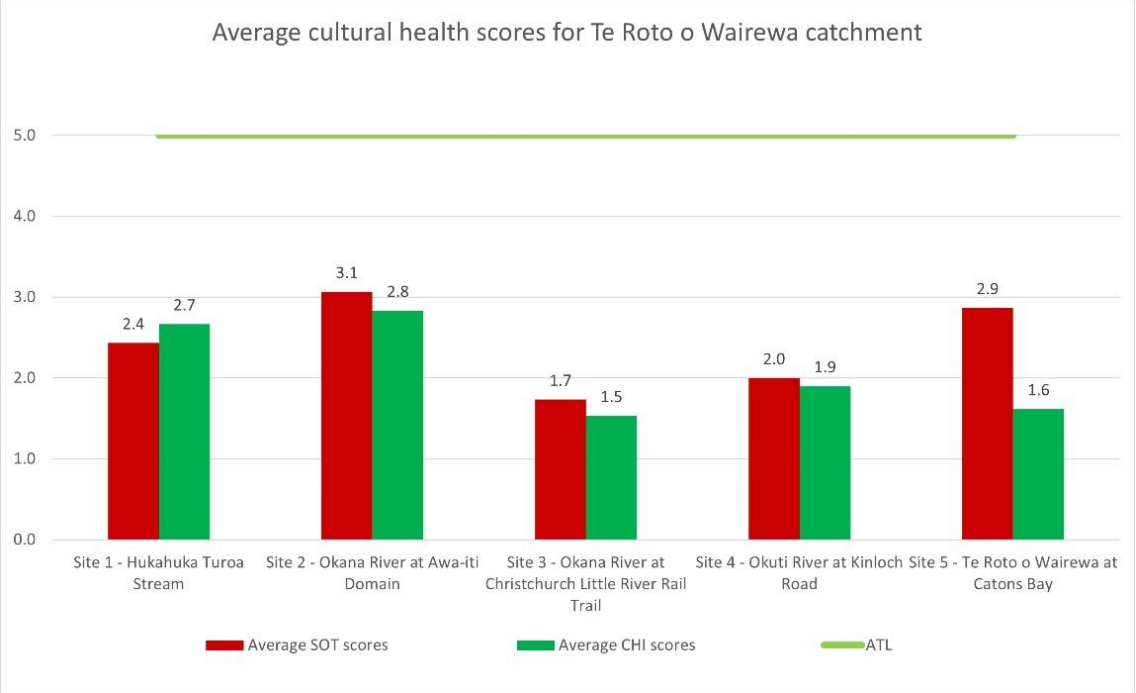

Figure 20. The SOT and CHI scores for overall health by site (Te Roto o Wairewa catchment).

5 Discussion

5.1 Overview of the catchment

Te Pātaka o Rākaihautū is predominantly rural with approximately 500 hectares throughout the catchment occupied by urban settlements as defined in the District Plan. For the purposes of the CSNDC, the Stormwater Management Plan only applies to 24 settlements that have a stormwater network.

Ngāi Tahu has a long and rich history of land use and occupancy throughout many coastal areas, harbours and bays of Te Pātaka o Rākaihautū. The bays are an important cultural landscape for Ngāi Tahu, with archaeological evidence and oral tradition maintaining the connection between people and place. Evidence of early Māori occupation include pā sites, fishing settlements, birding sites, and urupā. Some sites are registered archaeological sites (NZAA) and silent files, while others are recorded in oral traditions and historical sources.

Whakaraupō has a strong tradition of mahinga kai for Ngāi Tahu, and its name originates from the raupō reeds that were once plentiful at Ōhinetahi at the head of the harbour. Kaimoana such as pipi, tuaki, kutai, pāua, tio, kina and pūpū, and ika such as pātiki, pātiki rori, pīoki, hoka, aua, pāpaki, koiro and hokarari provided an abundant and reliable supply of mahina kai for tāngata whenua and their manuhiri. Three pā once existed around the bays of Koukourarata: Kaitara, Koukourarata, and Puāri, which became the main centres of Ngāi Tahu activity in the Canterbury region. The ability of tāngata whenua to practice mahinga kai has been severely affected by the degradation of Whakaraupō.

Akaroa Harbour is a significant cultural landscape with many cultural values associated with it. Natural features of the harbour and its coastline, streams, and ridgelines embed within them the Ngāi Tahu history and identity. Freshwater streams of the inner harbour influenced the positioning of early kāinga/temporary campsites used by Ngāi Tahu tupuna. Other cultural values associated with Akaroa Harbour include kai moana, wāhi tapu sites, taonga species, native vegetation, culturally significant landscapes, and many traditional Ngāi Tahu place names within cultural memory that warrant acknowledgment, protection and management.

Te Roto o Wairewa is a culturally significant mahinga kai site for Wairewa Rūnanga and Ngāi Tahu. Although the lake continues to be a productive environment, its mauri has been severely degraded. Previous State of the Takiwā assessments in 2005 and 2006 showed that the

catchment land use is having a marked effect on the culutal health of the lake. The assessment highlighted the dramatic loss of cultural health as you move from upper to lower catchment: source to sink. Sedimentation and the concentration of nutrients in the sediment of the lakebed are key issues. The waterways in Te Roto o Wairewa flow from maunga to lake, ki uta ki tai. This means that the cultural health of the lake is directly related to the cultural health of the waterways. Water quality and quantity in the catchments waterways has decreased significantly in the memory of tangata whenua of Wairewa. Land use change has reduced the catchments water yield and increased the presence of contaminants in surface water.

Cultural monitors conducted State of the Takiwā monitoring in two key sub-catchments of Te Pātaka o Rākaihautū: Whakaraupō and Te Roto o Wairewa. Both sub-catchments were found to be in a ‘poor to moderate’ state of cultural health.

5.1.1 Whakaraupō State of Takiwā Monitoring

Cultural monitoring was undertaken in Whakaraupō with Te Hapū o Ngāti Wheke (Rāpaki) Rūnanga cultural monitors in March 2025. The average cultural health score across seven sites was 2.0, indicating ‘poor to moderate’ cultural health. Sites were selected based on CCC surface water and aquatic ecology monitoring locations, CCC stormwater network infrastructure, geographic spread, and accessibility. The Te Pātaka o Rākaihautū SMP includes urban settlements as defined by the District Plan, however the majority of land in the catchment is classified as rural and therefore falls outside the scope of the SMP and CSNDC. All sites showed urban impacts, with some more affected than others. Most survey responses scored between 1 and 3, with site access for mahinga kai rated highest (2.4 on average). While access was generally easy, monitors were mostly unwilling to harvest due to concerns about water quality, exotic vegetation, and weeds. Observations included thick sediment, murky water, and foamy or slimy layers. Other deterrents included site location, runoff sources, and stream flows.

As part of the cultural impact assessment survey, monitors were asked: “What needs to happen at this site to restore it as a mahinga kai?” Across nearly all sites, a common response was the need to increase the diversity and abundance of native vegetation. There was a distinct lack of indigenous vegetation at some sites with other exotic weeds, grasses and trees dominating the landscape. Additional actions identified to support the restoration of these sites as mahinga kai included the removal of exotic weeds, improved vegetation maintenance, erosion and sediment control in the upper catchment, and enhancement of stream habitats.

SOT scores related to water quality were notably low at Site 1 – Lyttelton Port, Site 2 – Cass Bay Stream, and Site 5 – Te Rapu Outlet. At Site 1, the active operations of Lyttelton Port and marine vessel traffic contributed to the poor water quality scores reported by cultural monitors, alongside the presence of a direct stormwater discharge outlet into the harbour. At Cass Bay Stream, monitors observed an oily or slimy substance and foam in the water (Figure 21, though the source of these contaminants could not be identified at the time of monitoring. Water samples were collected at Site 2 on 19 March 2025 and sent to Hill Laboratories for analysis. Rainfall occurred the night prior to sampling, which likely influenced the levels of contaminants present in the stream.

Site 7 – Purau Stream scored the best with regards to cultural health, and was the only Whakaraupō site to score above 3.0 on average for both SOT and CHI scores. Stream observations made by monitors were healthier at Site 7 than all other sites. Cultural health scores for water clarity and habitat variety were 4.5 on average, the highest scores throughout the survey. Monitors accessed Purau Stream from Purau Reserve, a public reserve space along the true right of the awa. Although the site was easily accessible for monitors the surrounding catchment was bare in parts and lacked indigenous vegetation which impacted cultural health scores. Figure 22 below shows Purau Stream where monitors conducted their SOT surveys.

Cultural monitors identified site-specific issues affecting cultural health scores. At Site 1 – Lyttelton Port, concerns were raised about pollution from marine vessels and port operations. Site 4 – Allendale Outlet had serious concerns regarding a historic landfill, with potential contamination of Whakaraupō via stormwater runoff. At Site 6 – Te Wharau Stream, monitors noted slash buildup near the culvert, raising flood risks during heavy rain, and highlighted impacts from upstream farming at both Site 6 and Site 7 – Purau Stream. Inadequate fencing and setbacks allow stock access and increase the risk of contaminant runoff.

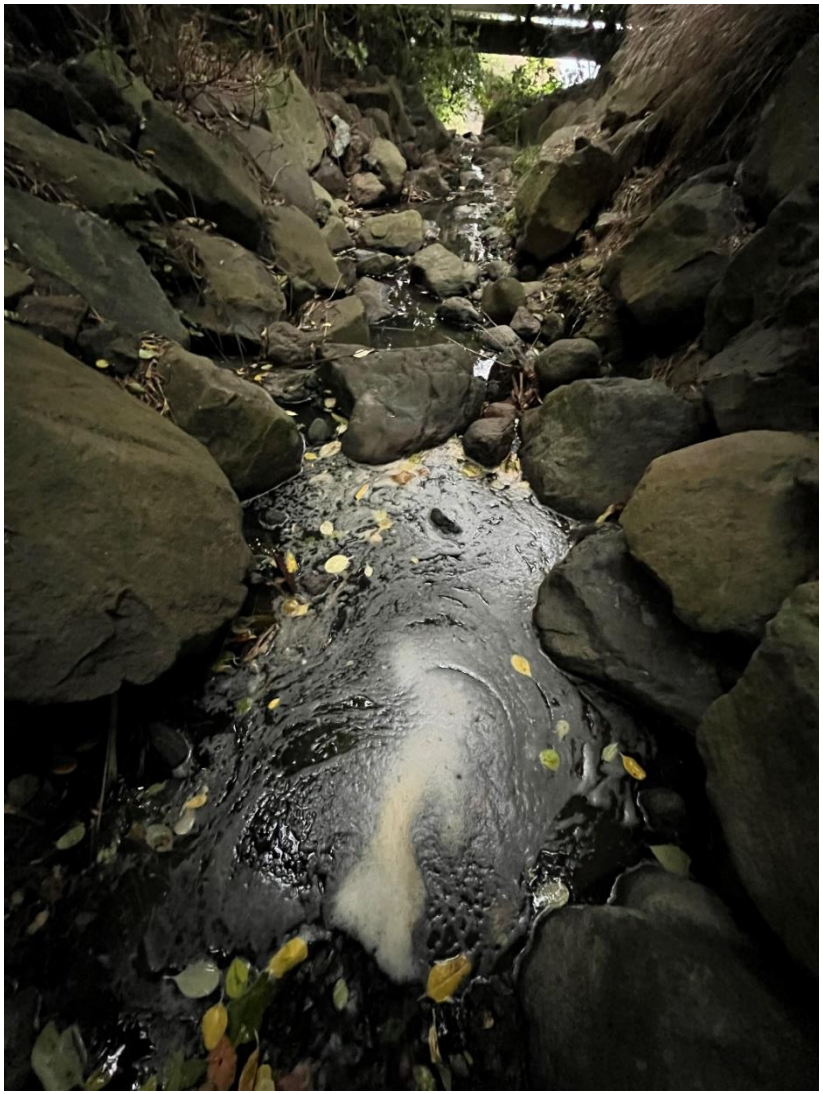

Figure 21. Cass Bay Stream during SOT monitoring, March 2025. Photo looking downstream.

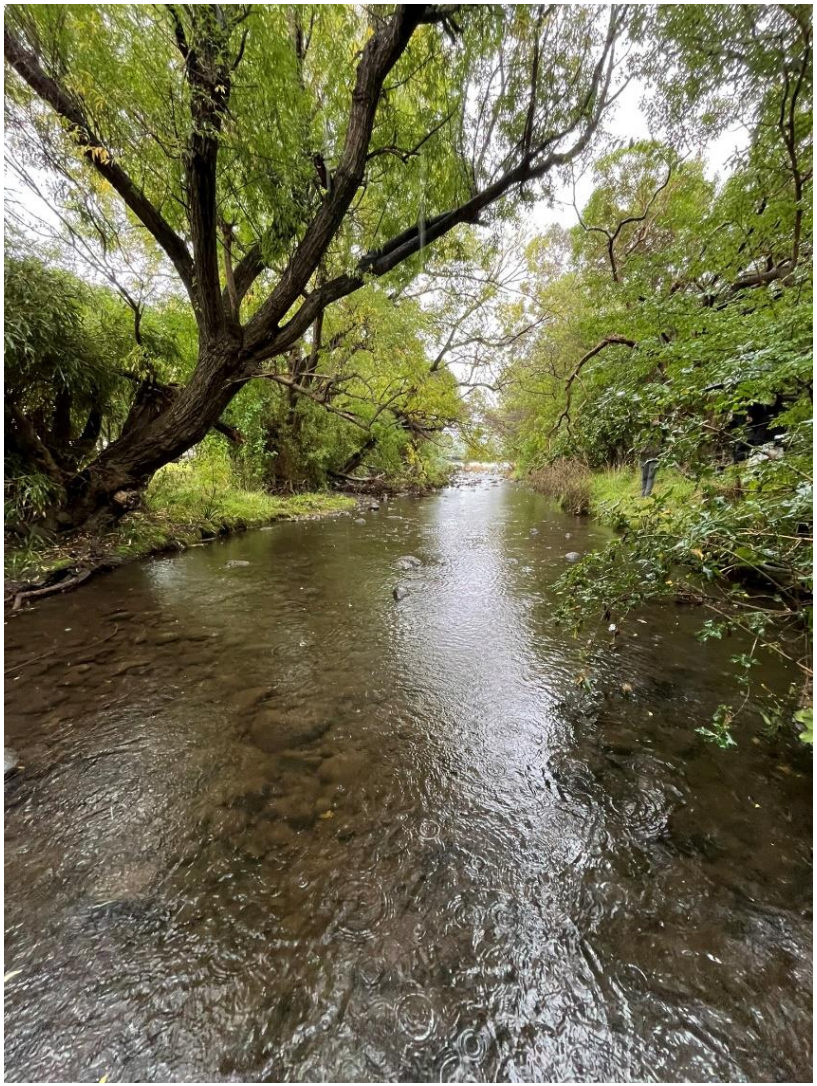

Figure 22. Purau Stream during SOT monitoring, March 2025. Photo looking downstream.

5.1.2 Te Roto o Wairewa State of Takiwā Monitoring

Cultural monitoring was undertaken with Wairewa Rūnanga on 11 April 2025. The average score from all cultural monitor surveys was 2.4, indicating 'poor to moderate' cultural health. Five monitoring sites were selected based on geographic location including upper and lower catchment areas. There are no existing CCC monitoring sites throughout the Te Roto o Wairewa catchment, therefore all sites were selected based on relevance to the CSNDC and Te Pātaka o Rākaihautū Stormwater Management Plan.

Cultural monitors identified widespread issues across the catchment, including invasive species (e.g., willows, gorse), significant waterway modifications (e.g., culverts), flooding concerns, sedimentation, bank erosion, algal blooms, and historic impacts such as deforestation and farming that contribute to poor water quality in Te Roto o Wairewa and its tributaries. Site 3 – Okana River at Christchurch Little River Rail Trail received some of the lowest cultural health scores, with most SOT categories averaging 2.0 or below. Particularly low scores were given for modification and willingness to harvest mahinga kai. Kinloch Road bridge was noted as contributing to flooding events during heavy rain, leading to erosion and restricted site access, further impacting cultural values. CHI scores were similarly low, with riverbed condition, water quality, and clarity often rated 1.0 (very unhealthy). During monitoring, the river was observed in a degraded state with low flows, poor clarity, strong effluent smells, and thick sediment. Monitors also noted the high banks at Site 3 made it unsafe for accessing mahinga kai.

The surrounding landscape in Little River is mostly rural and as such there is a high abundance of indigenous vegetation present along river and stream margins. In heavily urbanised areas most vegetation is cleared to allow for more infrastructure to be built. Cultural monitors noted many different indigenous species present at each monitoring site throughout the catchment. Over 85% of the vegetation observed by cultural monitors at four of the five monitored sites was identified as indigenous species. Site 4 – Okuti River at Kinloch Road was the only site with no native vegetation species recorded by cultural monitors. The awa is surrounded by farmland throughout the catchment and it is unclear whether stock can access the waterway in parts due to insufficient fencing. Figure 23 below shows Okuti River at Kinloch Road bridge and the surrounding exotic vegetation. Monitors noted that the awa upstream from this site is healthier, with a variety of habitat for fish species and mahinga kai. Downstream from the Kinloch Road bridge the awa starts to deteriorate, with little to no vegetation along river margins in parts, and minimal variety in habitat.

Site 2 – Okana River at Awa-iti Domain scored the highest on average in the Wairewa SOT survey. Monitors recorded the greatest diversity of indigenous vegetation, with a mixture of trees and riparian habitat along the true right margin, and wetland plants, small natives, and overgrown grasses along the true left. The riverbed featured varied rocks, gravel, and flow. Although water clarity was above average, lower river depth here compared to upstream and downstream areas may affect results. During heavy rainfall events the Okana River can carry significant volumes of water from the upper catchment, causing erosion and sedimentation downstream. Monitors noted that despite abundant native vegetation at Site 2, additional riparian planting is needed to stabilise banks and reduce erosion. Figure 24 shows the survey location.

Figure 23. Site 4 – Okuti River at Kinloch Road. Photo looking upstream.

Figure 24. Okana River at Awa-iti Domain. Photo looking upstream from SH75.

6 Conclusion and recommendations

Mahaanui Kurataiao Ltd facilitated cultural health monitoring in collaboration with Te Hapū o Ngāti Wheke and Wairewa Rūnanga during March and April 2025. Te Hapū o Ngāti Wheke conducted State of Takiwā (SOT) assessments at seven sites across the Whakaraupō catchment, while Wairewa Rūnanga completed assessments at five sites within the Te Roto o Wairewa catchment.

The monitoring results indicate that the overall cultural health of both catchments is rated as 'poor' to 'moderate'. The average SOT score for the Whakaraupō catchment was 2.0, and 2.4 for Te Roto o Wairewa, with a combined Cultural Health Index (CHI) average of 2.1. These scores fall significantly below the Attribute Target Level of 5.

Erosion and sedimentation were consistent concerns identified in many waterways across both catchments. Cultural monitors emphasised the importance of addressing these issues at their source in the upper catchments, rather than relying on downstream mitigation effects before or after sediment enters the harbour or lake. Weed control and the enhancement of native vegetation were also key themes. Lower levels of native vegetation were observed in the Whakaraupō catchment, primarily due to historic and ongoing urban development.

The degree of modification was among the lowest scoring indicators across all monitoring sites. Cultural monitors assessed the degree of modification on a scale from 1 (highly modified) to 5 (low modification), with an average score of less than 2.0. This reflected poor to moderate cultural health values. These low scores reflect the cumulative impacts of discharges, abstractions, development, and man-made structures such as culverts, bridges, and stormwater outlets – particularly in urbanised areas. Such modifications are known to compromise waterway health and impact Ngāi Tahu cultural values.

Wetlands, springs, and riparian margins are wāhi taonga for Ngāi Tahu, treasured for their role in protecting and enhancing mauri, as providing habitat for mahinga kai and maintaining the overall health of freshwater environments. These landscape features are considered collectively in relation to stormwater management throughout Te Pātaka o Rākaihautū as they are all fundamental to the cultural health of freshwater resources.

Additional site-specific concerns were also noted by monitors. In the Whakaraupō catchment, Te Hapū o Ngāti Wheke cultural monitors raised concerns relating to marine vessel and port-related pollution at Site (Lyttelton Port), contaminant runoff from a historic landfill at Site 4 (Allandale Outlet), and the build-up of woody debris partially blocking a culvert at Site 6 (Te

Wharau Stream). In the Te Roto o Wairewa catchment, Wairewa Rūnanga monitors identified the long-term impacts of historical deforestation and land use change, which have significantly degraded mahinga kai values. Elevated levels of sedimentation and nutrient accumulation in the lakebed remain key concerns for whānau, particularly in the lower catchment.

Recommendations have been compiled by cultural monitors and kaitiaki from Te Hapū o Ngāti Wheke and Wairewa Rūnanga, based on cultural monitoring results and on review of the first draft of the Te Patakā o Rākaihautū Banks Peninsula Stormwater Management Plan. These recommendations are intended to help moderate the effects of stormwater discharges throughout the takiwā.

6.1 Recommendations

The following recommendations have been provided from each Papatipu Rūnanga to help moderate the effects of stormwater discharge in their takiwā.

<u>Recommendations provided by Te Hapū o Ngāti Wheke (Rāpaki):</u>

- Investigate the feasibility of and implement (if necessary) a marine pest removal programme for Whakaraupō to help improve the cultural health of the harbour.
- Increase the monitoring frequency of water quality in Whakaraupō, particularly within the working port area to help address contaminant sources and issues.
- Implement enforceable controls for vessel owners to prevent biofouling accumulating within Whakaraupō.
- A catchment-based planting plan must be developed for streams that have been identified as key contributors of contaminant discharge into Whakaraupō. The planting plan must ensure that riparian margins are protected and provide sufficient habitat for taonga species. This plan should also include the removal of exotic pest species (i.e., willow) to encourage native vegetation growth and enhance indigenous biodiversity.
- Investigate direct discharges into streams located in urbanised areas such as Governors Bay and assess the feasibility of treatment devices to target contaminants.
- Develop and implement planting plans for upper catchment areas to reduce sedimentation in the lower catchment and Whakaraupō.
- Enhance and naturalise streams throughout Whakaraupō catchment, where possible, to increase indigenous habitat and enhance mahinga kai values.

- Work with Papatipu Rūnanga to protect and enhance existing mahinga kai areas (i.e., īnanga spawning areas).
- Restore access to traditional mahinga kai sites for mana whenua.
- Work with appropriate regulating authorities to improve fencing of waterways in upper catchment areas to prevent stock accessing and further contaminating the awa.
- Ensure any new development throughout Whakaraupō catchment implements appropriate setbacks from waterways and adheres to the policies and guidelines relating to stormwater as per the Ngai Tahu Subdivision and Development Guidelines document in the Mahaanui Iwi Management Plan.
- Ensure any construction activities within known contaminated sites adhere to stringent erosion and sediment control measures, to protect waterways and Whakaraupō from further contamination. Contaminated soils and materials must be captured and managed on-site.
- Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

<u>Recommendations provided by Wairewa Rūnanga:</u>

- Protect and enhance mahinga kai habitats, in collaboration with mana whenua, to enable mahinga kai to thrive, and desired species are plentiful enough for long-term harvest and present across all life stages.
- Ensure the protection and enhancement of known spring sites.
- Support regular State of Takiwā monitoring throughout the catchment.
- Develop a catchment-based indigenous vegetation planting plan that ensures riparian margins are protected and enhanced while also providing for sufficient habitat for taonga species.
- Ensure that stringent and enforceable controls are implemented on any land-use and earthworks activities to avoid further sedimentation of waterways and improve overall water quality throughout the catchment.
- Establish a suitable pest and weed control programme to maintain overgrown weeds in and alongside rivers and streams. This should include the removal of exotic vegetation such as pine to help restore the cultural health throughout the takiwā.
- Ensure the management of natural resources in the takiwā of Wairewa Rūnanga embraces ki uta ki tai, recognising and providing for te taiao interconnectivity in all decision-making processes.
- Investigate additional mitigation measures that address the water quality issues for Te Roto o Wairewa which may sit outside the scope for this SMP.

- Explore more effective flood mitigation measures for areas prone to flooding. This includes flood prone areas of Okana River and the Little River township where flooding has occurred consistently.
- Investigate options to improve instream habitats throughout Te Roto o Wairewa catchment. Measures to improve instream habitat must be discussed with Wairewa Rūnanga through appropriate channels.
- Ensure access to traditional mahinga kai sites are restored for mana whenua.
- Investigate methods to address bank erosion issues throughout the catchment.
- Ensure all future development takes into account Ngāi Tahu Subdivision and Development Guidelines, with particular focus on stormwater management policies.
- Improve lake level management to protect and enhance mahinga kai values and the customary relationship of tāngata whenua with Te Roto o Wairewa, and to improve flood management throughout the catchment.
- Engage with mana whenua prior to any proposed changes, enhancements, translocations and/or diversions rather than consult retrospectively.
- Ensure that all waterways in the catchment are treated to the same standard and managed for mahinga kai collection in the future.
- Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

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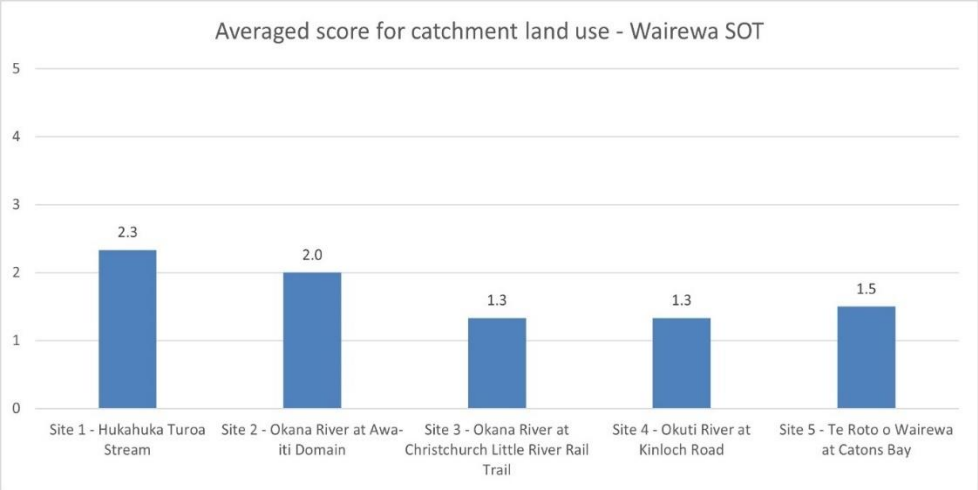
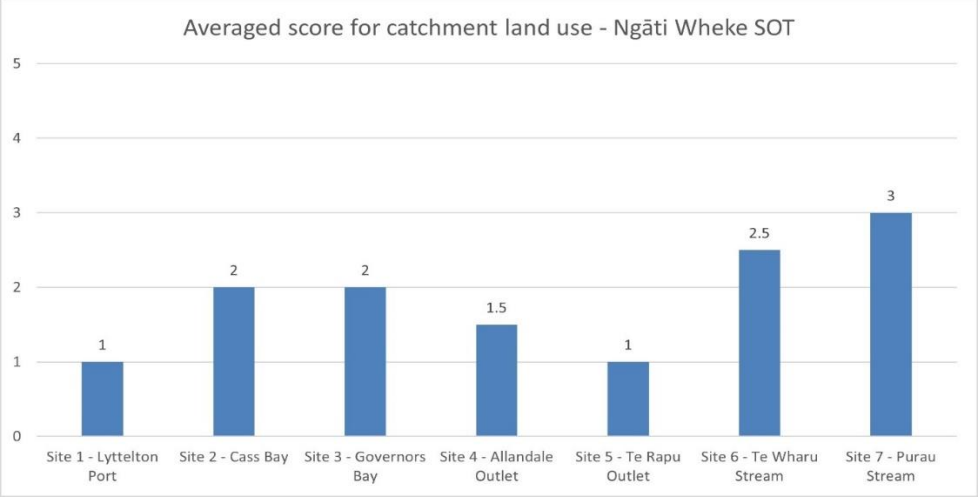
8 Appendix

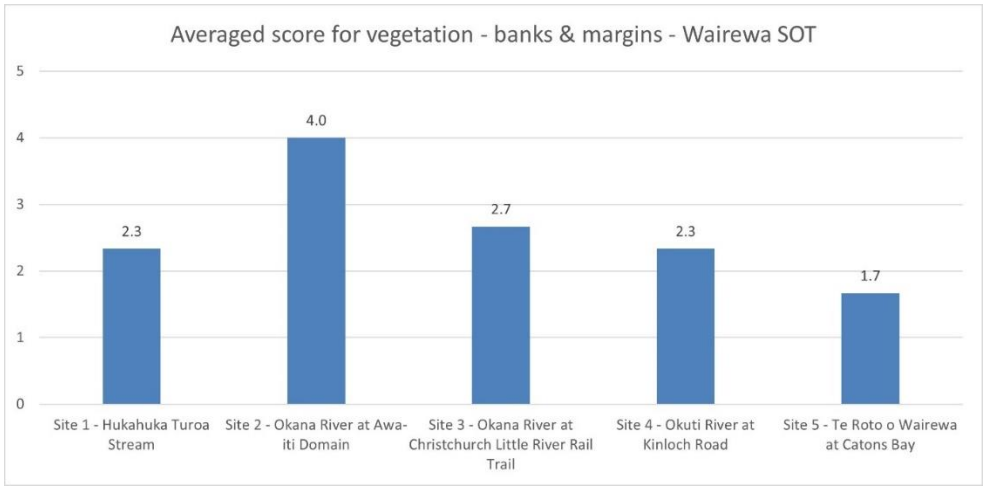
8.1 Appendix A: Graphed results from Cultural Stream Health Assessment & Site Assessment

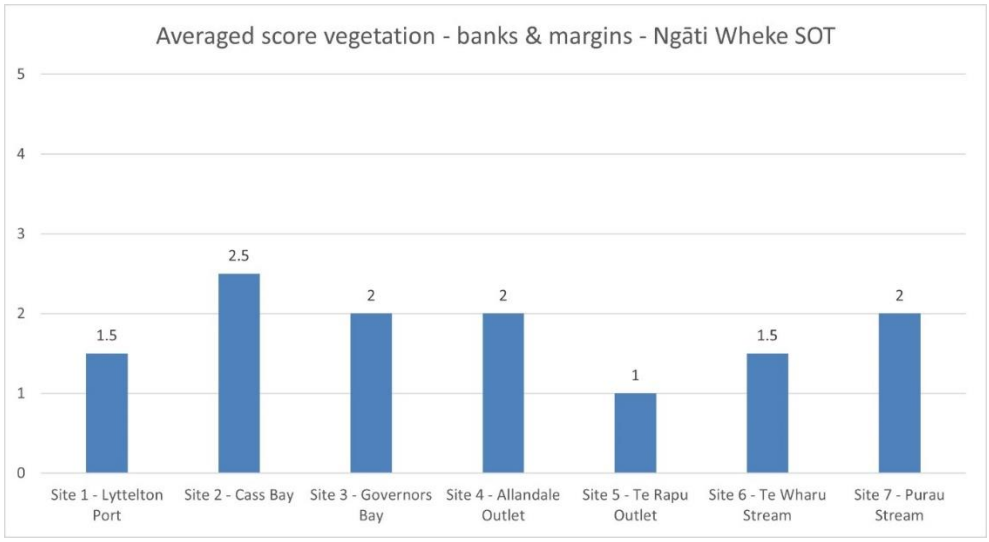
8.1.1 Observation of catchment land use.



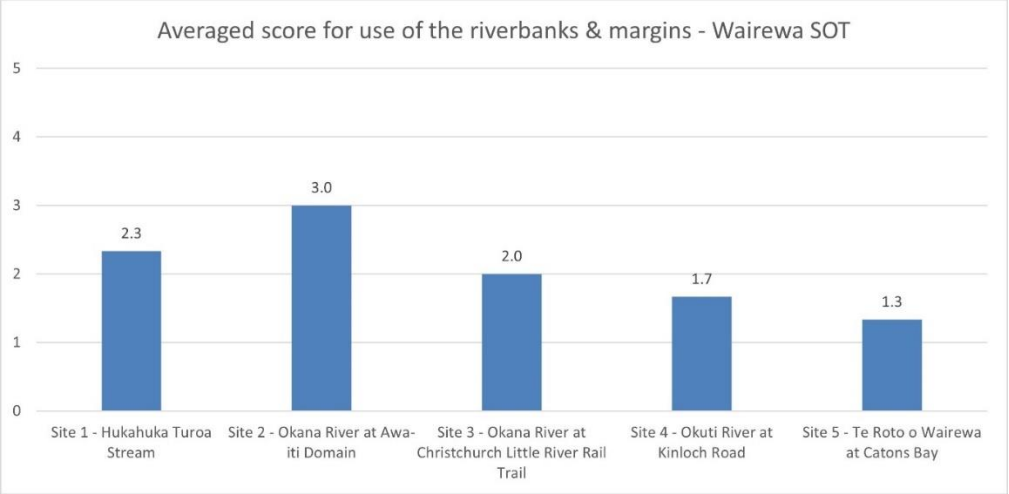


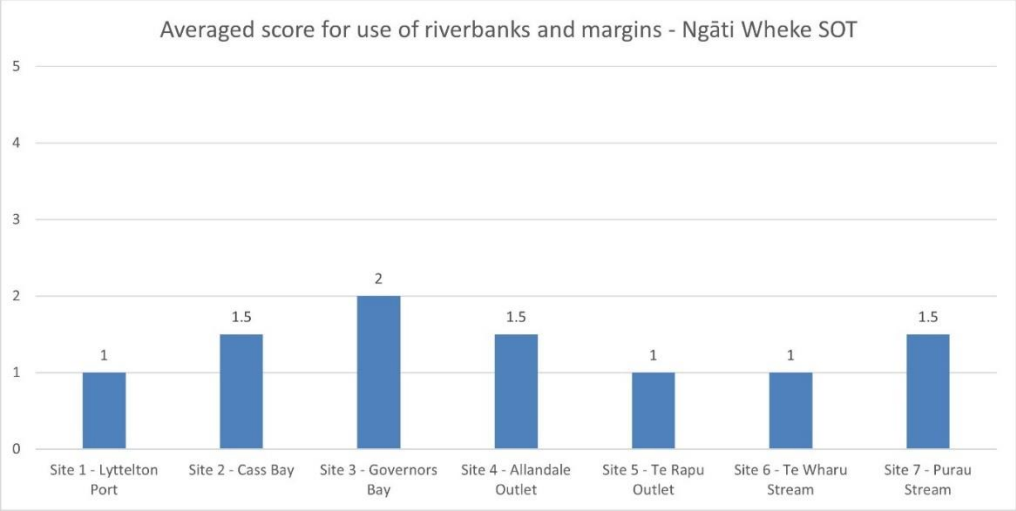
8.1.2 Assessment of vegetation cover along bank margins (100m either side).



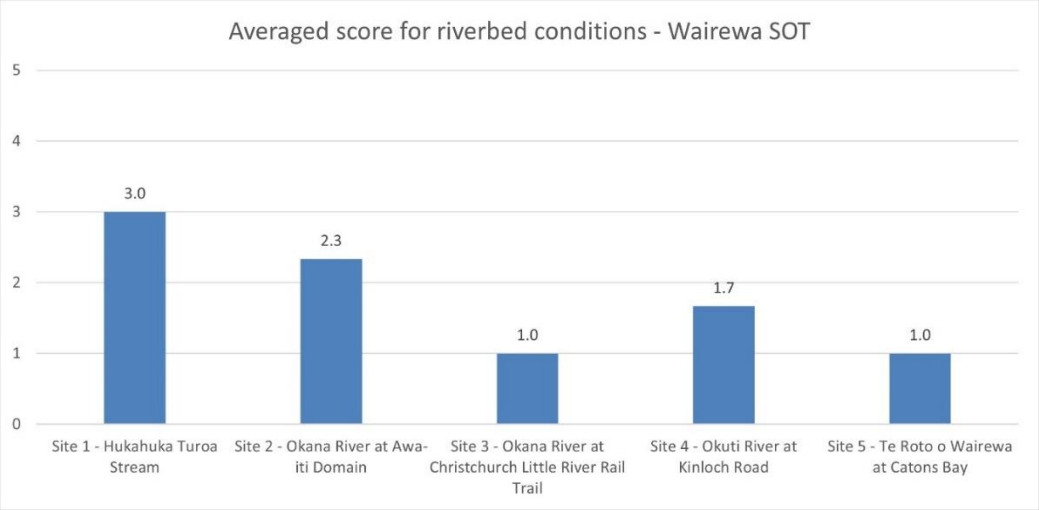


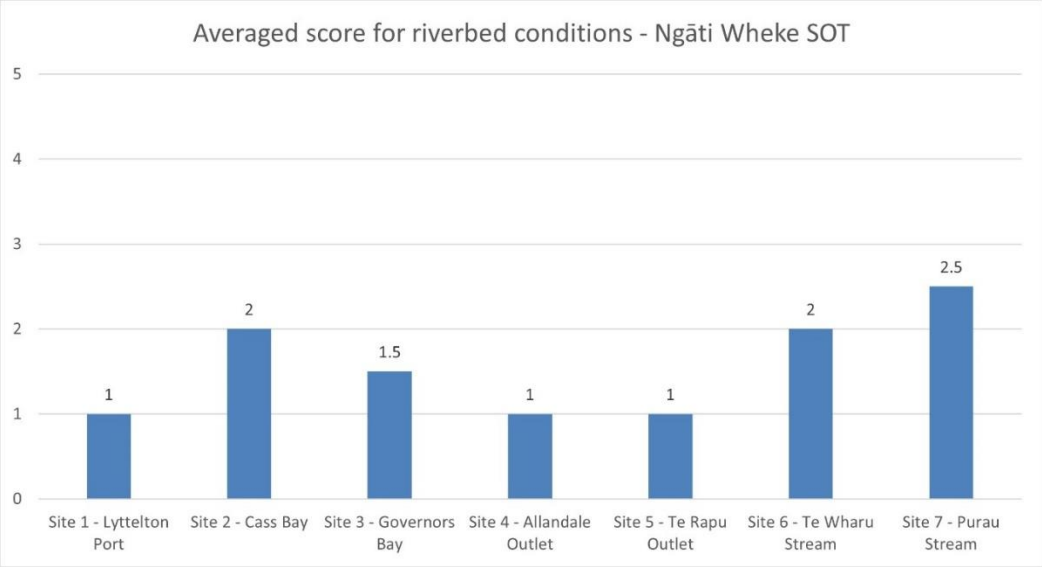
8.1.3 Use of the riverbanks and margins (100m either side).



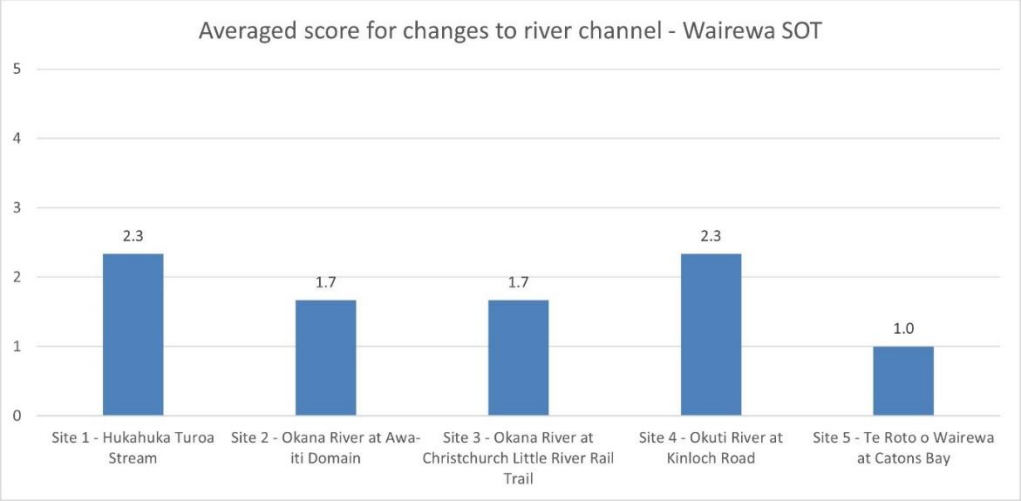


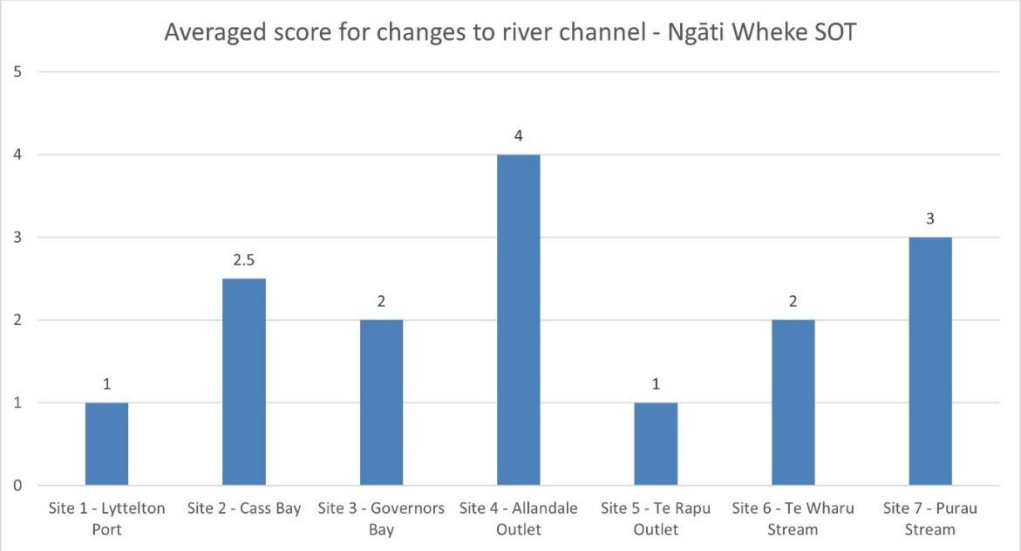
8.1.4 Assessment of riverbed conditions.



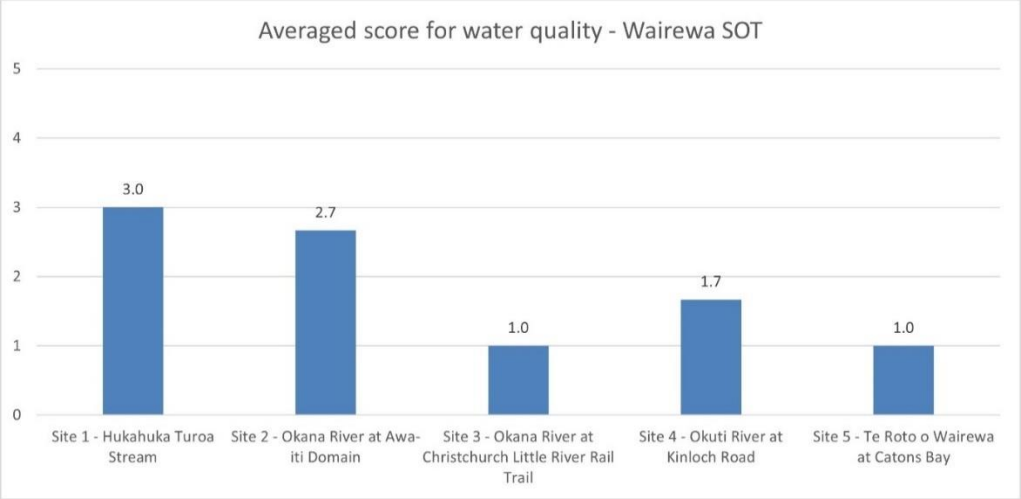


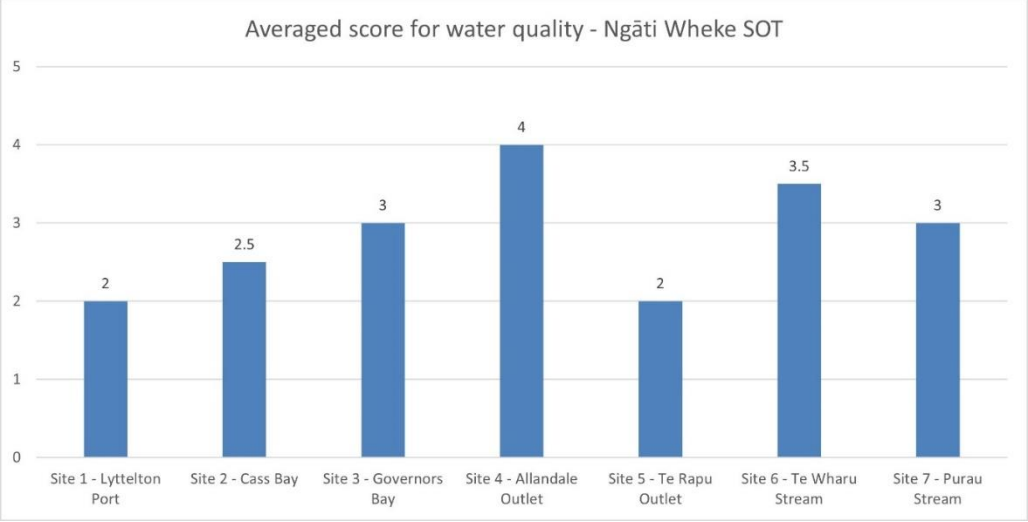
8.1.5 Changes to river channel.



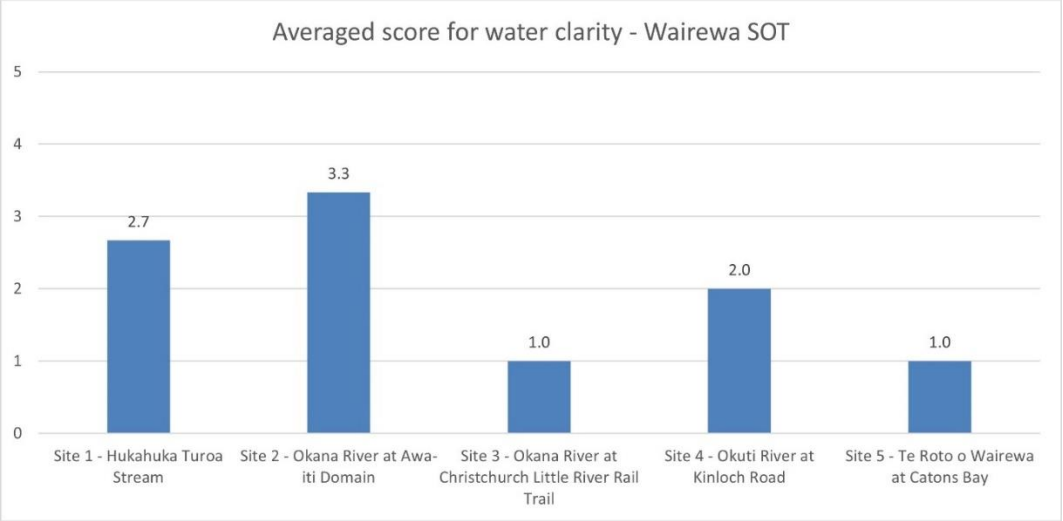


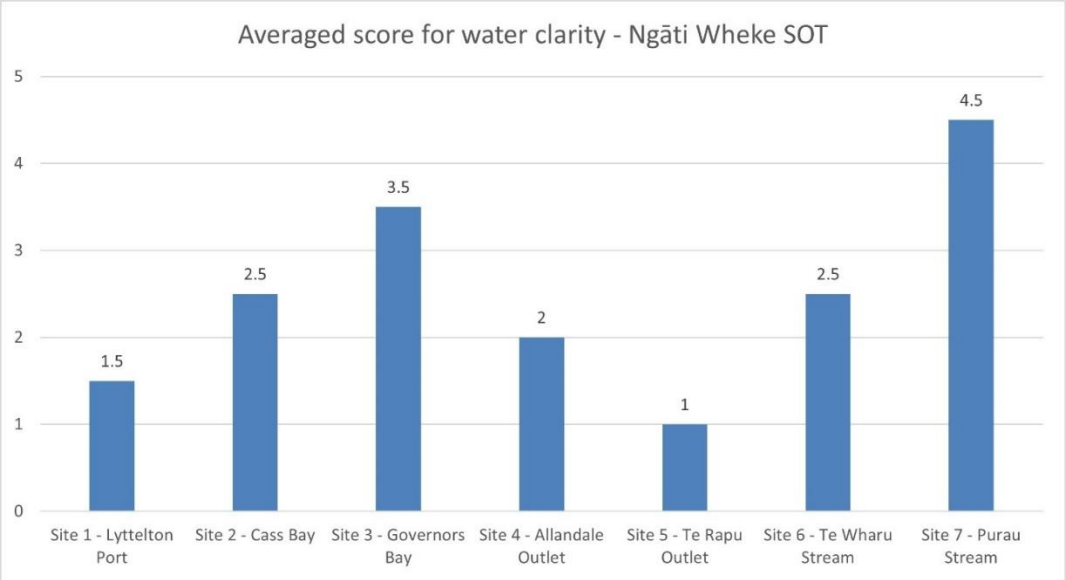
8.1.6 Assessment of water quality.



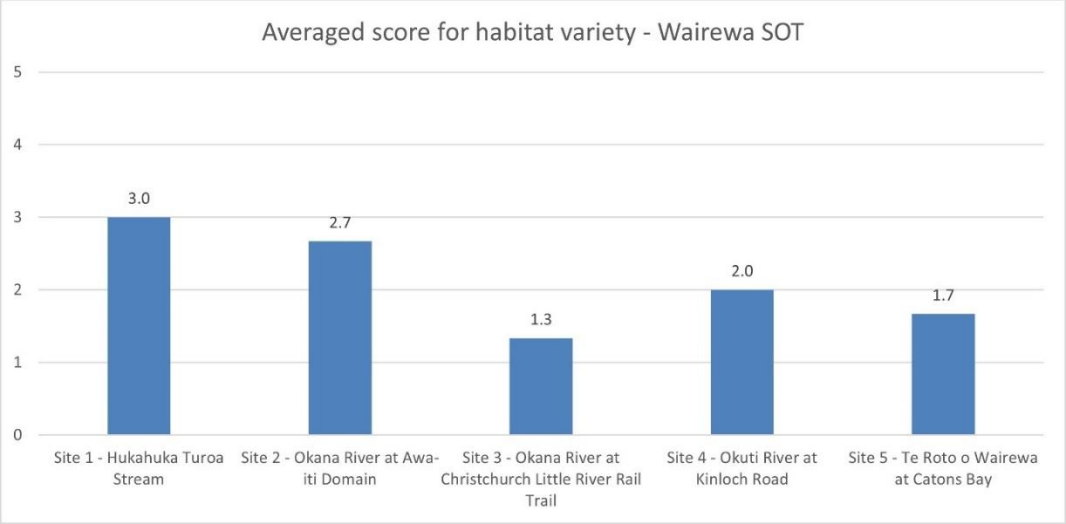


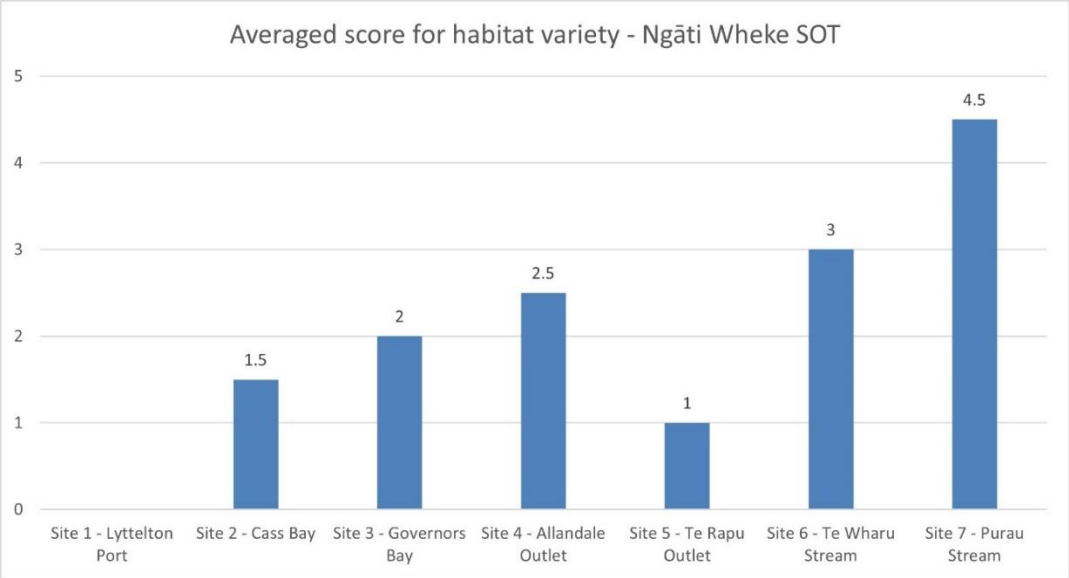
8.1.7 Assessment of water clarity.



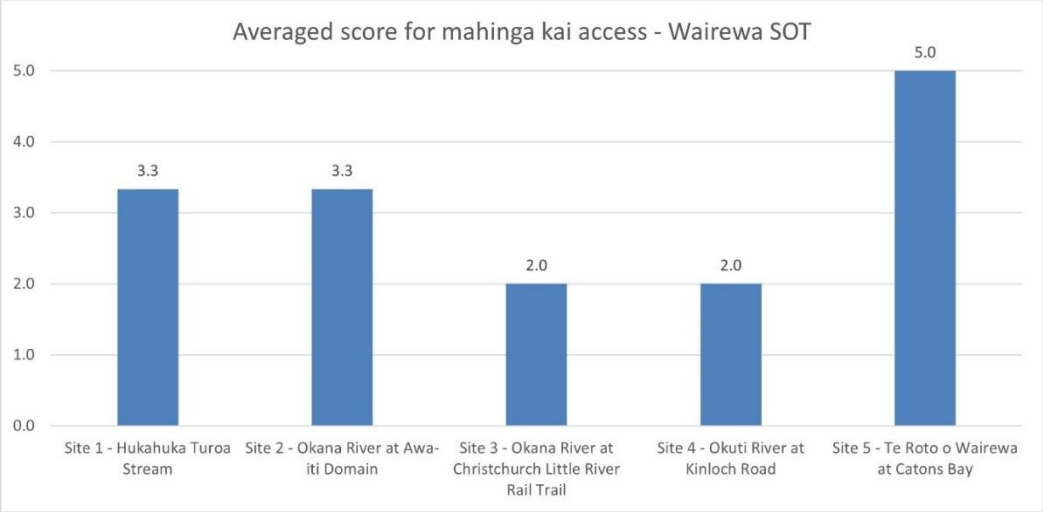


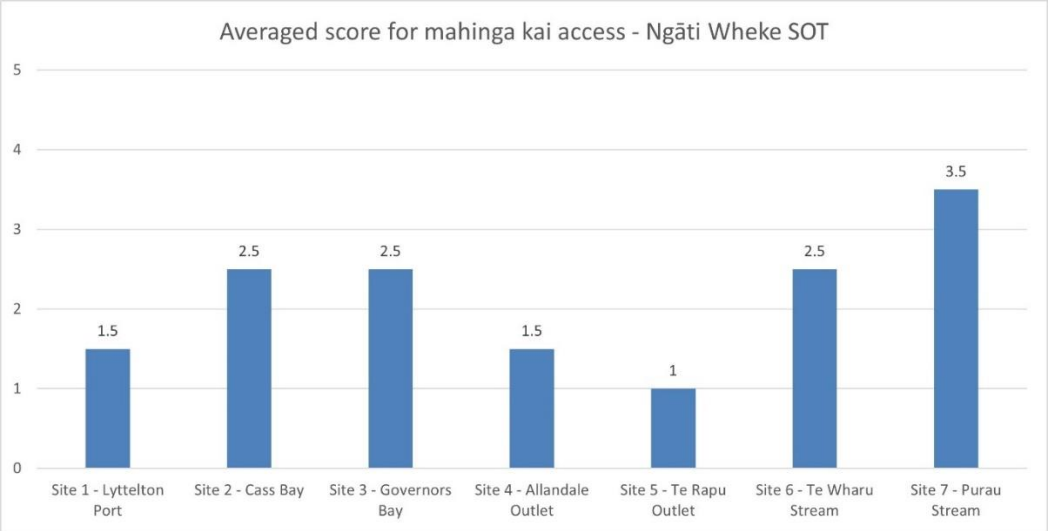
8.1.8 Assessment of habitat variety.



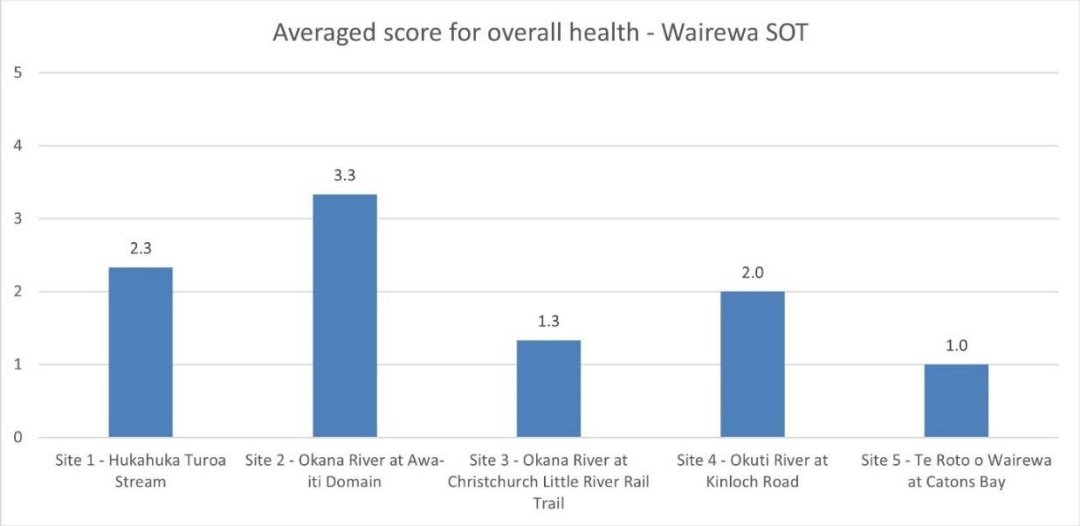


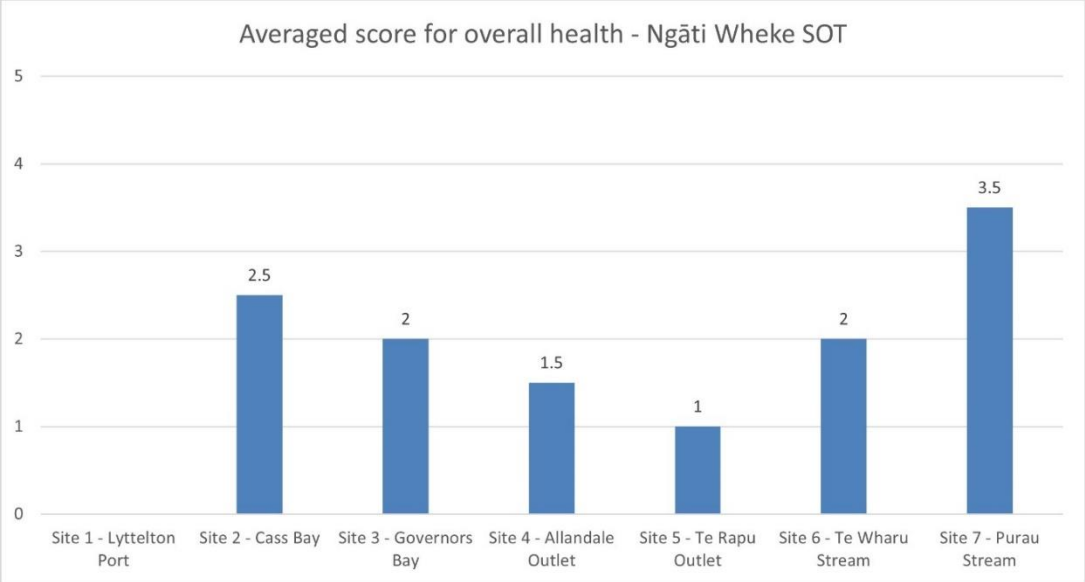
8.1.9 Sufficient site access for mahinga kai harvest.



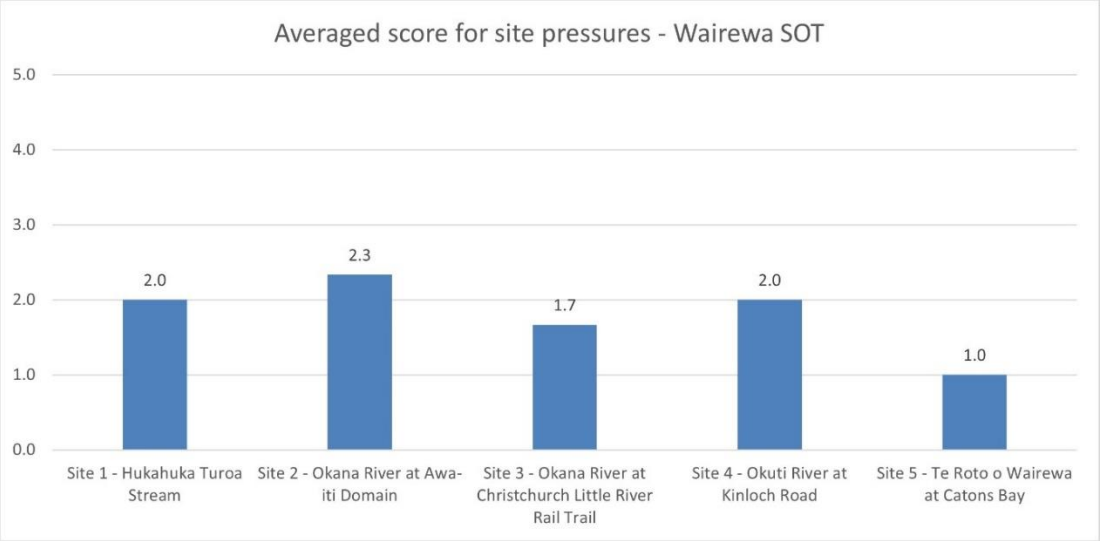


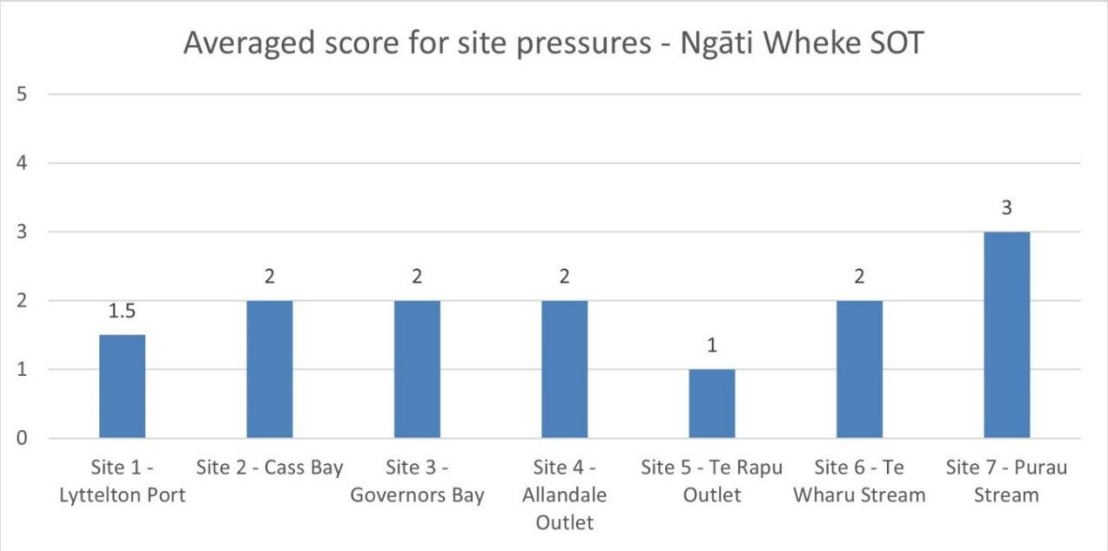
8.1.10 Overall health of waterway at each site.



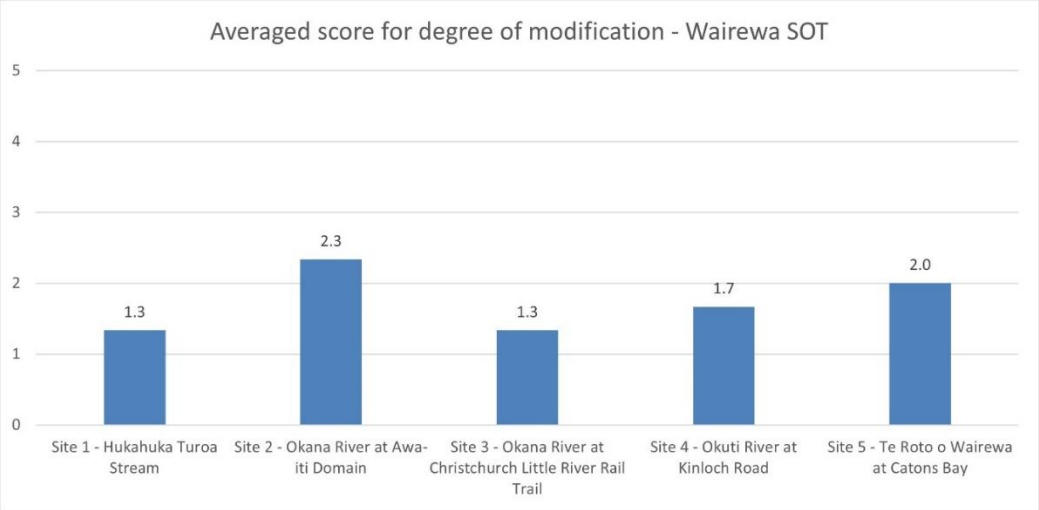


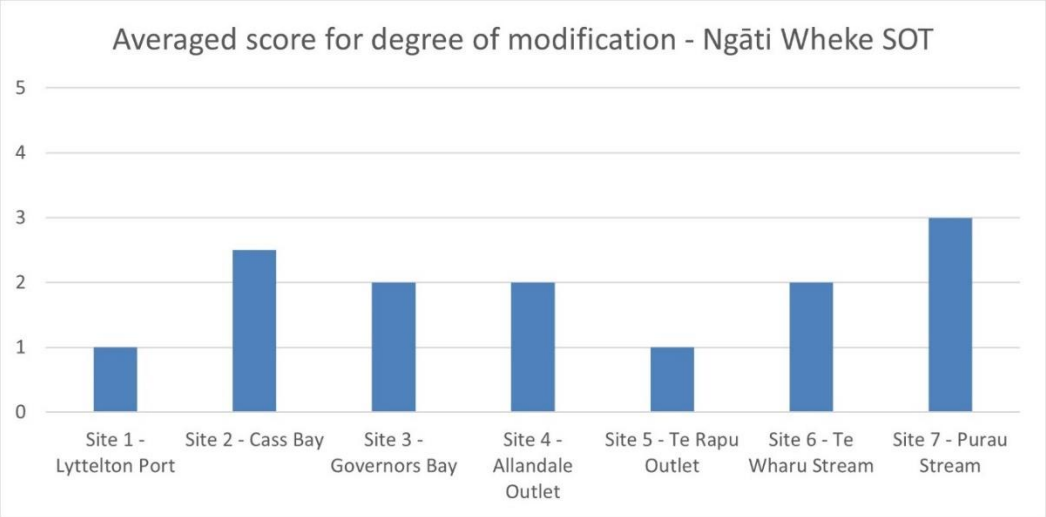
8.1.11 Site pressures



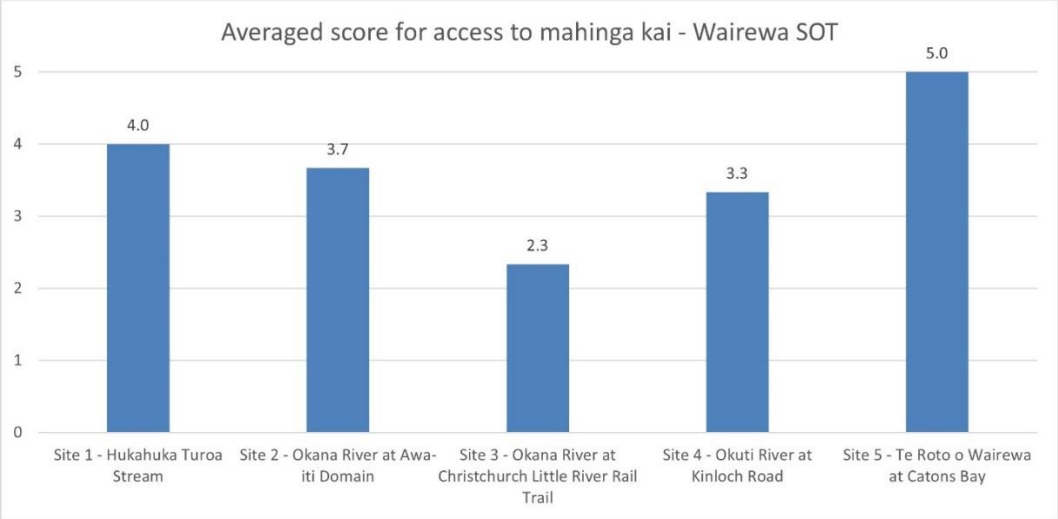


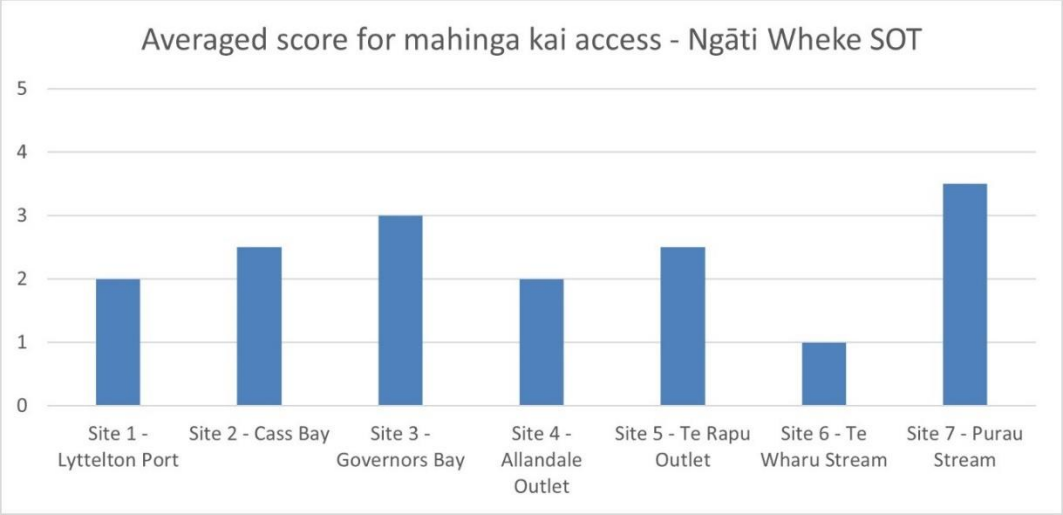
8.1.12 Degree of modification / change



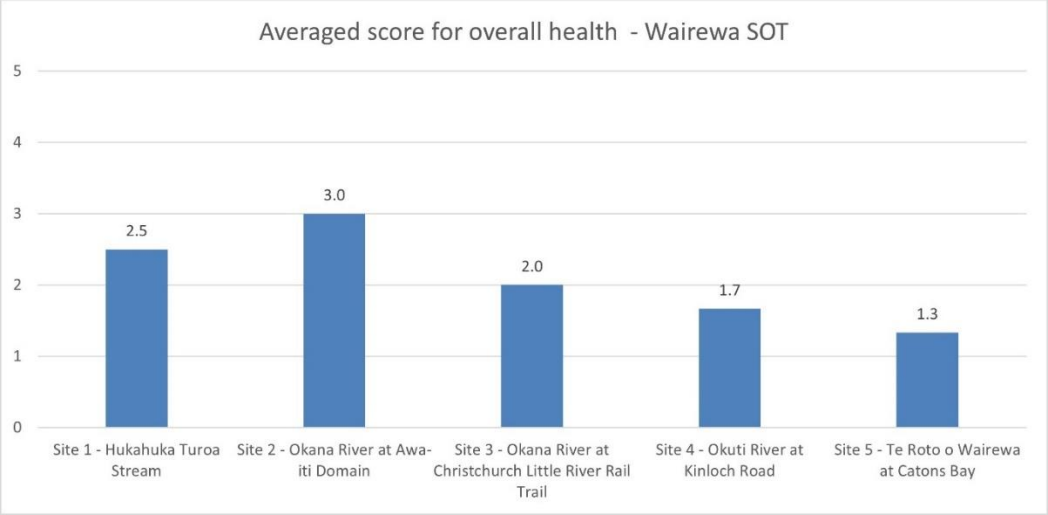


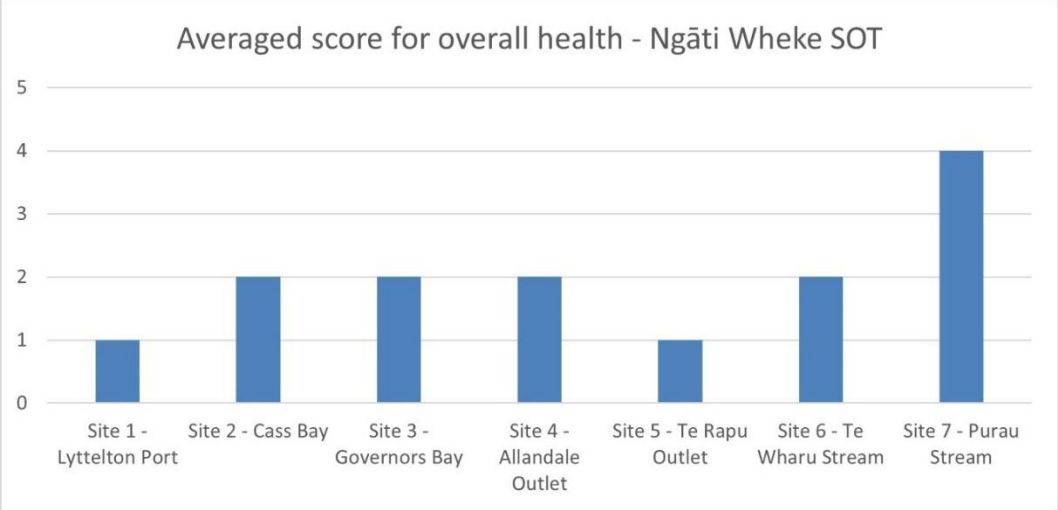
8.1.13 Sufficient access to harvest mahinga kai





8.1.14 Overall health





8.2 Appendix B: Raw Data for vegetation, fish and bird surveys.

8.2.1 Plant Species

Te Roto o Wairewa State of Takiwā			
Site Code	**Site Name**	**Plant Species (as recorded in survey)**	**Native/Introduced**
Site 1	Hukahuka Turoa Stream at Western Valley Road	Kānuka	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Māpou	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Kōtukutuku	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Makomako	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Mānuka	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Kāpuka	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Karamū	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Māhoe	Native
Site 1	Hukahuka Turoa Stream at Western Valley Road	Grass	Introduced
Site 2	Okana River at Awa-iti Domain	Harakeke	Native
Site 2	Okana River at Awa-iti Domain	Purei	Native
Site 2	Okana River at Awa-iti Domain	Rimu	Native
Site 2	Okana River at Awa-iti Domain	Tī kōuka	Native
Site 2	Okana River at Awa-iti Domain	Houhi	Native
Site 2	Okana River at Awa-iti Domain	Horoeka	Native
Site 2	Okana River at Awa-iti Domain	Kānuka	Native
Site 2	Okana River at Awa-iti Domain	Kāpuka	Native

Site 2	Okana River at Awa-iti Domain	Karamū	Native
Site 2	Okana River at Awa-iti Domain	Kōwhai	Native
Site 2	Okana River at Awa-iti Domain	Mānuka	Native
Site 2	Okana River at Awa-iti Domain	Ngaio	Native
Site 2	Okana River at Awa-iti Domain	Rāta	Native
Site 2	Okana River at Awa-iti Domain	Wīwī	Native
Site 2	Okana River at Awa-iti Domain	Kahakaha	Native
Site 2	Okana River at Awa-iti Domain	Ongaonga	Native
Site 2	Okana River at Awa-iti Domain	Grass	Introduced
Site 3	Okana River at Christchurch Little River Rail Trail	Purei	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Koromiko	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Horoeka	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Kōwhai	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Toetoe	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Wīwī	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Tī kōuka	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Karamū	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Kānuka	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Kāpuka	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Harakeke	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Mānuka	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Mingimingi	Native

Site 3	Okana River at Christchurch Little River Rail Trail	Mikimiki	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Tarata	Native
Site 3	Okana River at Christchurch Little River Rail Trail	Grass	Introduced
Site 4	Okuti River at Kinloch Road	Grass	Introduced
Site 4	Okuti River at Kinloch Road	Willow	Introduced
Site 4	Okuti River at Kinloch Road	Blackberry	Introduced
Site 4	Okuti River at Kinloch Road	Okaoka	Introduced
Site 5	Te Roto o Wairewa	Raupō	Native
Site 5	Te Roto o Wairewa	Tī kōuka	Native
Site 5	Te Roto o Wairewa	Houhi	Native
Site 5	Te Roto o Wairewa	Kāpuka	Native
Site 5	Te Roto o Wairewa	Karamū	Native
Site 5	Te Roto o Wairewa	Harakeke	Native
Site 5	Te Roto o Wairewa	Toetoe	Native
Site 5	Te Roto o Wairewa	Wīwī	Native
Site 5	Te Roto o Wairewa	Tarata	Native
Site 5	Te Roto o Wairewa	Ngaio	Native
Site 5	Te Roto o Wairewa	Māpou	Native
Site 5	Te Roto o Wairewa	Koromiko	Native
Site 5	Te Roto o Wairewa	Kōwhai	Native
Site 5	Te Roto o Wairewa	Grass	Introduced
Site 5	Te Roto o Wairewa	Willow	Introduced

Te Hapū o Ngāti Wheke State of Takiwā			
Site Code	**Site Name**	**Plant Species (as recorded in survey)**	**Native/Introduced**
Site 1	Lyttelton Port	Hebe	Native
Site 2	Cass Bay Stream at Cass Bay	Kāmahi	Native
Site 2	Cass Bay Stream at Cass Bay	Ngaio	Native
Site 2	Cass Bay Stream at Cass Bay	Karamū	Native
Site 2	Cass Bay Stream at Cass Bay	Tarata	Native
Site 2	Cass Bay Stream at Cass Bay	Tī kōuka	Native
Site 2	Cass Bay Stream at Cass Bay	Taupata	Native
Site 2	Cass Bay Stream at Cass Bay	Whauwhaupaku	Native
Site 2	Cass Bay Stream at Cass Bay	Grass	Introduced
Site 2	Cass Bay Stream at Cass Bay	Bamboo grass	Introduced
Site 3	Stream Reserve Drain at Governors Bay	Kawakawa	Native
Site 4	Stream Reserve Drain at Governors Bay	Karamū	Native
Site 4	Stream Reserve Drain at Governors Bay	Tōtara	Native
Site 4	Stream Reserve Drain at Governors Bay	Kāpuka	Native
Site 4	Stream Reserve Drain at Governors Bay	Whauwhaupaku	Native
Site 4	Stream Reserve Drain at Governors Bay	Mahoe	Native
Site 4	Stream Reserve Drain at Governors Bay	Periwinkle	Introduced
Site 4	Stream Reserve Drain at Governors Bay	Ivy	Introduced
Site 4	Stream Reserve Drain at Governors Bay	Willow	Introduced

Site 5	Allandale Outlet	Harakeke	Native
Site 5	Allandale Outlet	Kānuka	Native
Site 5	Allandale Outlet	Ngaio	Native
Site 5	Allandale Outlet	Akeakea	Native
Site 5	Allandale Outlet	Grass	Introduced
Site 6	Te Wharau Stream	Karamū	Native
Site 6	Te Wharau Stream	Willow	Introduced
Site 6	Te Wharau Stream	Grass	Introduced
Site 7	Purau Stream	Karamū	Native
Site 7	Purau Stream	Ngaio	Native
Site 7	Purau Stream	Tī kōuka	Native
Site 7	Purau Stream	Harakeke	Native
Site 7	Purau Stream	Grass	Introduced
Site 7	Purau Stream	Rasberry	Introduced
Site 7	Purau Stream	Blackberry	Introduced
Site 7	Purau Stream	Willow	Introduced
Site 7	Purau Stream	Clematis vitalba	Introduced

8.2.2 Bird Species

Te Roto o Wairewa State of Takiwā		
Site Code	**Site Name**	**Bird Species**
Site 1	Hukahuka Turoa Stream at Western Valley Road	Pīwakawaka
Site 2	Okana River at Awa-iti Domain	Pīwakawaka

Site 3	Okana River at Christchurch Little River Rail Trail	Mallard duck
Site 3	Okana River at Christchurch Little River Rail Trail	Korimako
Site 3	Okana River at Christchurch Little River Rail Trail	Pīwakawaka
Site 4	Okana River at Kinloch Road	Pīwakawaka
Site 4	Wairārāpa Stream at Jellie Park	Pīwakawaka
Site 5	Te Roto o Wairewa at Catons Bay	Kāmana / Crested grebe
Site 5	Te Roto o Wairewa at Catons Bay	Wāna / Mute swan

Te Hapū o Ngāti Wheke State of Takiwā		
Site 1	Lyttelton Port	Karoro
Site 1	Lyttelton Port	Sparrows
Site 2	Cass Bay Drain, Cass Bay	Tauhou waxeye
Site 2	Cass Bay Drain, Cass Bay	Blackbird
Site 2	Cass Bay Drain, Cass Bay	Sparrow
Site 3	Stream Reserve Drain, Governors Bay	Sparrow
Site 3	Stream Reserve Drain, Governors Bay	Blackbird
Site 4	Allandale Outlet	Pīwakawaka
Site 4	Allandale Outlet	Sparrow
Site 5	Te Rapu Outlet	Tauhou waxeye
Site 5	Te Rapu Outlet	Sparrow
Site 6	Te Wharau Stream	Korimako

Site 6	Te Wharau Stream	Sparrow
Site 6	Te Wharau Stream	Blackbird
Site 7	Purau Stream	Karoro
Site 7	Purau Stream	Kūkupa / Kererū
Site 7	Purau Stream	Pārera
Site 7	Purau Stream	Korimako
Site 7	Purau Stream	Blackbird
Site 7	Purau Stream	Mallard duck
Site 7	Purau Stream	Sparrow

8.3 Appendix C: Water Quality testing results

8.3.1 Te Hapū o Ngāti Wheke Monitoring

See below for surface water quality analysis results from Te Hapū o Ngāti Wheke monitoring provided by Hills Laboratory.

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	Lab No:	3819834	SPv1
Contact:	Matt Walcott	Date Received:	19-Mar-2025	
	C/- Mahaanui Kurataiao Limited	Date Reported:	27-Mar-2025	
	226 Antigua Street	Quote No:	136849	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

	Sample Name:	Site 2 - Cass Bay 19-Mar-2025 9:44 am
	Lab Number:	3819834.1
pH	pH Units	7.9
Electrical Conductivity (EC)	mS/m	24.8
Total Suspended Solids	g/m³	9
Dissolved Copper	g/m³	0.0040
Dissolved Lead	g/m³	0.00036
Dissolved Zinc	g/m³	0.0149
Total Nitrogen	g/m³	1.35
Total Ammoniacal-N	g/m³	0.026
Nitrite-N	g/m³	0.006
Nitrate-N	g/m³	0.55
Nitrate-N + Nitrite-N	g/m³	0.56
Total Kjeldahl Nitrogen (TKN)	g/m³	0.79
Dissolved Reactive Phosphorus	g/m³	0.112
Total Phosphorus	g/m³	0.21
Escherichia coli	MPN / 100mL	> 2,420
Chlorophyll a	g/m³	0.0020

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m³	1

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	Lab No:	3819833	SPv1
Contact:	Matt Walcott	Date Received:	19-Mar-2025	
	C/- Mahaanui Kurataiao Limited	Date Reported:	26-Mar-2025	
	226 Antigua Street	Quote No:	136849	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

		Sample Name:	Site 3 - Governors Bay 19-Mar-2025 10:08 am
		Lab Number:	3819833.1
pH	pH Units		7.6
Electrical Conductivity (EC)	mS/m		19.1
Total Suspended Solids	g/m³		8
Dissolved Copper	g/m³		0.0026
Dissolved Lead	g/m³		0.00040
Dissolved Zinc	g/m³		0.0070
Total Nitrogen	g/m³		1.09
Total Ammoniacal-N	g/m³		< 0.010
Nitrite-N	g/m³		0.007
Nitrate-N	g/m³		0.148
Nitrate-N + Nitrite-N	g/m³		0.155
Total Kjeldahl Nitrogen (TKN)	g/m³		0.94
Dissolved Reactive Phosphorus	g/m³		0.040
Total Phosphorus	g/m³		0.129
Escherichia coli	MPN / 100mL		1,733
Chlorophyll a	g/m³		0.0005

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m³	1

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	Lab No:	3819830	SPv1
Contact:	Matt Walcott	Date Received:	19-Mar-2025	
	C/- Mahaanui Kurataiao Limited	Date Reported:	27-Mar-2025	
	226 Antigua Street	Quote No:	136849	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

		Sample Name:	Site 4 - Allandale Outlet 19-Mar-2025 10:26 am
		Lab Number:	3819830.1
pH	pH Units		7.7
Electrical Conductivity (EC)	mS/m		18.9
Total Suspended Solids	g/m³		25
Dissolved Copper	g/m³		0.0016
Dissolved Lead	g/m³		0.00026
Dissolved Zinc	g/m³		0.0020
Total Nitrogen	g/m³		1.37
Total Ammoniacal-N	g/m³		0.012
Nitrite-N	g/m³		0.007
Nitrate-N	g/m³		0.35
Nitrate-N + Nitrite-N	g/m³		0.35
Total Kjeldahl Nitrogen (TKN)	g/m³		1.02
Dissolved Reactive Phosphorus	g/m³		0.030
Total Phosphorus	g/m³		0.125
Escherichia coli	MPN / 100mL		> 2,420
Chlorophyll a	g/m³		0.0010

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m³	1

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	**Lab No:**	3819832	SPv1
Contact:	Matt Walcott	**Date Received:**	19-Mar-2025	
	C/- Mahaanui Kurataiao Limited	**Date Reported:**	27-Mar-2025	
	226 Antigua Street	**Quote No:**	136849	
	Christchurch Central	**Order No:**		
	Christchurch 8011	**Client Reference:**		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

		Sample Name:	Site 6 - Te Wharau Stream 19-Mar-2025 10:46 am
		Lab Number:	3819832.1
pH	pH Units		7.5
Electrical Conductivity (EC)	mS/m		12.2
Total Suspended Solids	g/m³		15
Dissolved Copper	g/m³		0.0010
Dissolved Lead	g/m³		< 0.00010
Dissolved Zinc	g/m³		< 0.0010
Total Nitrogen	g/m³		1.62
Total Ammoniacal-N	g/m³		< 0.010
Nitrite-N	g/m³		0.005
Nitrate-N	g/m³		1.11
Nitrate-N + Nitrite-N	g/m³		1.11
Total Kjeldahl Nitrogen (TKN)	g/m³		0.51
Dissolved Reactive Phosphorus	g/m³		0.022
Total Phosphorus	g/m³		0.087
Escherichia coli	MPN / 100mL		1,733
Chlorophyll a	g/m³		0.0014

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m³	1

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	Lab No:	3819831	SPv1
Contact:	Matt Walcott	Date Received:	19-Mar-2025	
	C/- Mahaanui Kurataiao Limited	Date Reported:	27-Mar-2025	
	226 Antigua Street	Quote No:	136849	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

	Sample Name:	Site 7 - Purau Stream 19-Mar-2025 11:08 am
	Lab Number:	3819831.1
pH	pH Units	7.4
Electrical Conductivity (EC)	mS/m	9.2
Total Suspended Solids	g/m³	11
Dissolved Copper	g/m³	0.0008
Dissolved Lead	g/m³	< 0.00010
Dissolved Zinc	g/m³	< 0.0010
Total Nitrogen	g/m³	0.64
Total Ammoniacal-N	g/m³	< 0.010
Nitrite-N	g/m³	0.002
Nitrate-N	g/m³	0.162
Nitrate-N + Nitrite-N	g/m³	0.164
Total Kjeldahl Nitrogen (TKN)	g/m³	0.48
Dissolved Reactive Phosphorus	g/m³	0.015
Total Phosphorus	g/m³	0.053
Escherichia coli	MPN / 100mL	> 2,420
Chlorophyll a	g/m³	0.0008

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m³	1

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8.3.2 Wairewa Rūnanga Monitoring

See below for surface water quality analysis results from Wairewa Rūnanga monitoring provided by Hills Laboratory

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Certificate of Analysis

Client:	Mahaanui Kurataiao Limited	Lab No:	3853957	SPv1
Contact:	Matt Walcott	Date Received:	11-Apr-2025	
	C/- Mahaanui Kurataiao Limited	Date Reported:	22-Apr-2025	
	226 Antigua Street	Quote No:	128949	
	Christchurch Central	Order No:		
	Christchurch 8011	Client Reference:		
		Submitted By:	Matt Walcott	

Sample Type: Aqueous

Sample Name:		Site 1 Hukahuka Turoa Strea 11-Apr-2025 10:06 am	Site 2 Okana River at Awa 11-Apr-2025 10:47 am	Site 3 Okana River At Chrstchurch Little River Rail Trail 11-Apr-2025 11:36 am
Lab Number:		3853957.1	3853957.2	3853957.3
pH	pH Units	7.6	7.7	7.6
Electrical Conductivity (EC)	mS/m	12.9	14.6	15.0
Total Suspended Solids	g/m³	5	3	< 3
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010
Dissolved Zinc	g/m³	< 0.0010	< 0.0010	< 0.0010
Total Nitrogen	g/m³	0.30	0.31	0.30
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	0.166	0.123	0.133
Nitrate-N + Nitrite-N	g/m³	0.167	0.123	0.134
Total Kjeldahl Nitrogen (TKN)	g/m³	0.13	0.19	0.16
Dissolved Reactive Phosphorus	g/m³	0.021	0.023	0.023
Total Phosphorus	g/m³	0.041	0.046	0.046
Escherichia coli	MPN / 100mL	461	866	687
Chlorophyll a	g/m³	0.0004	0.0008	0.0004

Summary of Methods

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
pH	pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.	0.1 mS/m	1-3
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.	3 g/m³	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-3

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