

Mahaanui Kurataiao Ltd

# Pūharakekenui Cultural Monitoring Report

October 2023

## Executive Summary

This report details monitoring undertaken to assess mana whenua values in the Pūharakekenui 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 March and April of 2023 at eight sites within the Pūharakekenui catchment using the State of Takiwā and Cultural Health Assessment methods. Overall, this monitoring indicated that the catchment has slightly below or at moderate cultural health values. The Attribute Target Level for Mana Whenua Values of 5 (i.e., very good) was not met by the 2023 survey results. A previous State of Takiwā monitoring was undertaken by mana whenua in 2012. The results of the 2023 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 (above the limit value of 550 MPN/100 mL in the Canterbury Land and Water Plan) at two sites (STYX09 / Ōuruhia Reserve, Kā Pūtahi and STYX19 / Redwood Springs, Pūharakekenui) are of concern. Many of the same concerns listed in the 2012 State of Takiwā report were observed by monitors during the 2023 survey, including invasive introduced plant species, insufficient indigenous riparian planting and/or indigenous plants in general, and concerns around discharges or effluent runoff to the water from livestock close to the river, industry and construction. Recommendations have been made in this report based on the results of the 2023 survey.

## Acknowledgements

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# 1 Introduction

This report details monitoring undertaken to assess mana whenua values in the Pūharakekenui 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 March and April of 2023 at eight sites within the Pūharakekenui catchment. Five of these sites were subject to previous monitoring and are listed in the CCC Environmental Monitoring Programme for the CSNDC. Three of the monitoring sites were requested by the Kaitiaki of Te Ngāi Tūāhuriri Rūnanga.

Due to frequent and heavy rainfall in March and April 2023, the monitoring was separated into two phases. The first phase comprised a Cultural Health Assessment and indigenous vegetation and bird surveys in March 2023. The second phase comprised a fish survey and water quality testing in April 2023.

## 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 eight sites within the Pūharakekenui catchment (Table 1). The monitored site locations are shown in Figure 1. Five of these sites (STYX04 - 09) 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). Three of the sites (STYX 17-19) 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 Pūharakekenui catchment in 2023, by site code from the CCC EMP.**

CCC EMP monitoring site code	Site Name	Location	Significance	Coordinates (NZMG X, Y)	Monitored in 2012?
STYX04	Blakes Road, Kā Pūtahi	Kā Pūtahi Creek at Blakes Road.	Spring-fed water (pure), mahinga kai, indigenous species.	2480401, 5749645	Yes
STYX06	Marshlands Road, Pūharakekenui	Pūharakekenui/Styx River at Marshland Road Bridge.	Mahinga kai, kanakana-lamprey spawning habitat, indigenous species.	2482359, 5749393	Yes
STYX07	Teapes Road, Pūharakekenui	Pūharakekenui/Styx River at Richards Bridge/Teapes Road.	Mahinga kai, indigenous species.	2483977, 5751255	Yes
STYX08	Kainga Road, Pūharakekenui	Pūharakekenui/Styx River at Kainga Road/Harbour Road Bridge.	Mahinga kai, indigenous species.	2485000, 5756366	Yes
STYX09	Ōuruhia Reserve, Kā Pūtahi	Kā Pūtahi Creek at Ouruhia Reserve.	Spring fed water (pure), mahinga kai, indigenous species.	2481755, 5751732	Yes
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Styx River near the mouth of Te Riu O Te Aika Kawa/Brooklands Lagoon.	Traditional mahinga kai site.	2485845, 5756726	Yes
STYX18	Spencerville Road, Pūharakekenui	Pūharakekenui at Spencerville Road.	Traditional mahinga kai site.	2484955, 5753151	Yes
STYX19	Redwood Springs, Pūharakekenui	Pūharakekenui at Styx River Conservation Reserve (the reach between railway line and SH74).	Traditional mahinga kai site and reserve.	2479459, 5749178	No, but 2012 site is located nearby



Figure 1. Aerial imagery showing the location of sites. Waterways shown in blue to better highlight through urban areas. Image: Canterbury Maps, 2023.

## 1.2 Methodology

The survey in 2023 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 component of the SOT assessment is based on the SHMAK method to allow iwi, landowners, and community groups to assess stream health. This component includes an assessment of stream habitat, composition of stream bed, bank vegetation and deposits. 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 m length of the clarity tube) a black disc viewer (Biggs, Kilroy, & Mulcock, 1998). There are also sections for the assessment of macrophytes, periphyton and macroinvertebrates, but these methods were

not used in the 2023 monitoring due to river conditions (e.g., the depth of the water or silty riverbed conditions) and/or concerns with recording accuracies. There was no assessment of macrophytes, periphyton and macroinvertebrates in the 2023 survey.

### 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 2023 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 m 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. During the initial site check before the main data collection, each site was evaluated to determine if electric fishing could be conducted, or if the trapping method as described below was more suitable. Electric fishing was not undertaken as part of the 2023 survey as the sites were not suitable for this method. Trapping methods used in the 2023 survey included baited hīnaki (fyke nets), and gee minnow traps, with traps left overnight. 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 suitable and accessible sites (as per Section 1.1) by monitors using the testing kits provided by Hills Laboratory. The collected water samples were sent to Hills Laboratory for analysis of dissolved metals and other common contaminants (listed in Appendix C).

## 2 Background and traditional associations<sup>1</sup>

Waterways are a critical and highly significant aspect of the cultural landscape. They have direct traditional and contemporary importance to whānau with mana whenua status in the catchment. The interconnectedness of water in all its forms, as observed and utilised by local whānau, is a key characteristic underpinning tangata whenua relationships with the Pūharakekenui area (Ora Environmental, 1999). The Pūharakekenui catchment was well frequented by traveling Ngāi Tahu due to its position on the travel route connecting Kaiapoi Pā, Te Pātaka o Rākaihautū and Te Kete Ika a Rākaihautū (Te Waihora). Many sites were frequently utilised as nohoanga and for the seasonal collection of mahinga kai (Tau et al., 1990). Food and other resources sourced from the catchment were an important part of the Ngāi Tahu system of trade, which connected whānau and hapū from throughout Te Waipounamu (Christchurch City Libraries, 2006; Tau et. al., 1990). This included the practices of kai hau kai and tamatama which contributed to whanaungatanga between families.

Whānau of Ngāti Urihia hapū have a special association with the Pūharakekenui catchment. Members of Ngāti Urihia are the descendants of Urihia, son of Tūrākautahi, who was a senior grandson of Tūāhuriri. The Pūharakekenui catchment was one of the areas that the hapū of Kaiapoi Pā expanded into due to the resources in the area, with the traditional name of 'O Urihia/Ōuruhia' after Ngāti Urihia hapū. The following excerpt from Te Aika (2008) illustrates the association with particular reference to resource use and mahinga kai:

*“Kati Urihia dwelt at Ruataniwha Pa situated at the lower end of the Cam/Whakahume river (Mantell, 1848). The wāhi mahikakai of Kati Urihia includes the area of the catchment of Pūharakekenui/Styx river and Te Riu o Te Aika Kawa/Brooklands Lagoon. Wāhi Mahikakai refers to the area of Mana Whenua of the Hapū and whānau which worked the area for subsistence economic purposes” (Beattie, 1920 as quoted in Orchard, et. al. 2012).*

The general area of Ōuruhia can be established by assessing the places where the descendant of Urihia have exercised mana whenua. This is evidenced by practices such as tūrangawaewae, tapatapa and wāhi mahinga kai. These aspects are all important to whānau who have mana whenua status through take tupuna and additionally are aspects important to ahi kā. Through these means the area of Ōuruhia was established and maintained (Te Aika, 2008) and includes:

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<sup>1</sup> This section is largely taken from the State of Takiwā 2012 Pūharakekenui report by Orchard et. al.

- Te Riu o Te Aika Kawa/Brooklands Lagoon (tapatapa, wāhi tapu urupā, tūrangawaewae, mahinga kai)
- Pūharakekenui/Styx River (exclusive mahinga kai and wāhi wai tohi, wāhi tapu)
- Ruataniwha Pa and other sites of occupation (noho tūturu)
- Te Oranga/Horseshoe Lake (take tupuna).

Te Aika, a descendant of Urihia, developed strong associations with the Brooklands Lagoon area. This is recognised today in the traditional name for the lagoon which is “Te Riu o Te Aika Kawa” which means “the area of Te Aika protocols (authorities)”. The recognised name for the area provides direct evidence of the association between the Te Aika whānau and the lagoon although it should be noted that the term “riu” refers to “area” and thus it is the wider lagoon catchment that is associated with Te Aika whānau (Te Aika, 2008). Te Aika and his cousin, Wii Te Paa, exercised their mana whenua in statements and demonstrations to Walter Mantell (as recorded during his land sale activities for the Crown) concerning the Pūharakekenui awa, and in addition by showing their eel traps in the awa as evidence of having mana whenua status via the practice of mahinga kai (Te Aika, 2008). This is one example demonstrating that entire catchment may be the subject of mana whenua status consistent with the ‘Ki Uta Ki Tai’ philosophy of resource use and management amongst Ngāi Tahu (Tau et al., 1990). A catchment-wide approach to issues is both a feature of the Ngāi Tahu view of resource management and the traditional associations between Ngāi Tahu hapū and whānau, and the whenua and awa of the takiwā.

Several sites in the catchment were recorded as significant 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) 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”. See Sections 4.4, 4.5 and 4.6 for further information on traditional species of vegetation, fish and bird.

The Māori Reserve MR892 at Pūharakekenui is a significant modern-day indicator of the tūrangawaewae and the existence of permanent associations between particular hapū and whānau, and the area. The owners of the reserve were predominantly members of Ngāti Urihia hapū. Today the reserve remains an important tūrangawaewae for mana whenua under the management of the Te Hapū o Ngāti Urihia Ahu Whenua Trust, a legal entity formed to represent the owners. There are also sites of contemporary significance within the catchment, including the Pā Harakeke at Janet Stewart Reserve and other sites where restoration

activities have occurred such as Styx Mill Conservation Reserve, Smacks Creek Reserve and the Styx Esplanade Reserve. Styx Mill Conservation Reserve was originally an important mahinga kai area for Māori and a place where settlements had been established in the past (Christchurch City Council, 2003; Christchurch City Libraries, 2006). Smacks Creek Reserve and the Styx Esplanade Reserve are in the vicinity of waipuna, and appropriate management of these areas is highly significant to tangata whenua (Christchurch City Council, 2004a; 2004b).

## 2.1 Archaeological sites

Around Pūharakekenui and tributary streams such as Kā Pūtahi, there are several archaeological sites that largely relate to the extensive history of Māori occupation in the area. In particular, there are patterns of clustered archaeological sites in certain areas that relate to mahinga kai activity. A high number of recorded oven sites are located in a portion of Kā Pūtahi, west of the current State Highway 74 motorway (including two found during its construction). The ovens have been typically found within approximately 150 m of the stream. Along Pūharakekenui, east from Marshland Road, there are several midden and oven sites recorded near the awa. The pattern of these archaeological sites extends through to Te Riu o Te Aika Kawa. A single site is recorded in the western reach of Pūharakekenui, near the current State Highway 74 motorway (ArchSite, 2023). The records of archaeological sites on the New Zealand Archaeological Association database (ArchSite) are only for finds that are reported on the system and/or subject to archaeological investigation. As such, any gaps in the records along the streams may be due to patterns of occupation but may also be due to a lack of investigation or reporting. Figure 2 below gives an indication of these patterns based on Canterbury Maps (2019).



Figure 2. Archaeological sites (both Māori and non-Māori) with a 150 m buffer shown in blue. The general area of the archaeological clusters discussed above are shown in red. Note: not all archaeological sites are recorded. The layer was last updated in 2019. Image: Canterbury Maps, 2023.

## 2.2 Environmental background

Pūharakekenui is approximately 7000 ha in catchment area, with principal waterways being Pūharakekenui, Kā Pūtahi and Smacks Creek. Pūharakekenui is approximately 22 km in length and is a spring-fed river originating in the Harewood area. Artificial drains (e.g., wood-lined straight open drains), natural springs, basin ponding areas and Te Riu o Te Aika Kawa are also located within the catchment. The surrounding environment is a mix of urban and rural land use, with some industrial sites (e.g., Belfast Freezing Works) along Kā Pūtahi in

particular. Restoration works have occurred in reserve areas along the river including Styx Mill Conservation Reserve, Styx River Conservation Reserve, Kā Pūtahi Confluence Conservation Reserve, Ōuruhia Reserve and Te Korari/Janet Stewart Reserve. Areas in Belfast and Marshland have seen significant residential development in recent years, while a decrease in residential activity was observed in Brooklands due to the impacts of the 2010/2011 earthquakes on housing structures in this area (Christchurch City Council, 2017).

## 2.3 Previous monitoring

A SOT or CHA of Pūharakekenui and Te Riu o Te Aika Kawa catchment was undertaken in 2012 (Orchard et. al., 2012). This was the first cultural health survey for the catchment using the SOT system. A total of 19 sites were selected for monitoring throughout the Pūharakekenui 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.

The following is a summary of key results from previous monitoring:

- High levels of site modification (relative to the identified traditional use) and anthropogenic pressure were found across the catchment. Pressures were determined to be related to factors such as invasive species, physical disturbance and pollution.
- The overall SOT score for the catchment was 2.3 (on a scale of 1 to 5). One site was rated as very poor, six as poor, eight as moderate and four sites as good. No sites were assessed as being very good.
- Indigenous vegetation was mixed across the catchment with high scores in restored locations such as Styx Mill Reserve. The percentage of indigenous cover varied from 5% to 40%.
- Nine sites had recorded sightings of native birds, comprising a maximum of two species.
- Fish were caught at 15 sites out of 19. The biodiversity count across all sites was eight species, with the highest abundance of a species being shortfin tuna.
- More than half of the sites resulted in negative abundance score values (based on vegetation, bird and fish species) due to the dominance of exotic species.
- A SHMAK assessment was undertaken at eight sites. The invertebrate score was 4.3 out of 10 and the periphyton score was 7 out of 10.

- The CHI (cultural health index) stream health assessment averaged 2.7 out of 5. Three sites scored the lowest at 1.0. Eight sites achieved a score of three or above with the highest score of 3.9.
- Access for mahinga kai was considered good or very good for 11 of 19 sites. Four sites were evaluated as being unsuitable for mahinga kai. Although no sites were assessed as having good or very good mahinga kai values, 12 sites scored between 2 and 3 out of 5 for the CHI mahinga kai index.
- *E. coli* results demonstrated high levels in the catchment as 9 of the 18 sites tested exceeded the guideline of 260 *E. coli* MPN/100 mL. Eight of the sites exceeded 550 *E. coli*/100 ml.

Recommendations resulting from the 2012 report include:

- Controls to prevent further modification of waterways, including the damming of rivers and streams, abstraction of water from natural water bodies, mixing of waters from different ecosystems, and diverting of waters in other cases which may impact tangata whenua values.
- Naturalisation of existing waterways.
- Removal or relocation of stopbanks.
- Evaluation of other instream devices (culverts, weirs and floodgates).
- Designing river protection and stabilisation works to avoid adverse effects on tangata whenua values.
- Protection of wāhi tapu, wāhi taonga and puna/waipuna, particularly from contaminants.
- Restoration of water quality to a level at which mahinga kai can be safely gathered, including progressive elimination of contaminant inputs from wastewater/stormwater infrastructure and rural land uses.
- Control of pollution sources, particularly for *E. coli*.
- Prevention of overflow from wastewater system into waterways.
- Ensuring that suitably sized setbacks accommodate buffer and filter strips, or other run-off interception devices are present.
- Regular monitoring of contaminant levels.
- Fencing of waterways to exclude stock, with effective setbacks.
- Riparian restoration with locally sourced indigenous species, particularly around culturally significant sites and areas prone to erosion and sediment issues.
- Control of exotic and pest species.

- Prevention of further encroachment of urban development on waterways, and that all developments are consistent with riparian restoration activities.
- Create environments where important cultural resources can be attained in close proximity to enable tangata whenua to engage in cultural practices.
- Specific enquiry into all heavily degraded sites, and identification and implementation of remedial actions to improve the health of those sites.
- Restoration of areas known to be of high significance to Te Ngāi Tūāhuriri Rūnanga.
- Ingoa wāhi – in consultation with Te Ngāi Tūāhuriri Rūnanga, identify appropriate ingoa wāhi for use in signage, planning documents, management plans and other documents. An important aspect is use of correct Māori name associated with waterways.
- Further cultural monitoring and reporting on a regular basis throughout the catchment is recommended (four to five yearly intervals and seasonally).

## 3 Summary of sites and monitoring undertaken

The monitoring team comprised staff from Mahaanui Kurataiao Ltd (Fraser Doake and Rulon Nutira) and two whānau members of Te Ngāi Tūāhuriri Rūnanga; Cherie Williams and Frankie Williams. Due to the numerous heavy rainfall events in March and April 2023, the monitoring was split into two phases. The field work for the CHA, indigenous vegetation, and bird surveys were undertaken on the 16<sup>th</sup> and 17<sup>th</sup> of March 2023. The completion of the SOT forms, fish survey and water quality testing were undertaken on the 18<sup>th</sup> and 19<sup>th</sup> of April 2023 by Mahaanui Kurataiao Ltd staff (due to the unavailability of the whānau members). 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 primarily river or streams, with estuary or lagoon recorded for the two sites at the easternmost end of the catchment (STYX17 and STYX08) due their proximity to Te Riu o Te Aika Kawa. Farm or agriculture ecosystems were also noted for sites with farmland close to the riverbank (STYX06, STYX07, STYX08, and STYX18). Most monitored sites were in council-owned reserves. Sites such as STYX18, STYX07 and STYX09 had significant portions of private land abutting the river. Settlement types for all sites were recorded as nohoanga, and traditional significance of the sites were recorded as pā/kāinga and mahinga kai. Pā harakeke for harvesting was also recorded at STYX06.

The weather during the monitoring periods was either partly cloudy or heavy cloud with temperatures ranging from 15 to 19 °C. Winds were minimal to light from the northeast or southwest (between 13 to 18 km/h). All monitoring took place during first quarter moon (waxing) and tides were recorded as either low or unrecorded. Monitoring at STYX17 took place at low tide, with lowest tide occurred at 8:58 am on the day of monitoring. There was no precipitation during recording apart from drizzle during recording at STYX19. All sites had brief flooding (less than two days) around the time of recording and sites STYX09, STYX04 and STYX19 were recorded after heavy rain overnight.

### 3.1 Constraints and limitations

In March and April 2023, there were repeated heavy rain events, some of which caused flooding at the selected sites. Monitoring was delayed several times to allow for the river to return to baseline levels for the fish survey and water quality testing to take place. However,

it proved difficult to align an appropriate period at which the river was at baseline levels with the availability of the whānau monitors. As such, the monitoring was divided into two phases. No fish survey was able to be completed at STYX07 / Teapes Road, Pūharakekenui as the depth of the river was unsafe for staff to enter in order to set nets.

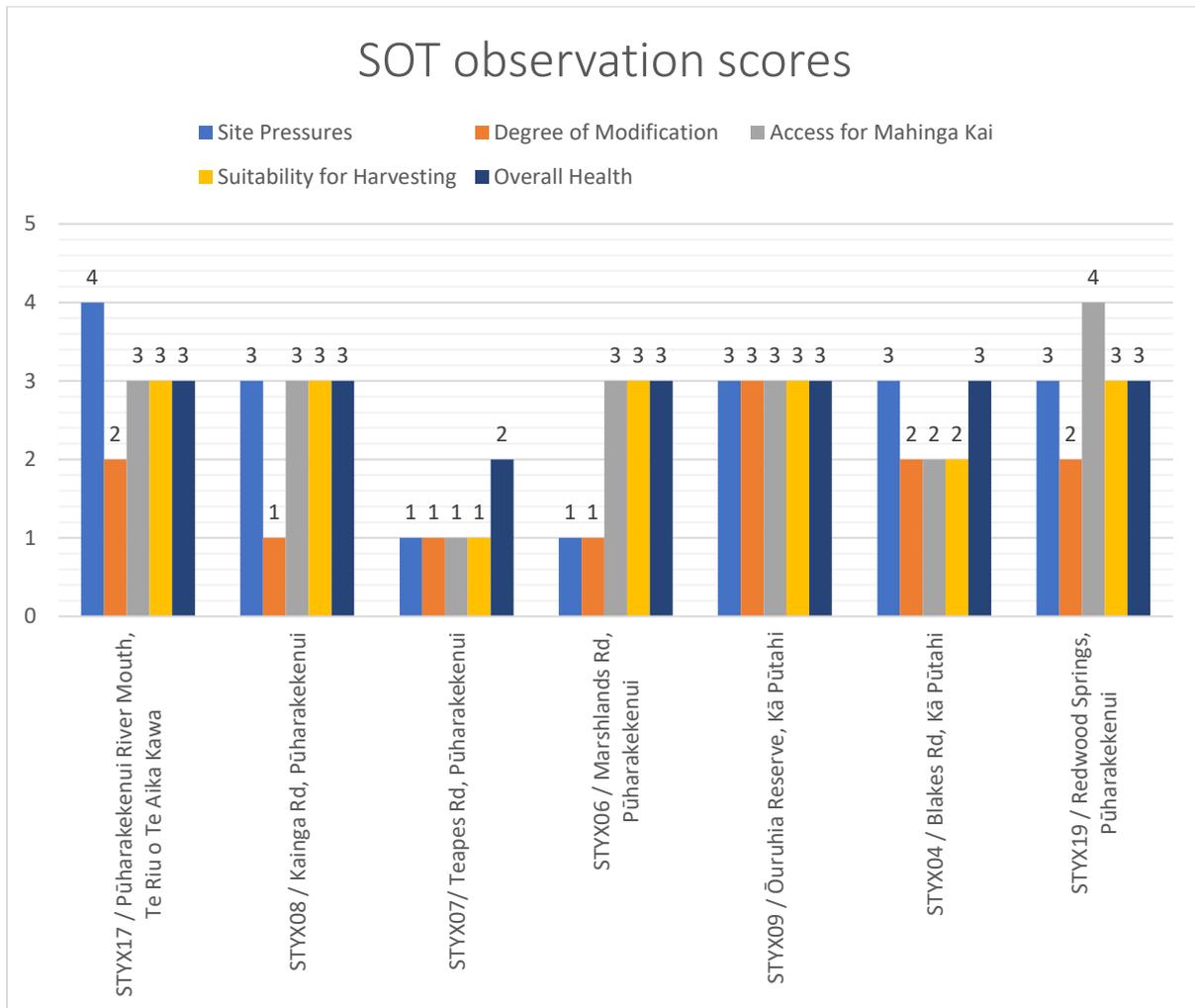
On the 18<sup>th</sup> of April 2023, Mahaanui Kurataiao Ltd staff went to site STYX18 / Spencerville Road, Pūharakekenui to retrieve nets set during the previous day to complete the fish survey and other monitoring requirements. On arrival it was discovered that mechanical weed clearance was underway on site and this work impacted the nets (gee minnow and fyke) which had been set the previous day, including the total loss of one of the fyke nets. Due to the time it took to determine if equipment was salvageable and to obtain another net in order to continue with monitoring at other sites, there was no further SOT, water quality or fish survey data recording undertaken at STYX18 / Spencerville Road, Pūharakekenui. The only full datasets recorded at this site was during the earlier phase of recording for the CHA and vegetation and bird surveys on the 16<sup>th</sup> and 17<sup>th</sup> of March 2023.

## 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 easternmost site on the left (STYX17 - downstream) and heading west/upstream 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, with scoring from 1 = poor quality/low values to 5 = high quality/values. The following scores were recorded for all sites except STYX18 (see Section 3.1 above). 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.**

Most of the scores ranged from 1 (poor values) to 3 (moderate values) for each category and site. The lowest scores were recorded at STYX08 / Kainga Road, Pūharakekenui, STYX07 / Teapes Road, Pūharakekenui and STYX06 / Marshland Road, Pūharakekenui, particularly for degree of modification and site pressures. At STYX08 / Kainga Road, Pūharakekenui, recorded observations for degree of modification included the drainage of the wetlands, the flood/tidal gates and the bridge/road. At STYX07 / Teapes Road, Pūharakekenui, every category except overall health scored a 1. Reasons for the scoring include: the surrounding farms creating site pressure, modification of the site through drainage of the wetlands, the bridge, straightening of the channel and earthquake repairs, and limited access for harvesting mahinga kai due to the river being fully fenced off and surrounded by farms. At STYX06 / Marshland Road, Pūharakekenui, recorded site pressures included the main road and bridge, heavy traffic and the urban area. Recorded observations for the degree of modification at this site included the bridge, rebattering of banks, and straightening for the river channel.

Scores of 4 (high value) were recorded for site pressure at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa and for access for mahinga kai at STYX19 / Redwoods Springs, Pūharakekenui. Boating was the main site pressure noted at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa. Access for mahinga kai at STYX19 / Redwoods Springs, Pūharakekenui was considered good due to the public reserve at the site. Further recorded observations are detailed in Section 4.2 as part of the CHA.

Figure 4 below shows the average score from all sites for each category. These numbers illustrate the score at the catchment level, including the overall health score. The average scores for the catchment are all under 3 (moderate values), with the lowest score for degree of modification (1.7 – low value).

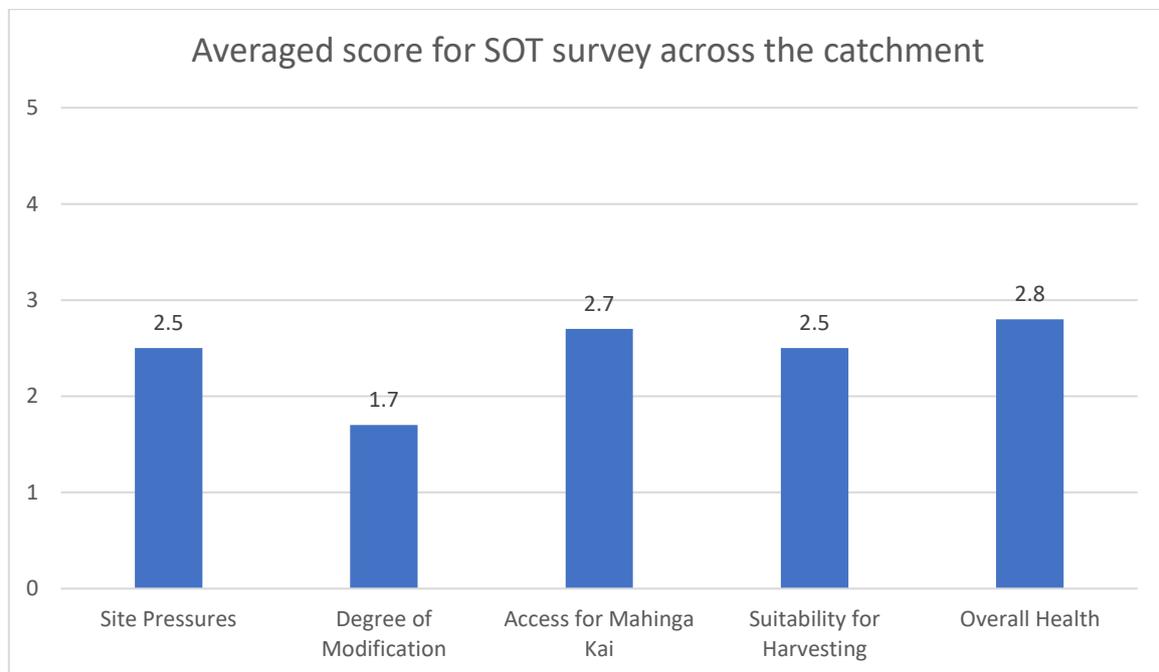


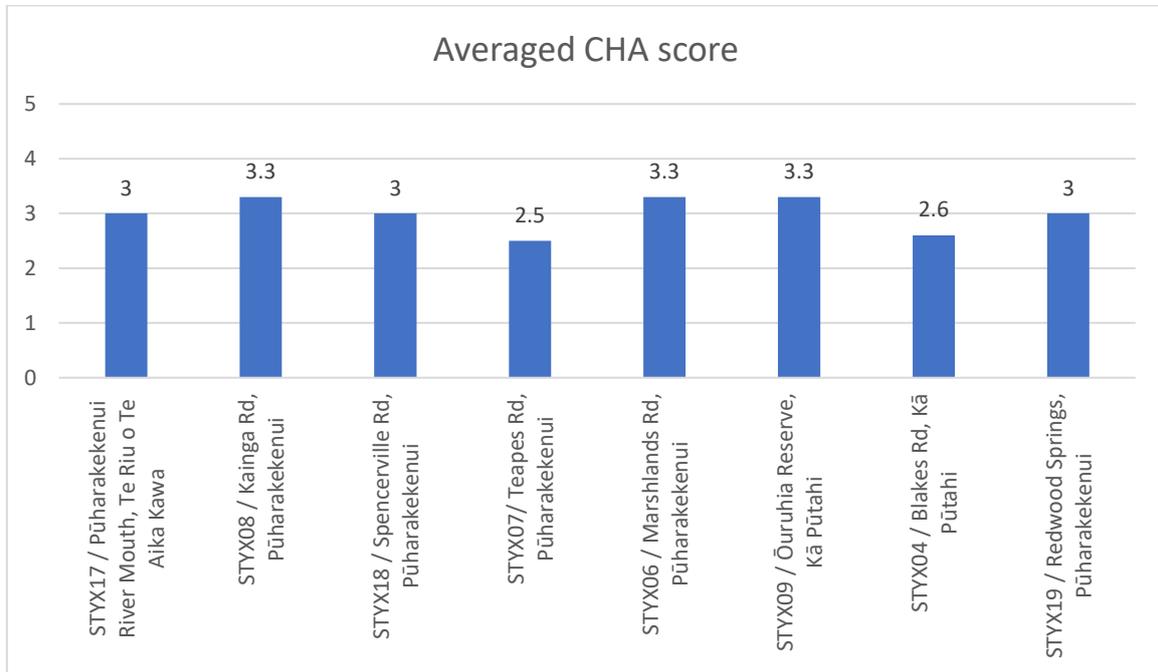
Figure 4. The averaged scores for the SOT survey for each category across the catchment.

## 4.2 Cultural Health Assessment

The graphed results for every question or category of the CHA can be found in Appendix A. The averaged<sup>2</sup> 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

<sup>2</sup> Calculated by adding all of the individual scores recorded by the monitors and dividing by the count of those numbers (3 – comprising two whānau monitors and one Mahaanui staff member who is also mana whenua).

(Figure 5). The overall results show a trend of scores around 2 (poor values) and 3 (moderate values).



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

The lowest averaged scores were recorded for catchment land use, riverbank use and development, riverbed condition, water quality, changes in the river channel and overall health. These scores ranged from 1 to 3.6, placing the sites from poor values to above moderate values. Higher averaged scores (above 4) were recorded for riverbank vegetation, range of habitat, minimal to no barriers to water flow and fish passage, and access. Despite the higher scores, for most of these categories there was only one site out of the eight surveyed which scored an average of four or higher for these categories. Questions on whether there is suitable fish passage and accessibility were the only categories with more than one score of 4 (high values). Only one score of 5 (high values) was recorded for STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa for accessibility.

All or most of the monitors in attendance recorded that they would return to the sites, with the exception of STYX08 / Kainga Road, Pūharakekenui and STYX07 / Teapes Road, Pūharakekenui. This site was not deemed accessible enough to return as the heavy fencing prevented access to the water. At all the sites, the monitors recorded that they had undertaken previous activities such as swimming, gathering materials, fishing and relaxing. However, some of these activities were contingent on the condition of the river at the time. Camping is not a permitted activity at any of the locations. The monitors made comments on some of the aspects that would prevent them using the site as well as concerns from observations made

on site or heard from other sources. The comments from the monitors have been summarised into broad categories and are detailed in the table below (Table 2).

**Table 2. Summary of the concerns identified in the responses to the Cultural Health Assessment for each site.**

Identified concern	STYX17	STYX08	STYX18	STYX07	STYX06	STYX09	STYX04	STYX19
Boats/jet ski	✓							
Discharge from industries (specifically Belfast Freezing Works)	✓				✓		✓	
No flow (when floodgates closed)		✓						
Cows close to river and/or effluent runoff		✓	✓	✓			✓	
Rubbish	✓	✓				✓		
Spraying of grass and weeds			✓				✓	
Fencing for stock too close to waterway			✓	✓				
Land use related runoff (fertilisers)			✓	✓			✓	
Minimal access			✓	✓	✓	✓		
No or minimal birds		✓			✓			
Road runoff					✓			
Weeds and plant overgrowth			✓	✓		✓	✓	✓
Sediment and silt (including as result of earthquakes)				✓		✓		
Construction sites (discharge)							✓	✓
Dead willows		✓						
Direct stormwater discharge into river		✓						✓
Insufficient native riparian planting			✓	✓	✓	✓		✓

Frequently cited concerns identified by the monitors include: insufficient indigenous riparian planting and/or insufficient indigenous plants in general, weeds and plant overgrowth (including plants that require maintenance such as harakeke), lack of access, and livestock close to the river and/or effluent runoff from livestock in proximity to the river. Some of the listed concerns were more specific to the geographical location of particular sites. For example, boats and jet skis were identified as concerns for swimming and setting nets for fishing at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa, and discharge from

the Belfast Freezing Works at sites located downstream from or near the factory location (STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa, STYX06 / Marshlands Road, Pūharakekenui and STYX04 / Blakes Road, Kā Pūtahi).

Monitors indicated that the activity they would most likely return to at the sites is to relax, which aligns with the number of reserves surveyed. Positive comments on the beauty of the site and the vegetation were recorded at STYX08 / Kainga Road, Pūharakekenui, STYX06 / Marshlands Road, Pūharakekenui, and STYX09 / Ōuruhia Reserve, Kā Pūtahi in particular. Other activities (such as swimming, fishing and gathering materials) were recorded as future cultural uses but many of these depended on actions to restore mahinga kai, wai māori and whenua. The comments from the monitors on actions to restore mahinga kai have been summarised into broad categories and are detailed in the table below (Table 3).

**Table 3. 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	STYX17	STYX08	STYX18	STYX07	STYX06	STYX09	STYX04	STYX19
Riparian planting (native species)	✓	✓	✓	✓	✓			
Rubbish bins	✓							
Controlling discharge	✓							
Improve water quality	✓	✓						
Monitor/maintain weeds and other plantings		✓				✓	✓	✓
Check flood gates working properly		✓						
Stock fencing/stock and farming activities further away from the river/wider buffer			✓	✓				
Improved access				✓	✓		✓	✓
Protection from road runoff					✓			
Remove sediment						✓		
Keep walkways tidy						✓		
Investigate discharge source <sup>3</sup>								✓

<sup>3</sup> During monitoring at STYX19 / Redwood Springs, Pūharakekenui a pipe directly discharging to the river was noted by the monitors. It is not known where this pipe comes from, resulting in the comments regarding an action to investigate the source of the discharge.

The most frequently identified actions to restore mahinga kai (and by extension wai māori and whenua) include: riparian planting (of appropriate indigenous species), monitoring and maintenance of weeds and other plants that require maintenance for the health of the plant (such as harakeke), and improving access to the river (although it was noted that the access issues in some areas are due to private property). Some of the actions listed above were not specifically noted by monitors at a particular site, for example, rubbish was a noted concern at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa and STYX08 / Kainga Road, Pūharakekenui, but rubbish bins were only noted as an actions at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa). However, Table 2 and Table 3 should be considered together as many of the actions are directly related to concerns and are generally of benefit to all sites across the catchment. Other general actions for the catchment as a whole noted in the SOT survey included: better management by landowner, consideration of ownership by Iwi, signage/interpretation, restoration of native plant species and pest/weed control.

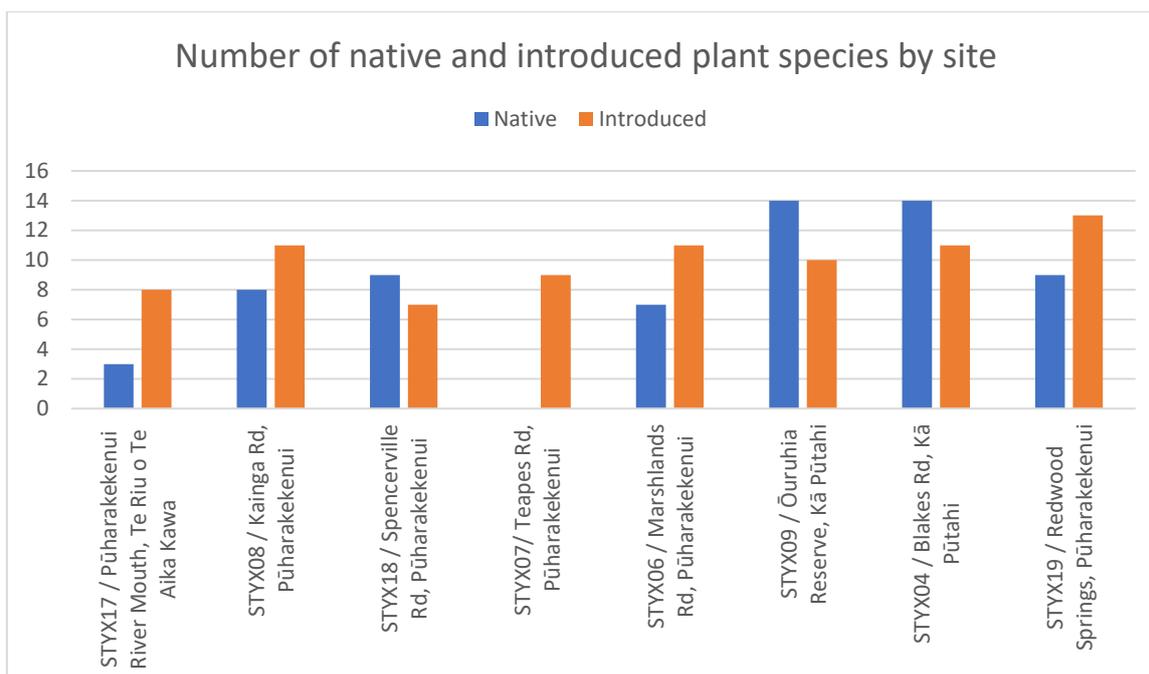
## 4.3 Vegetation Survey

### 4.3.1 Traditional

Vegetation characteristic of the area reflected the range of landforms present and, according to mātauranga Māori, included (but not limited to) raupō, harakeke/kōrari (flax/the flower stalk of harakeke), wiwi (rushes), tī kōuka (cabbage tree), forest species such as kiekie, tutu, pora (“Māori turnip”), and aruhe (bracken fernroot). This provided habitat for an abundance of other species and the area is important as a kōhanga (nursery) (Christchurch City Libraries, 2006; Tau et al., 1990; Ka Huru Manu, 2023).

### 4.3.2 Assessment

The full list of observed species can be found in Appendix B. Figure 6 below shows the numbers of native and introduced plant species observed and identified during the survey by site. Across the catchment, 45% of the recorded vegetation is native and 55% is introduced.



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

The number of introduced plant species recorded was high across the catchment with percentage cover ranging from 40% to 70%. At site STYX07 / Teapes Road, Pūharakekenui the percentage was 100% introduced species. Recorded species included willow (including dead trees), gorse, oxygen weed, pine, macrocarpa, poplar, old mans beard, monkey musk, blackberry, grasses and weeds. Comments recorded by the monitors included a specific mention of the old mans beard overgrowth at STYX08 / Kainga Road, Pūharakekenui; blackberry at STYX09 / Ōuruhia Reserve, Kā Pūtahi; and swamp willow and celery at STYX04 / Blakes Road, Kā Pūtahi.

Recorded native plant species recorded ranged from 30% to 60%. Species identified across the catchment include oioi (rush), harakeke, tī kōuka, raupō, wiwi, pūrei, kōhūhū, beech, fern, pōhuehue, horoeka (lancewood), toetoe, tōtara, puahou (fivefinger), kapuka (broadleaf), mingimingi, karamu, tarata (lemonwood), houhere, makomako (wineberry), kānuka and kōwhai. High numbers of native plant species were recorded at STYX09 / Ōuruhia Reserve, Kā Pūtahi and STYX04 / Blakes Road, Kā Pūtahi. These numbers reflect the dedicated planting at Ōuruhia Reserve and planting as part of mitigation for the new subdivisions around the Blakes Road site. Both sites retained high numbers of introduced plants as well. At the Ōuruhia Reserve site, although there was planting in the reserve, private property on the other side of the stream retained a number of introduced plant species captured in the scope of recording. For the Blakes Road site, the residual pine trees, willows and other scrub are likely from when the stream ran through farmland.

## 4.4 Bird Survey

### 4.4.1 Traditional

Based on mātauranga māori, bird species gathered from the area include pūtangitangi (paradise shelduck), pārerā (grey duck), weka, kiwi, and koreke (quail), raipo (New Zealand scaup), tataa (pāteke/brown teal), totokipio (New Zealand dabchick) (Christchurch City Libraries, 2006; Tau et al., 1990; Ka Huru Manu, 2023). 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 was recorded at STYX19 / Redwood Springs, Pūharakekenui with a total of eight. Species recorded here included pūtangitangi, pūkeko, pīwaiwaka, kakīānau (black swan), unidentified geese, unidentified ducks, manu pango (blackbird) and swallow. These species were some of the most common species recorded across the catchment, with the only common species not recorded at STYX19 being sparrow. The next highest was at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa with a total of seven recorded species. The coastal location of this site meant that there were records of different, more coastal dwelling species such as unidentified seagulls, tōrea (oystercatcher) and shag. Low numbers of bird species were recorded at STYX18 / Spencerville Road, Pūharakekenui, STYX07 / Teapes Rd, and Pūharakekenui and STYX04 / Blakes Road, Kā Pūtahi.

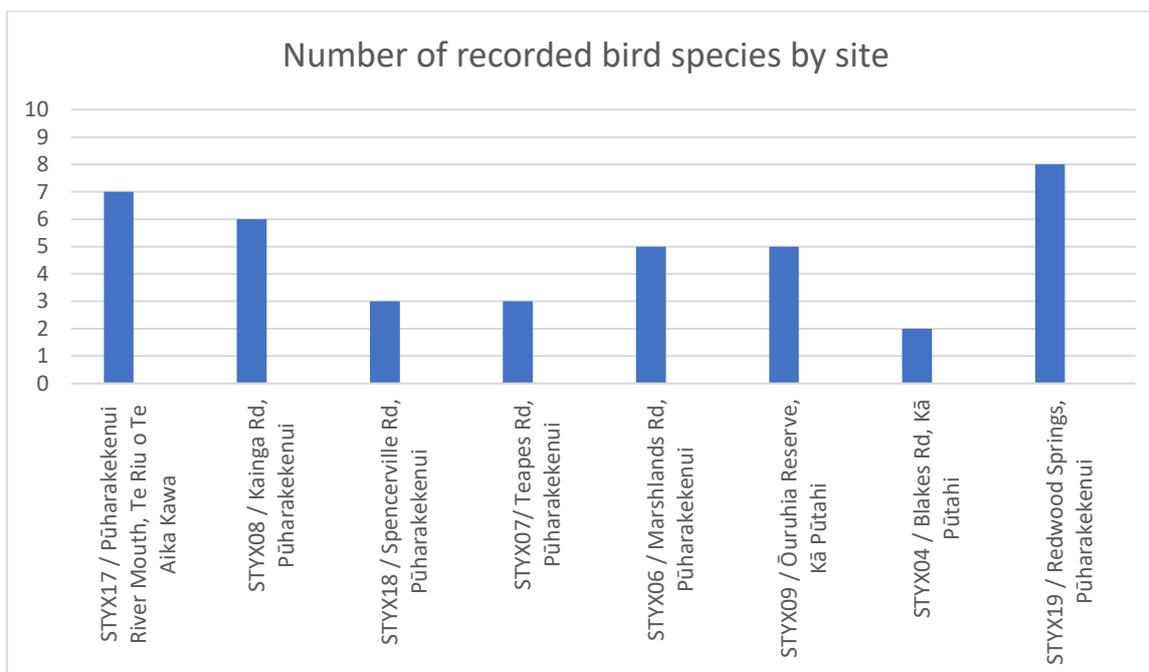


Figure 7. Numbers of bird species recorded at each site.

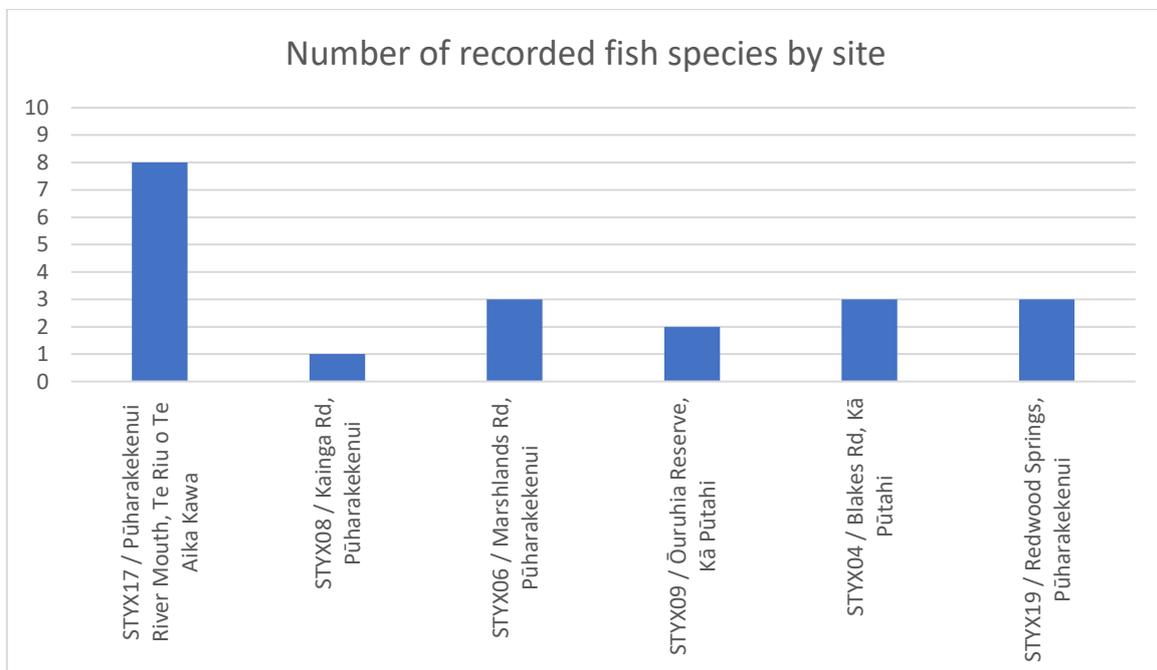
## 4.5 Fish Survey

### 4.5.1 Traditional

Based on mātauranga māori and previous surveys, fish species present included tuna (eels), kanakana (lamprey), inanga (whitebait), and pātiki (flounder), paraki (smelt), waharoa (horse mussel), mata (juvenile whitebait), aua (yellow-eyed mullet), panako, kōkopu (native trout), pipiki (fish sp.). This is not an exhaustive list. Many other coastal fish and shellfish species were abundant in Te Riu o Te Aika Kawa. The entire catchment is important as a spawning site for a variety of species (Christchurch City Libraries, 2006; Tau et al., 1990; Ka Huru Manu, 2023).

### 4.5.2 Assessment

No species were recorded at STYX18 due to the destruction of the nets in place, although unidentified trout species were observed during the CHA monitoring. No species were recorded at STYX07 as the depth of the river was unsafe to enter and set nets, but an unidentified trout was observed during the monitoring for the CHA. Monitors also noted observations of kākahi at the same location (abundance was not recorded). These have not been included in the results below as they did not constitute part of the fish survey (Figure 8).



**Figure 8. Numbers of fish species recorded at each site.**

The site at Pūharakekenui River Mouth, Te Riu o Te Aika Kawa (STYX17) recorded the highest number of fish species (eight). The location of this site on the coast and at the mouth of the river is a factor in the range of species found here, as species such as tunnelling mud

crabs are marine species. In addition to the caught species, a high abundance of pūpū was observed at this site. Other species recorded included elver, tīpokopoko (common bully), redfin bully, shortfin tuna, pātiki, rainbow trout and kanae (grey mullet).

Recorded species variety was low across the remaining sites, with between one and three different species recorded. Species of tuna and tīpokopoko were most commonly recorded. Īnanga was recorded at STYX04 / Blakes Road, Kā Pūtahi and a pātiki was observed (but not caught) at STYX08 / Kainga Road, Pūharakekenui. Abundance at the sites was low, with only one to two individuals of each species recorded at most sites. At STYX06 / Marshlands Road, Pūharakekenui, there were three individual tīpokopoko (common bully), and at STYX19 / Redwood Springs, Pūharakekenui there were three individual longfin tuna. The greatest abundance was at STYX04 / Blakes Road, Kā Pūtahi with five individual tīpokopoko (common bully) recorded. Size ranges recorded for all shortfin tuna were 320 to 660 mm and for longfin tuna the recorded size range was 560 to 990 mm.

## 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 April 2023<sup>4</sup> (Table 4 and Table 5). 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 4. 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	Temperature (°C)	Electrical conductivity (µS/cm)	Water clarity (cm)
STYX17	18/4/23 9.08am	N/A	6.86	14	1331	40cm
STYX08	18/4/23 9.30am	N/A	6.86	14	166	N/A
STYX06	18/4/23 10.48am	N/A	7.1	13.7	91.5	79.3cm
STYX09	19/4/23 10.53am	0.38m/s	6.83	14.3	102.5	65cm
STYX04	19/4/23 9.57am	0.21m/s	6.6	14.4	110.6	108cm

<sup>4</sup> Records of dissolved oxygen were taken but the results were indicative of a calibration issue. As such these results have not been included here.

<b>STYX19</b>	19/4/23 9.02am	0.45m/s	7.03	14.02	95.9	74cm
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Velocity rates were only able to be recorded in accessible locations. Velocity rates were generally low but broadly in range with previous monitoring records (Instream, 2018). Velocity was a noted issue at STYX08 / Kainga Road, Pūharakekenui, with monitors noting the water looked ‘polluted’ and attributed this to the lack of flow.

The measured pH at all sites were within the range of 6.5 and 8.5, 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 the sites were below the maximum temperature of 20 °C set out in the LWRP (freshwater outcomes for Canterbury rivers).

The electrical conductivity was highest at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa due to the saltwater present at this location. The proximity to Te Riu o Te Aika Kawa is also likely the reason for the higher electrical conductivity at STYX08 / Kainga Road, Pūharakekenui compared to other sites.

Clarity ranged from 40 cm to 108 cm of visibility, although most sites were above 60 cm of visibility. Low clarity at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa is likely due to the coastal location as there are typically higher concentrations of suspended sediments in estuarine waters (NIWA, 2012). The comparison of the measured visual clarity against long-term values is required to determine the percentage change over time (which shall not exceed 20% under the LWRP receiving water standards).

**Table 5. Results from records of the SHMAK testing (observation based).**

Site Code	Bed Composition	Bank Vegetation True Left	Bank Vegetation True Right	Deposits
<b>STYX17</b>	70%-Mud or silt, 30%-Sand	80%-Wetland vegetation, 15%-Introduced trees, 5%-Other conifers	70%-Wetland vegetation, 25%-Pasture and weeds, 5%-Other conifers	>5mm
<b>STYX08</b>	80%-Mud or silt, 20%-Sand	70%-Native trees, 20%-Introduced trees, 10%-Other conifers	50%-Native trees, 30%-Introduced trees, 20%-Other conifers	1-3mm
<b>STYX06</b>	80%-Mud or silt, 10%-Water plant rooted in stream bed, 10%-Gravels	50%-Pasture and weeds, 30%-Short tussock improved, 10%-Introduced trees, 10%-Native trees	60%-Native trees, 30%-Introduced trees, 10%-Wetland vegetation	1-3mm

<b>STYX09</b>	70%-Mud or silt, 10%-Gravels, 10%-Small cobbles, 10%-Large cobbles	50%-Native trees, 40%-Introduced trees, 10%-Other conifers	40%-Introduced trees, 30%-Native trees, 20%-short tussock improved, 10%-Other conifers	1-3mm
<b>STYX04</b>	40%-Mud or silt, 20%-Gravels, 20%-Small cobbles, 20%-Large cobbles	85%-Introduced Trees, 10%-Other conifers, 5%-Native trees	80%-Introduced trees, 15%-Other conifers, 5%-Native trees	1-3mm
<b>STYX19</b>	80%-Mud or silt, 10%-Small cobbles, 10%-Large cobbles	90%-Introduced trees, 10%-Pasture and weeds	70%-Introduced trees, 10%-Native trees, 10%-Wetland vegetation, 10%-Pasture grasses and weeds	1-3mm

Mud was the predominant composition of the stream bed, although gravels and cobbles of varied sizes were noted as well. The bank vegetation is based on observed 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 in Section 4.4 and in Appendix B. Estimates of loose deposited material on the stream bed were between 1 and 3 mm indicating moderate coverage at the edge or elsewhere. At STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa, deposits were greater than 5 mm, comprising thick horizontal surfaces. However, as noted with the clarity levels above, this is likely due to the coastal nature of the site.

## 4.7 Water Quality Testing

Four sites were selected for water sampling on the 18<sup>th</sup> and 19<sup>th</sup> of April 2023. These were: STYX08 / Kainga Road, Pūharakekenui, STYX06 / Marshlands Road, Pūharakekenui, STYX09 / Ōuruhia Reserve, Kā Pūtahi and STYX19 / Redwood Springs, Pūharakekenui (Table 6). The water samples were sent to Hills 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 6. Results from the water sample testing provided by Hills Laboratory. 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	STYX08 / Kainga Road, Pūharakekenui	STYX06 / Marshlands Road, Pūharakekenui	STYX09 / Ōuruhia Reserve, Kā Pūtahi	STYX19 / Redwood Springs, Pūharakekenui
<i>E. coli</i> (MPN/100mL)	193	365	<b>1,414</b>	<b>816</b>
Total Arsenic (g/m <sup>3</sup> )	<b>0.0017</b>	< 0.0011	<b>0.0016</b>	<b>0.0011</b>
Total Boron (g/m <sup>3</sup> )	0.036	0.028	0.044	0.037
Total Calcium (g/m <sup>3</sup> )	17.2	15.7	14.2	17.0
Total Copper (g/m <sup>3</sup> )	< 0.00053	0.00055	< 0.00053	< 0.00053
Total Iron (g/m <sup>3</sup> )	0.57	0.180	0.39	0.22
Total Lead (g/m <sup>3</sup> )	0.00025	0.00021	0.00048	0.00017
Total Magnesium (g/m <sup>3</sup> )	5.1	2.5	2.9	2.7
Total Manganese (g/m <sup>3</sup> )	0.055	0.0145	0.099	0.039
Total Potassium (g/m <sup>3</sup> )	2.5	1.30	2.5	1.73
Total Sodium (g/m <sup>3</sup> )	22	7.1	9.9	6.8
Total Zinc (g/m <sup>3</sup> )	<b>0.0054</b>	<b>0.0025</b>	<b>0.0077</b>	<b>0.0137</b>
Chloride (g/m <sup>3</sup> )	32	6.3	10.1	6.7
Nitrate-Nitrogen (g/m <sup>3</sup> )	0.35	0.64	0.72	0.34
Sulphate (g/m <sup>3</sup> )	8.9	5.1	3.3	6.3

The water quality results in Table 6 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. The measured concentrations of metals and metalloids (arsenic, boron, copper, lead, manganese and zinc) were lower than the aforementioned standards set out in the LWRP. 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<sup>3</sup> 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 arsenic, boron, copper, lead, manganese and zinc. The total zinc

concentrations across all sites exceeded this trigger value of 0.0024 g/m<sup>3</sup>. In addition, the total arsenic concentrations across all sites except STYX06 / Marshlands Road, Pūharakekenui exceeded the 0.0010 g/m<sup>3</sup> trigger value for arsenic (III). The concentrations of total boron, copper, lead, and manganese 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 or speciated (for arsenic).

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. Sites STYX08 / Kainga Road, Pūharakekenui, STYX06 / Marshlands Road, Pūharakekenui had readings below the accepted limit. The level of *E. coli* at STYX06 / Marshlands Road, Pūharakekenui was also below the limit but it should be noted it was above guidelines for safe ('green') swimming. Additionally, sites STYX09 / Ōuruhia Reserve, Kā Pūtahi and STYX19 / Redwood Springs, Pūharakekenui had *E. coli* levels that exceeded the plan limit as well as safe parameters for swimming. The levels from STYX09 / Ōuruhia Reserve, Kā Pūtahi in particular were more than 2.5 times the limit value of 550 MPN/100 mL. All sites should be further monitored 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 Pūharakekenui catchment, the average score of overall health from the SOT survey of the monitored sites (excluding STYX18 / Spencerville Road, Pūharakekenui) was 2.8. The average score from the Cultural Health Assessment survey (based on the score for overall health) for all sites was 3. These scores do not meet the set target level of 5 (Figure 9). This score demonstrates that there is still significant work to be done to improve the cultural health of sites in the catchment, as well as the catchment overall.

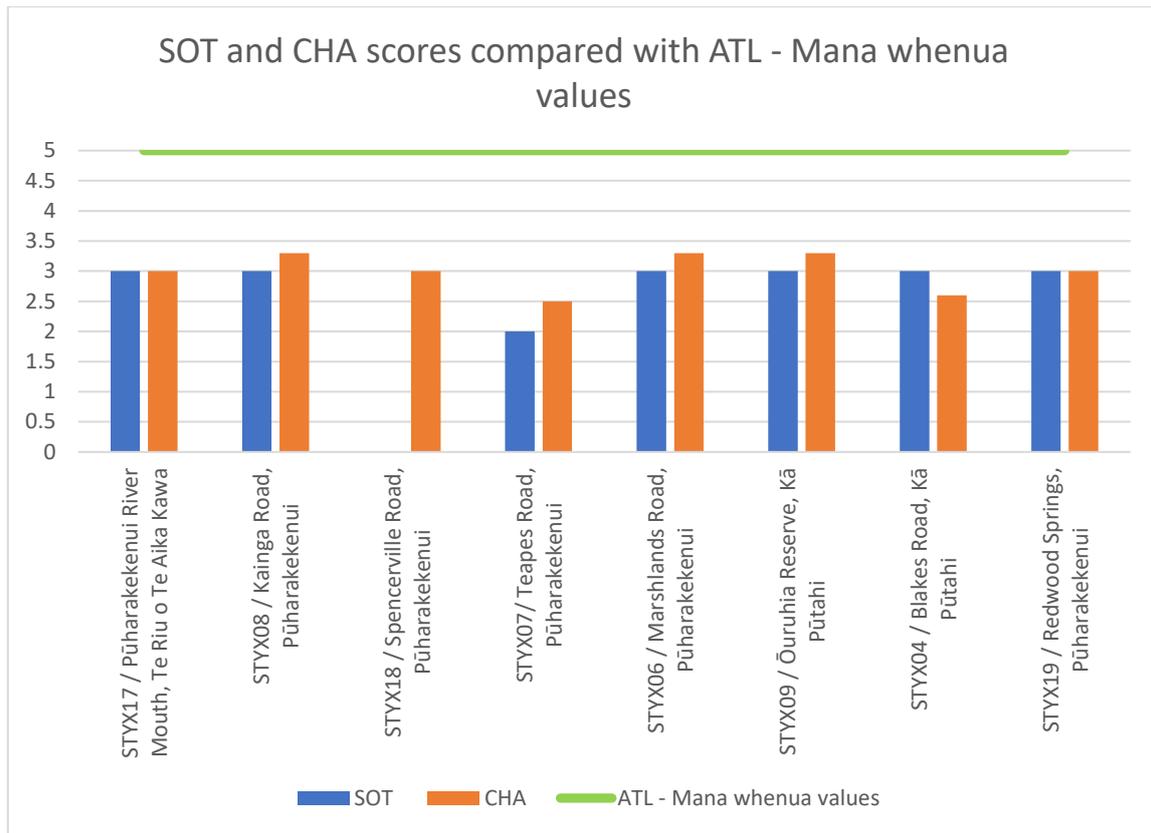


Figure 9. The SOT and CHA scores for overall health by site in comparison to the attribute target level for mana whenua monitoring as per Condition 54 of the CSNDC.

## 5 Discussion

### 5.1 Overview of the catchment

The overall averaged score from the SOT monitoring was just under 3 (moderate values) for the catchment, with an overall score of 2.8. The overall score for the catchment in the 2012 SOT survey was 2.3. As such there is slight improvement in the overall score of 0.5, but this difference does not signify significant progress in the cultural health of the catchment. The 2012 SOT survey recorded high levels of site modification (relative to the identified traditional use) and pressure across the catchment. Scores for these categories were also low in the 2023 study, indicating continued high levels of site modification except for STYX17 / Pūharakekenui River Mouth. In the 2012 study, site pressures were determined to be related to factors such as invasive species, physical disturbance and pollution. In the 2023 survey, the most common concerns that monitors noted were insufficient indigenous riparian planting and/or insufficient indigenous plants in general, weeds and plant overgrowth, lack of access, and livestock close to the river and/or effluent runoff from livestock in proximity to the river. Invasive species of plants seem to be an ongoing issue from 2012 to 2023. Pollution was noted at some sites with regards to the appearance of the water, and in concerns around discharges or runoff to the water. In the 2012 SOT survey, eight sites had *E. coli* levels exceeding the limit of 550 MPN/100 mL. Of the four sites tested in the 2023 study, two of the sites exceed the *E. coli* limit, with one site recording particularly high levels. High levels of *E. coli* were recorded at Ōuruhia Reserve in the 2012 survey. This indicates that *E. coli* contamination is still an issue in the catchment, requiring further investigation and controls to determine the source and stop the high contamination levels. However, the 2023 survey did not identify any other contaminants of concern in the water samples.

Scores from the CHA ranged from 1 (poor values) to 3.6 (moderate to high values), with average of 3 (moderate values). In the 2012 SOT study, the CHI score (equivalent of CHA) was 2.7. Like the overall SOT score, there was a slight improvement in the score of 0.3, but this difference does not signify significant progress in the cultural health of the catchment. Monitors noted several actions to restore mahinga kai: riparian planting of appropriate indigenous species, monitoring and maintenance of weeds and other plants that require maintenance (such as harakeke), and improving access to the awa. Although, it was noted that the access issues in some areas are due to private property. Recommendations in the 2012 SOT survey included controlling further modifications, naturalisation, stopbanks, evaluation of in-stream devices, river protection and stabilisation works, protection of wāhi

tapu, wāhi taonga and waipuna, restoration of water quality for mahinga kai, control of pollution sources, preventing overflow of wastewater, setbacks, monitoring of contaminants levels, fencing, riparian restoration, control of pest species, prevention of further encroachment of urban development, create environments with important cultural resources, investigate heavily degraded sites, restoration of high significance areas, ingoa wāhi, and further cultural monitoring.

Although there was a higher recorded overall percentage of introduced plant species identified across the catchment (55%), the overall percentage of native species across the catchment was recorded as 45% with some sites up to 60% indigenous vegetation cover. The 2012 survey recorded ranges from 5% to 40% indigenous vegetation cover across the sites. Traditional vegetation such as raupō, harakeke, wiwi, tī kōuka were recorded at surveyed sites, often due to restoration efforts at a number of sites. Restoration activity was also noted in the 2012 SOT survey and the results of the 2023 survey show that efforts progressed the restoration of indigenous biodiversity in the catchment. Traditional fish species such as tuna, inanga, and pātiki were present in the 2023 survey, and coastal fish and shellfish species were recorded at the river mouth. No kanakana were recorded but these have a more specific methodology to catch and have been recorded previously (Instream, 2018). The fish survey in the 2012 SOT study caught eight different species in total with the largest abundance being of shortfin tuna. There were more species variations recorded overall in the 2023 survey (11 species). Shortfin tuna was caught during the 2023 survey but in low abundance numbers of one or two at each site. A comparison of the fish survey in 2012 and 2023 does not yield any particular trends in the presence and health of the fish populations in the catchment. Further surveying may be required to get a more accurate measurement of health. Traditional bird species pūtangitangi were recorded in the 2023 survey. Other traditional species such as weka and kiwi are no longer found in Christchurch in general, and species such as koreke is now extinct. There was more variety of bird species recorded in the 2023 survey than in the 2012 SOT survey of both native and non-native types.

#### 5.1.1 STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa

The SOT scores for STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa were 4 (high values) for site pressures, 2 (poor values) for degree of modification and 3 (moderate values) for all other categories. The overall health for the site as recorded in the CHA monitoring was 3 (moderate values). Scores across the CHA categories were largely under at or below this score, with a higher score of 4.6 (high values) for no barriers and fish passage, and a score of 5 for safe access. Many of the results for STYX17 / Pūharakekenui River Mouth,

Te Riu o Te Aika Kawa reflect the different coastal environment of the site (Figure 10). This includes high levels for electrical conductivity, thicker deposits and lower recorded clarity in the SHMAK records. There were high numbers and abundance of fish and bird species with many coastal-dwelling types recorded. However, there were low numbers of native vegetation, with higher numbers of introduced plant species indicating further work for restoration of indigenous biodiversity at this site. Monitors commented on the presence of boats and jet skis as concerns specific to the site. Identified issues of concern shared with other sites included: discharge from industries (specifically Belfast Freezing Works) and rubbish. Actions to restore mahinga kai include: riparian planting/restoration of native plant species, controlling discharge, improve water quality, rubbish bins.



Figure 10. Looking northwest at the hīnaki placed during monitoring at STYX17 / Pūharakekenui River Mouth, Te Riu o Te Aika Kawa.

#### 5.1.2 STYX08 / Kainga Road, Pūharakekenui

The SOT scores for STYX08 / Kainga Road, Pūharakekenui were consistent at 3 (moderate values) for most categories. A low score of 1 for degree of modification is due to the drainage of the wetlands, the flood/tidal gates and the bridge/road. The overall health for the site as recorded in the CHA monitoring was 3.3 (moderate values). Scores across the CHA categories were largely under at or below this score, with a higher score of 4 (high values) for riverbank vegetation and a score of 4.3 (high values) for in-stream habitats. *E. coli* levels were elevated but not above the guideline limit level. The number of native plant species was mid-range but there was a higher number of introduced species (Figure 11). Only one fish species was

observed at the site. The site had the third highest number of bird species recorded. Identified concerns specific to the site include a lack of flow when the floodgates are closed and dead willows. Identified issues of concern shared with other sites included: cows close to the river/effluent runoff from stock, rubbish, no or minimal birds, and direct stormwater discharge to river. Actions to restore mahinga kai include: riparian planting/restoration of native plant species, rubbish bins, controlling discharge and improving water quality.



Figure 11. Looking upstream at STYX08 / Kainga Road, Pūharakekenui.

### 5.1.3 STYX18 / Spencerville Road, Pūharakekenui

Monitoring at STYX18 / Spencerville Road, Pūharakekenui was impacted by the equipment issue discussed above, which meant that a range of recording was not able to be undertaken.

Results that were recorded show an average score overall health of 3 (moderate values) for CHA. Scores across the CHA categories were largely under at or below this score, with higher scores of 3.6 (moderate to high values) for in-stream habitats, 3.3 (moderate values) for minimal barriers, and 4.6 (high values) for fish passage. The greatest issue of concern noted by monitors were that cows were observed close to the river and that the lack of riparian planting along this part of the river meant that there was minimal barrier to runoff of nutrients. Other identified issues of concern shared with other sites included: spraying of grasses and weeds, fencing for stock too close to the river, land use related runoff (fertilisers), minimal access, weeds and plant overgrowth, and insufficient riparian and/or native planting. Monitors noted low numbers of bird species, some trout observed in the river, and that the harakeke was “beautiful” where there was a small strip planted with natives on the true right bank. Numbers of native plants were higher than introduced plant species overall, but were concentrated on only one side of the riverbank as this site is a restored reserve. The true left bank comprised willows, grasses and weeds. Actions to restore mahinga kai include: riparian planting with native plant species and ensuring stock fencing and farming activities are further away from the river, i.e., increasing the buffer.

#### 5.1.4 STYX07/ Teapes Road, Pūharakekenui

The SOT scores for STYX07/ Teapes Road, Pūharakekenui were very low across all categories, with ratings of 1 and 2 (poor values). The average overall health score of 2.5 (poor to moderate values) was recorded for the CHA monitoring. Scores across other CHA categories were at or under this rating, apart from the slightly higher score of 2.6 (poor to moderate values) for in-stream habitats, a score of 3.3 (moderate values) for barriers and 4 (high values) for fish passage. The depth of the river at this site prevented some recording methods being undertaken. No native plant species were recorded, and there was a low number of bird species. The greatest issue of concern noted by monitors is that the site was heavily farmed on all sides with cows next to the water and that there was no native riparian planting to act as a filter for the effluent runoff from the livestock (Figure 12). There were also concerns about runoff of fertilisers from crops planted close to the river (Figure 13). Other identified issues of concern shared with other sites included: fencing for stock too close to the river, land use related runoff (e.g., fertilisers), minimal access, weeds and plant overgrowth, sediment and silt (including as result of earthquakes) and generally insufficient riparian and/or native planting. It was noted that monitors had heard that the land use, runoff and nitrates going into the water was “killing off the ecosystem of the river here”. At the time of recording one of the monitors noted that the water looked “polluted”. These issues were significant enough that the monitors recorded that they would not use this site. The monitors noted that

trout and kākahi were observed in the river. No native plants were recorded from this site and minimal birds were recorded. Actions to restore mahinga kai include: riparian planting with native plant species, ensuring stock fencing and farming activities are further away from the river (i.e., increasing the buffer) and improving access.



**Figure 12.** Looking upstream at the river and riverbank, showing the lack of buffer between livestock and the river.



**Figure 13. Looking downstream at the river and riverbank, showing the lack of buffer between crops and the river.**

#### 5.1.5 STYX06 / Marshlands Road, Pūharakekenui

The SOT scores for STYX06 / Marshlands Road, Pūharakekenui ranged from 1 (poor values) for site pressures and degree of modification, to 3 (moderate values) for the remaining categories. The overall health for the site as recorded in the CHA monitoring was 3.3 (moderate values). Scores across the CHA categories were largely at or under this score, with a higher score of 3.6 (moderate to high values) for water quality and safe access, and 4.6 (high values) for fish passage. *E. coli* rates were above safe guidelines for swimming, but not over the limit value under the Canterbury LWRP. Recorded vegetation comprised native and introduced plant species, but there was a higher number of introduced plant species. Number

of fish species recorded was low but on par with two other sites. Bird numbers were roughly mid-range. Identified issues of concern shared with other sites included: discharge from industries (specifically Belfast Freezing Works), minimal access, no or minimal birds and insufficient riparian planting (native). Also noted for this site was concern for runoff from the road. Monitors noted that the riparian zone was well planted and established on the southern end but not yet established on northern end (Figure 14). The water quality was described as “nice and clear” at confluence with Kā Pūtahi. The Pā harakeke on site was also noted with the harakeke described as “beautiful”. Actions to restore mahinga kai include: riparian planting with native plant species, improved access and protection from road runoff.

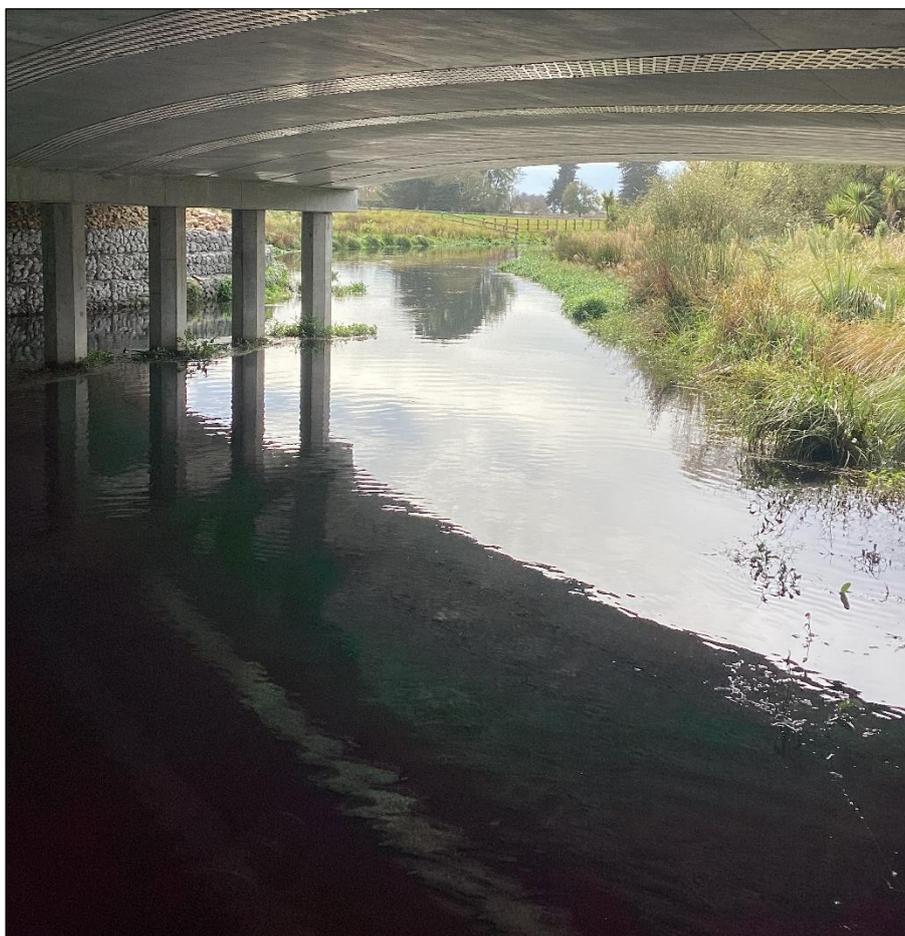


Figure 14. Looking downstream at STYX06 / Marshlands Road, Pūharakekenui.

#### 5.1.6 STYX09 / Ōuruhia Reserve, Kā Pūtahi

The SOT scores for STYX09 / Ōuruhia Reserve, Kā Pūtahi were all consistent at 3 (moderate values). The overall health score from CHA for this site was 3.3 (moderate values).

The measured *E. coli* level was 1,414 MPN/100 mL — more than 2.5 times the limit value of 550 MPN/100 mL in the LWRP. This measured value is comparable to the Christchurch City

Council (2023) long-term monitoring sites upstream and downstream of the site. The reported long-term median *E. coli* value upstream of this site is below the 550 MPN/100 mL limit. However, the long-term median *E. coli* value at the monitoring site downstream of STYX09 exceeded 1,200 MPN/100 mL. The measured *E. coli* in the present report is below the long-term maximum measured upstream and downstream of the site. Further monitoring of *E. coli* and the investigation of possible sources may be required.

Recorded vegetation comprised high rates of native plant species due to the planted reserve, but also reasonable number of introduced plant species due to private land located alongside the site. Numbers of fish species recorded were low and numbers of bird species were roughly mid-range. Identified issues of concern shared with other sites included: rubbish, minimal access, weeds and plant overgrowth, sediment and silt (including as result of earthquakes), and insufficient riparian planting (native). Monitors noted that the reserve was nice and well planted, but that sediment was of particular concern for this area, as was the untidiness of the paths (Figure 15). Blackberry was noted to be strangling some areas. Actions to restore mahinga kai include: monitoring and maintaining weeds and other plantings, removal of sediment and keeping walkways tidy.



Figure 15. Looking downstream at STYX09 / Ōuruhia Reserve, Kā Pūtahi.

#### 5.1.7 STYX04 / Blakes Road, Kā Pūtahi

The SOT scores for STYX04 / Blakes Road, Kā Pūtahi were either 2 (poor values) or 3 (moderate values). The overall health score from the CHA monitoring was 2.6 (poor to moderate values). Scores across the other CHA categories were at or below this rating, with a higher score of 3 (moderate values) for habitats and riverbank use/development. Recorded vegetation comprised high rates of native plant species due to the planting associated with the establishment of the recent subdivision, but also a reasonable number of residual introduced plant species due to the former land use as farmland (Figure 16). Numbers of fish species recorded was low but on par with two other sites. Numbers of bird species were the lowest recorded and the reason for this is unclear. Identified issues of concern shared with

other sites included: perceived discharge from industries (specifically noted as Belfast Freezing Works; no specified discharge point was recorded), cows close to river and/or effluent runoff, spraying of grass and weeds, land use related runoff (fertilisers), weeds and plant overgrowth and discharge from construction sites (ongoing as part of the subdivision development). Monitors noted that there was minimal canopy cover and it was particularly concerning that the waterway is overgrown with swamp willow and celery. Actions to restore mahinga kai include: monitoring and maintaining weeds and other plantings, and improved access.



Figure 16. Looking upstream at STYX04 / Blakes Road, Kā Pūtahi.

### 5.1.8 STYX19 / Redwood Springs, Pūharakekenui

The SOT scores for STYX19 / Redwood Springs, Pūharakekenui varied from 2 (poor values) to 4 (high values), with most of the scores at 3 (moderate values). The overall health score from the CHA monitoring was 3 (moderate values). Scoring across the other CHA categories were at or under this rating, with higher scores of 3.6 (moderate to high values) for barriers and 4 (high values) for fish passage and safe access.

The *E. coli* measured was 816 MPN/100 mL, over the limit value of 550 MPN/100 mL in the LWRP. This value is comparable to the Christchurch City Council (2023) long-term monitoring sites upstream and downstream of the site. The reported long-term median *E. coli* values upstream and downstream of the site are below the 550 MPN/100 mL limit. However, the measured *E. Coli* in the present investigation is below the long-term maximum measured upstream and downstream of the site. Further monitoring of *E. coli* and the investigation of possible sources may be required.

Recorded vegetation comprised mid-range rates of native plant species and higher numbers of introduced plant species, with a lot of exotic grasses and weeds observed in riparian margins, and oxygen weed in the river (Figure 17). The number of fish species recorded was low but on par with two other sites (STYX06 / Marshlands Road, Pūharakekenui and STYX04 / Blakes Road, Kā Pūtahi). The number of bird species was the highest recorded in the catchment. Identified issues of concern shared with other sites included: weeds and plant overgrowth, construction sites (discharge), direct stormwater discharge into river, and insufficient riparian planting (native). Monitors noted an unknown discharge of water 5 m west of the railway bridge as well as potential sediment runoff from the construction site occurring on the north side of the site. Monitors also noted that there was good access to natural springs. Actions to restore mahinga kai include: monitoring and maintaining weeds and other plantings, improved access, and investigation of the source of the discharge near the railway bridge.



Figure 17. Looking downstream at STYX19 / Redwood Springs, Pūharakekenui.

## 6 Conclusion and recommendations

Mahaanui Kurataiao Ltd undertook cultural monitoring in March and April of 2023 at eight sites within the Pūharakekenui catchment using the SOT and CHA methods. Overall, this monitoring indicated that the catchment has slightly below or at moderate cultural health values. The Attribute Target Level for Mana Whenua Values of 5 (very good) was not met by the survey results. The results from the 2023 survey showed a slight improvement in the overall health scores recorded in comparison to the 2012 survey, but the difference did not signify significant improvements in cultural health. Of concern were high *E. coli* levels (above the limit value of 550 MPN/100 mL in the Canterbury LWRP) at two sites (STYX09 / Ōuruhia Reserve, Kā Pūtahi and STYX19 / Redwood Springs, Pūharakekenui). Many of the same concerns and recommendations for actions listed in the 2012 SOT report were observed by monitors during the 2023 survey, including invasive introduced plant species, insufficient indigenous riparian planting and/or insufficient indigenous plants in general, and concerns around discharges or effluent runoff to the water from livestock close to the river, industry and construction. Additional concerns were raised around weeds and plant overgrowth, lack of access, rubbish, spraying of grass and weeds, fencing for stock too close to waterway, land use related runoff (e.g., fertilisers), no or minimal birds, sediment and silt (including as result of earthquakes) and unidentified direct stormwater discharge into river, as well as some other site specific concerns (boats/jet ski, no flow when floodgates closed, dead willows and road runoff).

### 6.1 Recommendations

The following recommendations result from the 2023 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 provide 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.
- *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. 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.
- The location of stock fencing, buffers and riparian margins should be consistent with recommended waterway setbacks in the Mahaanui Iwi Management Plan 2013 (refer **WM12.5**).
- The source of the discharge observed near the railway at STYX19 / Redwood Springs, Pūharakekenui must be identified and investigated.
- Discharge from construction sites must be regularly monitored for compliance with erosion and sediment control plans and any relevant contamination control plans.
- 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.
- The Pūharakekenui flood gates should be checked and maintained regularly to make sure they are not impeding river flow.
- Methods to protect the river from road runoff, particularly on high vehicle use roadways, should be investigated and implemented.

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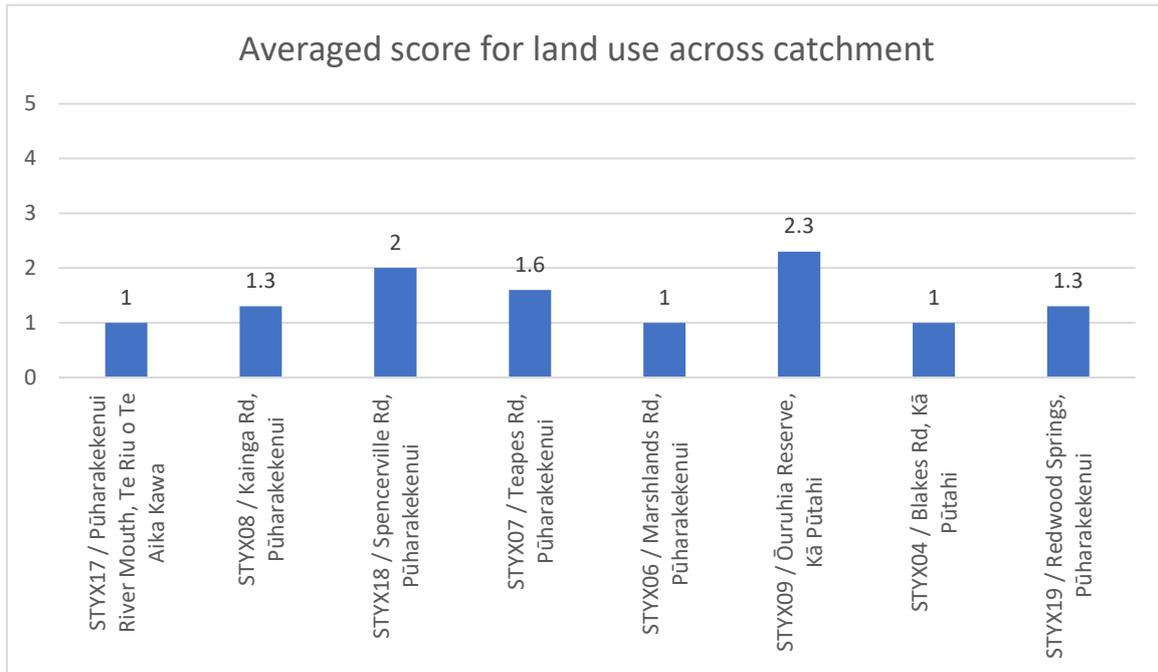
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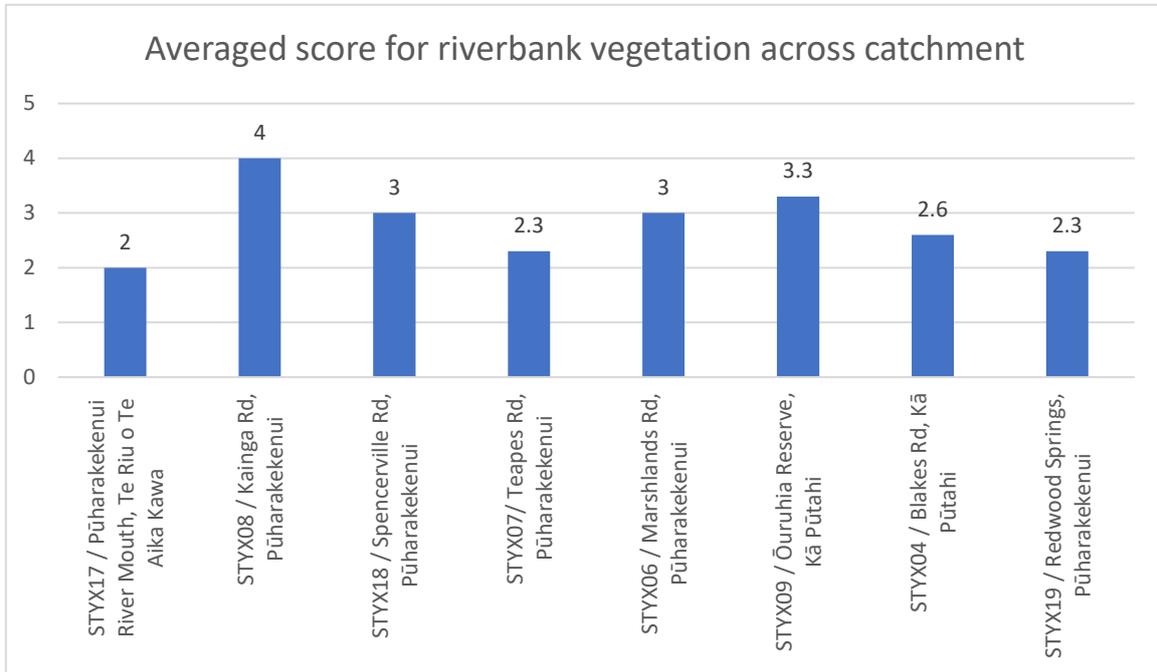
## 8 Appendix

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

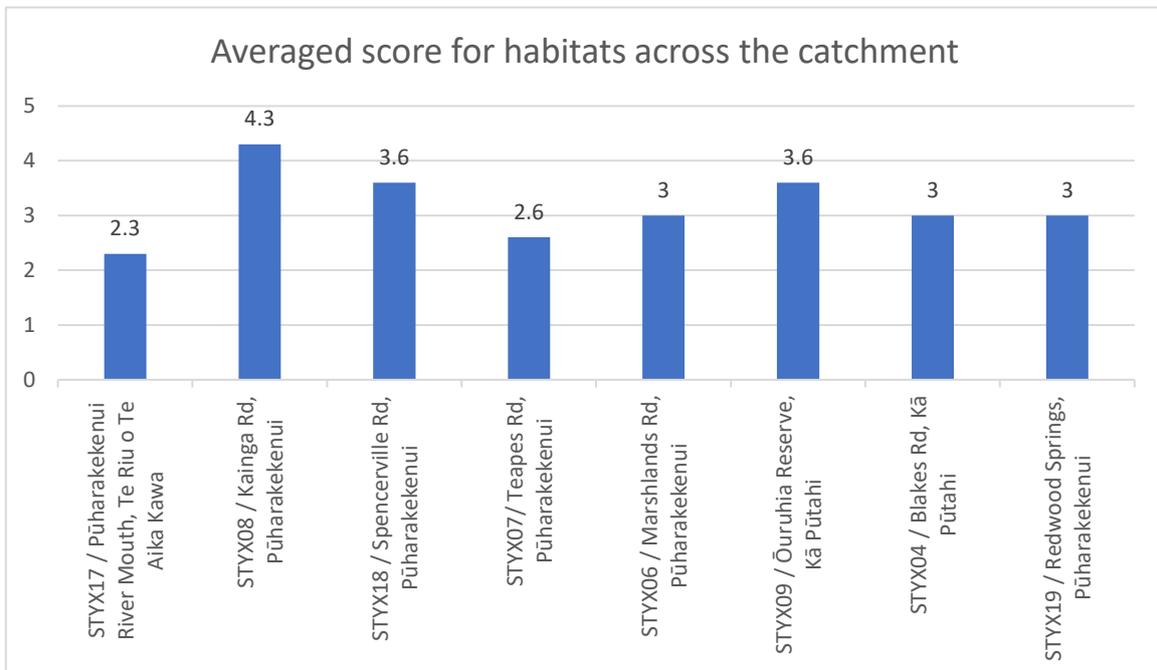
#### 8.1.1 Observation of catchment land use.



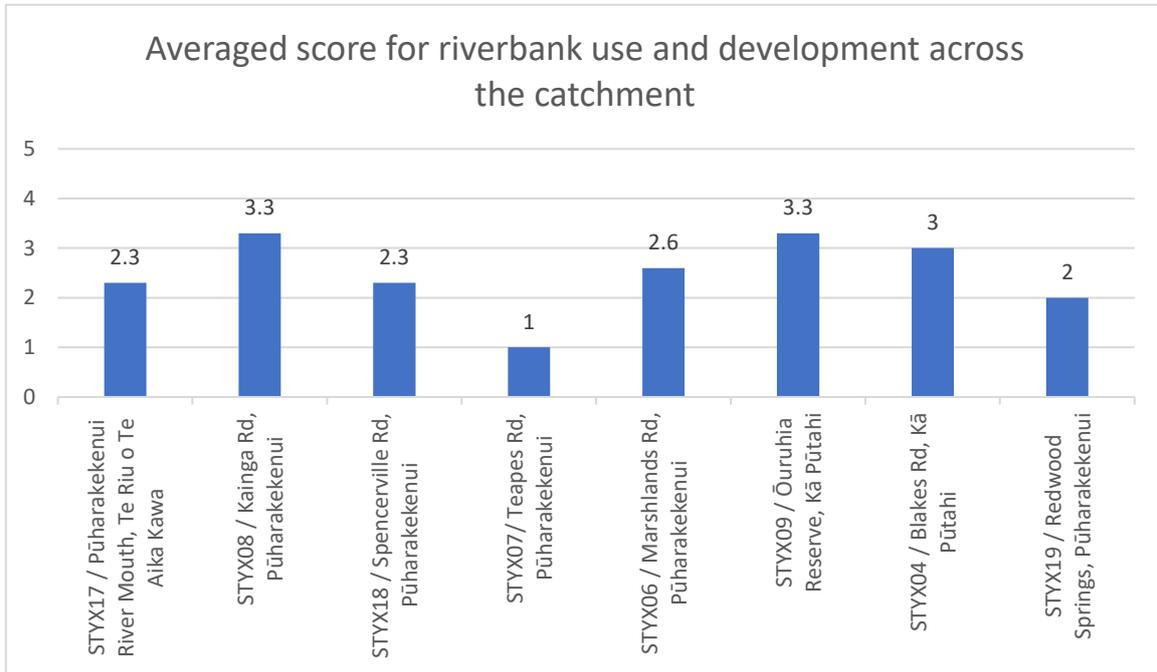
**8.1.2 Are you satisfied that stream riverbank vegetation is healthy and that it is the right vegetation?**



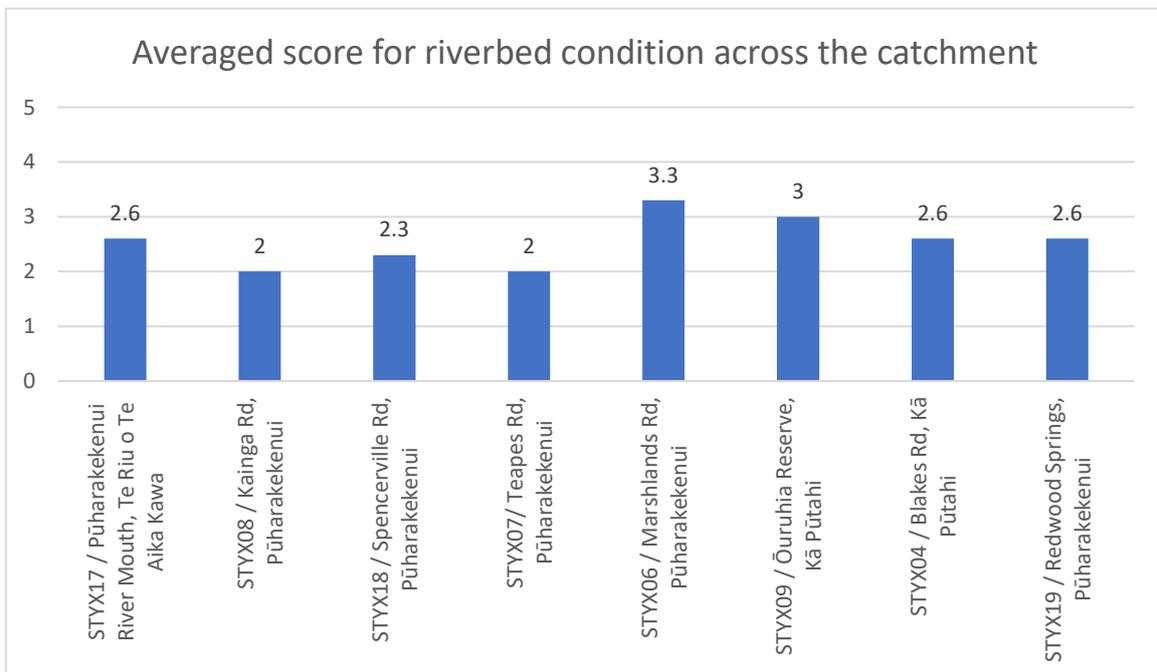
**8.1.3 Are you satisfied that there are a range of habitats instream and along the riverbank?**



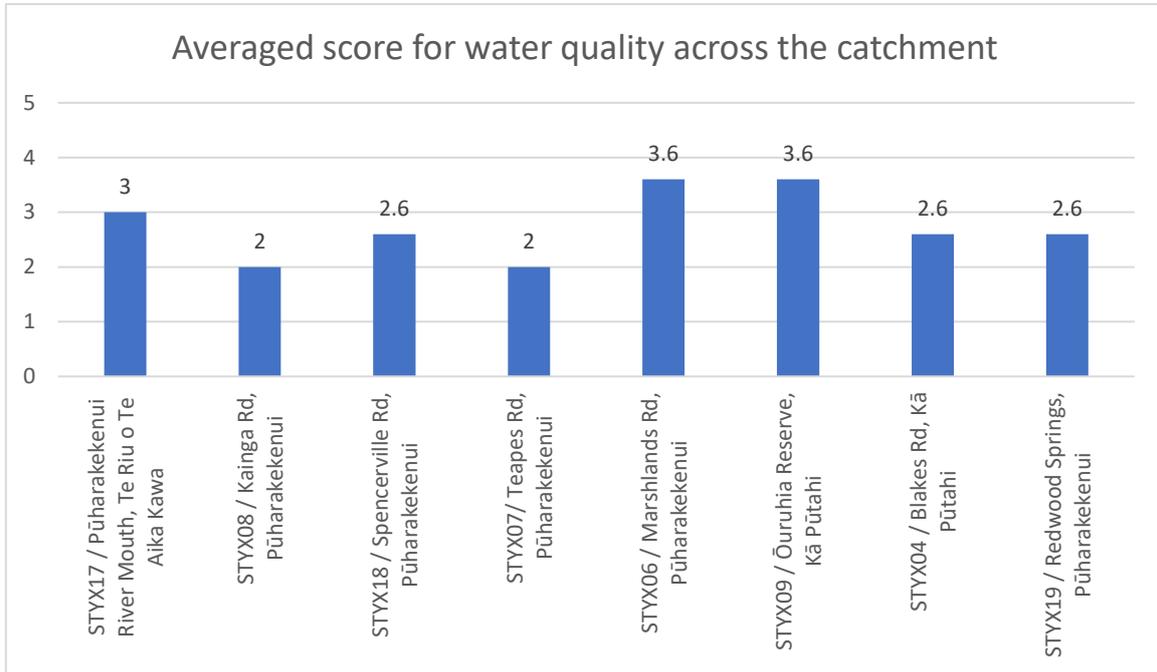
**8.1.4 Are you satisfied that the riverbanks are protected from what you believe is inappropriate use and development?**



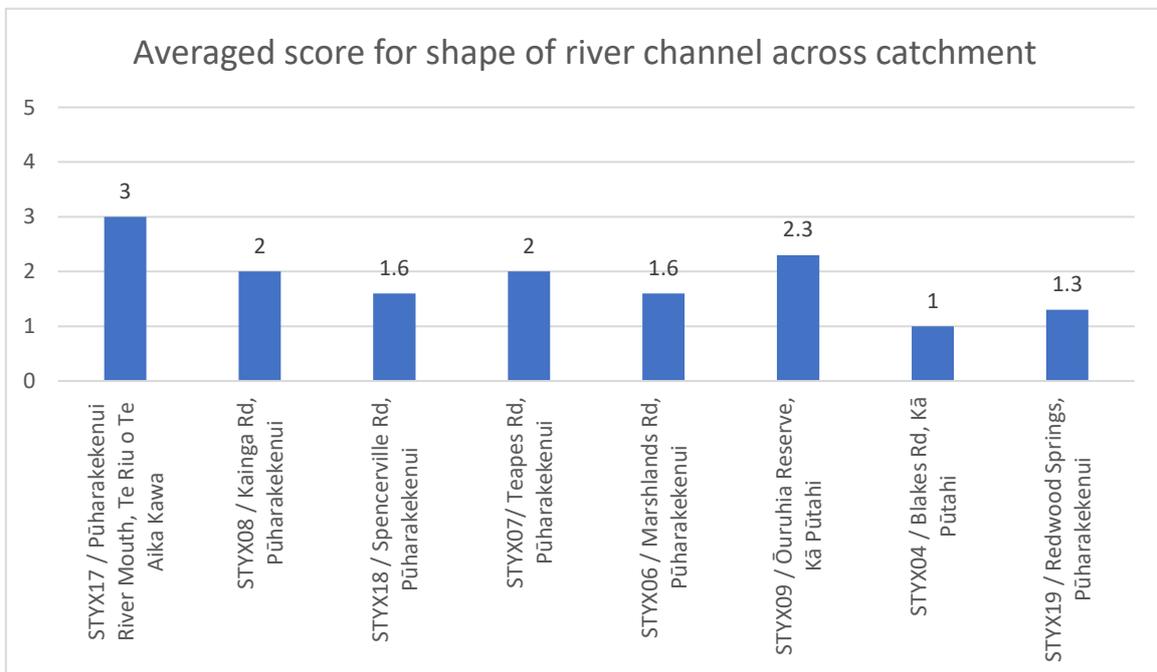
**8.1.5 Are you satisfied that riverbed condition appears healthy?**



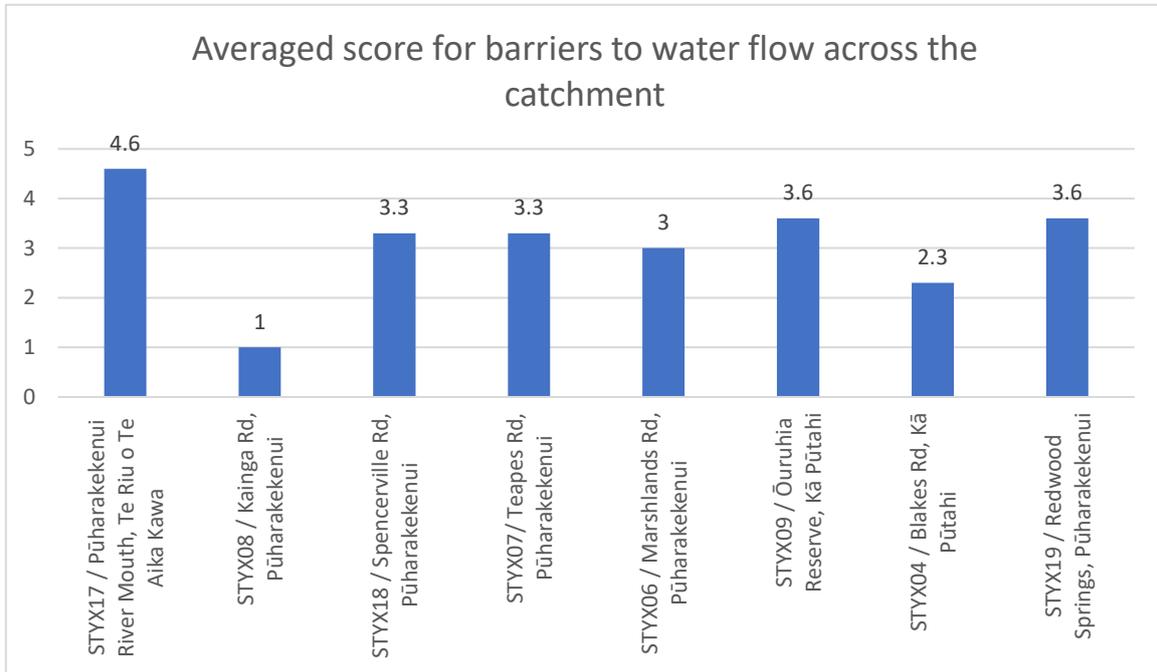
8.1.6 Are you satisfied with water quality?



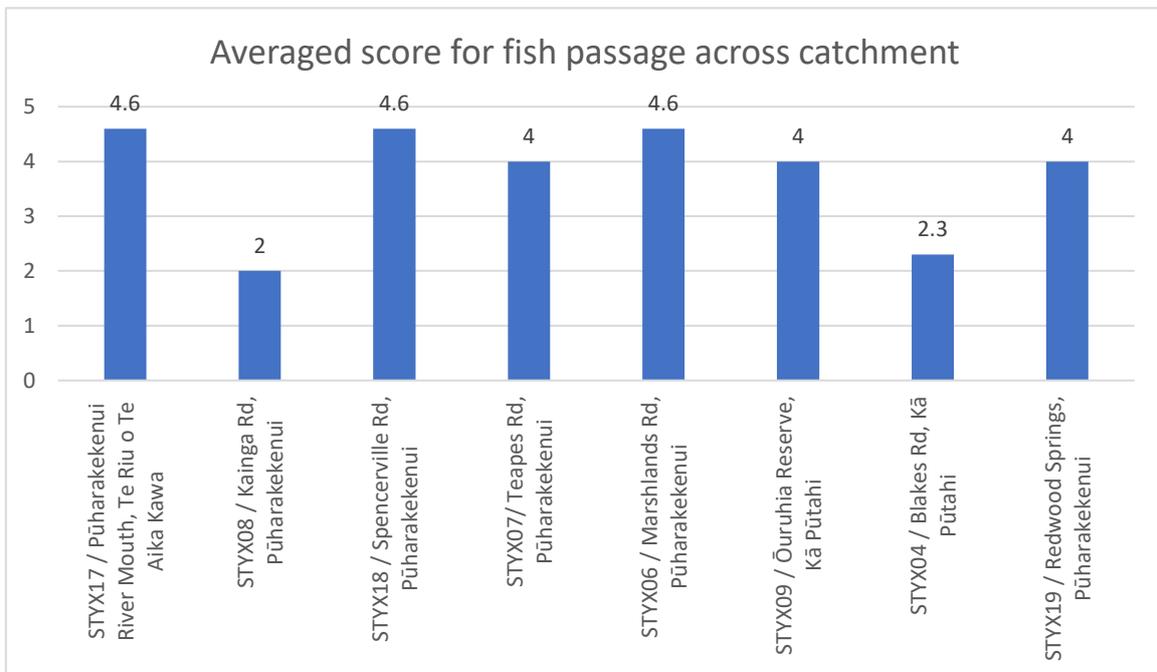
8.1.7 Are you satisfied with the shape of the river channel or has it been changed?



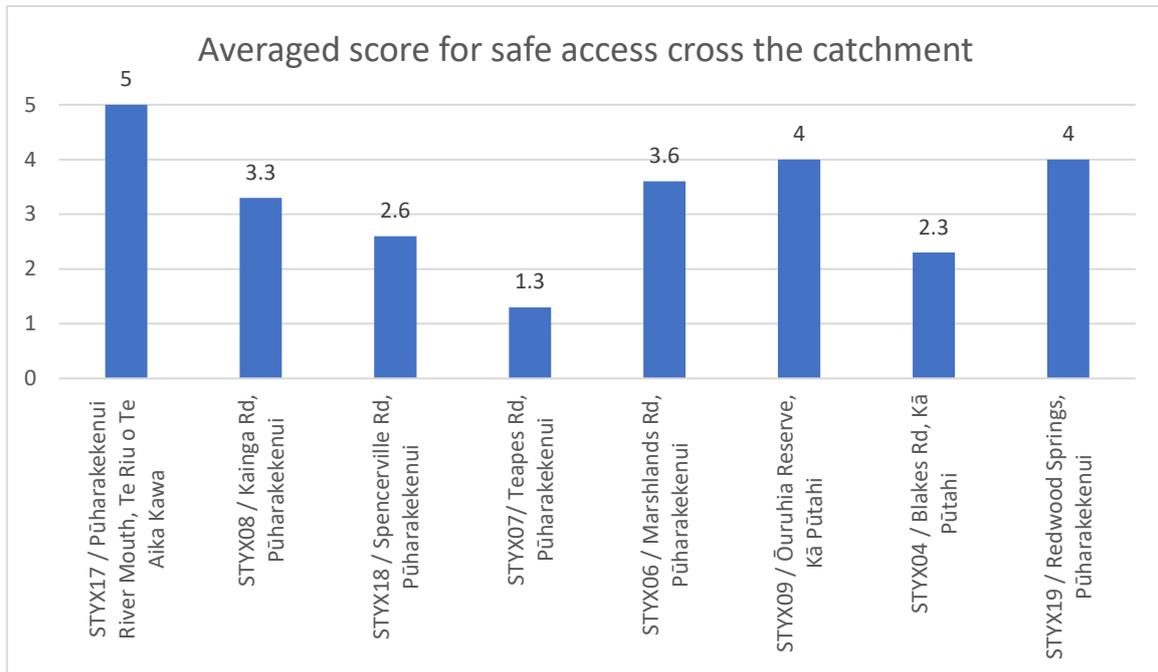
**8.1.8 Are you satisfied that there are no barriers (e.g. dams, culverts etc) to the water flow?**



**8.1.9 Are you satisfied that fish are able to move throughout the catchment?**



### 8.1.10 Are you able to safely access this 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
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Oioi (rush)	Native	Lots
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Harakeke	Native	Some
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tī Kōuka	Native	Some
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Dead willows	Introduced	Lots
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Willow	Introduced	Unrecorded
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Dandelion	Introduced	Unrecorded
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Exotic weeds	Introduced	Unrecorded
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Grasses	Introduced	Lots
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Gorse	Introduced	Some
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pine	Introduced	Some
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Macrocarpa	Introduced	Some
STYX08	Kainga Rd, Pūharakekenui	Tī Kōuka	Native	Some
STYX08	Kainga Rd, Pūharakekenui	Harakeke	Native	Lots
STYX08	Kainga Rd, Pūharakekenui	Raupō	Native	Lots
STYX08	Kainga Rd, Pūharakekenui	Wiwi	Native	Some
STYX08	Kainga Rd, Pūharakekenui	Pūrei	Native	Some
STYX08	Kainga Rd, Pūharakekenui	Kōhūhū	Native	Few
STYX08	Kainga Rd, Pūharakekenui	Beech Tree	Native	Few

<b>STYX08</b>	Kainga Rd, Pūharakekenui	Fern	Native	Unrecorded
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Willow	Introduced	Lots
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Dead willow	Introduced	Unrecorded
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Poplar	Introduced	Some
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Grasses and Weeds	Introduced	Lots
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Thistle	Introduced	Some
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Gorse	Introduced	Some
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Old mans beard	Introduced	Lots
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Silver Birch	Introduced	Unrecorded
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Vine	Introduced	Unrecorded
<b>STYX08</b>	Kainga Rd, Pūharakekenui	Blackberry	Introduced	Unrecorded
<b>STYX08</b>	Kainga Rd, Pūharakekenui	White Poplar	Introduced	Unrecorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Harakeke	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Pōhuehue	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Pūrei	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Ti Kōuka	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Horoeka (lancewood)	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Toetoe	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Tōtara	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Puahou (fivefinger)	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Tawhai (beech tree)	Native	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Willow	Introduced	Not recorded

<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Blackberry	Introduced	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Monkey musk	Introduced	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Gorse	Introduced	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Grasses	Introduced	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Vine	Introduced	Not recorded
<b>STYX18</b>	Spencerville Rd, Pūharakekenui	Dead willow	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Grasses	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Weeds	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Monkey musk	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Thistles	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Willow	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Blackberry	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Dead willow	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Vine	Introduced	Not recorded
<b>STYX07</b>	Teapes Rd, Pūharakekenui	Fennel	Introduced	Not recorded
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Harakeke	Native	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Toetoe	Native	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Tī Kōuka	Native	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Pūrei	Native	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Lancewood	Native	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Kōhūhū	Native	Some
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Pōhuehue	Native	Some

<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Willow	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Poplar	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Bindweeds	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Grasses and Weeds	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Old mans beard	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Celery	Introduced	Lots
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Watercress	Introduced	Some
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Blackberry	Introduced	Not recorded
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Broom	Introduced	Not recorded
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Dock	Introduced	Not recorded
<b>STYX06</b>	Marshlands Rd, Pūharakekenui	Elderberry	Introduced	Not recorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Harakeke	Native	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Pūrei	Native	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Ti Kōuka	Native	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Kōhūhū	Native	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Pōhuehue	Native	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Tōtara	Native	Few
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Toetoe	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Kapuka (broadleaf)	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Mingimingi	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Karamu	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Puahou (fivefinger)	Native	Unrecorded

<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Horoeka (lancewood)	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Tarata (lemonwood)	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Houhere	Native	Unrecorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Willow	Introduced	Lots
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Poplar	Introduced	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Pine	Introduced	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Blackberry	Introduced	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Celery	Introduced	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Watercress	Introduced	Some
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Grasses	Introduced	Not recorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Swamp willow	Introduced	Not recorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Dock	Introduced	Not recorded
<b>STYX09</b>	Ōuruhia Reserve, Kā Pūtahi	Vine	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Pūrei	Native	Few
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Harakeke	Native	Few
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Toetoe	Native	Few
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Ferns	Native	Few
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Tarata (lemonwood)	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Kohuhu	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Mingimingi	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Harakeke	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Kōwhai	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Pōhuehue	Native	Unrecorded

<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Horoeka (lancewood)	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Tī Kōuka	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Makomako (wineberry)	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Kānuka	Native	Unrecorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Pine	Introduced	Lots
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Willow	Introduced	Lots
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Poplar	Introduced	Some
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Blackberry	Introduced	Some
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Watercress	Introduced	Some
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Vine	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Swamp willow	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Bindweed	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Thistles	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Grasses	Introduced	Not recorded
<b>STYX04</b>	Blakes Rd, Kā Pūtahi	Celery	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Tī Kōuka	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Harakeke	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Toetoe	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Pūrei	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Koromiko	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Kōhūhū	Native	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Pōhuehue	Native	Lots

<b>STYX19</b>	Redwood Springs, Pūharakekenui	Fern	Native	Unrecorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Makomako (wineberry)	Native	Unrecorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Willow	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Blackberry	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Poplar	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Thistle	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Old mans beard	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Bindweeds	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Grasses and Weeds	Introduced	Lots
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Vine	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Fennel	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Dock	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Swamp willow	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Oxygen weed	Introduced	Not recorded
<b>STYX19</b>	Redwood Springs, Pūharakekenui	Gorse	Introduced	Not recorded

### 8.2.2 Fish Species

Site Code	Date	Site Name	Fish Species	Native/ Introduced	Method	Abundance
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tunnelling Mud crab	Native	Gee Minow	Lots
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Elver	Native	Gee Minow	1

<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tīpokopoko (Common Bully)	Native	Gee Minow	9
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Redfin Bully	Native	Gee Minow	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Shortfin Tuna	Native	Hīnaki	2
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pātiki	Native	Hīnaki	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Rainbow Trout	Introduced	Hīnaki	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Kanae (Grey Mullet)	Native	Hīnaki	2
<b>STYX08</b>	April 2023	Kainga Rd, Pūharakekenui	Pātiki	Native	Observation	1
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Shortfin Tuna	Native	Hīnaki	2
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Longfin Tuna	Native	Hīnaki	1
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Tīpokopoko (Common Bully)	Native	Gee Minow	3
<b>STYX09</b>	April 2023	Ōuruhia Reserve, Kā Pūtahi	Shortfin Tuna	Native	Hīnaki	1
<b>STYX09</b>	April 2023	Ōuruhia Reserve, Kā Pūtahi	Tīpokopoko (Common Bully)	Native	Gee Minow	1
<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Shortfin Tuna	Native	Hīnaki	1

<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Tīpokopoko (Common Bully)	Native	Gee Minow	5
<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Īnanga	Native	Gee Minow	1
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Longfin Tuna	Native	Hīnaki	3
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Tīpokopoko (Common Bully)	Native	Gee Minow	2
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Upland Bully	Native	Gee Minow	1

<b>Site Code</b>	<b>Date</b>	<b>Site Name</b>	<b>Fish Species</b>	<b>Native/ Introduced</b>	<b>Method</b>	<b>Abundance</b>
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tunnelling Mud crab	Native	Gee Minow	Lots
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Elver	Native	Gee Minow	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tīpokopoko (Common Bully)	Native	Gee Minow	9
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Redfin Bully	Native	Gee Minow	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Shortfin Tuna	Native	Hīnaki	2
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pātiki	Native	Hīnaki	1

<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Rainbow Trout	Introduced	Hīnaki	1
<b>STYX17</b>	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Kanae (Grey Mullet)	Native	Hīnaki	2
<b>STYX08</b>	April 2023	Kainga Rd, Pūharakekenui	Pātiki	Native	Observation	1
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Shortfin Tuna	Native	Hīnaki	2
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Longfin Tuna	Native	Hīnaki	1
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Tīpokopoko (Common Bully)	Native	Gee Minow	3
<b>STYX09</b>	April 2023	Ōuruhia Reserve, Kā Pūtahi	Shortfin Tuna	Native	Hīnaki	1
<b>STYX09</b>	April 2023	Ōuruhia Reserve, Kā Pūtahi	Tīpokopoko (Common Bully)	Native	Gee Minow	1
<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Shortfin Tuna	Native	Hīnaki	1
<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Tīpokopoko (Common Bully)	Native	Gee Minow	5
<b>STYX04</b>	April 2023	Blakes Rd, Kā Pūtahi	Īnanga	Native	Gee Minow	1
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Longfin Tuna	Native	Hīnaki	3
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Tīpokopoko (Common Bully)	Native	Gee Minow	2
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Upland Bully	Native	Gee Minow	1

Site Code	Site Name	Fish Species	Size Range
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Shortfin Tuna	320 – 660mm
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pātiki	320mm
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Rainbow Trout	500mm
STYX17	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Kanae (Grey Mullet)	190mm
STYX06	Marshlands Rd, Pūharakekenui	Shortfin Tuna	590 - 630mm
STYX06	Marshlands Rd, Pūharakekenui	Longfin Tuna	560mm
STYX09	Ōuruhia Reserve, Kā Pūtahi	Shortfin Tuna	550mm
STYX04	Blakes Rd, Kā Pūtahi	Shortfin Tuna	500mm
STYX19	Redwood Springs, Pūharakekenui	Longfin Tuna	900 - 990mm

### 8.2.3 Bird Species

Site Code	Date	Site Name	Bird Species
STYX17	March/April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Unidentified Seagulls
STYX17	March 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Unidentified Ducks
STYX17	March 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Tōrea (oystercatcher)
STYX17	March/April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pūtangitangi
STYX17	March 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Unidentified Goose
STYX17	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Shag
STYX17	April 2023	Pūharakekenui River Mouth, Te Riu o Te Aika Kawa	Pūkeko
STYX08	March/April 2023	Kainga Rd, Pūharakekenui	Swallow
STYX08	March/April 2023	Kainga Rd, Pūharakekenui	Pūkeko
STYX08	March 2023	Kainga Rd, Pūharakekenui	Blackbird

<b>STYX08</b>	March/April 2023	Kainga Rd, Pūharakekenui	Shag
<b>STYX08</b>	March/April 2023	Kainga Rd, Pūharakekenui	Unidentified Ducks
<b>STYX08</b>	April 2023	Kainga Rd, Pūharakekenui	Kakīānau (black swan)
<b>STYX18</b>	March 2023	Spencerville Rd, Pūharakekenui	Sparrow
<b>STYX18</b>	March 2023	Spencerville Rd, Pūharakekenui	Pūkeko
<b>STYX18</b>	March 2023	Spencerville Rd, Pūharakekenui	Swallow
<b>STYX07</b>	March 2023	Teapes Rd, Pūharakekenui	Pūkeko
<b>STYX07</b>	March 2023	Teapes Rd, Pūharakekenui	Shag
<b>STYX07</b>	March 2023	Teapes Rd, Pūharakekenui	Manu pango (blackbird)
<b>STYX06</b>	March/April 2023	Marshlands Rd, Pūharakekenui	Pīwaiwaka
<b>STYX06</b>	March/April 2023	Marshlands Rd, Pūharakekenui	Pūkeko
<b>STYX06</b>	March 2023	Marshlands Rd, Pūharakekenui	Manu pango (blackbird)
<b>STYX06</b>	March 2023	Marshlands Rd, Pūharakekenui	Unidentified Goose
<b>STYX06</b>	April 2023	Marshlands Rd, Pūharakekenui	Kakīānau (black swan)
<b>STYX09</b>	March 2023	Ōuruhia Reserve, Kā Pūtahi	Pūkeko
<b>STYX09</b>	March 2023	Ōuruhia Reserve, Kā Pūtahi	Pūtangitangi
<b>STYX09</b>	March/April 2023	Ōuruhia Reserve, Kā Pūtahi	Unidentified Ducks
<b>STYX09</b>	March/April 2023	Ōuruhia Reserve, Kā Pūtahi	Pīwaiwaka
<b>STYX09</b>	March 2023	Ōuruhia Reserve, Kā Pūtahi	Sparrow
<b>STYX04</b>	March 2023	Blakes Rd, Kā Pūtahi	Pūkeko
<b>STYX04</b>	March 2023	Blakes Rd, Kā Pūtahi	Swallow
<b>STYX19</b>	March/April 2023	Redwood Springs, Pūharakekenui	Unidentified Ducks

<b>STYX19</b>	March/April 2023	Redwood Springs, Pūharakekenui	Pūkeko
<b>STYX19</b>	March 2023	Redwood Springs, Pūharakekenui	Swallow
<b>STYX19</b>	March 2023	Redwood Springs, Pūharakekenui	Manu pango (blackbird)
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Unidentified Geese
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Pūtangitangi
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Pīwaiwaka
<b>STYX19</b>	April 2023	Redwood Springs, Pūharakekenui	Kakīānau (black swan)

### **8.3 Appendix C: Water Quality testing results**

See following pages for result tables from water sample analysis as provided by Hills Laboratory.



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<b>Client:</b> Mahaanui Kurataiao Limited	<b>Lab No:</b> 3246204	DWAPV1
<b>Contact:</b> Fraser Doake C/- Mahaanui Kurataiao Limited 226 Antigua Street Christchurch Central Christchurch 8011	<b>Date Received:</b> 18-Apr-2023 <b>Date Reported:</b> 26-Apr-2023 <b>Quote No:</b> <b>Order No:</b> <b>Client Reference:</b> <b>Submitted By:</b> Fraser Doake	

Sample Type: Aqueous				
Sample Name:	Kainga Road 18-Apr-2023 10:00 am		Aesthetic Values	Maximum Acceptable Values (MAV)
Lab Number:	3246204.1			
Routine Water + E.coli profile kit				
Escherichia coli	MPN / 100mL	193	-	< 1
Routine Water Profile				
Turbidity	NTU	1.84	≤ 5	-
pH	pH Units	7.5	7.0 - 8.5	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	57	-	-
Free Carbon Dioxide	g/m <sup>3</sup> at 25°C	3.9	-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	64	≤ 200	-
Electrical Conductivity (EC)	mS/m	24.6	-	-
Electrical Conductivity (EC)	µS/cm	246	-	-
Approx Total Dissolved Salts	g/m <sup>3</sup>	165	≤ 1000	-
Total Arsenic	g/m <sup>3</sup>	0.0017	-	0.01
Total Boron	g/m <sup>3</sup>	0.036	-	2.4
Total Calcium	g/m <sup>3</sup>	17.2	-	-
Total Copper	g/m <sup>3</sup>	< 0.00053	≤ 1	2
Total Iron	g/m <sup>3</sup>	0.57	≤ 0.3	-
Total Lead	g/m <sup>3</sup>	0.00025	-	0.01
Total Magnesium	g/m <sup>3</sup>	5.1	-	-
Total Manganese	g/m <sup>3</sup>	0.055	≤ 0.04 (Staining) ≤ 0.10 (Taste)	0.4
Total Potassium	g/m <sup>3</sup>	2.5	-	-
Total Sodium	g/m <sup>3</sup>	22	≤ 200	-
Total Zinc	g/m <sup>3</sup>	0.0054	≤ 1.5	-
Chloride	g/m <sup>3</sup>	32	≤ 250	-
Nitrate-N	g/m <sup>3</sup>	0.35	-	11.3
Sulphate	g/m <sup>3</sup>	8.9	≤ 250	-

Note: The Maximum Acceptable Values (MAV) are taken from the Water Services (Drinking Water Standards for New Zealand) Regulations 2022, published under the authority of the New Zealand Government-2022. Copies of this publication are available from: <https://www.legislation.govt.nz/regulation/public/2022/0168/latest/whole.html>

The standards set limits for the concentration of determinands in drinking water. The Maximum Acceptable Values (MAVs) for any determinand must not be exceeded at any time.

The Aesthetic Values are taken the publication, 'Aesthetic Values for Drinking Water Notice 2022' issued by the Water Services Regulator ('Taumata Arowai'). Aesthetic values specify or provide minimum or maximum values for substances and other characteristics that relate to the acceptability of drinking water to consumers (such as appearance, taste or odour).

Note that the units: g/m<sup>3</sup> are the same as mg/L and ppm.



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<b>Client:</b> Mahaanui Kurataiao Limited	<b>Lab No:</b> 3246203	DWAPv1
<b>Contact:</b> Fraser Doake C/- Mahaanui Kurataiao Limited 226 Antigua Street Christchurch Central Christchurch 8011	<b>Date Received:</b> 18-Apr-2023 <b>Date Reported:</b> 26-Apr-2023 <b>Quote No:</b> <b>Order No:</b> <b>Client Reference:</b>	
	<b>Submitted By:</b> Fraser Doake	

Sample Type: Aqueous			
Sample Name:	Marshlands Rd 18-Apr-2023 11:30 am		
Lab Number:	3246203.1		
Routine Water + E.coli profile Kit			
Escherichia coli	MPN / 100mL	365	< 1
Routine Water Profile			
Turbidity	NTU	0.70	≤ 5
pH	pH Units	7.6	7.0 - 8.5
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	50	-
Free Carbon Dioxide	g/m <sup>3</sup> at 25°C	2.5	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	49	≤ 200
Electrical Conductivity (EC)	mS/m	13.5	-
Electrical Conductivity (EC)	µS/cm	135	-
Approx Total Dissolved Salts	g/m <sup>3</sup>	91	≤ 1000
Total Arsenic	g/m <sup>3</sup>	< 0.0011	0.01
Total Boron	g/m <sup>3</sup>	0.028	2.4
Total Calcium	g/m <sup>3</sup>	15.7	-
Total Copper	g/m <sup>3</sup>	0.00055	≤ 1
Total Iron	g/m <sup>3</sup>	0.180	≤ 0.3
Total Lead	g/m <sup>3</sup>	0.00021	0.01
Total Magnesium	g/m <sup>3</sup>	2.5	-
Total Manganese	g/m <sup>3</sup>	0.0145	≤ 0.04 (Staining) ≤ 0.10 (Taste)
Total Potassium	g/m <sup>3</sup>	1.30	-
Total Sodium	g/m <sup>3</sup>	7.1	≤ 200
Total Zinc	g/m <sup>3</sup>	0.0025	≤ 1.5
Chloride	g/m <sup>3</sup>	6.3	≤ 250
Nitrate-N	g/m <sup>3</sup>	0.64	11.3
Sulphate	g/m <sup>3</sup>	5.1	≤ 250

Note: The Maximum Acceptable Values (MAV) are taken from the Water Services (Drinking Water Standards for New Zealand) Regulations 2022, published under the authority of the New Zealand Government-2022. Copies of this publication are available from: <https://www.legislation.govt.nz/regulation/public/2022/0168/latest/whole.html>

The standards set limits for the concentration of determinands in drinking water. The Maximum Acceptable Values (MAVs) for any determinand must not be exceeded at any time.

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<b>Client:</b>	Mahaanui Kurataiao Limited	<b>Lab No:</b>	3248602	DWAPv1
<b>Contact:</b>	Fraser Doake C/- Mahaanui Kurataiao Limited 226 Antigua Street Christchurch Central Christchurch 8011	<b>Date Received:</b>	19-Apr-2023	
		<b>Date Reported:</b>	28-Apr-2023	
		<b>Quote No:</b>		
		<b>Order No:</b>		
		<b>Client Reference:</b>		
		<b>Submitted By:</b>	Fraser Doake	

Sample Type: Aqueous					
Sample Name:		Onuhia 19-Apr-2023 11:35 am		Aesthetic Values	Maximum Acceptable Values (MAV)
Lab Number:		3248602.1			
Routine Water + E.coli profile Kit					
Escherichia coli	MPN / 100mL	1,414		-	< 1
Routine Water Profile					
Turbidity	NTU	1.96		≤ 5	-
pH	pH Units	7.5		7.0 - 8.5	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	52		-	-
Free Carbon Dioxide	g/m <sup>3</sup> at 25°C	3.2		-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	47		≤ 200	-
Electrical Conductivity (EC)	mS/m	14.9		-	-
Electrical Conductivity (EC)	µS/cm	149		-	-
Approx Total Dissolved Salts	g/m <sup>3</sup>	100		≤ 1000	-
Total Arsenic	g/m <sup>3</sup>	0.0016		-	0.01
Total Boron	g/m <sup>3</sup>	0.044		-	2.4
Total Calcium	g/m <sup>3</sup>	14.2		-	-
Total Copper	g/m <sup>3</sup>	< 0.00053		≤ 1	2
Total Iron	g/m <sup>3</sup>	0.39		≤ 0.3	-
Total Lead	g/m <sup>3</sup>	0.00048		-	0.01
Total Magnesium	g/m <sup>3</sup>	2.9		-	-
Total Manganese	g/m <sup>3</sup>	0.099		≤ 0.04 (Staining) ≤ 0.10 (Taste)	0.4
Total Potassium	g/m <sup>3</sup>	2.5		-	-
Total Sodium	g/m <sup>3</sup>	9.9		≤ 200	-
Total Zinc	g/m <sup>3</sup>	0.0077		≤ 1.5	-
Chloride	g/m <sup>3</sup>	10.1		≤ 250	-
Nitrate-N	g/m <sup>3</sup>	0.72		-	11.3
Sulphate	g/m <sup>3</sup>	3.3		≤ 250	-

Note: The Maximum Acceptable Values (MAV) are taken from the 'Water Services (Drinking Water Standards for New Zealand) Regulations 2022', published under the authority of the New Zealand Government-2022. Copies of this publication are available from: <https://www.legislation.govt.nz/regulation/public/2022/0168/latest/whole.html>

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<b>Client:</b>	Mahaanui Kurataiao Limited	<b>Lab No:</b>	3248601	DWAPv1
<b>Contact:</b>	Fraser Doake C/- Mahaanui Kurataiao Limited 226 Antigua Street Christchurch Central Christchurch 8011	<b>Date Received:</b>	19-Apr-2023	
		<b>Date Reported:</b>	28-Apr-2023	
		<b>Quote No:</b>		
		<b>Order No:</b>		
		<b>Client Reference:</b>		
		<b>Submitted By:</b>	Fraser Doake	

Sample Type: Aqueous					
Sample Name:		Redwood Springs 19-Apr-2023 9:40 am		Aesthetic Values	Maximum Acceptable Values (MAV)
Lab Number:		3248601.1			
Routine Water + E.coli profile Kit					
Escherichia coli	MPN / 100mL	816		-	< 1
Routine Water Profile					
Turbidity	NTU	1.30		≤ 5	-
pH	pH Units	7.6		7.0 - 8.5	-
Total Alkalinity	g/m <sup>3</sup> as CaCO <sub>3</sub>	52		-	-
Free Carbon Dioxide	g/m <sup>3</sup> at 25°C	2.9		-	-
Total Hardness	g/m <sup>3</sup> as CaCO <sub>3</sub>	53		≤ 200	-
Electrical Conductivity (EC)	mS/m	14.2		-	-
Electrical Conductivity (EC)	µS/cm	142		-	-
Approx Total Dissolved Salts	g/m <sup>3</sup>	95		≤ 1000	-
Total Arsenic	g/m <sup>3</sup>	0.0011		-	0.01
Total Boron	g/m <sup>3</sup>	0.037		-	2.4
Total Calcium	g/m <sup>3</sup>	17.0		-	-
Total Copper	g/m <sup>3</sup>	< 0.00053		≤ 1	2
Total Iron	g/m <sup>3</sup>	0.22		≤ 0.3	-
Total Lead	g/m <sup>3</sup>	0.00017		-	0.01
Total Magnesium	g/m <sup>3</sup>	2.7		-	-
Total Manganese	g/m <sup>3</sup>	0.039		≤ 0.04 (Staining) ≤ 0.10 (Taste)	0.4
Total Potassium	g/m <sup>3</sup>	1.73		-	-
Total Sodium	g/m <sup>3</sup>	6.8		≤ 200	-
Total Zinc	g/m <sup>3</sup>	0.0137		≤ 1.5	-
Chloride	g/m <sup>3</sup>	6.7		≤ 250	-
Nitrate-N	g/m <sup>3</sup>	0.34		-	11.3
Sulphate	g/m <sup>3</sup>	6.3		≤ 250	-

Note: The Maximum Acceptable Values (MAV) are taken from the Water Services (Drinking Water Standards for New Zealand) Regulations 2022, published under the authority of the New Zealand Government-2022. Copies of this publication are available from: <https://www.legislation.govt.nz/regulation/public/2022/0168/latest/whole.html>

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