Mahaanui Kurataiao Ltd

Ōtūkaikino Monitoring Report

January 2023

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Introduction

This report details monitoring undertaken to assess mana whenua values in the Ōtūkaikino catchment as required under the conditions of the Comprehensive Stormwater Network Discharge Consent (CSNDC; CRC214226) held by Christchurch City Council.

The Ōtūkaikino River, and catchment, is located to the northwest of the city and is bounded by the Waimakariri River in the north and Johns Road in the south (Figure 1). This waterway follows the original riverbed of the Waimakariri South Branch, which was the main stem of the Waimakariri River until a series of stop banks and groynes were created during flood protection works at McLeans Island. This severed the connectivity and the Ōtūkaikino branch of the Waimakariri River became the lowland spring fed waterway it is today.

Prior to these flood protection works, the South Branch of the Waimakariri River was highly significant to mana whenua, and was associated with many mahinga kai sites, urupā, kāinga and kāinga nohoanga (Tau, Goodall, Palmer, & Tau, 1990). The name Ōtūkaikino also refers to a protected wetland reserve to the east of the waterway, which has been designated by mana whenua as a traditional Wai Whakaheketūpāpaku (water burial site). These connections reiterate the significance of the Ōtūkaikino catchment to mana whenua, both historically and in the present day, and therefore the importance of the ecological health of this catchment.

Current state of the Ōtūkaikino waterway

The current Ōtūkaikino waterway covers 16 km in length, with the headwater springs located in the Issacs Conservation and Wildlife Trust site and on rural land in McLeans Island. While some riparian planting of natives has occurred in these upper reaches, much of the riparian margins are dominated by willow, and few of the springs have been planted. In the mid-reaches, between the Scout Camp and Clearwater Resort, significant riparian restoration works have been undertaken with many of these plantings well established. This section is dominated by willows, but it also includes some pockets of regenerating wetland habitat. Willow clearance and control works have been undertaken by Environment Canterbury along this section (underway at the time of project monitoring). The Groynes reserve area consists of multiple ponds, restoration plantings and is a popular recreation area. Plantings along the stream in this area are dominated by willows and other exotic species. The downstream reach of the Ōtūkaikino River consists of the Groynes reserve to the Waimakariri River. This section of the waterway has had extensive ecological restoration plantings and willow removal works are ongoing. Due to the May 2021 floods, extensive sedimentation has occurred in the lower reaches of the stream where it meets the Waimakariri River. The Ōtūkaikino wetland is located between State Highway 74 and Main North Road and is a remnant of the original wetlands that would have covered the Ōtūkaikino catchment. It is managed as a Living Memorial in conjunction with mana whenua, the Department of Conservation and Lamb and Hayward.

Mana whenua monitoring

Through the CSNDC, Christchurch City Council is required to develop and implement a program to monitor for mana whenua values. The purpose of this monitoring is to:

1. Measure mana whenua values, which in part can be affected by stormwater discharges,
2. Determine compliance with the conditions of the consent,
3. Inform stormwater mitigation, and
4. Inform management of waterway health.

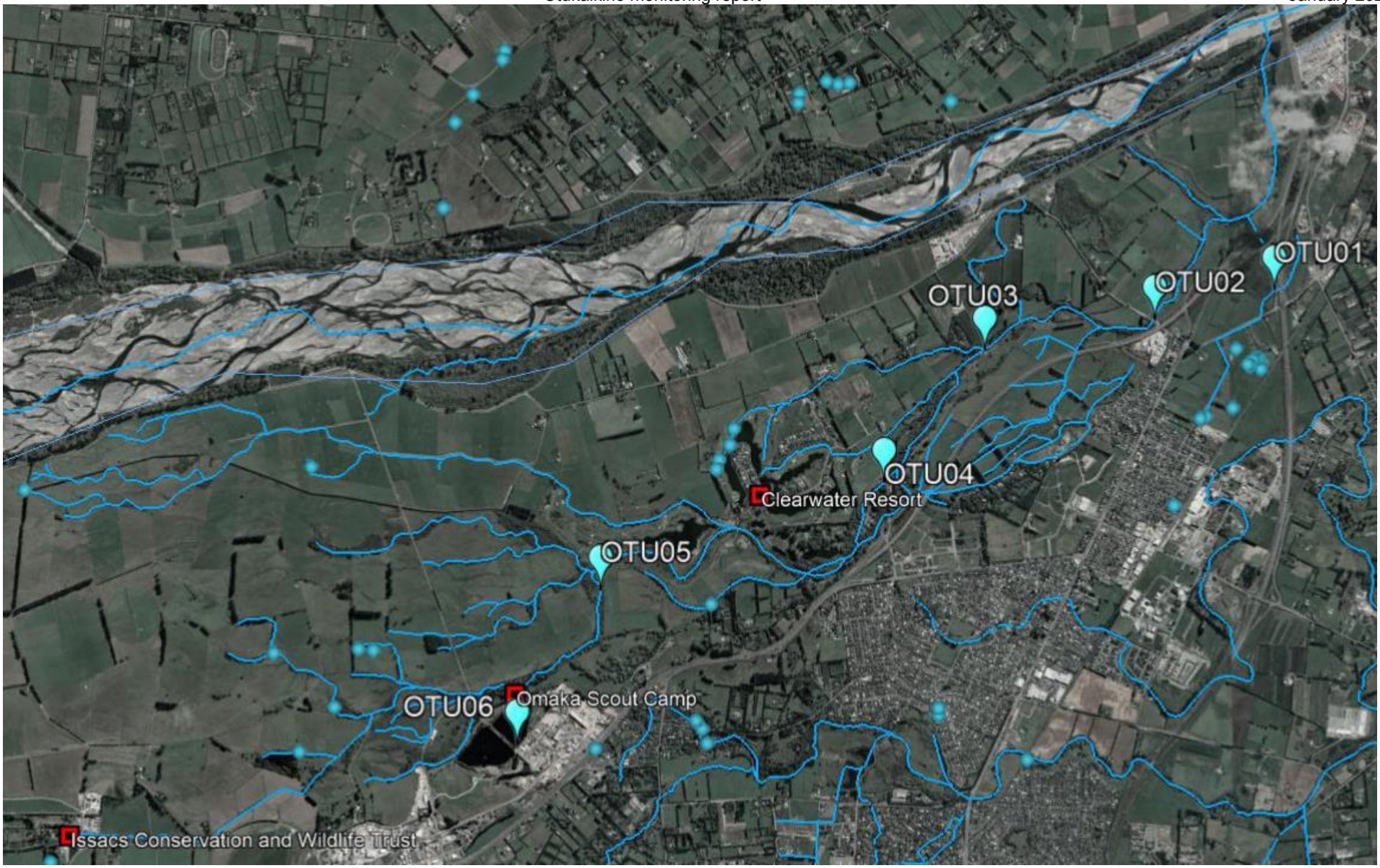

Figure 1: Ōtūkaikino catchment and sites monitored (blue pins).

Methodology

A total of six sites were selected (Table 1 and Table 2) for monitoring based on the principles of Ki uta, Ki tai/mountains to sea to ensure that the methods used capture the whole catchment, from the springs to the Waimakariri River. The sites were selected based on traditional significance, accessibility, ecological value, and exposure to a variety of land use issues. Monitoring was conducted over a three day period between 26th-29th April 2022, with tau kōura being placed one month prior.

Table 1. Monitoring sites for Ōtūkaikino catchment 2022.

No.	Site Name	Significance	Land Use
OTU01	Ōtūkaikino wetland	Wāhi tapu site, remnant wetland	Reserve
OTU02	Dickeys road bridge	Downstream site	Rural/Reserve
OTU03	Ōtūkaikino downstream of dog park	Kōura previously found at this site	Rural/reserve
OTU04	Groynes picnic area 2a	Downstream of groynes weir	Reserve/Park
OTU05	Ōtūkaikino @ Issacs Conservation Reserve waterway	Confluence of streams downstream of the Isaac conservation park. Significant riparian planting has been undertaken here	Reserve
OTU06	Lake Rua	Contemporary recreation site, fed by Waimakariri spring system	Reserve

Table 2. Monitoring sites covered in this report alongside the comparable site code from the Christchurch City Council (CCC) Environmental Monitoring Programme (EMP).

Mana whenua values monitoring site code	CCC EMP monitoring site code	Location	Coordinates
OTU01	OTUKAI12	Wilsons Drain at Ōtūkaikino wetland	NZMG: Easting 2481289 Northing 5752533
OTU02	OTUKAI13	Ōtūkaikino River Downstream of Dickeys Road	NZMG: Easting 2480445 Northing 5752383
OTU03	OTUKAI14	Ōtūkaikino River downstream of Groynes Dog Park	NZMG: Easting 2479190 Northing 5752161
OTU04	OTUKAI15	Ōtūkaikino River at Groynes Picnic Area 2a	NZMG: Easting 2478376 Northing 5751111
OTU05	OTUKAI16	Ōtūkaikino River at Isaacs Conservation Park Walkway	NZMG: Easting 2476275 Northing 5750499
OTU06	Mana whenua values monitoring only.	Lake Rua	NZMG: Easting 2475725 Northing 5749420

These sites were assessed utilising the State of the Takiwā, Cultural Health Index (CHI), water quality sampling, and fishing surveys (where appropriate). The State of the Takiwā monitoring system was developed by Ngāi Tahu to facilitate mana whenua to gather, store, analyse and report on information relevant to the cultural health of waterways and catchment in their takiwā. It is built on a Ki uta, Ki tai framework for natural resource management. It is suitable for a wider range of sites than other methodologies, including non-wadable sites and

larger waterbodies. This assessment also considers the surrounding land uses, terrestrial ecological values, cultural importance, and historical use patterns and therefore provides a complete overview of catchment health.

State of Takiwā and Cultural Health assessment

The Cultural Health Index 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. It 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 = very poor, 5 = very good) for eight individual indicators: water quality, water clarity, flow and habitat variety, catchment land use, riparian vegetation cover, riverbed condition/sediment, use of the riparian margin (pressures), and degree of channel modification. These scores are then combined and provide the cultural stream health measure. This combined score was found to correlate strongly to the presence and diversity of pollution sensitive benthic macroinvertebrates (Tipa & Teirney, 2003).

State of the Takiwā is a monitoring methodology developed by Ngāi Tahu as a response to the State of Environment monitoring (Mattingley & Pauling, 2005). It combines Mātauranga Māori and western science practises to give a holistic view of catchment health. Mātauranga Māori is captured through a series of indicators which are then captured through five components: a site definition form, a site visit form, a site assessment form, a cultural stream assessment, and a stream health monitoring and assessment kit (SHMAK) form.

The site definition form describes the type of site, significance to mana whenua, and traditional abundance of taonga species, therefore providing a mātauranga based baseline from which the monitoring data can be assessed. 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 (i.e., seasonal patterns, wet weather events, maramataka/lunar cycles). The main part of the State of Takiwā assessment is the site assessment forms. This section identifies and scores site pressures, the degree of modification, the suitability and access restrictions for mahinga kai practices, as well as identifying the presence and abundance of taonga plant, bird, and fish species. The cultural stream assessment component follows the methodology set out by Tipa & Nelson (2003) as discussed above and complements the site assessment form.

The final component of the State of the Takiwā assessment is based on part of the SHMAK methodology developed by NIWA (Biggs, Kilroy, & Mulcock, 1998) to allow iwi, landowners, and community groups to assess stream health. This consists of five stones being collected from near the stream edge at each site and then the macroinvertebrate communities assessed visually. Periphyton cover was also assessed using the SHMAK methodology and the same five stones. This gives a brief overview of the instream health and habitat conditions.

Water quality testing

Water samples were collected and sent to Christchurch City Council laboratories to analyse dissolved metals, nitrogen, phosphate, and *E. Coli*. The dissolved metals analysed were limited to common stormwater contaminants (zinc, copper, and lead) as these are the stormwater contaminants of concern in this catchment.

Indigenous vegetation and bird surveys

A survey was conducted at each site whereby vegetation within a 100 m radius of each site was identified and recorded, and percentage of cover was estimated to the nearest 5%. An emphasis was placed on mahinga kai and rongoā indigenous species. Birds observed on the day were also recorded and records of recent bird surveys were investigated to supplement these observations.

Fish survey

Fish surveys were conducted at four sites using four different techniques (Table 3). Hīnaki/fyke nets and gee minnow traps were used at most sites due to stream width and depth (Figure 2). Two hīnaki/fyke nets and two gee minnow traps were placed at each of these sites on opposite banks and were left overnight. The hīnaki/fyke nets were baited with cat food and the gee minnows baited with marmite.

Table 3. Fishing methods utilised at each site.

Electric Fishing	Hīnaki/fyke net + Gee Minnow	Tau kōura
OTU05	OTU02 OTU03 OTU04	OTU01 OTU02 OTU03 OTU04 OTU05

Figure 2: Hīnaki/fyke net in situ at OTU04. The leader was staked upstream in low flow conditions and downstream in high flow conditions.

Only one site was suitable for electric fishing (OTU05) due to the depth, width and flow of the sites selected. The Kainga EFM300 was used in conjunction with a handheld scoop net and larger push net (NIWA, 2022). Surveying was conducted along a 30 m reach with one pass over each side of the stream. Fish were identified immediately and then released downstream at the cessation of fishing. Fish seen, but not caught were recorded as unidentified where required (e.g. unidentified bully, unidentified elver).

Tau kōura were also placed at five sites. These are traditional fishing traps made from aruhe/bracken fern bundles and are used to collect wai kōura/crayfish and other small fish (tuna/elvers, tīpokopoko/species of bully and īnanga/whitebait; Figure 3). These were left in-situ for a month to allow colonisation before being pulled up and the community analysed.

Figure 3: LEFT: Tau kōura are bundles of aruhe/bracken fern that become colonised by instream fish and macroinvertebrate species. RIGHT: Fish species found in tau kōura at site OTU03.

Ngā hua/Results

State of the Takiwā assessment

Takiwā site assessments show that many sites are highly modified (relative to traditional condition), with the Ōtūkaikino wetland (OTU01) being the only site with remnant habitat and therefore scoring “very good”. The restoration plantings have become well established at the Issacs Conservation Reserve (OTU05), and the stream has been naturalised which is reflected in this site scoring “good”. The remaining sites scored poor to moderate due to the lack of indigenous plantings, and the change of this waterway from a major braid in the Waimakariri River to a lowland stream. Lake Rua (OTU06) received a “very poor” score as the Roto Kōhatu lakes are artificially created due to quarrying activities interacting with ground water and they are not hydrologically connected into the streams and waterways in the catchment.

Due to the surrounding agricultural and industrial land use, most sites scored low in terms of site pressure (Figure 4). Lake Rua (OTU06) was determined to have the highest level of site pressure, scoring a “very poor”. This is due to the adjacent industrial land uses, the presence of a historical landfill, and power boat activities being undertaken on adjacent Lake Tahi. Sites OTU02 and OTU03 scored “poor” due to little planting on the riparian margins and adjacent agricultural land use. Site OTU02 was also close to the motorway and has a bridge crossing the stream at this point. Site OTU03 also had extensive willow clearance works occurring at the time of monitoring causing sedimentation, a significant site pressure. Site OTU01 had “moderate” site pressure due to being bound by the motorway on two sides. Sites OTU04 and OTU05 had “moderate” and “good” site pressures respectively, reflecting restoration planting efforts and that these sites are located on reserve land.

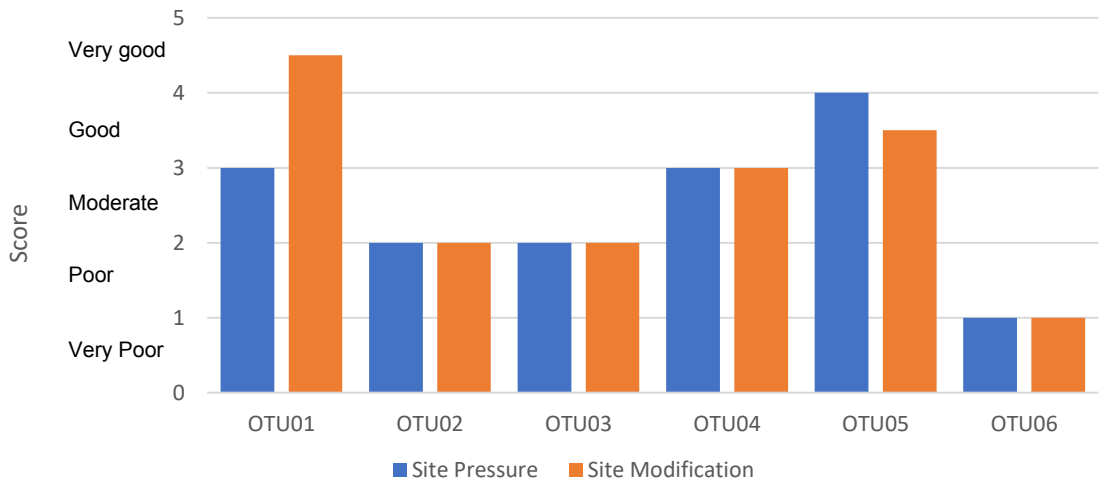

Figure 4: Levels of site modification and pressure from surrounding land use.

The Takiwā overall health assessment identifies the general site condition and categorised four sites as moderate and two sites as good (Figure 5). No sites were rated as very good. These scores aligned closely with the degree of site modification and reflect the rural and reserve land use within this catchment.

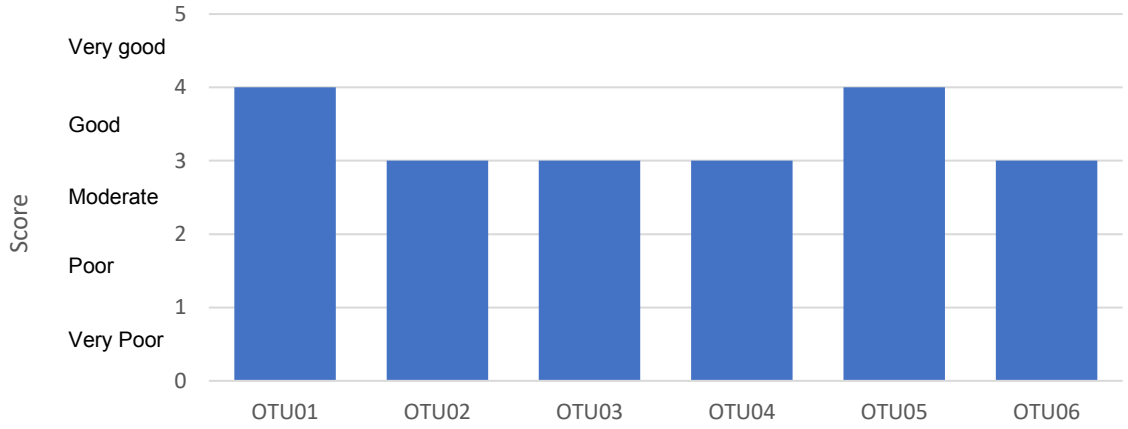

Figure 5: Takiwā overall health assessment.

Cultural Health Assessment

The cultural health of the catchment was based on surrounding land use, vegetation, riverbed condition, water clarity, habitat variety and changes to river channel (Figure 6). This varied significantly between sites, with two sites scoring a very good (OTU01 and OTU05), two sites scoring good (OTU02 and OTU04) and two sites scoring moderate (OTU03 and OTU06). The sites that scored poorly also had low indigenous vegetation cover, low species diversity and high levels of modification and pressure.

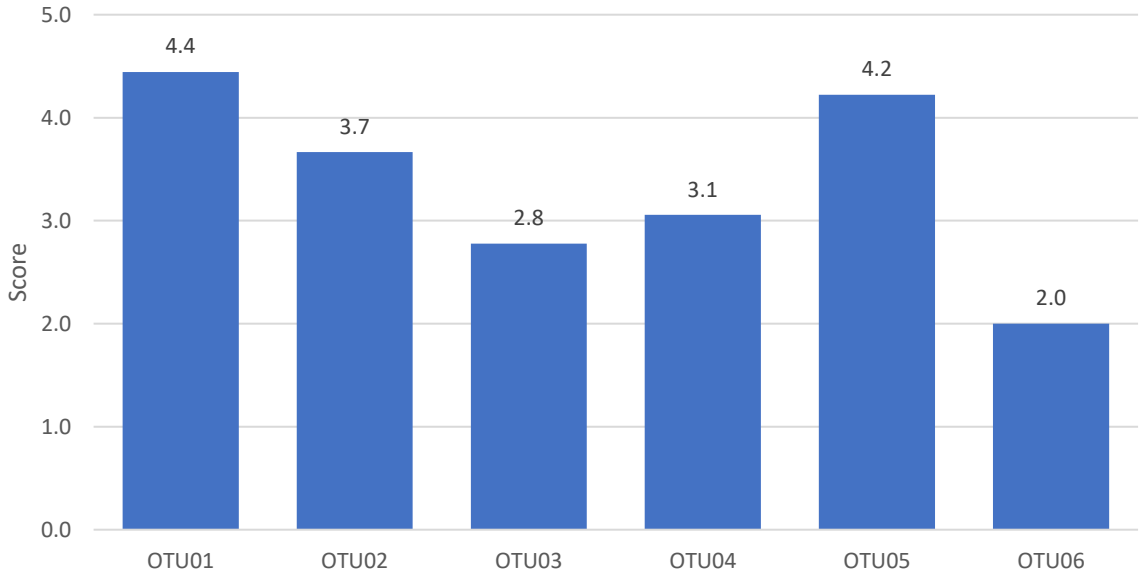

Figure 6: Cultural Health Index assessment.

Stream Health and Macroinvertebrate Assessment Kit (SHMAK)

A benthic macroinvertebrate and periphyton assessment was conducted at four sites (OTU02, OTU03, OTU04 and OTU05) utilising the five stone method as outlined in Biggs, Kilroy, & Mulcock (1998). The macroinvertebrate community was consistent between the sites, with all sites having stony and smooth cased caddisflies present. Mayfly larvae were also present at most sites (except OTU05). A damselfly and dragonfly larvae was found at the Groynes picnic area. All sites also had an abundance of flatworms, worms and pollution tolerant snails. Periphyton mainly consisted of thick black/brown films with some short brown

filaments at sites OTU03, OTU04 and OTU05, indicating abundant macroinvertebrate populations (Figure 7).

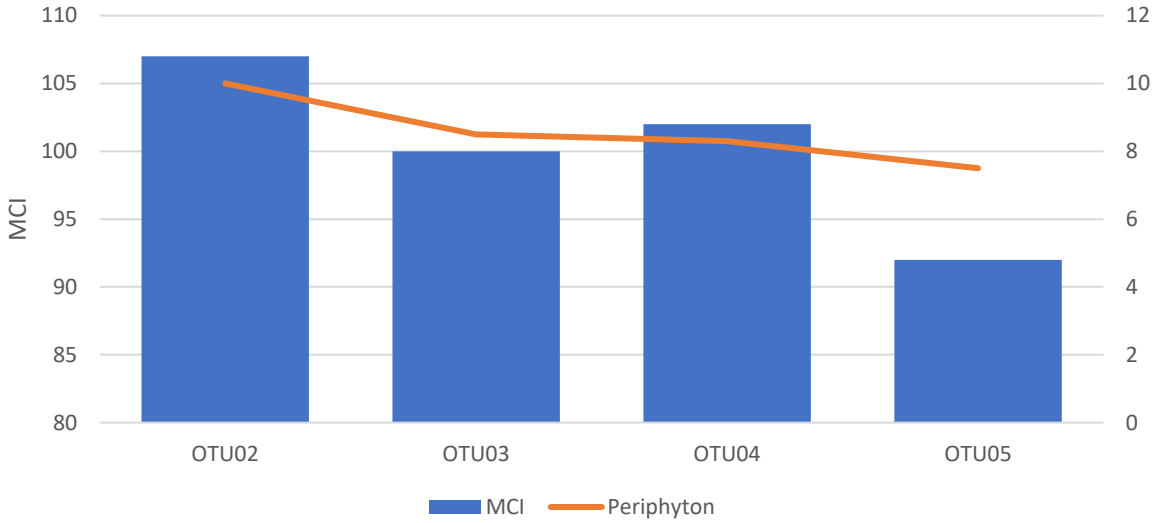

Figure 7: Stream Health and Macrophyte assessment.

Rākau (Vegetation)

Mahinga kai/indigenous vegetation diversity varied across the sites monitored, with the Ōtūkaikino wetland (OTU01) having the greatest number of mahinga kai and/or indigenous species (15), followed by the Issacs Conservation Reserve (OTU05). The other four sites had much lower plant species diversity, being dominated by willows, blackberry, and other exotic invasive species (Figure 8).

The most common mahinga kai species found were wātakirihi/watercress and harakeke/New Zealand flax, found at four sites. This was followed by toetoe, karamū, tī kouka/cabbage tree, matipō and houhere/lacebark located at three sites. These species (with the exception of wātakirihi/watercress) would have traditionally been abundant in these areas.

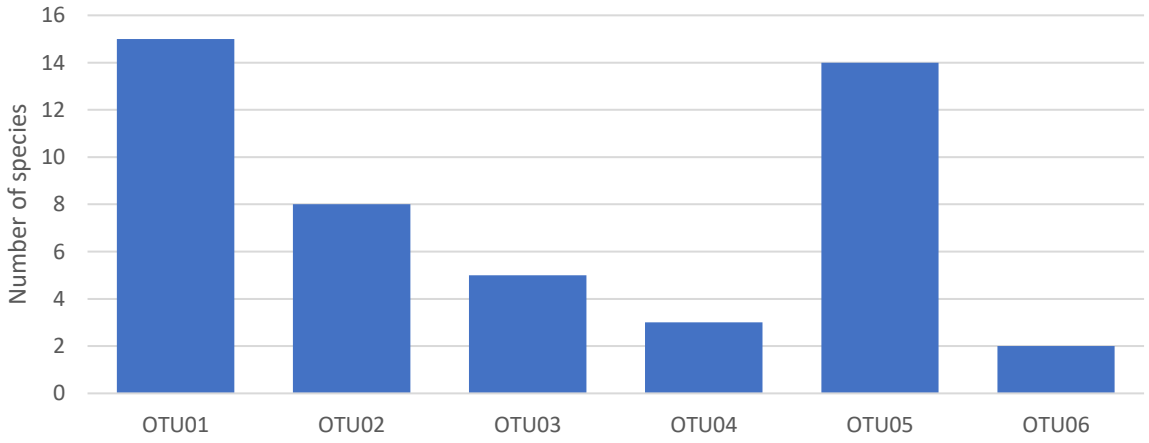

Figure 8: Mahinga kai and/or indigenous diversity across the sites.

The coverage of native plant species varied significantly between sites, with Ōtūkaikino wetland (OTU01) having 100% indigenous vegetation coverage. Issacs Conservation Reserve (OTU05) had 90% site coverage with some invasive broom, blackberry and

remnant willows present along the site margins (Figure 9). The remaining sites had little coverage with native vegetation and were dominated by willow, poplar, blackberry, and other exotic species.

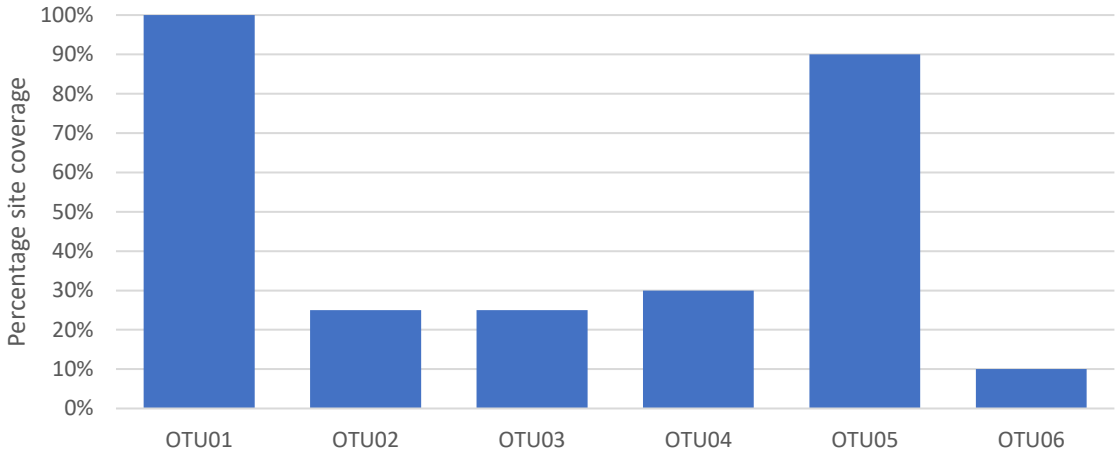

Figure 9: Indigenous vegetation site coverage.

Ika (Indigenous Fish Species)

The combined use of the four different fish survey techniques provided information on fish species from a selection of sites across the catchment (Figure 10). Seven fish species were recorded in these surveys: tuna/shortfin and longfin eel, elvers (juvenile eel), tīpokopoko/common bully and upland bully, īnanga/whitebait, and pātiki/flounder (observed only). Although these methodologies only provide an indicative population estimate, the use of hīnaki/fyke nets and tau kōura aligns with traditional methods and therefore provide an example of the type of mahinga kai that can be caught at each location. The most diverse sites were OTU04 and OTU05. OTU04 also had the greatest number of tuna/longfin eel caught (Figure 10).

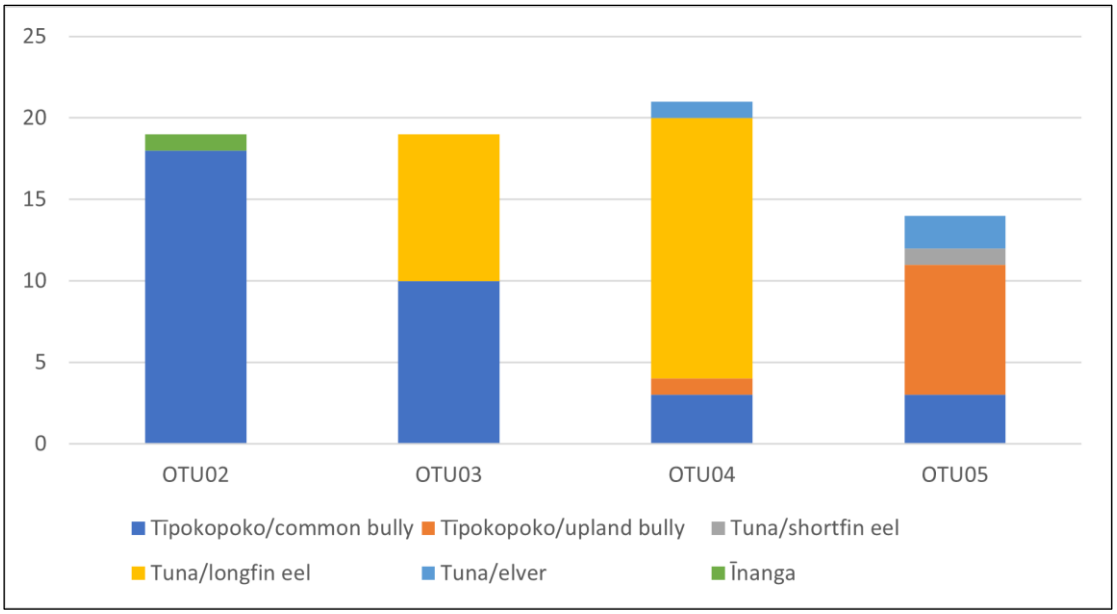

Figure 10: Abundance of fish caught at each site from all methods (see Appendix 2 for size range). The pātiki is not included in this graph as it was observed only.

Tau kōura were used at five sites (OTU01, OTU02, OTU03, OTU04 and OTU05) and left in situ for a month. There were no species found in the tau kōura at OTU01 and OTU05. Three tau kōura located at OTU02, OTU03 and OTU04 contained tīpokopoko/common (18 total from OTU02 and OTU03) and an upland bully (1 at OTU04) when collected. No kōura/crayfish were found during this survey, despite being recorded at least once in Ōtūkaikino in the NZ Freshwater Fish Database (NZFFD).

Gee minnows and hīnaki/fyke nets were used at three sites. At the Dickeys Road bridge site (OTU02), ten tīpokopoko/common bully were caught in the gee minnow traps and the hīnaki/fyke nets caught a single īnanga/whitebait. No tuna/longfin or shortfin eels were caught at this site, despite undercuts and pools being present. Nothing was caught in the gee minnow traps at OTU03, however heavy sedimentation was occurring from willow clearance works up stream on the day of monitoring. This may have impacted catch rates. Nine tuna/longfin eel were caught at this site in the hīnaki/fyke nets (Figure 11). The two hīnaki/fyke nets set at the Groynes picnic area (OTU04) caught different species. The first net contained 16 tuna/longfin eel, and the second net contained 3 tīpokopoko/common bully and an elver (juvenile eel). A pātiki/flounder was also observed at this site while bringing in the nets.

Figure 11: LEFT: Tuna/longfin eel caught using a hīnaki/fyke net. RIGHT: Tīpokopoko/common bully) and an elver caught using a gee minnow trap.

Issacs Conservation Reserve (OTU05) was the only site at which electric fishing was conducted as the other sites were too wide or deep. Eight tīpokopoko/upland bully were caught at this site, alongside three tīpokopoko/common bully, two elver (juvenile eel) and one tuna/shortfin eel. Significant macrophyte growth had occurred at this site since the initial survey, restricting the channel and making electric fishing difficult (Figure 12). The electric fishing results reported during this monitoring are likely to represent species diversity, but not species abundance.

Figure 12. Issacs Conservation Reserve (OTU05). LEFT: November 2021 showing a clear channel. RIGHT: May 2022 showing significant macrophyte growth.

Manu (Indigenous Bird Species)

The overall abundance of bird species was low (Figure 13). Native species were identified at all sites with pīwakawaka/fantail being the most common species (five sites), pāpango/scaup observed at three sites, and kōtare/kingfisher at two sites. Other birds observed were kāruhiruhi/pied shag, korimako/bellbird, kahu/harrier hawk, rakiraki/mallard duck, kāmana/crested grebe, tārapuka/black billed gull, kawaupaka/little cormorant, matuku/bittern, pukeko, koitareke/marsh crake, and kuruwhengu/shoveler. The Ōtūkaikino wetland (OTU01) had the greatest bird species diversity, followed by Lake Rua (OTU06).

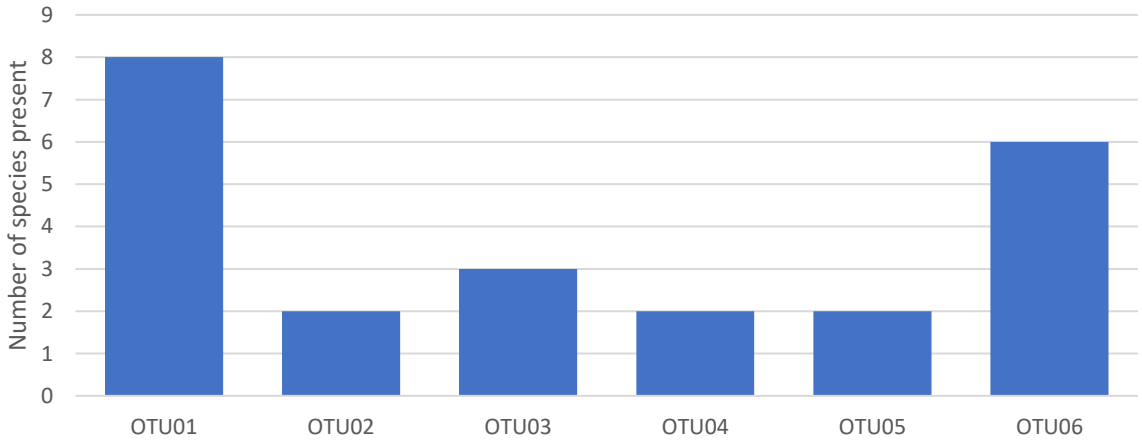

Figure 13: Indigenous bird species present at each site.

Water Quality Testing

All sites were tested for dissolved reactive phosphorus (DRP), Nitrate-nitrogen, *E. Coli*, dissolved copper, and dissolved zinc (Appendix 3). All metals tested were below the ANZEEC guideline values for 95% species protection. *E. Coli* levels were elevated at sites OTU01 (Ōtūkaikino wetland) and OTU03 (downstream of dog park), but under the NPS-FM

guideline values, these sites received a fair grade. Nitrate-nitrogen was elevated in the Ōtūkaikino wetland and exceeded the NPS-FM guideline for high conservation value systems. This may be due to the surrounding agricultural land use and should be investigated further. Dissolved reactive phosphorus (DRP) exceeded the NPS-FM guideline value for Attribute Band A (natural reference conditions) at four sites (OTU01, 02, 03, & 04). Three of these four sites also exceeded the guideline values for Attribute Band B (minor impact on ecosystems). Phosphorous is likely to enter the stream through sediment runoff and the elevated samples in the lower half of the catchment likely reflects the surrounding agricultural land use. The pH measurements averaged 7.2, within the parameters of the Canterbury Land and Water Regional Plan.

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 State of Takiwā 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).

The average score from the monitored sites in the Ōtūkaikino catchment (as detailed in this report), is 3.3. This score is consistent in both the Cultural Health Assessment and State of Takiwā methodologies and does not meet the set target level of '5'. This score demonstrates that while there were individual sites that scores much closer to the target level (such as OTU01 and OTU05), there is still significant work to be done to improve the cultural health of sites in the catchment, as well as the catchment overall.

Kōrero / Discussion

Overview of the catchment

Overall, the cultural health of the Ōtūkaikino catchment is considered to be moderate. Some sites had measures which contributed to higher cultural health scores such as restoration planting with indigenous plant species, good instream habitat, and suitable access. No sites monitored were traditionally used for mahinga kai practices as this waterway was created from the main branch of the Waimakariri River during flood management works in the 1930s, by which point the majority of the catchment had become private farmland.

Indigenous planting was evident at most sites but it was patchy in distribution with willows and grass dominating most of the sites surveyed. Water clarity was high throughout the catchment with no scums, foams or sheens present at any of the sites monitored. All sites had good flow and depth with minimal sedimentation present in the main channel. The fish community across all sites surveyed (OTU02-OTU05) was typical of Ōtautahi urban streams and was dominated by tīpokopoko/common bully and tuna/longfin eel. There was a lack of juvenile eels present, with only three elvers were caught across all surveyed sites. Furthermore, only a single tuna/shortfin eel was caught. While this may indicate barriers to recruitment and the size range of tuna, the date of the project monitoring (in April) is after the summer months when the migration of elvers upstream is expected. Further aquatic monitoring in this catchment is required to determine whether there are consistent low populations of elver and shortfin eels.

Fine sediment is a significant issue within the catchment, with several sites exhibiting sediment accumulation. This has been exacerbated through the lack of riparian planting at most sites and recent willow removal works downstream of the Groynes. Furthermore, the May 2021 floods caused significant sediment deposition in the furthest downstream reaches of the Ōtūkaikino and therefore monitoring could not be conducted further downstream than Dickeys Road bridge.

Water quality testing and assessment identified some areas of concern. Zinc was detected throughout the catchment, but in concentrations below the ANZECC guidelines for 95% species protection. Copper concentrations were below the limits of detection. High levels of phosphorous, *E. coli* and nitrate-nitrogen were identified at many of the sites within this catchment.

Site OTU01: Ōtūkaikino wetland

The site with the best cultural health was the Ōtūkaikino wetland (OTU01) reflecting its status as a restored remnant wetland (Figure 14) and wāhi tapu site. This site is utilised as a modern wāhi tapu/cremation memorial garden and good cultural health is necessary for these activities. However, despite scoring highly in most areas, this site was identified as being under significant pressure due to being bound by the motorway on two sides. This site also had the greatest diversity of native bird and plant species (8 and 15 respectively). *E. Coli* levels were elevated at this site and is likely due to the large number of waterfowl that inhabit the wetland but should be investigated further. Nitrate-nitrogen was also elevated at this site and is likely due to upstream agricultural land use.

Figure 14: Ōtūkaikino wetland (OTU01) with raupō/bulrush and tī kouka/cabbage tree swamp and regenerating kahikatea forest.

Site OTU02: Dickeys Road bridge

This site scored poorly in site modification and pressure due to the motorway and bridge, but has good access for whānau and a small patch of riparian planting (Figure 15). The number of indigenous vegetation species identified was low overall. Phosphorous was elevated at this site and likely reflects the surrounding agricultural land use. The fish population of this site was dominated by tīpokopoko/common bully. No tuna/short or longfin eel were caught. This differs from a previous survey where tīpokopoko/giant bully and tuna/longfin eel were caught at this site (Noakes, 2017). The number of bird species observed overall was low, with pīwakawaka/fantails and rakiraki/mallard ducks the dominant species observed at this site. Further planting of the riparian margins of this site would increase bird diversity, mahinga kai and cultural values.

Figure 15. Downstream of Dickey's Road bridge (OTU02) showing willow dominated riparian margins.

Site OTU03: Downstream of Groynes Dog Park

This site had second lowest cultural health score as willow clearance work was underway during the period of monitoring, meaning the site had little riparian vegetation and channel shading (Figure 16). Furthermore, an increase in sediment was evident along the banks of the stream and benthic macroinvertebrate abundance was decreased. This site scored poorly in site modification and pressure due to minimal planting on the riparian margins and adjacent agricultural land use. A tau kōura was placed at the confluence of the Ōtūkaikino stream and Kaikanui Creek, and caught ten tīpokopoko/common bully. Tuna/longfin eel were also caught at this site in hīnaki/fyke nets and substantial wātakirihi/watercress beds were present in Kaikanui creek (Figure 16). Phosphorous and *E. coli* were elevated at this site, indicative of the surrounding agricultural land use and the proximity of the dog park respectively. Birdlife was low in number of species overall, but slightly more varied at this site, consisting of a single kōtare/kingfisher, kahu/harrier hawk and pāpango/scaup. Restoration riparian planting will increase the bird diversity and cultural health of this site.

Figure 16: LEFT: Downstream from Groynes dog park showing significant willow removal works on the true right bank of Ōtūkaikino stream. RIGHT: Kaikanui creek where it enters the Ōtūkaikino stream with large wātakirihi/watercress beds evident.

Site OTU04: Groynes Picnic area

This site was dominated by willows (Figure 17) but had extensive bank habitat along both sides and native vegetation interspersed across the site. Several mature karamū were present at this site and were fruiting on the day of monitoring. Variation in bird species was low but pīwakawaka/fantail were abundant at this site, and kāmana/crested grebe were also observed. This site had a significant number of mature tuna/longfin eel. One elver was also caught, indicating some recruitment of juveniles. A pātiki/flounder was also observed during the site assessment. This site was assessed to be in good cultural health, but moderate in site modification and pressure due to the presence of fine sediment over the bottom of the channel and accumulation of sediment near the riparian margins.

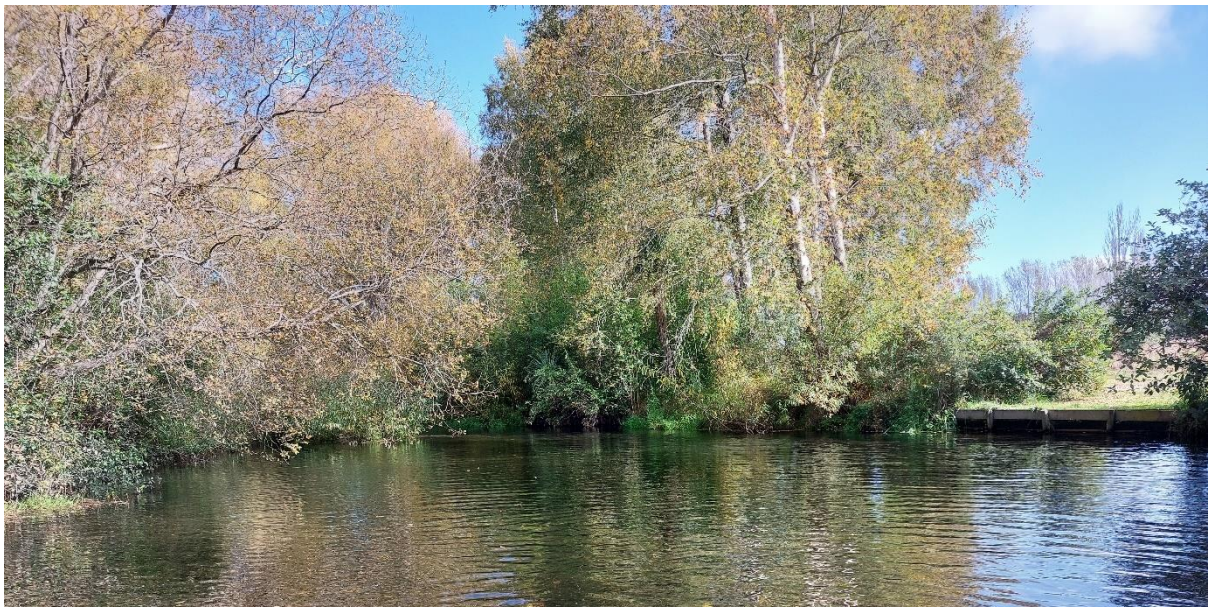

Figure 17: Site OTU04 showing the dominance of willow species through this stretch.

Site OTU05: Issacs Conservation Reserve

This site has had significant extant restoration planting occur with along the riparian margins of the stream conducted by the Issacs Conservation Trust (see Figure 12), and therefore had the second greatest plant species abundance of all sites surveyed, with many mahinga kai and rongoā species present. The abundance of native plant species, lack of stream sedimentation, and the abundance of watercress gave this site the second highest score of cultural health. However, willow regrowth and blackberry vine were observed at this site, and planting is setback from the stream resulting in extensive macrophyte growth. Number of bird species were low. Pīwakawaka/fantail and kotare/kingfisher were observed at this site on the day of monitoring, and korimako/bellbird were observed during the initial site selection.

Site OTU06: Lake Rua, Roto Kōhatu Reserve

The site with the poorest cultural health was Lake Rua reflecting the lack of native plantings and the surrounding industrial land use (Figure 18). Furthermore, these lakes are former gravel pits and were created when gravel mining activities encountered groundwater. The lakes also do not have a direct connection to Ōtūkaikino stream and its tributaries, and therefore there is no pathway for the recruitment of migratory fish species. This site however is a very popular swimming and waka ama site, and is frequented by whānau. It is therefore a good candidate for additional restoration planting and remediation. Only two mahinga kai plant species were identified at this site; raupō/bulrush and wātakirihi/watercress. Multiple bird species were present, including pāpango/scaup, kāruhiruhi/pied shag, tārapuka/black billed gull, pīwakawaka/fantail, kāmana/crested grebe, and kawaupaka/little cormorant.

Figure 18: Lake Rua site (OTU06).

Conclusions

The mātauranga monitoring conducted in April 2022 and detailed in this report has produced the first cultural health assessment of this catchment, thereby establishing a baseline from which future improvements in cultural health can be measured. Overall, this monitoring indicated that the catchment is in moderate cultural health, with those sites at which extensive restoration works have been undertaken scoring the highest. Adjacent agricultural and transportation land uses were identified as the largest pressures on site health, and the catchment has been highly modified from a braided river to a low plains spring-fed stream. Phosphorous, *E. coli* and nitrate-nitrogen were identified to be the contaminants of concern within this catchment and further studies should be conducted to identify the likely sources of these. From this monitoring the overall score of the catchment was 3.3, which does not meet the attribute target level of '5' under Condition 54 of the CSNDC.

None of the sites surveyed are currently utilised for mahinga kai practices due to the historic and cultural significance of the sites, issues around site access, lack of indigenous planting, sedimentation, and water contamination.

Recommendations

- 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. These works must have stringent erosion and sediment controls in place during works to protect the awa.
- Nitrate, phosphate, and *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 *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

It is noted that at the time of finalising this report, the 2022 annual report released by Christchurch City Council states that the following activities will be undertaken:

- An investigation into increasing levels of *E. coli* in the Ōtūkaikino River will be implemented.
- Construction of a stormwater wetlands in Belfast (Ōtūkaikino River catchment) is prioritised.

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Appendix 1: State of Takiwā Site forms (Site OTU02)

State of the Takiwā **Site Definition Form** Site Code OTU02 02

Site Name: Dickeys Road

Defined by: Stephanie on: __/__/____

Assessment type: (tick one) ☐ New site ☐ Update

Region of NZ: Canterbury *eg Otago*

Catchment/Feature: Ōtukaikino *eg Waiau River*

Zone (tick one): ☐ Mountains ☐ Hills ☐ Upper Plains ☐ Mid Plain ☑ Lowland Plains ☐ Urban ☐ Coastal/marine ☐ Other. Specify: .....

Ecosystem Types: ☐ Alpine ☐ Native forest ☐ Exotic forest ☐ Tussock/dryland ☑ Farm/agrisystem ☑ River/Stream ☐ Lake/Wetland ☐ Estuary/Lagoon ☐ Coastal/Dune ☐ Marine ☐ Other. Specify: .....

Ownership: ☐ Private ☑ Council ☐ DOC ☐ Maori ☐ LINZ ☐ Crown ☐ Unknown ☐ Other. Specify: .....

Mana Whenua: Ngāi Tūāhuriri

Site Description (100m radius. Including site issues, pressures and general notes):

Legal Protection: ☐ Informal/none ☐ Reserve ☐ NZAA site/silent file ☐ Legal covenant ☐ Conservation ☐ Other. Specify: .....

Settlement Site: ☐ Nohoanga ☐ Topuni ☐ Tribal property ☐ SA ☐ Unsure

SITE-SIGNIFICANCE DETAIL Is this a traditional site? Yes (No) Unsure Are there any signs of traditional use? Yes (No)

Significance of site: ☐ Urupa ☐ Pā/Kāinga ☐ Mahinga kai ☐ Wāhi Pakanga ☐ Other

Please explain site significance / List any observations:

Traditional Abundance List species and resources traditionally known to be present at this site.

NGĀ MANU / BIRD SPECIES	Abundance	NGĀ IKA / FISH SPECIES	Abundance
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots

NGĀ RAKAU / PLANT SPECIES	Abundance	OTHER TAONGA / Natural Resources	Abundance
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots
	Few Some Lots		Few Some Lots

Geographical Position Area (sq m): ____ Altitude (m): _____ Map No (if 260 series): ____

East: _____ North: _____ Accuracy/Offset (m): ____

Photos taken? Yes No Direction facing, Photo 1: N Photo 2: S Photo 3: E Photo 4: W

Use camera on 35mm or equivalent. Preferably take four photos, facing North, East, South and West, from the GPS reference point. Also consider Upstream, Downstream, etc.

Describe these photos:

OFFICE USE ONLY Entered into Takiwā database by: ____ Date: __/__/____

Photo filed: ☐ Filename: .....

Site mapped: ☐ TUMONZ/GIS code: .....

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State of the Takiwā **Visit Form** Site Code

Use a separate form for Questionnaire Visit Code

VISIT DETAILS Site Name: Dicky's Rd Bridge No. in Group:

Visit date: 26/04/2022 Time: 09:30 am/ pm Hours at Site:

Visitor Name: ☐ First visit here? ☐ First evaluation here?

Visitors from: Visit Purpose:

Weather Centre

1. Temperature: Enter °C here ___ °C or indicate approximately on scale below

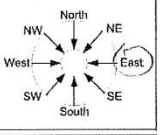
Hot	25°C or more
Warm	20
Mild	15
Cool	10
Cold	5
Freezing	0°C or less

2. Cloudiness (circle one): (Clear sky) Mainly clear Streaky Partly cloudy Heavy Breaking Overcast

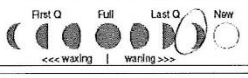
3. Precipitation (circle one): (None) Mist or fog Drizzle Light Moderate Heavy Hail Snow

4. Wind If wind, circle its direction

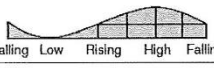
(circle one) None Minimal (Light) Stiff or breezy Gusty Strong



5. Moon: Circle the shape or tick if not applicable: ☐



6. Tide: Draw a circle on the sea-level curve, or tick if not applicable: ☐



7. Extra comment on weather:

Heritage/Archeological Details Are there any signs of traditional use? Yes (No)

Describe signs / list observations

Site Issues or Pressures Motocross and farmland

Site Actions or Responses

Recent Flow Conditions

Circle the number best describing the past 6 weeks:

5 (Stable flow)
4 Brief flooding (less than 2 days)
3 Several brief floods
2 Prolonged flooding (5 days +)
1 Prolonged low flows

Recent Land Use Conditions (Up to 1 km upstream and within 500m of banks.)

List any disturbances to the stream that are noticed or known (last 6 weeks). eg stock in channel, wastes, chemicals, stormwater, weed clearance, earthworks, etc.

Photos taken? Yes No Direction facing, Photo 1: ☐ Photo 2: ☐ Photo 3: ☐ Photo 4: ☐

Use camera on 35mm or equivalent. Preferably take four photos, facing North, East, South and West, from the GPS reference point. Also consider Upstream, Downstream and of any s

Describe these photos:

OFFICE USE ONLY Entered into Takiwā database by: Date: __/__/____

Site previously mapped : ☐ Photo filed: ☐ Filename: .....

Site mapped: ☐ TUMONZ/GIS code: .....

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State of the Takiwā **Site Assessment - General** Site Code

A Visit form is also needed Assessment Code Visit Code

ENTRY DETAILS Site Name: Visit date: __/__/____

Visitor Name: Number of people represented: ___

A. SITE ASSESSMENT DETAILS For each question, please circle the appropriate number, then explain it in the box following.

1. How would you describe the pressure on this site? Immense presure 1 (2) 3 4 5 Minimal pressure

Details (including recreational access, surrounding landuse, discharges, etc.):
Road (bridge), motorway, paddocks

2. What is the degree of modification/change at this site? Extreme modification 1 (2) 3 4 5 Low modification

Details (including drainage, burning, discharges, abstractions, developments):
- Bridge, diversion of waihakariri
- little native riparian planting

Questions 3, 4, 5 and 6 consider suitability for harvesting mahinga kai

3. IDo you consider access to this site is sufficient to harvest mahinga kai? Not able to gather 1 2 (3) 4 5 No restrictions

Details:
Watercress & eels, WQ good enough

4. Would you harvest mahinga kai at this site? Definitely no 1 2 3 4 (5) Definitely yes

Details:

5. Tick if site is wahi tapu: ☐

6. Would you return to this site in the future? Yes No

Details:

7. What actions are required to improve the health of this site? Tick relevant boxes.

- ☐ Better management by landowner, council, etc.
- ☐ Consideration of ownership/purchase by tribe/rūnanga.
- ☐ Protection / Access arrangement for significant sites with landowner
- ☐ Interpretation / Signage
- ☑ Restoration of native species
- ☑ Pest / weed control
- ☐ Other Specify:

7. How would you describe the overall health of this site? Very unhealthy 1 2 (3) 4 5 Very healthy

Details (including any problems, pressures, issues, smells etc. noticed):

Next page for Abundance questions ...

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State of the Takiwā — Site Assessment - General

B. ASSESSMENT OF ABUNDANCE For each question, please list the species that you can see or hear, and circle their abundance. If they are mahinga kai species, please tick the MK box. List more on blank paper if necessary.

1. NGĀ RAKAU MĀORI / NATIVE PLANT SPECIES	Abundance	MK	Notes (condition, habits, etc.)
Toi toi	Few Some Lots	☐	
Lacebark	Few Some Lots	☐	
Flax	Few Some Lots	☐	
Hufenbechia	Few Some Lots	☐	
Coprosma	Few Some Lots	☐	
Rimu	Few Some Lots	☐	
Mahoe (Whiteywood)	Few Some Lots	☐	
Willow	Few Some Lots	☐	
Grass	Few Some Lots	☐	
Water Cress	Few Some Lots	☐	

1a. What % of the total site area is covered by native plant species? (within 100m radius) — 0% a little 25% 50% 75% most 100%

2. NGĀ MANU MĀORI / NATIVE BIRD SPECIES	Abundance	MK	Notes (condition, habits, etc.)
Fan tail	Few Some Lots	☐	
Lacebark	Few Some Lots	☐	
Swallows	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	

3. NGĀ IKA MĀORI / NATIVE FISH SPECIE	Abundance	MK	Notes (condition, habits, etc.)
Mayfly	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	

4. NGĀ TAONGA MĀORI / Other Natural Resources	Abundance	MK	Notes (condition, etc.)
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	

5. INTRODUCED PLANTS AND ANIMALS	Abundance	MK	Notes (condition, controls, signs, etc.)
Swallows	Few (Some) Lots	☐	
Willows	Few Some (Lots)	☐	
Poplars	Few Some (Lots)	☐	
Blackberry	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	
	Few Some Lots	☐	

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State of the Takiwa **CHI: Cultural Stream Assessment** **Site Code** ____

Use general assessment code if have one >> **Assessment Code** ____ **Visit Code** ____

ENTRY DETAILS Site Name: ____ Visit date: __ __ / __ __ / __ __ __ __

Visitor Name: ____ Number of people represented: __ __

A. Cultural Stream Health Assessment For each question, please circle a number.

	Unhealthy		Healthy
1. Catchment Land Use	Land heavily modified Wetlands and marshes lost	1 **2** 3 4 5	Appears unmodified
2. Vegetation - banks & margins (100m either side)	Little or no vegetation - neither exotic nor indigeneous	1 2 **3** 4 5	Complete cover of vegetation - mostly indigenous
3. Use of the river banks & margins (100m either side)	Margins heavily modified	1 2 3 **4** 5	Margins unmodified
4. Riverbed conditions (sediment)	Covered by mud, sand, slime or weed	1 2 **3** 4 5	Clear of mud, sand, slime and weed
5. Changes to river channel	Evidence of modification, eg stopbanks, straightening, gravel removal, shingle build-up	1 2 3 **4** 5	Appears unmodified
6. Water Quality, eg foams, oils, slime, weeds, etc.	Appears polluted	1 2 3 **4** 5	No pollution evident
7. Water clarity	Water badly discoloured	1 2 3 **4** 5	Water is clear
8. A variety of habitats	Little or no current, uniform depth and limited variety of flow related habitats	1 2 3 4 **5**	Current and depth varies, creating a variety of flow related habitats
9. Overall health of the river at this site	Very unhealthy	1 2 3 **4** 5	Very healthy

Please explain your answer:

B. MAHINGA KAI SPECIES For each question, please list the species that you can see or hear, and circle their abundance. You can use a blank page to list more if necessary.

BIRDS: Please list the mahinga kai bird species that you can see at this site

1.	2.	4.	3.
5.	6.	7.	8.

PLANTS: Please list the mahinga kai plant species that you can see at this site

1.	2.	4.	3.
5.	6.	7.	8.

C. SITE ACCESS FOR HARVESTING MAHINGA KAI

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

Not able to gather at this site 1 2 3 4 5 Able to gather - no restrictions

Please explain your answer:

Would you return to this site in the future? Yes No

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State of the Takiwa SHMAK Assessment

B. STREAM-BED LIFE

B1 Invertebrates

For each of 5 stone, sediment or water plant samples, tick a box if you can see any of these.

	1	2	3	4	5	Score
Worms (eg thin brown/red)		✓	✓			1
Flatworms, leeches						3
Freshwater crustaceans (amphipods, water fleas)						5
Small bivalves (up to 4 mm across)						3
Snails (4-6 mm across, rounded)	✓					3
Snails (1-3 mm across, pointed)					✓	4
Limpet-like molluscs (Latia, up to 8 mm wide)						7
"Axehead" caddis (Oxyethira, 2-3 mm long)						3
Midge larvae (3-7 mm long, white - red)						2
Damselfly larvae						4
Cranefly larvae						5
Beetle larvae and adults						6
Caddisfly larvae (rough stony cases, or of sticks & free living)	✓		✓	✓	✓	6
Smooth-cased caddisfly larvae (Olinga, to 10 mm, chestnut-brown)	✓	✓				9
Spiral caddis (Helicopsyche, to 3 mm wide)						10
Mayfly larvae (2-15 mm long)	✓	✓			✓	9
Stonefly larvae (large species, to 20 mm)						10

B2 Periphyton (on exposed surfaces)

Using the same 5 samples, tick a box if you can see any of these.

			1	2	3	4	5	Score
Thin mat/film	Under 0.5 mm thick	Green						7
		Light brown						10
		Black or dark brown	✓	✓	✓	✓	✓	10
Medium mat	0.5 - 3 mm thick	Green						5
		Light brown						7
		Black or dark brown						9
Thick mat	Over 3 mm thick	Green or light brown						4
		Black or dark brown						7
Filaments, short	Under 2 cm long	Green						5
		Brown or reddish						5
Filaments, long	Over 2 cm long	Green						1
		Brown or reddish						4

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Appendix 2: Ika abundance and sizes

Site	Tīpokopoko/common bully	Tīpokopoko/upland bully	Tuna/shortfin eel	Tuna/longfin eel	Tuna/elver	Īnanga/ whitebait
OTU02	18 (31-70 mm)					1 (79 mm)
OTU03	10 (65-126 mm)			9 (500-820 mm)		
OTU04	3 (120-760 mm)	1 (41 mm)		16 (440-1000 mm)	1 (100 mm)	
OTU05	3 (49-60 mm)	8 (47-103 mm)	1 (400 mm)		2 (120-150 mm)	

Appendix 3: Water quality testing results

Site	Copper	DRP	E. coli	Nitrate-Nitrogen	pH	Zinc	Iron	Lead
	mg/L	mg/L	MPN	mg/L		mg/L	mg/L	mg/L
OTU01	<0.0001	0.007	260	1.6	7.3	0.0013		
OTU02	<0.0001	0.009	86	0.47	7.2	0.00071		
OTU03	<0.0001	0.0064	280	0.3	7.2	0.00077		
OTU04	<0.0001	0.009	150	0.24	7.1	0.0015		
OTU05	<0.0001	0.0022	110	0.38	7.2	0.0016		
OTU06	<0.0001	0.0033	10	0.13	7.2	0.0024	0.0033	<0.0001

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