

Ō TŪ WHAREKAI ORA TONU

CULTURAL HEALTH ASSESSMENT OF Ō TŪ WHAREKAI / THE ASHBURTON LAKES



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Whakaahua Taupoki - Cover Photographs:

Ruka - Top: View of Kirihonuhonu / Lake Emma, looking towards Mahaanui / Mount Harper (09/02/2010).

Waekanui - Middle: View of Ō Tū Wharekai / Lower Maori Lake looking north, with Uhi / Clent Hills in the right midground (10/02/2010).

Raro - Bottom: View of Ō Tū Roto / Lake Heron looking north to the outlet of Lake Stream, with Te Urupā o Te Kapa / Mount Sugarloaf in the midground just to the right of centre (11/02/2010).

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Te Whakarāpopotanga - *Executive Summary*

- Te Rūnanga o Arowhenua is working in partnership with the Department of Conservation to restore the Ō Tū Wharekai / Ashburton Lakes area as part of a national initiative to protect and enhance wetlands and waterways of outstanding significance. Part of this work is to undertake an assessment of the cultural values and health of the Ō Tū Wharekai area.
- The first report produced through this project, the '*Ō Tū Wharekai Cultural Values Report*' was completed in September 2009. It aimed to identify, compile and record the traditional and contemporary cultural values of tangata whenua associated with Ō Tū Wharekai / the Ashburton Lakes, and involved a site visit and reviewing published and unpublished literature and tribal records.
- The values report confirmed Ō Tū Wharekai as an area of immense cultural significance to Ngāi Tahu Whānui, being both an important seasonal mahinga kai area and a major travelling route between the settlements on the eastern coast of Te Waipounamu (the South Island) and those on Te Tai Poutini (the West Coast).
- This second report complements and extends the cultural values report by assessing the contemporary cultural health and state of the Ō Tū Wharekai / Ashburton Lakes area, as well as identifying the pressures, issues, actions and opportunities that exist which can be taken into account to guide and assist the future management, development and restoration of the area.
- The methodology employed to assess the cultural health of Ō Tū Wharekai included a Ngāi Tahu monitoring team undertaking Takiwā, Cultural Health Index and SHMAK assessments, e.coli testing and electric fishing and fyke net surveys of 24 selected sites across the Ō Tū Wharekai / Ashburton Lakes area.
- Overall, the results of the study found the Ō Tū Wharekai / Ashburton Lakes area to be in a state of moderate cultural health. In particular, the assessments and analysis point towards a significant issue with the historical loss of native flora and fauna and subsequent grazing and stock pressure on both the landscape and waterways of the area.
- The moderate overall assessment is however balanced by the existence of important areas of remnant vegetation and habitat including raupō and carex wetlands, tall tussocklands, and beech forest, aruhe, tī kouka and houhi patches, many of which show the benefits of protection from grazing pressure.
- Protecting, enhancing and extending adequate native river and lake riparian and wetland buffers and other native vegetation, particularly medium to large shrubs and tall tussocklands, and a greater focus on dealing with sources of contaminants and sedimentation into waterways from both surrounding land-use and recreational and settlement areas will be the most important challenges for the future management of Ō Tū Wharekai.
- Recommendations for future management include:
 1. That all waterways which continue to be important for food gathering are managed and enhanced for food gathering quality into the future.
 2. That increased protection and enhancement of waterways through the development of native riparian and wetland buffer zones be investigated and implemented.
 3. Greater advocacy, rates relief and other economic methods for the protection and enhancement of native riparian and wetland buffer zones and vegetation patches in currently poor or un-vegetated or un-fenced areas on private land.

4. Specific restoration, pest and weed eradication and exotic species control in and around all lakes, including the use of tī kouka, houhi, kowhai, maukoro, mikimiki, beech and aruhe and other native plants that prove to compete well with, or can be planted underneath willow and other exotic species invading lakes and wetlands. This should consider the removal of pest fish from specific areas.

The following lakes and sites should be a priority:

- Ō Tū Wharekai (East) / Lower Māori Lake
 - Kirihonuhonu / Lake Emma
 - The Oliver Stream area of Ō Tū Roto / Lake Heron
 - The Swin river access area of Ō Tū Roto / Lake Heron
 - Te Puna a Taka / Lake Clearwater; and
 - Ōtautari / Lake Camp.
5. Specific measures to control siltation/sedimentation and e.coli contamination of Ō Tū Wharekai (East) / Lower Māori Lake and further protection of Ō Tū Wharekai (West) / Upper Māori Lake, including the potential purchase of surrounding land, the control of exotic species, and the development of better buffers, particularly around the road edge corner of Lower Māori Lake and incoming water ways of both lakes.
 6. Consideration for the complete and ongoing removal of exotic fish from the Māori Lakes and work towards making the lake complex a native fish only area.
 7. Further tuna/eel monitoring surveys and investigation to understand the potential of an annual cultural harvest, particularly at the Māori Lakes.
 8. Further investigation and control of human and agricultural pollution at Te Puna a Taka / Lake Clearwater and the Oliver Stream area of Ō Tū Roto / Lake Heron.
 9. Support for future wānanga and hui to reconnect tangata whenua with the Ō Tū Wharekai / Ashburton Lakes Area, particularly around future interpretation and cultural harvest opportunities of both tuna, raupō (for mokihi), hua kaki anau (black swan eggs) and other mahinga kai.
 10. Investigation into the habitat requirements of, and future possibilities (including specific sites), for the reintroduction of eastern buff weka into the area.
 11. Greater research into the impacts of, and solutions for, treating and dealing with non-point and point source pollution of waterways in the area.
 12. Continued regular monitoring, including cultural assessments, to understand the success, or otherwise, of future management and development of the catchment.

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1.0 TE WHAKATŪWHERATANGA - INTRODUCTION

1.1. Tāhuhu kōrero - Background

Te Rūnanga o Arowhenua is working in partnership with the Department of Conservation to restore the Ō Tū Wharekai / Ashburton Lakes area as part of a national initiative to protect and enhance wetlands and waterways of outstanding significance. Part of this work is to undertake an assessment of the cultural values and health of the Ō Tū Wharekai area (Figure 1 shows the study area of the project). The major objective of this project is to:

- Identify, compile and record the traditional and contemporary cultural values of tangata whenua associated with Ō Tū Wharekai / Ashburton Lakes to assist the future management, development and restoration of the area.

The major tasks and outcomes of this project are to:

1. Involve Te Rūnanga o Arowhenua in the management of the Ō Tū Wharekai / Ashburton Lakes area.
2. Undertake research, hold hui and complete a GIS map/layer and report of the traditional cultural values associated with the Ō Tū Wharekai / Ashburton Lakes area¹.
3. Complete a monitoring plan, undertake monitoring and assessment hīkoi, analyse results and report on the cultural health of the Ō Tū Wharekai / Ashburton Lakes area.
4. Hold a hui to discuss recommendations for the future management of the Ō Tū Wharekai / Ashburton Lakes area based on the reports.

1.2. Te take o tēnei mahere - Purpose of this report

The purpose of this report is to provide the Department of Conservation with a clear, concise and professional report containing an assessment of the contemporary Ngāi Tahu cultural health and state of the Ō Tū Wharekai / Ashburton Lakes area, as well as identifying the pressures, issues, actions and opportunities that exist which can be taken into account to guide and assist the future management, development and restoration of the area.

1.3. He aha kai roto i tēnei mahere - What this report includes

This report includes the following information:

- An overview of geographical and historical information for Ō Tū Wharekai;
- An outline of the methods used to gather information, assess and analyse the Ngāi Tahu cultural health and state of Ō Tū Wharekai;
- The results and analysis of the data and information collected during the assessment;
- A discussion of the results and the conclusions drawn from these; and
- Recommendations for future management that take into account Ngāi Tahu cultural values and health related matters identified through the project.

¹ A report entitled 'Ō Tū Wharekai / The Ashburton Lakes: An Overview of the Ngāi Tahu Cultural Association with Ō Tū Wharekai' was completed in September 2009 to complete this objective.

2.0 WHAKATAKI WĀHI - GEOGRAPHICAL AND HISTORICAL OVERVIEW

This section provides a brief overview of the Ō Tū Wharekai / Ashburton Lakes area, its location, history and significance. It also includes an outline of previous research undertaken in the catchment.

2.1. Te āhuatanga o tēnei wāhi - Location and natural features of Ō Tū Wharekai

Ō Tū Wharekai / the Ashburton Lakes are situated in the South Canterbury high country, within a basin at the head of the Southern Branch of the Hakatere / Ashburton River, above the Ashburton Gorge. The basin is flanked by the Upper Rangitata River to the South and the Upper Rakaia River to the North (see Figure 1). The area contains a number of significant high country lakes and wetland systems, all with their own inflowing tributaries, which are sources for either the Southern Branch of the Hakatere / Ashburton River or the Rakaia River. The area is nationally significant, having some of the best examples of remaining inter-montane wetland systems, high country tussocklands, braided river habitats and is home to a number of rare and threatened native plant, bird, fish, insect and lizard species. It is also an important recreational and agricultural area, with bach settlements and campsites for sports fishing, windsurfing, swimming and boating at Te Puna a Taka / Lakes Clearwater and Ō Tū Roto / Lake Heron, as well as a number of high country pastoral farming stations throughout the basin.

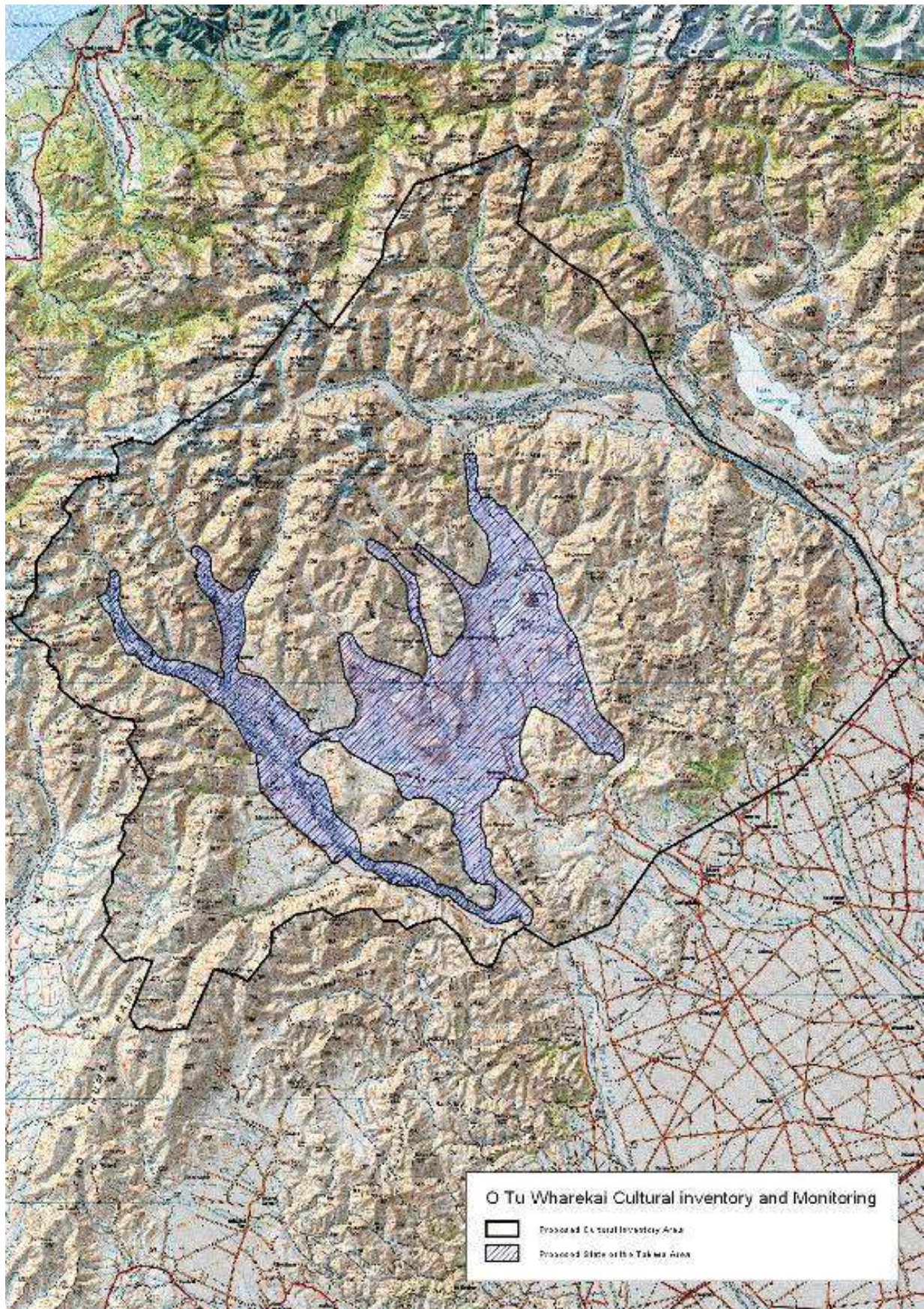
The Southern Branch of the Hakatere/Ashburton River is sourced from glaciers upon Mt.Arrowsmith and the major lakes of the Ashburton Basin, including Te Puna a Taka (Lake Clearwater), Ōtautari (Lake Camp), Kirihonuhonu (Lake Emma), and Ō Tū Wharekai (Maori Lakes). The river flows from Mt.Arrowsmith between Puteawhatiia/Big Hill Range and Wild Mans Brother Range, joining with the outflows of the above lakes around the vicinity of Hakatere corner. Below the Ashburton gorge the river is joined by another source, Ōtauā Tākou (the Stour River), flowing from the Mt.Somers Range on the eastern side of the basin and running around the eastern side of Uhi (Clent Hills). The Rakaia river is fed by two main glaciers (Lyell and Ramsay), as well as two major tributaries (the Mathias and Waitatari/Wilberforce Rivers), and Lake Stream which flows from Ō Tū Roto (Lake Heron), the biggest waterbody within the Ashburton Lakes basin. The Rangitata River is fed by three major tributaries including the Havelock, Clyde and Lawrence rivers, as well as the Potts River, which flows in from the Ashburton Lakes basin area along the western side of Puteawhatiia/Big Hill Range.

The original vegetation of the area was predominately both tall and short tussocklands, including haumata/snow tussock (*Chionochloa rigida*), wī kura/red tussock (*Chionochloa rubra*) and pātītī/fescue tussock (*Festuca novae-zelandiae*), with patches of tāwhairauriki/mountain beech forest (*Northofagus solandri* var. *cliffortioides*), mountain tōtara (*Podocarpus hallii*), mountain toatoa (*Phyllocladus alpinus*), and tūmatakuru/matagouri (*Discaria toumatou*), houhi/mountain ribbonwood (*Hoheria lyallii*), mikimiki (*Coprosma* spp.) and maukoro/native broom (*Carmichaelia* spp.) shrublands. Extensive wetland systems would have occurred around the lakes, dominated by raupō (*Typha orientalis*), pūkio/carex secta and other carex species.

Harrington, Cooper, Davis, Higham & Mason (1986) suggest that “pre-human natural fires and burning from both the Polynesian and European eras has resulted in the widespread modification of the vegetation communities and has contributed to the predominance of tussockland communities. In more recent times agricultural development....[including] repeated burning and grazing and....pasture development....has modified much of the lower tussocklands and resulted in a significant exotic component in the flora”(p22&70). The fauna of Ō Tū Wharekai includes both common and rare wetland, high country and braided river bird species including karoro/black-back gull, pūtakitaki/paradise duck, pākura/pūkeko, kōau/black shag, ngutu pare/wrybill, tarapirohe/black-fronted tern, turiwhatu/dotterel, kāmāna/crested grebe, matuku/bittern, koitāreke/marsh crake, whio/blue duck, kea, and kārearea/NZ falcon. Kāhu/harrier hawk and pīhoihoi/pipit are typical in the open country of the basin while kōpara/bellbird, pīwaiwaka/fantail, riroriro/grey warbler, miromiro/tomtit, titipounamu/rifleman and tauhou/silvereye are present in and around forest remnants.

A selection of mokomoko/lizards, geckos and skinks are also present along with the distinct Mount Somers giant weta, kahukura/butterflies and other kārara/insects. The area is also important for threatened native fish species including the tuna/longfin eel and kōkōpū/upland longjaw galaxias.

Figure 1: Map of Ō Tū Wharekai Cultural Inventory and Monitoring Area (source: Department of Conservation).



2.2. Te Manawhenua - Ngāi Tahu Association with Ō Tū Wharekai

Ō Tū Wharekai / The Ashburton Lakes is an area of immense cultural significance to Ngāi Tahu Whānui, being both an important seasonal mahinga kai area and a major travelling route between the settlements on the eastern coast of Te Waipounamu (the South Island) and those on Te Tai Poutini (the West Coast). Ō Tū Wharekai is the Ngāi Tahu name used to refer to both the wider Ashburton Lakes area as well as being the specific name of the two small interconnected wetlands within the Ashburton Lakes, more commonly known as the Māori Lakes. Due to its importance, Ō Tū Wharekai / The Ashburton Lakes area was recognised as a Statutory Acknowledgement through the Ngāi Tahu Claims Settlement Act 1998.

Three main ‘pounamu trails’ are associated with the Ō Tū Wharekai area, including the Rangitata, Rakaia and Hakatere trails. These trails were interlinked and provided access over to Te Tai Poutini through the Whitcombe, Mathias, Browning and Sealey Passes. There is also a trail along the foothills of Alford Forest that linked these three rivers together (see Figure 7).

Archaeological evidence exists that supports Ngāi Tahu traditions relating to Ō Tū Wharekai as well as showing Māori occupation and use of Ō Tū Wharekai and the three ‘pounamu trails’ intersecting the area. There are several Māori archaeological sites, located along the Hakatere, the Rakaia and along the foothills between the Hakatere and Rakaia Rivers, such as middens and ovens, while there are reported rock shelters near the Ashburton Gorge and a quarry site on Mt Alford. There have also been several adzes, including a toki pounamu (greenstone adze), found in the area of Mt Somers and Mt Alford.



Figure 2: Māori adze understood to be found at Clent Hills, Ashburton Gorge, 8 miles from Mt Somers (source: Canterbury Museum)



Figure 3: Photographs showing an Umu-tī, the earth ovens used for cooking kōura, in South Canterbury (source: Mark Adams)

There are numerous Ngāi Tahu place-names, sites and traditions relating to the mountains, rivers, lakes and settlements associated with Ō Tū Wharekai. Hinepaaka is a particularly important landmark located near Alford Forest that was used by those utilising the trails associated with Ō Tū Wharekai and is well known within Ngāi Tahu traditions. Several of the mountain names within the area, including Pūteawhatiia (Big Hill Range), Tarahaoa (Mt. Peel), Te Āruhe Pora (Two Thumb Range), Te Kāhui Kaupeka (Mt. D’Archiac) and Te Kiekie (Mt. Somers) are known as passengers of the Ārai-te-Uru waka, an important Ngāi Tahu canoe tradition and creation story of Te Waipounamu (Beattie 1945; Andersen 1942; & Taylor 1950).

A number of sites within the area were also recorded as significant sites by Ngāi Tahu elders in the information gathered by H.K Taiaroa during the time of the 1879 Smith-Nairn Commission. These sites include: Hakatere ki te Toka (South Ashburton River), Kirihonuhonu (Lake Emma), Ō Tū Roto (Lake Heron), Ō Tū Wharekai (Maori Lakes), Ōpihako (Mt. Winterslow), Ōpuke (Mt. Hutt), Ōtaua Tākou ki Hakatere (Stour/Ashburton Confluence), Ōtautari (Lake Camp), Te Āruhe Pora (Two Thumb Range), Te Kiekie (Mt. Somers), Te Maka Kaha (Mt. Alford), Te Puna a Taka (Lake Clearwater), Tokinui (Rakaia/Mathias Confluence), and Uhi (Clent Hills) (Taiaroa 1880).



Figure 4: Catching a weka using the whakaki method (source: Heaphy 1846)

The information from Taiaroa (1880) is particularly important as it included lists of the species taken as mahinga kai at these specific sites. As Tau (2006, p12) states “these lists are critical because they are the earliest written records from Ngāi Tahu elders that allow us to construct a picture of what the landscape was like”. The traditional food and resource species recorded from these lists for the Ō Tū Wharekai area are shown in the table below. The most widely used species in the area included: tuna (eels), aruhe (bracken fernroot), kāuru (cabbage tree root), weka (wood hen) and kiore (Polynesian rat).

Table 1: Summary of Ō Tū Wharekai traditional mahinga kai sites and species (source: Taiaroa 1880)

Site/Name	Location	Significance	Mahinga Kai
Hakatere ki te Toka	South Ashburton River	A food gathering site	aruhe, kiore, weka
Kirihonuhonu	Lake Emma	A permanent settlement	tuna, aruhe, weka
Ō Tū Roto	Lake Heron	A permanent settlement	weka, aruhe, kāuru
Ō Tū Wharekai	Maori Lakes	A food gathering settlement	weka, aruhe, kāuru
Ōpihako	Mt. Winterslow	A food gathering site	weka, kāuru, kiore
Ōpuke	Mt. Hutt	A food gathering site and forest	weka, kiore, korerū, kākā, tūi, matai, pōkākā
Ōtaua Tākou ki Hakatere	Stour/Ashburton Confluence	A permanent settlement	weka, aruhe, kāuru
Ōtautari	Lake Camp	A permanent settlement	tuna, aruhe, weka
Te Āruhe Pora	Two Thumb Range	A food gathering settlement	kāuru, aruhe, weka
Te Kiekie	Mt. Somers	A food gathering site	weka, kiore, korerū, kākā, tūi, matai, pōkākā
Te Maka Kaha	Mt. Alford	A food gathering site	weka, kiore, korerū, kākā, tūi, matai, pōkākā
Te Puna a Taka	Lake Clearwater	A permanent settlement	tuna, aruhe, weka
Tokinui	Rakaia/Mathias Confluence	A food gathering settlement	weka, kākāpō, kāuru, aruhe, tuna
Uhi	Clent Hills		tuna, aruhe, weka



Figure 5: Hinaki or eel trap (source: Te Papa Tongarewa)

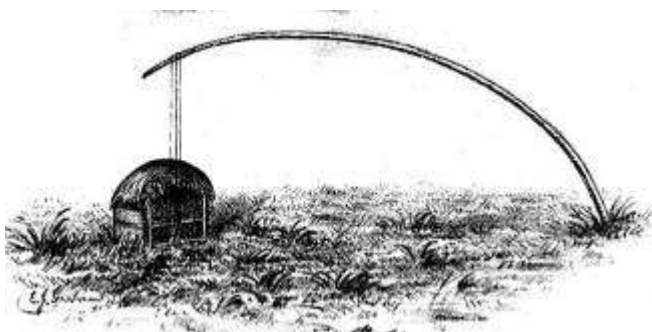


Figure 6: Tawhiti kiore or rat trap (source: White, 1897)

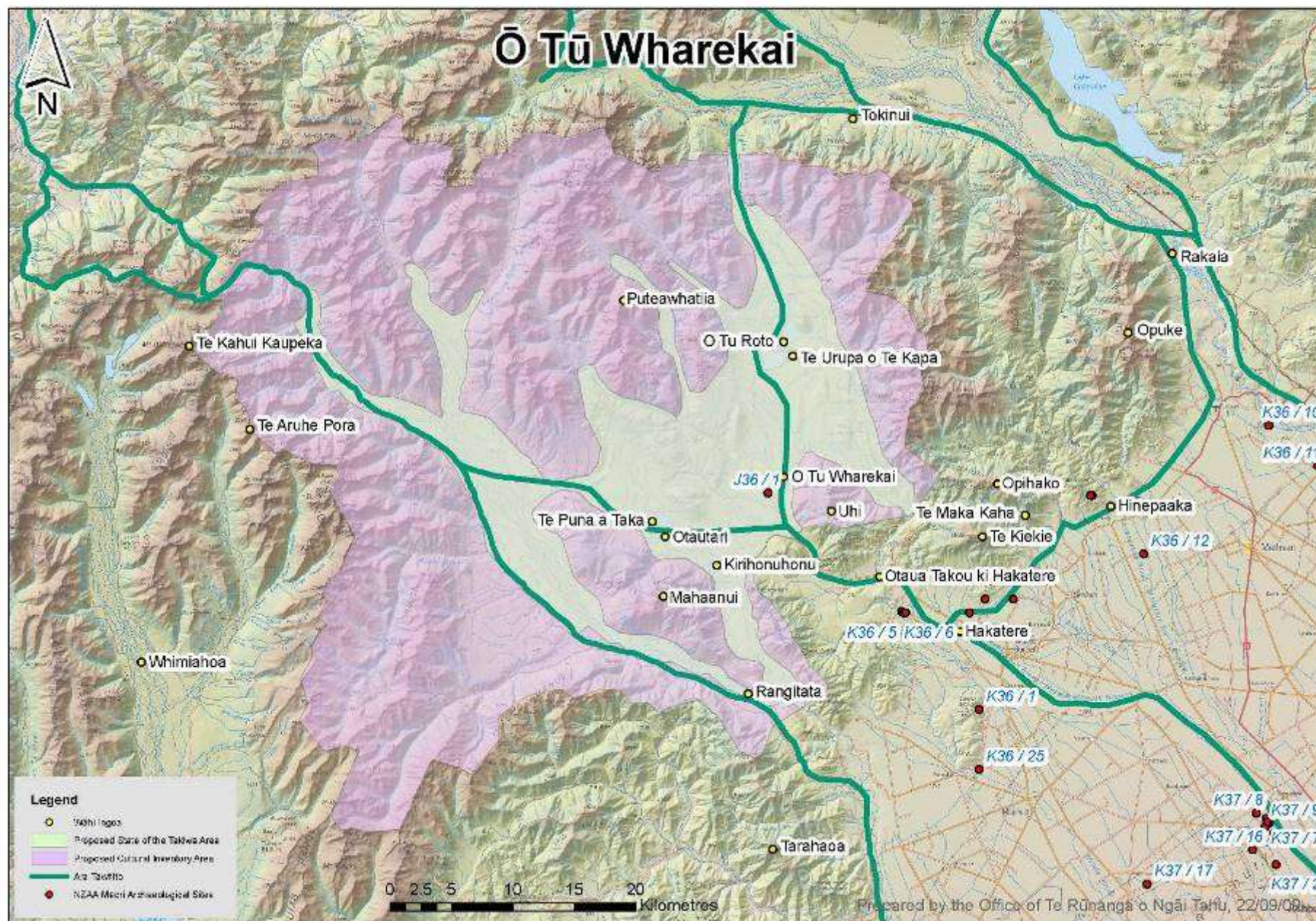


Figure 7: Māori trails, place-names and archaeological sites associated with Ō Tū Wharekai (Source: Te Rūnanga o Ngāi Tahu)

2.3. Te Ao Hurihuri - Recent History of Ō Tū Wharekai

Following the Kemps Purchase of Canterbury by the British Crown from Ngāi Tahu in 1848, high country areas such as the Ashburton Lakes were progressively sub-divided into large farming 'runs', mainly for sheep farming. From the late 1850's, therefore, a number of early runs were established in and around Ō Tū Wharekai which began the process of native vegetation clearance and habitat degradation through burning and grazing. Merino sheep were established as the dominant stock of the mountainous areas of the high country, while Romney's and other breeds were put to work on the hills and flat land. While other forms of farming and agriculture have developed over time, sheep farming predominates. The arrival of the railway to Mt Somers in 1889 supported the agricultural growth in the area, making the region more accessible, and the transportation of stock, as well as local mining activities, easier and more economically viable. From the 1920's, largely due to the advent of the motorcar, recreational use of the area began, with hunting and shooting, and later boating, hiking and even skiing becoming popular (Whelan 1990).

Early European explorers, run holders and settlers to the area included: Thomas and Emma Potts (Hakatere Station), Samuel Butler (Mesopotamia Station), John Barton Arundel Acland (Mt. Possession/Mt. Peel Station), Charles and Ellen Tripp (Mt. Possession/Mt. Somers Station), F.G.P. Leach (Upper Lake Heron station), John Dudley (Clent Hills), Richard Morton and Leonard Stace (Stonechubie/Erewhon Station), Laurence Kennaway (Alford Forest), and A. Lean, O. Mathias, G.K. Mellish, W. Turton and W.D. Barnard (Double Hill). Julius von Haast and Dr. Andrew Sinclair were amongst the first European's to study the geology and botany of the upper Rakaia and Rangitata rivers, with Sinclair unfortunately dying at Mesopotamia trying to cross the Rangitata. Many of these 'pioneers' are remembered in the contemporary landscape through placenames, but are also an important source of information about the past ecology and wildlife of the area. Many significant writings and works were completed by these early settlers and explorers and provide a glimpse of the landscape that confronted them, as well as an understanding of how they transformed the landscape into what we see today (Haast 1866, Acland 1930; Barker 1870; Butler 1863; Kennaway 1874; Potts 1882; Scotter 1972).

It is clear that during these early years of European settlement "native vegetation, [was] regarded as an obstruction to travel and grazing, [and therefore] was often cleared by burning" (Department of Conservation, 2009). Kennaway (1874) gives a haunting testament to the process describing that "a hot, roaring belt of fire blazed up the hill-side, hissing and cracking, and...screaming human screams, as the thick untouched jungle of scores of years withered and twisted in the flames". Barker (1867) also famously wrote about 'the exceeding joy of burning' stating, with some irony, that "we always avoided burning where a grove of pretty Ti-ti palms [tī kouka/cabbage trees] grew; but sometimes there would be one or two on a hill-side growing by themselves, and then it was most beautiful to see them burn".

This extensive burning, along with the subsequent introduction of the range of exotic species associated with pastoral farming, as well as the ongoing effects of intensive and long term grazing, has lead to large scale vegetation changes with the basin, as well as leading to the loss of a number of native bird species, namely the eastern buff weka. T.H. Potts, an early runholder of the Hakatere Station lamented the loss of such species in his work *Out in the Open* and "remarked on the short-sightedness of introducing birds of prey and insect eaters to help agriculture while unprotected native hawks and insectivorous kiwi were being destroyed [mostly for sport]" (Star, 2007). Furthermore, the use of the basins for agriculture have undoubtedly had an impact on the integrity and original quality and extent of the wetlands, lakes, streams and rivers of the area, along with their associated flora and fauna.

To protect the outstanding natural features of the basin, over time large areas have developed into a complex of nature reserves, wildlife refuges, public conservation lands, and most recently an extensive conservation park. Associated with the establishment of the Hakatere Conservation Park has been the development of the Arawai Kākāriki Wetland Restoration Programme, which has provided central government funding to the Department of Conservation to help protect and restore three nationally important wetlands, including Ō Tū Wharekai, as well as Whangamarino in Waikato, and Awarua/Waituna in Murihiku/Southland. The research outlined in this report is funded as part of this programme.

2.4. Ngā Tohutoro Rangahau - *Other Information Sources and Research*

As well as the important work of Taiaroa (1880), Beattie (1945), Andersen (1942) and Taylor (1950) in recording Māori traditions and placenames of the Ō Tū Wharekai area, and the early writings of Acland (1930), Barker (1870), Butler (1863), Kennaway (1874), Potts (1882) and Haast (1866) regarding pioneer life, the original flora and fauna and subsequent landscape change, a number of other historical, and conservation and policy related research and information has been gathered and published about the area. These include:

- A range of historical texts covering European settler life, exploration and activities for mid, central and South Canterbury (Anderson 1916; Pinney 1971; Cochrane 1996; Relph 2007), Ashburton Borough/County (Brown 1940; Scotter 1972; Hewson 1996), the Upper Ashburton and Ashburton Gorge (Vance 1976; Chapman 1996), the Rakaia Head waters (Moreton 1918a; Anderson 1981), Lake Heron (Moreton 1918b), Erewhon (Beckett 1978), Mesopotamia (Newton 1960), and Double Hill Station (Ensor 1990).
- Tangata Whenua Values Reports for Environment Canterbury by Tipa (2001) and Goodall (2001) for the Rangitata and Hakatere catchments respectively;
- Management plans, issues and options and discussion papers (Taylor 1981; Canterbury Regional Council 1992; & Mosley 2001);
- Masters thesis's by Murray (1984) and Bray (2002) on balancing conservation and agriculture; and
- Heritage (Whelan 1990) and Ecological/Biological (Burrows 1997; Harrington et al 1986; Jane 1984; Stokes 1992; Davis 1979) surveys and assessments.

Most recently, the Arawai Kākāriki Wetland Restoration Programme has lead to the following studies being undertaken:

- Lakes and Streams Surveys (Dungey 2008)
- Lizard Surveys (Lettink 2008)
- Braided River predator detection study (Pickerell 2007)
- Southern Crested Grebe Habitat Survey (Crump 2008)
- Ashburton Lakes SPI Report (de Winton/NIWA 2008)
- Ashburton Lakes Fish Survey (Dungey 2008)
- Ō Tū Wharekai Cultural Values and Health Assessment (Norton, Pauling & Home 2009)
- Waikakahi/Freshwater Mussel Surveys 2010

3.0 NGĀ KAUNEKE - *METHODS*

The data collection undertaken within this study was conducted over a one week period from the 8-12 of February 2010. It involved members of Te Rūnanga o Arowhenua who assessed 25 sites across the Ō Tū Wharekai / Ashburton Lakes area, chosen due to their significance as, and linkages to, traditional and/or contemporary mahinga kai (food gathering sites and/or areas). The rūnanga monitoring team was also supported by Hills Laboratories who undertook the e.coli water testing. The data collection primarily involved cultural health site assessments using the Takiwā tool. This was further complemented by the use of the Cultural Health Index, Stream Health Monitoring and Assessment Kit, electric fishing surveys, fyke netting and the collection and testing of water samples for the analysis of E.coli and antibiotic resistant E.coli. The data collected from the site assessments were then analysed for inclusion in the report.

The following sub-sections give an outline of the planning undertaken, people involved, equipment used, sites assessed, and methods used to collect data, as well as an overview of the data analysis undertaken.

3.1. Kōrero Arotake - *Monitoring Hui and Planning*

To initiate the study, a number of hui were held along with an initial site visit to the Ō Tū Wharekai / Ashburton Lakes area.

The first planning meeting took place at Arowhenua in March 2009 and involved Mandy Home (Te Rūnanga o Arowhenua Marae/Environmental Manager), Takerei Norton (Ngāi Tahu Heritage Consultant), Craig Pauling (Ngāi Tahu Monitoring Consultant / Project Manager) and Kennedy Lange (Department of Conservation - Raukapuka Office). This meeting discussed potential monitoring sites, the focus of monitoring and the methods to be employed. The meeting also made plans for a site visit to the study area and the logistics and planning required to complete it.

A site visit to the study area was undertaken in April 2009 and involved visiting potential monitoring sites and understanding access issues and other logistical concerns for the monitoring to be undertaken. This visit also allowed for photographic records and other data and material to be collected around the location of traditional sites and placenames for the '*Ō Tū Wharekai Cultural Values Report*' that was subsequently completed in September 2009. This work also allowed for the identification of appropriate monitoring sites that were located in areas of traditional significance, as well as information and mātauranga on the species that were both present and known to be utilised by Ngāi Tahu in the past.

As part of the planning work and research for the Cultural Values Report, a literature review was also undertaken to collect supporting information to understand both the natural and human history of the area, along with past ecology and vegetation cover and the changes to these over time. A number of reports including the Survey Report for the Protected Natural Areas Programme for the Heron Ecological Region (Harrington et al 1986) and the Inventory of Historic and Archaeological Site of Ō Tū Roto (Whelan 1990) were referenced.

A further meeting was also held between Craig Pauling and Karl Russell (Te Rūnanga o Arowhenua Mahinga Kai Practitioner) in December 2009 to discuss and refine monitoring sites, methods and equipment requirement for the fyke netting and measuring of tuna (eels) from the Ashburton Lakes.

From these meetings, a monitoring plan was developed that guided the data collection activities and included:

- A background to the field work, the aims and expected outcomes;
- An explanation of the area and sites to be assessed;
- A timetable and schedule of activities;
- The data collection methods;
- A budget;
- Health and Safety considerations;
- Maps, Assessment forms and other important information.

The monitoring plan for the cultural health assessment of Ō Tū Wharekai is included as Appendix A.

3.2. Tāngata Arotake - *Monitoring Team*

The following people were involved in the initial hui, planning fieldwork, and/or reporting:

- | | |
|---------------------|---|
| • Mandy Waaka-Home | • Iaeen Cranwell |
| • Karl Russell | • Takerei Norton |
| • Wayne Anglem | • Craig Pauling |
| • Rawiri Reihana | • John and David Aitken
(1000 Airplanes Ltd) |
| • Wetere Home | • Francis Ganderton (Canterbury
Health Laboratories) |
| • Daniel Neame | • Kennedy Lange, Wendy
Sullivan and Rose Clucas
(DoC Raukapuka) |
| • Caleb Murphy | |
| • Makarini Rupene | |
| • Te Marino Lenihan | |

3.3. Taputapu Arotake - *Monitoring Equipment*

The following equipment was used during the study and fieldwork:

- 4WD Vehicles
- Boat/Waka
- Takiwā forms (All sites), CHI forms (River/Stream sites only)
- SHMAK Kit, manual and forms (River/Stream sites only)
- Electric Fishing Machine/Gear
- Fyke nets, weights and stakes
- Vials, labels and bags for fish samples
- Spotlight gear and torches for night fish spotting
- Knives and tweezers for sample collection
- Fish scales and ruler
- Chilly bins, fish bins and bags
- E.coli water vials (100mls) and ice packs
- Digital Camera/Video Camera
- GPS unit and Maps
- Panasonic Toughbook Laptop
- Pens and folders and Monitoring Plan
- Identification booklets
- First Aid Kit/Weather Reports
- Satellite Phone/Cellphone

3.4. Wāhi Arotake - *Monitoring Sites*

A total of 24 sites were identified and assessed as part of the study. The sites are listed below along with an indication of the type of monitoring that was undertaken at each. These sites are also shown in Figure 8 on the following page.

Te Rakitata / Rangitata River

1. Erewhon = Takiwā/CHI/E.coli
2. Potts River = Takiwā/CHI/SHMAK/E.coli/Efish
3. Mesopotamia = Takiwā/CHI/SHMAK/E.coli/Efish
4. Pudding Valley Stream = Takiwā/CHI/SHMAK/E.coli/Efish

Te Puna a Taka / Lake Clearwater

5. Clearwater Upper (Craddock Stream Wetland) = Takiwā/E.coli
6. Clearwater Settlement = Takiwā/E.coli + Hinaki-Fyke
7. Clearwater Outlet = Takiwā/E.coli + Hinaki-Fyke
8. Lambies Stream = Takiwā/CHI/SHMAK/E.coli/Efish

Ōtautari / Lake Camp

9. Ōtautari Northside = Takiwā/E.coli + Hinaki-Fyke
10. Ōtautari Southside = Takiwā + Hinaki-Fyke

Kirihonuhonu / Lake Emma

11. Northern Wetland/Inlet = Takiwā/E.coli + Hinaki-Fyke

Hakatere / Ashburton River

12. Hakatere ki te Toka (Heron Rd Bridge) = Takiwā/CHI/SHMAK/E.coli/Efish
13. Hakatere Corner (Outflow of Clearwater/Emma) = E.coli
14. Otatau Tākou ki Hakatere (Stour/Ashburton River Confluence) = Takiwā/CHI/SHMAK/E.coli/Efish

Ō Tū Wharekai / Māori Lakes

15. Upper Māori Lake = Takiwā/E.coli + Hinaki-Fyke
16. Lower Māori Lake = Takiwā/E.coli + Hinaki-Fyke
17. Lower Maori Lake Outlet (to Hakatere) = E.coli
18. Jacobs Stream = E.coli
19. Gentleman's/Clent Hill Stream = E.coli

Ō Tū Roto / Lake Heron

20. Swin River Access = Takiwā/E.coli + Hinaki-Fyke
21. Oliver Stream Inlet = Takiwā/CHI/SHMAK/E.coli/Efish+ Hinaki-Fyke
22. Dunbar Stream Inlet = Takiwā/CHI/SHMAK/E.coli/Efish+ Hinaki-Fyke

Rakaia River

23. Lake Stream (Heron Outlet) = Takiwā/CHI/SHMAK/E.coli/Efish+ Hinaki
24. Tokinui = Takiwā/CHI/E.coli

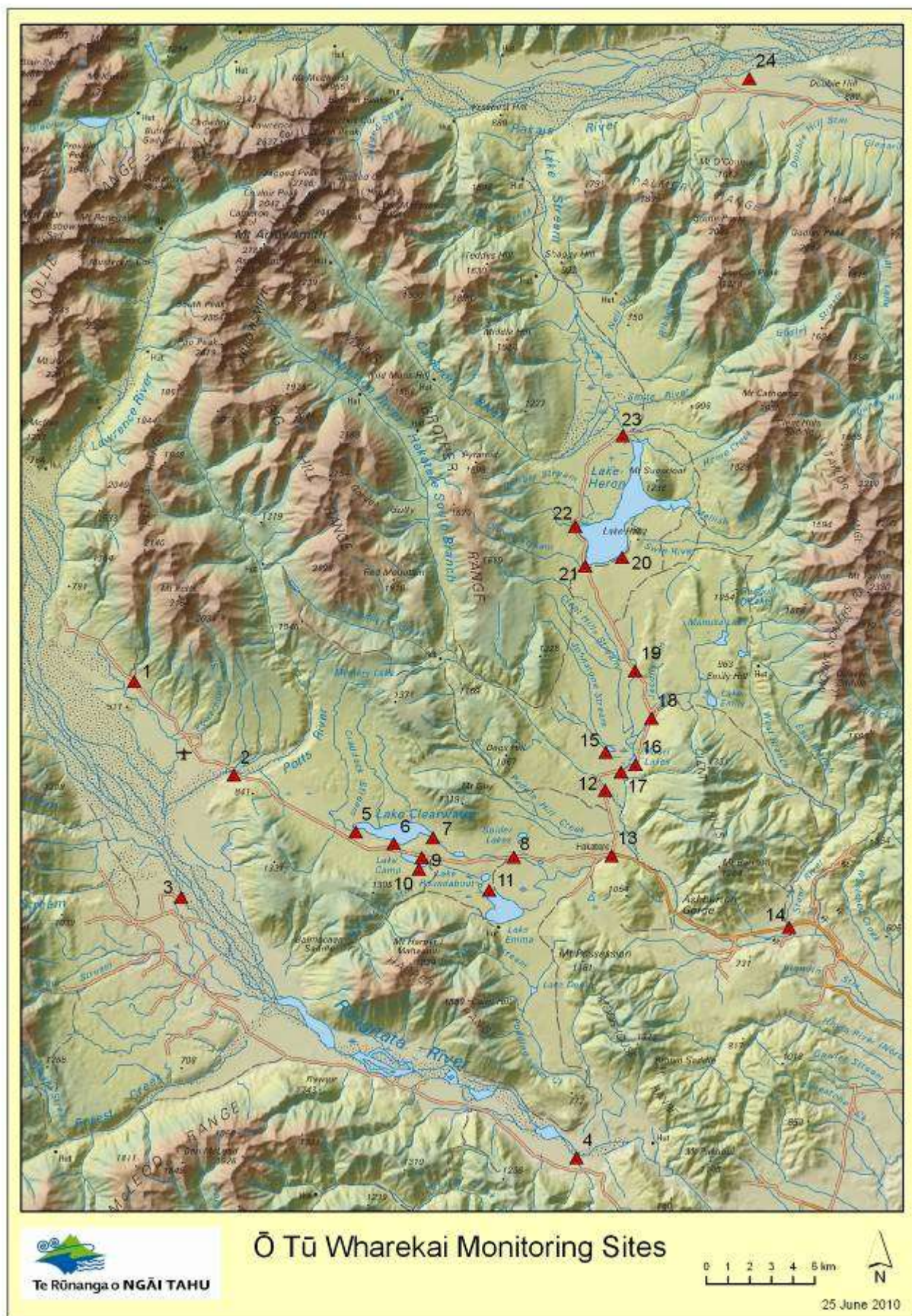


Figure 8: Map showing sites of the Ō Tū Wharekai Cultural Health Assessment (Source: Te Rūnanga o Ngāi Tahu)

3.5. Kauneke Arotake - *Data Collection and Assessment*

The data collection undertaken within the study involved the following types of assessment:

1. Takiwā Site Assessments
2. Cultural Health Index - Water Quality Assessment
3. Stream Health Monitoring Assessment
4. E.Coli Water Testing
5. Fish Surveys: Electric Fishing and Fyke Netting

The specific details of each type of assessment are outlined in the subsections below, while the monitoring forms used during the study are included in Appendix B.

The general process followed for the data collection at all sites involved the following steps:

- After arriving at the site, the monitoring team gathered together so that any appropriate mihi, karakia and/or kōrero could be given.
- The team then completed the Takiwā Site Definition and Visit Details forms, including obtaining GPS coordinates and photographic records for the site.
- The team then completed the Takiwā site assessment form and gathered the water sample for E.coli testing. At all river/stream sites the team then undertook the various tests as part of the SHMAK kit, completed the Cultural Health Index water quality form, before finally undertaking an electric fishing survey of the site. At lake sites, fyke nets were set in the evening and recovered the following morning.
- Before departing, a general kōrero/discussion was held about the site, and travel and other details about the next site and/or activity.

3.5.1. Takiwā Assessments

The basis for assessments undertaken involved using the Takiwā assessment forms. These forms are based on the forms developed for the Cultural Health Index, FORMAK, SHMAK, Kaimoana Guidelines, and Wetland Indicators and were developed by Te Rūnanga o Ngāi Tahu in conjunction with Ngāi Tahu Papatipu Rūnanga. The Takiwā forms aim to record observations and assessments of rūnanga/iwi members for a particular site and at a particular time. The form attempts to capture cultural information and values about the site to turn what is more commonly described as ‘anecdotal evidence’ into something more defensible.

The first step of the Takiwā site assessment involves completing the Site Definition form. This required recording information on the site name, referring to both traditional and current names, the location, legal protection issues, and the traditional significance and condition of the site, as well as recording the exact geographical details using a GPS receiver. For Takiwā assessments, a site is defined as the area within 100 metres of the point of monitoring.

In the second step, visit specific details such as the individuals involved, the date, time, weather conditions and other information relevant to the visit, including photographic records are then recorded on the Visit Details form.

The third step involves completing the site assessment form. The first part of the site assessment form involved ranking the following aspects of site health using a 1 to 5 scale, where 1 is the least/worst score and 5 is the highest/best score:

- Amount of pressure from external factors;
- Levels of modification/change at the site;
- Suitably for harvesting mahinga kai;

- Physical and legal access issues;
- Willingness to return to the site (simply a yes or no answer); and
- Overall state/health of the site.

The second part of the site assessment form involved undertaking abundance and diversity counts for native bird, plant and fish species, other resources (such as stone, bone or driftwood) as well as introduced plant and animal species. This was achieved via visual and aural identification of individual species along with a weighting given to their relative abundance (few/some/many) at the site. The assessment of fish species was undertaken at all river sites through electric fishing while at lake sites fyke netting was undertaken to assess the health and abundance of tuna or freshwater eels (see section 3.5.5 below).

The assessment of taonga plant species also included a question to indicate the relative dominance of native species versus exotic or weed species at the site. This is represented as a percentage of the total site area covered by the taonga plants and gives an important indicator of change at the site over time.

From this information, index scores are quantified for overall site health (total averaged factor scores out of 5) and species abundance (an open ended number, which can be positive or negative and where higher is better). The site health score is then assigned a rank from very good to very poor and used in the overall analysis of the catchment (Pauling 2007).

3.5.2. Cultural Health Index Waterway Assessment

The Cultural Health Index (CHI) was developed by Gail Tipa and Laurel Tierney with support from the Ministry for the Environment and Te Rūnanga o Ngāi Tahu. The original CHI was completed in 2003 (Tipa & Tierney 2003), with a revised version being published in 2006 (Tipa & Tierney 2006).

The methodology for the Cultural Health Index is very similar to the Takiwā site assessment, where a form is completed relating to a number of ranking questions, along with the identification of valued bird, plant and fish species. The major difference is that the Cultural Health Index is focussed solely on assessing the cultural health of the waterway at a particular site, rather than land resources over the entire site. Other obvious differences are the exclusion of assessments for pest and weeds and other resources. Another difference in the CHI is the grading and scoring system associated with it.

The CHI has three components - traditional association, mahinga kai and stream health. To derive the index at a particular stream site, first traditional association is identified, then mahinga kai values are assessed, and finally cultural stream health is evaluated. Almost all the necessary data for these measures are derived from the recording forms.

Component 1 – Site status

This identifies whether or not the site is of traditional significance to tāngata whenua and can be determined when the sites are first selected. The second part of the status grade indicates whether tāngata whenua would return to the site in future.

Stream sites are classified according to traditional association and intention to use in the future, including:

- *Is there a traditional association between tāngata whenua & the site?* Sites of traditional significance are assigned an 'A'. Sites that do not have a traditional association are assigned a 'B'.

- *Would Māori come to the site in the future?* Whether the tāngata whenua would return to the site or not is also recorded. If the tāngata whenua would return, the site is awarded a 1, and if not, a 0.

Component 2 – Mahinga kai

Examining the health of mahinga kai recognises that mauri is tangibly represented by the physical characteristics of a freshwater resource, including the indigenous flora and fauna, the fitness for cultural usage and its productive capacity.

The mahinga kai measure has four elements, each of which is scored on a 1–5 basis (1 is poor health, 5 is very healthy):

- Identification of mahinga kai species present at the site. A score is given depending on the number of species present. The productive capacity of a site is reflected in the ability of the freshwater resource to yield mahinga kai.
- Comparison between the species present today and those sourced traditionally from the site. A score is given based on the number of species of traditional significance that are still present. Maintaining cultural practices, such as the gathering of mahinga kai, is an important way of ensuring the transfer of cultural values through the generations.
- Access to the site. Do tāngata whenua have physical and legal access to the resources they want to gather?
- Assessment of whether tāngata whenua would return to the site in the future as they did in the past.

The four mahinga kai elements are then averaged to produce a single score between 1 and 5.

Component 3 – Cultural stream health

The cultural stream health measure is the average of 1–5 scores awarded to each of eight individual indicators:

- | | |
|----------------------------|-------------------------------|
| • Water quality | • Riparian vegetation |
| • Water clarity | • Riverbed condition/sediment |
| • Flow and habitat variety | • Use of riparian margin |
| • Catchment land use | • Channel modification |

The Overall Cultural Health Index

The three components are brought together in an overall Cultural Health Index score. When the CHI is calculated for a specific site, a score is generated and expressed as: A-0 / 2.1 / 4.2 where:

- A identifies the site as traditional (rather than a B for non-traditional)
 - 0 indicates that Māori would not return to this site in the future (1 indicates they would return)
 - 2.1 is the mahinga kai score (score of 1-5)
 - 4.2 is the overall evaluation of stream health (score of 1-5)
- (Tipa & Tierney 2003 & 2006)

3.5.3. Stream Health Monitoring (SHMAK) Assessment

The Stream Health Monitoring and Assessment Kit (SHMAK) was developed by the National Institute of Water and Atmospheric Research (NIWA) in partnership with Federated Farmers of New Zealand and partly funded by the Ministry for the Environment (MfE) (Biggs et al 2000).

An Iwi-SHMAK kit was also developed by NIWA in partnership with Te Rūnanga o Ngāi Tahu and funded by MfE (Ogilvie & Penter 2001).

SHMAK allows the measurement of water flow/velocity, pH, temperature, conductivity, clarity, streambed composition, riparian vegetation, invertebrates, periphyton and catchment activity through the use of a number of monitoring instruments and the recording of data onto forms. The information collected is ranked using a scoring system to understand how healthy the stream is and how it may be changing over time.

SHMAK was used to collect the following types of data and using the following methods:

Biological Data

Common and easily recognised biological indicator organisms known to be characteristic of certain stream health conditions were observed and/or counted, including:

- Types of stream invertebrates (e.g., insects, snails).
- Types of periphyton (algae/slimes on the bed of the stream).

This was achieved by scooping samples into containers and using an identification sheet to identify and record the different species present.

Stream Habitat Data

Measurements and observations of physical and chemical conditions at a monitoring site, consisting of:

- Water velocity (measuring the time it takes an object to float a set distance downstream);
- Water pH (using pH strips dipped in a separate water sample from the site);
- Water temperature (using a thermometer dipped in a separate water sample);
- Water conductivity (using a conductivity meter dipped in a separate water sample);
- Water clarity (using a water clarity tube filled with water from the site)
- Composition of the stream bed (by observation and estimation of percentages of rocks, gravels, sand, plants, etc);
- Presence and extent of loose, silty deposits on the stream bed (by observation and estimation according to a set guide); and
- Stream-bank vegetation at the site (by observation and estimation of percentages of different types of vegetation).

Each monitoring observation was recorded on special forms and assigned a score. Individual factor scores were then combined to develop overall scores for stream habitat, invertebrates and periphyton health. An overall rating for sites was then calculated based on pre-determined rankings within the SHMAK methodology. These scores depend on the type of stream which is in turn based on the composition of the stream-bed and the relative abundance of fine substrates in the bed (Biggs et al 2000).

3.5.4. E.Coli Water Testing

E.coli water testing involved two assessments, using a single 100ml water sample collected from each site:

- Laboratory analysis to quantify the total E.coli in the sample (per 100mls); and
- Further laboratory analysis of the sample to identify the main source of any E.coli present in the river water, through anti-biotic resistance analysis.

Water samples were collected in plastic screw top 100ml vials, labelled with the site code, put on ice in a chilly bin, and posted (via Mt. Somers store) to Hill's Laboratory for analysis within 24 hours. Results from the laboratory analysis were then sent back to the monitoring team for inclusion in the analysis of the study.

Background to E.coli and Anti-biotic Testing

Faecal Coliforms are a group of bacteria that include E.coli. Members of the coliform group also include other bacteria that may be found in the soils, and also in the intestines of birds. A positive faecal coliform result therefore indicates the possibility of faecal contamination, but is not totally reliable.

The presence of E.coli, however, indicates contamination with faecal material from the intestinal tract of a mammal or birds. As a general rule, the drinking water standard uses the detection of 1 E.coli in 100ml of water as rendering it unfit for human consumption (Ministry of Health 2000). There are also standards for shell-fish gathering and contact recreation (Ministry for the Environment 2003). A summary of these standards are included as Appendix C of this report.

Drinking water supplies susceptible to contamination with sewage or other excreted matter may cause outbreaks of diarrhoea or intestinal infections. Kaimoana gathered near water contaminated with faecal matter may also contain intestinal pathogens because shellfish filter and concentrate organisms inside their body.

It is sometimes difficult to detect bugs like campylobacter that cause health problems, because they occur in very low numbers. Instead we rely on tests that will reveal the presence of bugs associated with faeces (such as E.coli and faecal coliforms) that show contamination of the water, but do not usually cause harm themselves.

A further piece of analysis that can be carried out with E.coli is the detection of anti-biotic resistance. Anti-biotic resistance in E.coli is a strong indication that the E.coli has previously been exposed to anti-biotics, or has acquired the anti-biotic resistance factor by association with an E.coli containing the factor. Specific anti-biotics (eg. Apramycin) are uniquely associated with the agricultural use of antibiotics, and the detection of this resistance indicates agricultural origin of the E.coli. Resistance to other anti-biotics used solely by humans can therefore indicate contamination from human effluent and so on. Moreover, a sample showing no resistance or 'sensitivity' can indicate that the contamination is more likely from a natural source, such as a bird or from the soil (Pauling et al 2005).

3.5.5. Electric Fishing and Fyke Netting

Electric Fishing is a method widely used to survey fish within wadeable rivers and streams. The method involves the use of a specially designed machine that creates an electric field in the water that temporarily stuns fish to facilitate their capture in nets for closer inspection and identification.

This study utilised the Kainga EFM 300 packset in-conjunction with a hand held scoop net and larger mesh net. The EFM 300 consists of a battery-powered backpack generator unit, a fibreglass wand with cathode, and an earthing wire. The machine allows output voltage, frequency, and pulse width to be controlled and also incorporates a timer that records the number of minutes in use. The EFM 300 also includes four separate safety circuits to maximise user safety. Both machine and net operators wear full length neoprene waders and rubber safety gloves, with cotton inners during surveying (NIWA 2007).

Electric fishing surveys were conducted at river and stream sites over a 10-20 metre stretch of river and involved one pass on each bank, taking between 10-20 minutes in total. Voltage settings were normally 300 volts and adjusted to optimise the electric field according to the indicator on the wand. Fish were scooped out, counted and inspected to ascertain the species type and record their general size, before being returned to the water. At some sites a selection of fish were also photographed. Data on fishing time, distance of river fished, fish numbers, species and size were recorded on the fish section of the Takiwā site assessment form.

Fyke netting surveys were also undertaken to obtain data on the presence/absence, and abundance, along with catch effort information of the tuna/eel species within the lakes. Standard fyke nets were set within all lakes at major inflow and outflow areas, as well as mid-lake edge sites. Nets were numbered, recorded by GPS and set either on sunset or after dark and left overnight. The nets were then checked the following morning, with size and weight data being collected for the tuna (eels) caught by measuring and weighing each eel using a special measuring trough and fish scales. Clove oil was used to calm the eels to enable the collection of this data.

3.6. Data Analysis

After the fieldwork was concluded, data from the completed monitoring forms was loaded into the Takiwā database, from which scores for the Takiwā, Cultural Health Index and SHMAK assessments were calculated.

Scores from the sites were then analysed and graphed using excel to show the relative rankings of the sites from very good to very poor. Other data was also extracted from the database in relation to the presence and abundance of native and exotic species and how these related to the relative scores of each site. Individual indicator scores from each assessment tool were also isolated, totalled and averaged across the sites. This allowed an evaluation of the relative significance of different aspects of health to be undertaken and assessed.

E.coli and anti-biotic resistance test results were obtained from Hills Laboratories and the data entered into excel spreadsheets. The data was then assessed against national drinking water, shellfish gathering and recreational standards for E.coli and graphed to show the number of samples that passed and failed the different standards, as well as the number that had anti-biotic resistance.

Results of Hinaki-Fyke netting for tuna/eel species were analysed by calculating Catch Per Unit Effort (CPUE) for each species (long and short fin), each site as well as the overall total for each lake, and the overall across all sites and for both species. Length frequency graphs were also developed for each lake and each species by grouping tuna into 20cm length increments.

The results from the above assessments and analysis are outlined and discussed in the following sections.

4.0 NGĀ HUA - RESULTS

This section outlines the results of the monitoring fieldwork and subsequent analysis carried out within the study.

4.1. Takiwā Site Assessments

Takiwā assessment results across the 20 sites monitored ranged from good to poor, with the majority being of moderate health (50%). A further 35% of the sites were rated as good, while the remaining 15% were rated as poor. No sites were rated as very poor or very good.

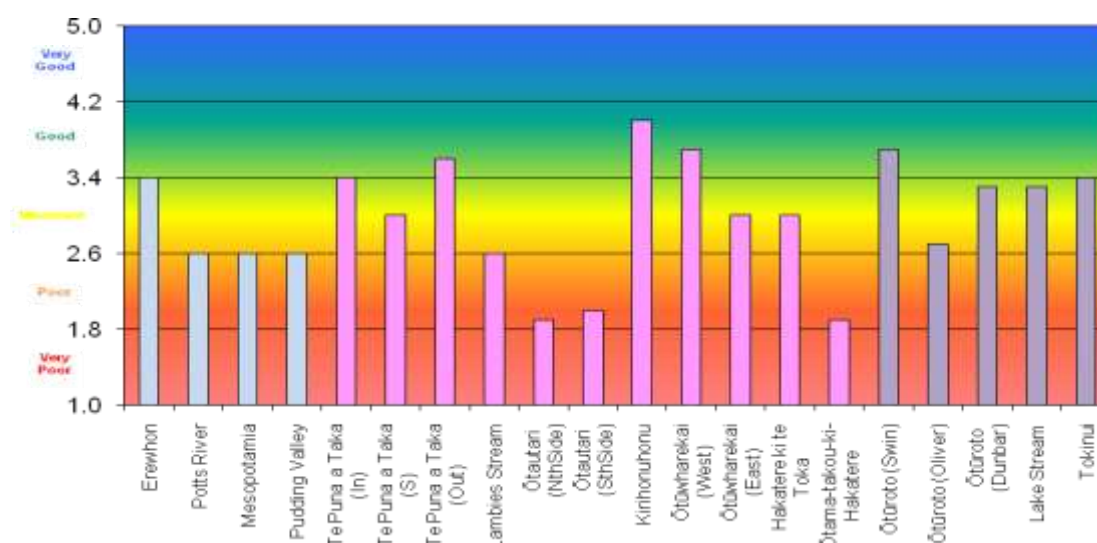


Figure 9: Ō Tū Wharekai Takiwā Assessment Scores

Overall, the sites scored well on willingness to harvest and access indicators but poorly on biodiversity and valued species abundance indicators.

The best rating site was Kirihonuhonu/Lake Emma (4.0), followed by Ō Tū Wharekai (West)/Upper Maori Lake and Ō Tū Roto/Lake Heron at Swin River Access (both 3.7) and Te Puna a Taka/Lake Clearwater (Outlet) (3.6). The worst rating sites were Ōtautari/Lake Camp (North Side) and Ōtautari/Lake Camp (South Side) (2.0).

Features of high scoring sites included the degree of remnant native vegetation, and a lack of modification to, or intense pressure on, the site. Features of low scoring sites included a lack of native flora and/or fauna, high modification and/or intense pressure from farming or recreational activities. Overall, critical issues noted were the general loss of native flora and fauna and the continued pressure being put on what is left through agriculture and recreation, particularly at Ōtautari/Lake Camp.

Full results for the Takiwā assessments are included as Appendix D, along with a record of site photographs in Appendix H.

4.2. Cultural Health Index River and Stream Assessments

A total of 10 CHI assessments were done within the study. These included all river and stream sites associated with the chosen assessment sites and included 3 from the Rangitata catchment, 3 from the Hakatere and 4 from the Rakaia.

Stream health scores for the sites assessed ranged from moderate to good, with indicators relating to catchment landuse, river margin use and bed condition being worse overall than those relating to water clarity, modification and habitat variety. Mahinga kai scores for the sites were however very poor to poor, as can be seen clearly in Figure 10 below.

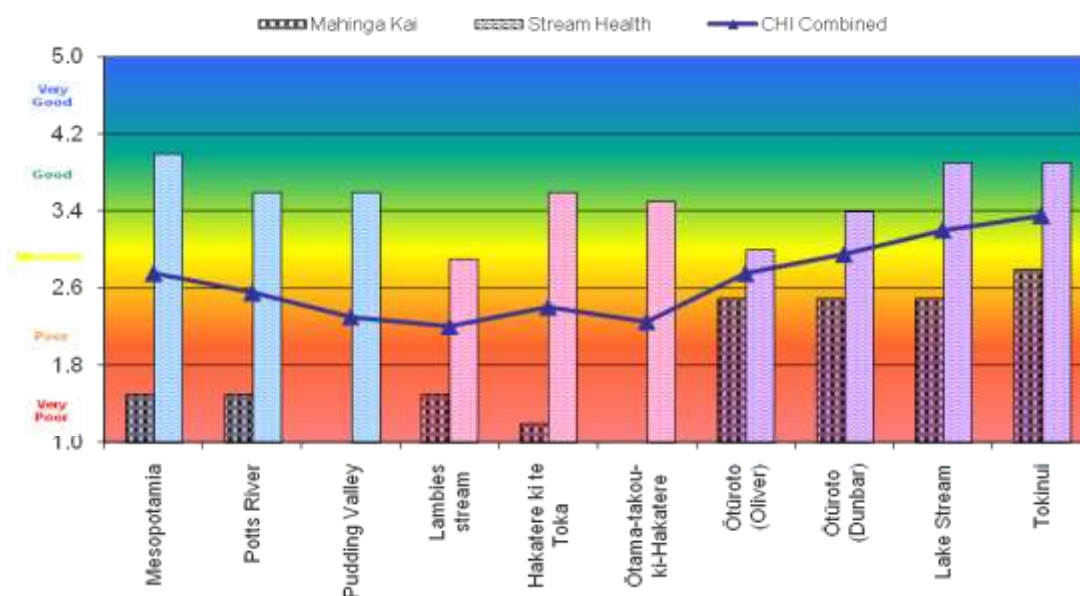


Figure 10: Ō Tū Wharekai CHI Assessment Scores

Combined CHI scores resulted in 50% of the sites being rated as moderate, 40% being poor and the final 10% being good. Tokinui (A-1 2.8 3.9) was the highest ranking site, followed by Lake Stream (A-1 2.5 3.9), with Lambies Stream (B-0 1.5 2.9) being the worst. Full results for the CHI assessments are included as Appendix E.

4.3. Stream Health Monitoring and Assessment Kit Results

Only 8 sites were able to be tested using SHMAK and included those river and stream sites assessed using the CHI, except Lambies Stream and Tokinui.

The SHMAK results highlighted some differences in overall ratings when compared with the CHI scores above, with the SHMAK scores resulting in a greater number of higher rating sites. Overall, however, SHMAK scores, especially those relating to habitat, were again moderate, supporting the Takiwā and CHI assessments.

The SHMAK scores were high for temperature, conductivity, clarity, bank vegetation and invertebrate indicators, but were poor for flow, pH, bed condition and periphyton indicators.

Full results for the SHMAK assessments are included as Appendix F and are shown in Figure 11 below.

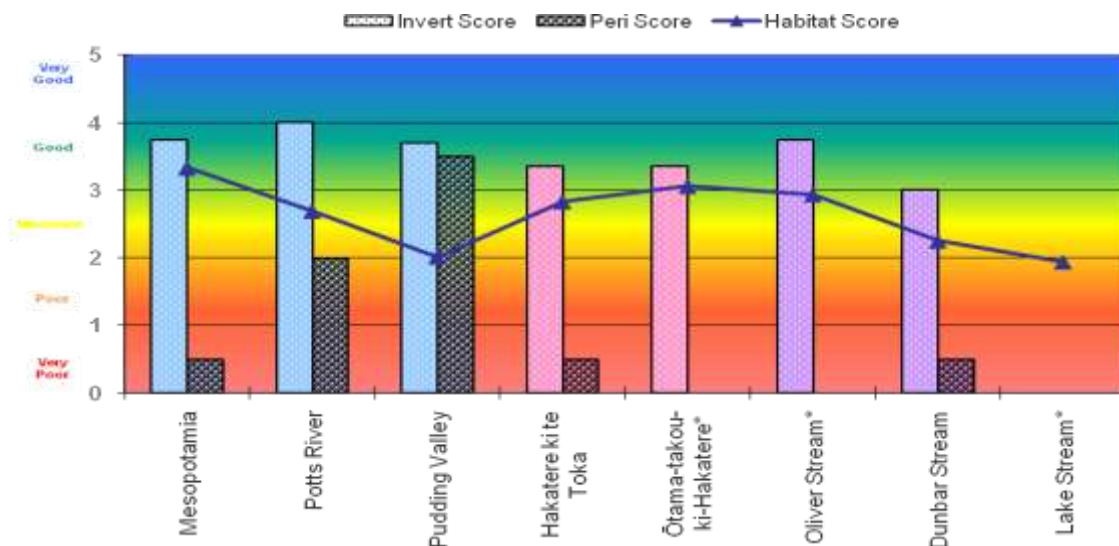


Figure 11: Ō Tū Wharekai SHMAK Assessment Scores * Indicates an incomplete site record

4.4. E.coli Water Testing and Anti-biotic Resistance

A total of 25 sites were assessed for E.coli, with 22 of these being analysed for anti-biotic resistance. This included all 20 sites assessed using the Takiwā tool as well as 5 further associated sites.

Overall, the e.coli assessments supported the Takiwā, CHI and SHMAK results, with the majority of sites (52%) being rated as moderate, but with a higher proportion of lower rated sites (12% being poor and a further 8% being very poor). Only one site, Erewhon (being the upper most catchment site) came close to achieving the drinking water standard, with a result of less than 1 e.coli/100mls. 10 sites or 40% (including Erewhon) achieved the shellfish (food) gathering standard, with a further 13 sites failing the shellfish standard including 3 sites (Hakaterere Bridge, Hakaterere Corner and Oliver Stream) that also failed the recreational standard for water quality.

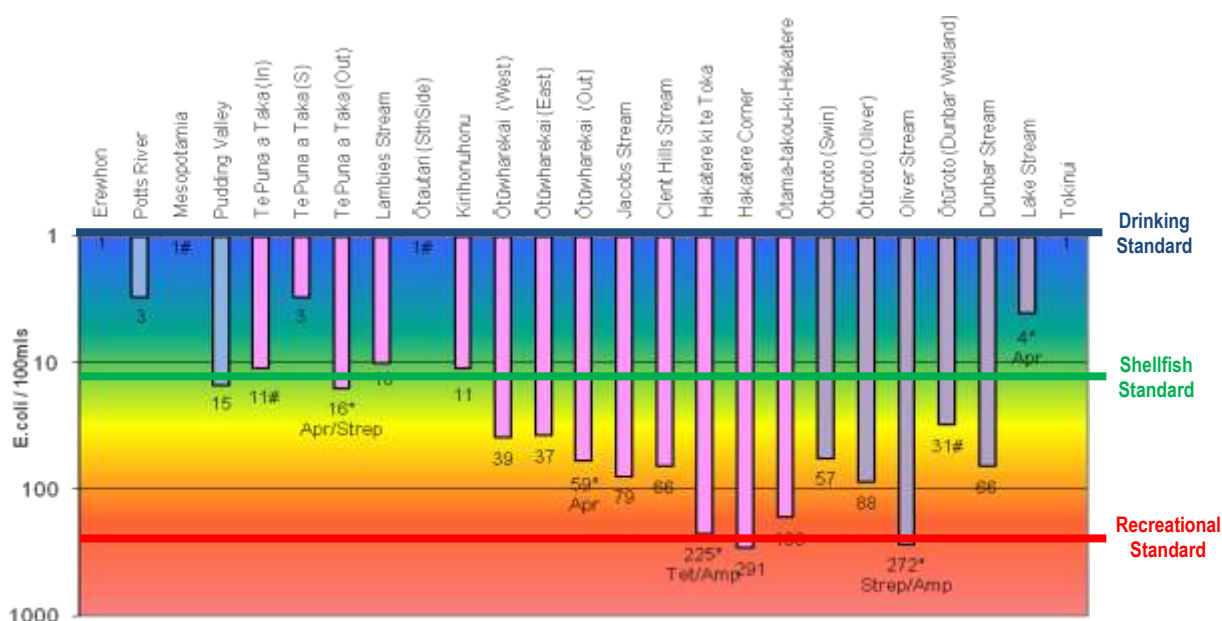


Figure 12: Ō Tū Wharekai E.coli Testing and Anti-Biotic Resistance # Indicates where no Anti-Biotic resistance test was undertaken

A total of 5 sites also showed resistance to anti-biotics, with apramycin being the most common, followed by ampicillan and streptomycin.

Apramycin (present at the outlets of the Lower Maori Lake, Lake Clearwater and Lake Heron) is an anti-biotic that is used exclusively in agriculture, and therefore indicates agricultural sourced faecal pollution, most likely from stock.

Ampicillin (present at Hakatere Bridge and Oliver Stream) is an anti-biotic of the penicillin group most commonly used by humans to treat bacterial infections, and can therefore indicate human sourced contamination at these sites (Aitken, 2007). For Oliver Stream, this is most likely to be from the campsite present at this site.

Streptomycin (found at Oliver Stream and the outlet of Lake Clearwater) is another anti-biotic mostly used within agriculture, further indicating agricultural sourced pollution.

The other anti-biotic identified, Tetracycline (present at Hakatere Bridge), is an older anti-biotic used extensively in human medicine to treat various infections, but also within agriculture due to it being cheap. This can therefore indicate both human and agricultural sourced pollution (Aitken, 2007).

Overall, the results for both Oliver Stream and Hakatere Bridge/Corner are the most alarming due to the high levels of e.coli and the type of anti-biotic resistance being present.

Full results for the E.coli testing are included as Appendix G.

4.5. Native Species Abundance

Native species abundance indicators were measured for the 20 sites monitored using Takiwā and included assessing the abundance of native plant, bird and fish species minus the abundance of exotic species, the comparative numbers of traditional and contemporary species present and the dominance of native vegetation at each site.

Overall, native species abundance, and in particular native vegetation dominance, across all sites was moderate to poor. 70% of the sites had less than 50% of the site area dominated by native vegetation.

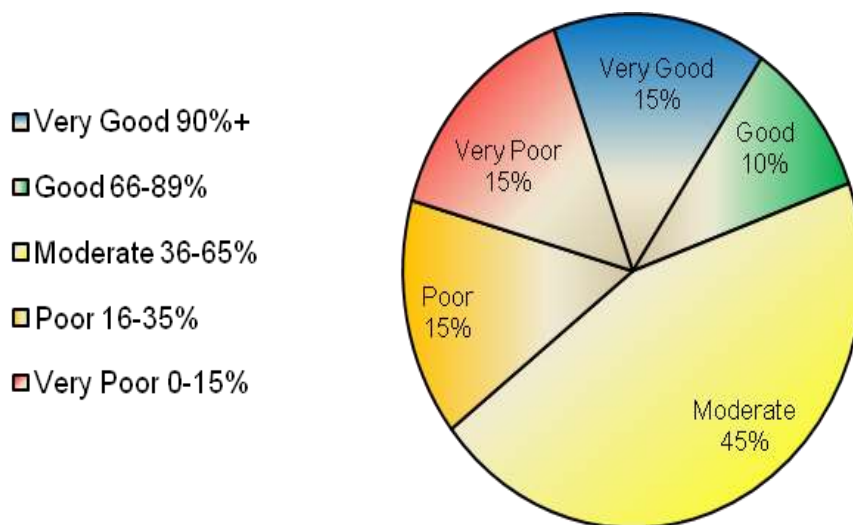


Figure 13: Native Vegetation Dominance across Ō Tū Wharekai sites

Kirihonuhonu/Lake Emma had the best, most diverse and intact native vegetation, having a large remnant wetland present, complete with carex and coprosma species, tussocks and reeds as well as matagouri and taramea at the assessment site. The wetland was largely intact, with very few large exotic species (eg. willow), as well as having a largely unfarmed catchment. The site did however have a number of small weedy exotic species which could be better managed. The Erewhon site overlooking Mount Sunday was also impressive, having an extensive braided river shurbland of poa/silver tussock and tūmatakuru/matagouri on the flat and lower hills between Mount Sunday and the Potts Range, as well as a remnant patch of tāwhairauriki/beechn along with ferns, koromiko, and houhi/mountain ribbonwood within the stream valley coming off the Potts Range.

Of the native plants distributed across all sites, tūmatakuru (matagouri) was the most prevalent, being found at 15 of the 20 sites assessed. This was followed by mikimiki/coprosma species (8 sites), pātītī/fescue tussock and taramea (both 6 sites), while a solitary tī kouka/cabbage tree and a small patch of aruhe/bracken fern was found at the Potts River Site. As mentioned above, tāwhairauriki/beechn was present at the Erewhon site and a significant patch of raupō was present at both Māori Lakes, being a rarity in the high country. A patch of restored plants including kōwhai, maukoro/native broom and mikimiki/coprosma sp. are also present at the Swin River Access site at Lake Heron. Large swathes of tī kouka and tāwhairauriki/beechn were prominent on the hills around the Tokinui site.

Birds were not overly abundant during the assessments, with kāmāna (crested grebe) being the most commonly seen (4 sites), followed by karoro (black backed gulls), kāhu (NZ hawk) and koau (shags) (all 3 sites). In a rare sighting, a lone karearea (falcon) was seen at Ōtautari.

Tuna/longfin eels (10 sites), kōkōpara/bullies (8 sites), waikākahi (freshwater mussels) and tuna/shortfin eels (5 sites) were the most common native fish species encountered through both the electric fishing and fyke netting surveys.

The most common plants or animals encountered across all sites however were exotic, with willows being present at 16 sites out of 20 sites. Exotic pasture grasses and weeds (11 sites), rosehip (10 sites) and pine (8 sites) were the next most common exotic plant species identified. Brown trout were present at 4 sites while swallows and rabbits were both noted at 2 sites.

Table 3 on page 29 shows a summary of all species and resources found across the sites.

Table 2: Native and Exotic Species and Resources observed across Ō Tū Wharekai sites

Type	Rangitata		Hakitere		Rakaia		Total		
	No.	Species	No.	Species	No.	Species	No.	Species	
Manu / Birds	1	Matuku	2	Kaki Anau	2	Kāhu	4	Kamana / Crested Grebe	Rare
	1	Pipipi	2	Kamana	2	Kamana	3	Kahu / Harrier Hawk	Rare
			2	Koau	2	Karoro	3	Koau / Shag	Rare
			1	Karearea	1	Koau	3	Karoro / Black-backed Gull	Rare
			1	Karoro	1	Matuku	2	Kaki Anau / Black Swan	Rare
			1	Kahu	1	Pihohoi	2	Matuku / Bittern	Rare
			1	Pipipi	1	Putakitaki	2	Pipipi / Brown Creeper	Rare
			1	Putakitaki			2	Putakitaki / Paradise Duck	Rare
			1	Poaka			1	Pihohoi / Pipit	Rare
							1	Poaka / Pied Stilt	Rare
							1	Karearea / Falcon	Rare
Rakau / Plants	4	Tumatakuru	8	Tumatakuru	3	Tumatakuru	15	Tumatakuru / Matagouri	Abundant
	2	Mikimiki	5	Patiti	3	Pukio	8	Mikimiki / Coprosma sp.	Occasional
	2	Wi	4	Mikimiki	2	Mikimiki	6	Patiti / Fescue Tussock	Occasional
	1	Aruhe	4	Taramea	2	Haumata	6	Taramea / Spaniard	Occasional
	1	Pikopiko	2	Wi	2	Taramea	4	Pukio / Carex sp	Rare
	1	Koromiko	2	Raupo	1	Tawhai	4	Wi / Silver Tussock	Rare
	1	Houhi	1	Pukio	1	Kōwhai	3	Haumata / Snow Tussock	Rare
	1	Wi Kura	1	Haumata	1	Maukoro	2	Maukoro / Native Broom	Rare
	1	Wiwi	1	Wiwi	1	Patiti	2	Wi Kura / Red Tussock	Rare
	1	Tawhai	1	Wi Kura	1	Ti kouka	2	Tawhai / Beech	Rare
	1	Ti kouka	1	Maukoro			2	Wiwi / Reed	Rare
	1	Toetoe					2	Ti Kouka / Cabbage Tree	Rare
							2	Raupo / Bullrush	Rare
							1	Aruhe / Bracken Fern	Rare
							1	Pikopiko – Fern	Rare
							1	Koromiko / Hebe	Rare
							1	Houhi / Mountain Ribbonwood	Rare
							1	Kōwhai	Rare
Ika / Fish	3	Kokopara	6	Tuna (roa)	4	Tuna (roa)	10	Tuna (roa) / Longfin eel	Common
	2	Koaro	5	Tuna (paku)	3	Kokopara	8	Kokopara / Bully	Occasional
			3	Waikakahi	2	Waikakahi	5	Waikakahi / Freshwater Mussel	Occasional
			2	Kokopara			5	Tuna (paku) / Shortfin eel	Occasional
			1	Cant. Galaxias			3	Koaro	Rare
			1	Koaro			1	Cant. Galaxias	Rare
Taonga / Resources	1	Papa	1	Kahukura			1	Papa / Clay	Rare
	1	Waipuna	1	Kapowai			1	Waipuna / Spring	Rare
			1	Karara			1	Kahukura / Butterfly	Rare
							1	Kapowai / Dragonfly	Rare
							1	Karara / Insect	Rare
Exotic Plant	4	Grass/Weeds	8	Willow	5	Willow	16	Willow	Abundant
	3	Rosehip	5	Grass/Weeds	3	Pinus Radiata	11	Grass/Weeds	Common
	3	Willow	5	Pinus Radiata	2	Grass/Weeds	10	Rosehip	Common
	1	Blackberry	5	Rosehip	2	Rosehip	8	Pinus Radiata	Occasional
	1	Broom	2	Silver Birch			3	Thistle	Rare
	1	Elm	2	Thistle			2	Silver Birch	Rare
	1	Poplar	1	Blackberry			2	Elm	Rare
	1	Thistle	1	Broom			2	Broom	Rare
			1	Dockleaf			1	Poplar	Rare
			1	Elm			1	Blackberry	Rare
			1	Monkey Must			1	Dockleaf	Rare
			1	Pasture/Grass			1	Monkey Mustard	Rare
							1	Pasture/Grass	Rare
Exotic Bird			2	Canada Geese	1	Swallow	2	Canada Geese	Rare
			1	Quail			2	Swallow	Rare
			1	Swallow			1	Quail	Rare
Exotic Fish	1	Brown Trout	1	Brown Trout	2	Brown Trout	4	Brown Trout	Rare
			1	Perch			1	Perch	Rare
Exotic Mammal			1	Rabbits	1	Rabbits	2	Rabbits	Rare
					1	Possum	1	Possum	Rare

4.6. Tuna Fyke Netting Surveys

Fyke netting was undertaken at 11 sites to gain an understanding of the health of both species of tuna/eel present throughout the area. This included understanding both population diversity (expressed through length frequency data) and population health (expressed through catch per unit effort (CPUE) data).

Ō Tū Wharekai East / Lower Māori Lake was the most abundant tuna fishery, netting 46 Longfin and 28 Shortfin tuna from 11 nets, giving a total CPUE of 5.82 kg/net/night. This was followed by Ō Tū Roto / Lake Heron, which netted longfin tuna exclusively (49 from 14 nets, with a CPUE of 2.05 kg/net/night). The best sites within Ō Tū Roto were the Oliver Stream (28 eels at CPUE of 2.98) and Dunbar Stream (19 eels at CPUE 3.11) outlet sites. Ōtautari, Te Puna a Taka, Kirihonuhonu and the Ō Tū Wharekai West / Upper Māori Lake had very low eel abundance and diversity (see table 3 and figure 14).

As well as being the most abundant, Lower Māori Lake also had the greatest diversity of size and species, as well as a greater overall size of its longfin tuna, when compared to Ō Tū Roto. While the Upper Māori lake was considerably less abundant than the Lower Māori lake, it had tuna that were larger. Furthermore, the shortfin eels in the Lower Māori Lake were bigger overall than the longfins, but there were almost half as many shortfins and longfins.

Ōtautari had very low abundance and diversity, but did achieve a relatively high CPUE, due to a lone and extremely large female longfin (11.4kg and 1.5metres long) caught at the Southside site. The occurrence of this large female may have been due to her being landlocked, as Ōtautari has no obvious surface outflow (see figure 14). It would be interesting to know if more netting sites and greater effort in Ōtautari, Te Puna a Taka and Kirihonuhonu would result in greater success.

Table 3: Total number, weight and CPUE (kg/net/night) of Tuna caught in Fyke nets at Ō Tū Wharekai sites

Feature	Site	No. of nets	Longfin			Shortfin			Overall		
			no.	weight (kg)	CPUE	no.	weight (kg)	CPUE	no.	weight (kg)	CPUE
Te Puna a Taka	Settlement	1	1	1.23	1.23				1	1.23	1.23
	Outlet	3	5	2.93	0.98	2	1.25	0.42	7	4.18	1.39
	<i>Overall</i>	4	6	4.16	1.04	2	1.25	0.31	8	5.41	1.35
Ōtautari	Northside	3									
	Southside	3	1	11.4	3.80				1	11.4	3.80
	<i>Overall</i>	6	1	11.4	1.90				1	11.4	1.90
Kirihonuhonu	Inlet <i>Overall</i>	3	2	0.92	0.31	1	0.8	0.27	3	1.72	0.57
Ō Tū Wharekai East	Main Perimeter	11	46	41.94	3.81	28	22.07	2.01	74	64.01	5.82
Ō Tū Wharekai West	Main Perimeter	9	4	14.46	1.61	2	7.58	0.84	6	22.04	2.45
	<i>Overall</i>	20	50	56.4	2.82	30	29.65	1.48	80	86.05	4.30
Ō Tū Roto	Swin R Access	5	2	1.39	0.28				2	1.39	0.28
	Oliver Strm Area	5	28	14.89	2.98				28	14.89	2.98
	Dunbar Wetland	4	19	12.42	3.11				19	12.42	3.11
	<i>Overall</i>	14	49	28.7	2.05				49	28.7	2.05
	Lake Stream	5	4	1.64	0.33				4	1.64	0.33
Total	Overall	52	112	103.22	1.99	33	31.7	0.61	145	134.92	2.59

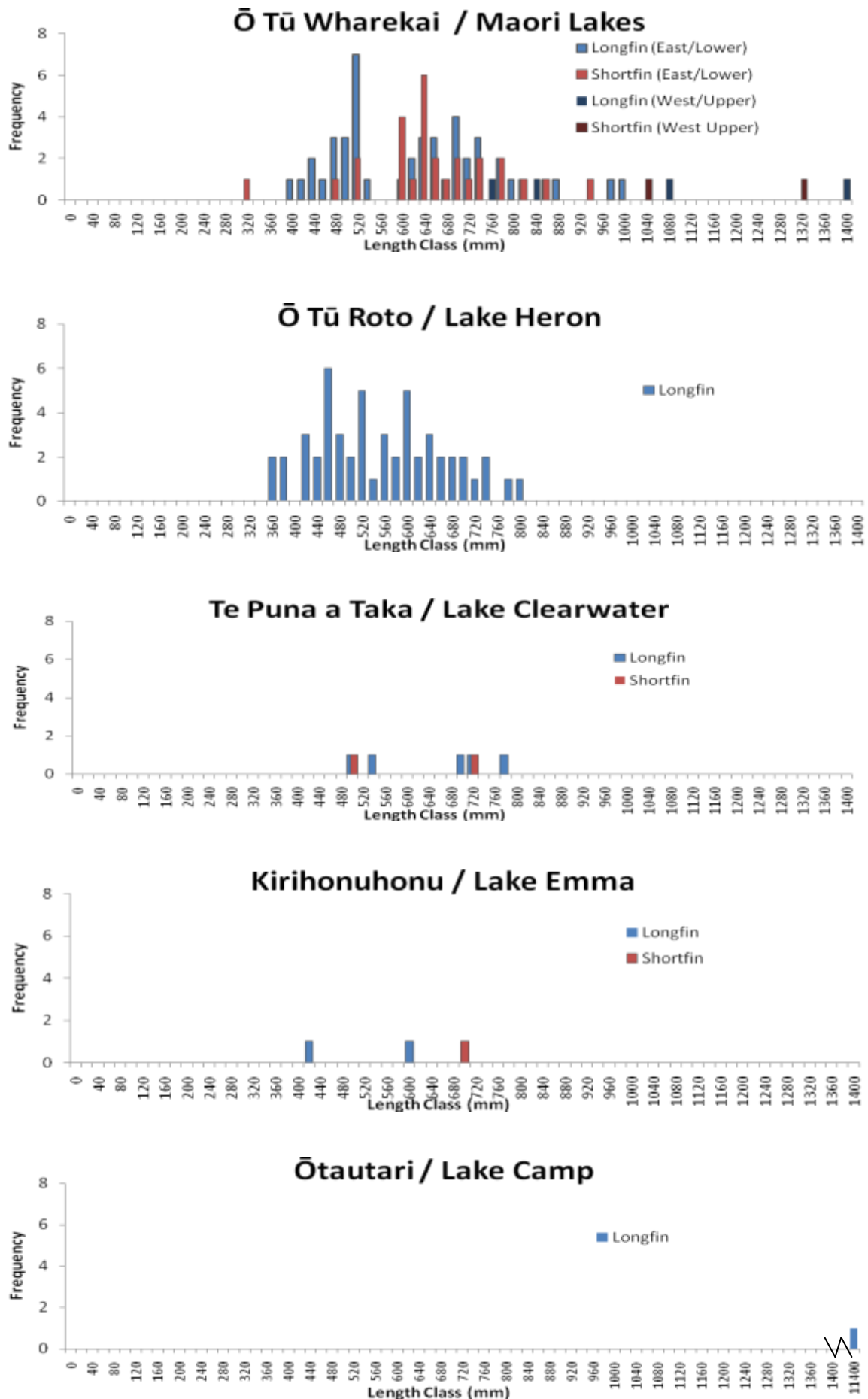


Figure 14. Length-Frequency distributions of longfin and shortfin eels caught fyke netting across the lakes of the Ō Tū Wharekai / Ashburton Lakes Area

4.7. Kōrerorero - Discussion

When taking into account the results of all types of assessment undertaken, the cultural health of the Ō Tū Wharekai / Ashburton Lakes area is considered to be **moderate**. The takiwā, CHI, SHMAK and e.coli testing results all found the majority of sites to be of moderate health. No sites were found to be very good by any assessment type, and only one site was found to be very poor (Hakatere ki te toka) via e.coli testing. CHI assessments resulted in a higher number of poor sites than good sites; due largely to poor mahinga kai scores associated with a lack of native species encountered at the assessment sites. All other assessment methods found a greater number of good rather than poor sites, indicating some positive aspects of the area.

Overall however the assessments and analysis point to long-term modification of the area, particularly in relation to the historical loss of native flora and fauna and subsequent grazing and stock pressure, as the biggest issue facing the Ō Tū Wharekai / Ashburton Lakes area. Indicators in relation to native flora and fauna abundance, mahinga kai health and species habitat were generally poor, in turn impacting on overall cultural health. A general lack of medium to large native shrub and tree species, such as maukoro/native broom, kōwhai, and mikimiki/coprosma within the lakes basin and the dominance of exotic species across the area is another indicator of extensive modification. Further highlighting this conclusion are species that are now either locally extinct or rare within the lakes basin area, noted as culturally significant mahinga kai from historical tribal records, but now not present at the assessment sites, including weka, aruhe and tī kouka.

Many sites demonstrate specific evidence of this long-term modification and consistent pressure including:

- Extensive lakebed siltation of Ō Tū Wharekai (East) / Lower Māori lake;
- High e.coli results and agricultural anti-biotic resistance e.coli present at the outlets of Ō Tū Wharekai (East) / Lower Māori Lake, Te Puna a Taka / Lake Clearwater and Ō Tū Roto / Lake Heron, Oliver Stream and Hakatere Bridge.
- Noticeable vegetation browsing and associated erosion throughout the basin, particularly noticeable at Te Puna a Taka/Lake Clearwater and around the Māori Lakes;
- The prevalence of willows, pines and other exotic vegetation at Ōtautari / Lake Camp, Te Puna a Taka / Lake Clearwater, Otua Tākou ki Hakatere / Stour River and around Ō Tū Roto / Lake Heron, herbaceous weeds at Kirihonuhonu/Lake Emma, and exotic fish, including perch, across the sites.



Figure 15. Heavy grazed vegetation common to many sites (left).

Figure 16. Dominant exotic vegetation and bachs at Ōtautari/Lake Camp (below).



Issues related to human settlement and recreational pressure are a further factor influencing the overall assessment, particularly associated with the use of Ōtautari / Lake Camp as a boating lake, the bach settlements at Te Puna a Taka / Lake Clearwater and the camp ground at Oliver Stream. Oliver Stream had the highest e.coli result of all sites (272/100mls) as well as the presence of both Ampicillin and Streptomycin resistance e.coli, indicating human sourced contamination, most likely associated with the camping ground. From a cultural perspective, a major value of waterways is their ability to provide for mahinga kai, and such pollution can affect the willingness of tangata whenua to harvest food from these areas.

All of the above factors require further monitoring and better future management to improve the cultural health of the Ō Tū Wharekai / Ashburton Lakes area. In particular, restoration programmes for native shrubs and trees, specifically wetland species that can compete with or replace willows, will be important. Greater attention to measures that can avoid, remedy and/or mitigate siltation, runoff and e.coli pollution of waterways and lakes from surrounding land use will be critical into the future. Management of, and investment in, riparian fencing and planting and wetland protection and enhancement is one option. As well as the important ecological function that a vegetated riparian zone or wetland area provides, native riparian and wetland vegetation is an important cultural indicator of health, providing significant habitat and breeding areas for native birds, fish and insects, and in particular mahinga kai species.

Figure 17. Remnant beech forest and riparian vegetation near Mount Sunday (below).

Figure 18. The lone ti kouka found at the Potts River (right).



On a positive note, there are a number of areas of remnant biodiversity and positive management that should be highlighted. These include:

- The existing native bush patch (beech and other riparian species) at the Erewhon site near Mount Sunday;
- The area of aruhe and a remnant tī kouka encountered at the Potts River site;
- Patches of houhi (mountain ribbonwood), tāwhairauriki/beech forest and tall tussocks through the Lake Stream area which show the benefits of less grazing pressure;
- Extensive tī kouka areas around the Double Hill/Tokinui area;
- Extensive raupō wetlands of the Ō Tū Wharekai (West) / Upper Māori Lake;
- Willow control at Ō Tū Wharekai (East) / Lower Māori Lake;
- Native restoration plantings at the Swin River Access Site;
- Diversity and intactness of the Kirihonuhonu wetlands; and
- The extensive native grasslands and wetlands around the Lake Stream site.



Figures 19 & 20. Patches of houhi/mountain ribbonwood and tāwhairauriki/beech forest (left) and the healthy long tussock and shrublands showing the benefit of less grazing (right) in the Upper Lake Stream area .



Figure 21. The beginnings of native lake edge vegetation restoration at Ō Tū Roto/Lake Heron (left).

Figure 22. Willow control at Ō Tū Wharekai (East)/Lower Māori Lake (right).

In relation to the presence and abundance of tuna/eel species, Ō Tū Wharekai (East) / Lower Māori Lake provided a positive result, with Ō Tū Roto / Lake Heron being noted as a critical habitat for long fin eel. The other lakes were disappointing however, particularly Te Puna a Taka / Lake Clearwater. Further monitoring within all lakes would be important to gain a better picture of species health, and in understanding the sustainability of cultural harvest, which may require depletion sampling. The transfer of large long fin female eels from Ōtautari / Lake Camp could also be investigated due to the land-locked nature of that lake.



Figure 23. Hauling in a catch of tuna from Ō Tū Wharekai (East)/Lower Māori Lake (left).

Figure 24. Measuring the large female long fin tuna at Ōtautari/Lake Camp (right).

The combined monitoring results from all assessments are shown diagrammatically in Figure 25 on Page 37. A full list of recommendations for the future management of the Ō Tū Wharekai / Ashburton Lakes area based on these findings are outlined in the following section along with the overall conclusions of the study.

5.0 TE WHAKAMUTUNGA - CONCLUSIONS

The Ō Tū Wharekai / Ashburton Lakes area holds immense cultural significance to Ngāi Tahu Whānui, being valued as an important mahinga kai and travelling area, both in the past and today. While the area has undergone modification and shows signs of pressure from surrounding land use, cultural values remain strong.

This report outlines the results of a cultural health study of the Ō Tū Wharekai / Ashburton Lakes area aimed at quantifying how tāngata whenua view the contemporary cultural health and state of the area and to identify the pressures, issues, actions and opportunities that exist to guide and assist the future management, development and restoration of the area.

Overall, the results of the study found the Ō Tū Wharekai / Ashburton Lakes area to be in a state of moderate cultural health. In particular, the assessments and analysis point towards a significant issue with the historical loss of native flora and fauna and subsequent grazing and stock pressure on both the landscape and waterways of the area.

This conclusion is evidenced by a lack of medium to large native shrub and tree species and tall tussocklands, and obvious vegetation browsing and associated erosion within the lakes basin, along with the dominance of exotic species across the entire area. Further highlighting this conclusion are notable local species extinctions from the lakes basin area, known as culturally significant mahinga kai from historical tribal records, but now not present, including weka, aruhe and tī kouka.

Extensive siltation of the Ō Tū Wharekai (East) / Lower Māori lakebed and high e.coli results and agricultural anti-biotic resistant e.coli present at the outlets of Ō Tū Wharekai (East) / Lower Māori Lake, Te Puna a Taka / Lake Clearwater and Ō Tū Roto / Lake Heron, Oliver Stream and Hakatere Bridge are also so important findings.

The moderate overall assessment is however balanced by the existence of important areas of remnant vegetation and habitat including raupō and carex wetlands, tall tussocklands, and beech forest, aruhe, tī kouka and houhi patches, many of which show the benefits of protection from grazing pressure. The presence and abundance of tuna, particularly at Ō Tū Wharekai (East) / Lower Māori Lake and the threatened long fin species at Ō Tū Roto / Lake Heron were indicators of potential and continued cultural significance. Willow control at Ō Tū Wharekai (East) / Lower Māori Lake and native lake edge restoration plantings at the Swin River Access Site on Ō Tū Roto / Lake Heron were also positive.

Protecting, enhancing and extending adequate native river and lake riparian and wetland buffers and other native vegetation, particularly medium to large shrubs and tall tussocklands, and a greater focus on dealing with sources of contaminants and sedimentation into waterways from both surrounding land-use and recreational and settlement areas will be the most important challenges for the future management of Ō Tū Wharekai. Continuing to deal with introduced pests and weeds and reducing grazing pressure is also important.

These actions would assist in gaining positive outcomes for the protection, enhancement and potential re-introduction of mahinga kai species into the area and increasing opportunities for cultural reconnection by tangata whenua with Ō Tū Wharekai. These actions would also be critical for conservation outcomes and improving the area for the wider community to enjoy.

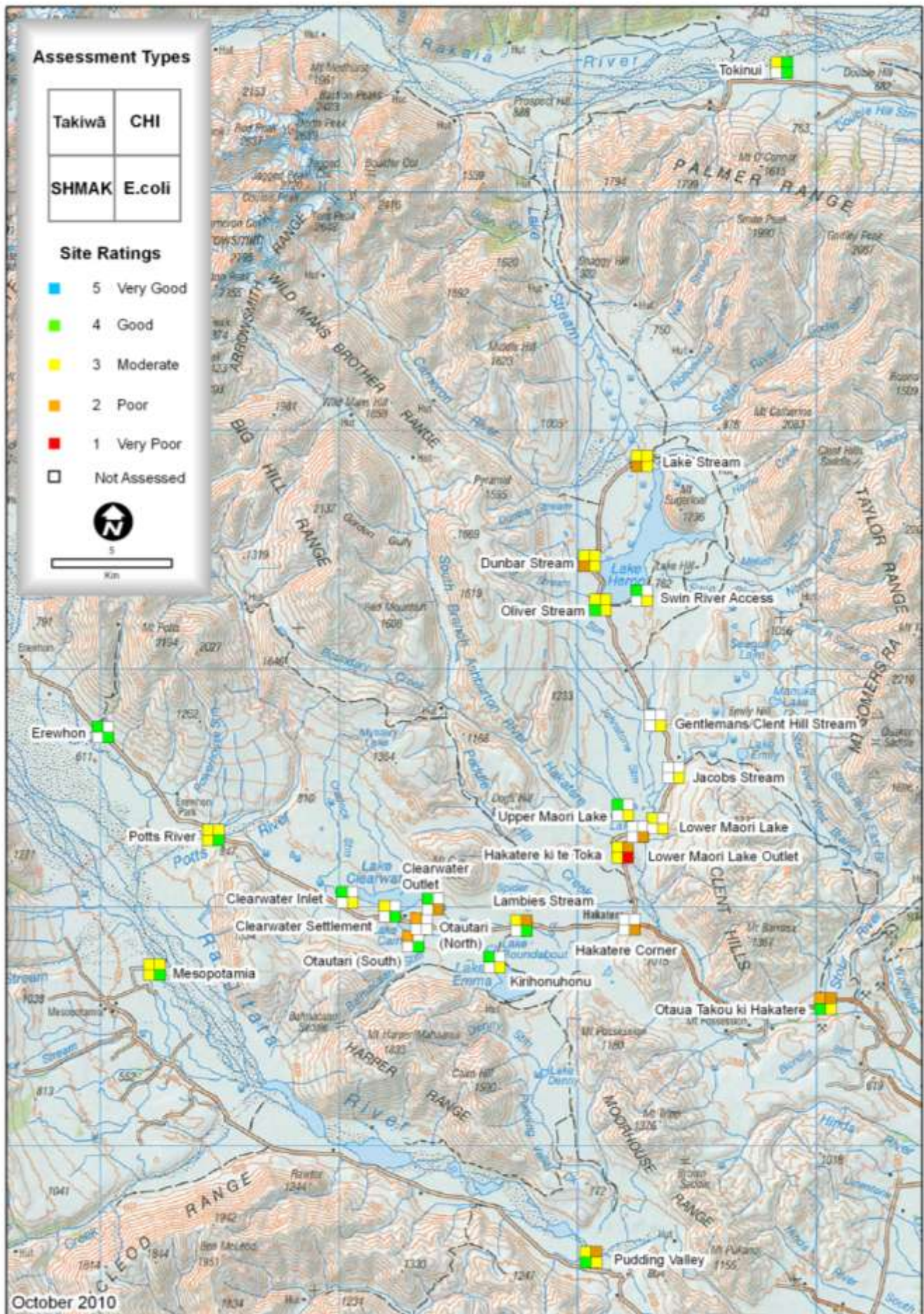


Figure 25. Combined Assessment Results for Ō Tū Wharekai sites.

5.1. Ngā Tūtohu - Recommendations

1. That all waterways which continue to be important for food gathering are managed and enhanced for food gathering quality into the future.
2. That increased protection and enhancement of waterways through the development of native riparian and wetland buffer zones be investigated and implemented.
3. Greater advocacy, rates relief and other economic methods for the protection and enhancement of native riparian and wetland buffer zones and vegetation patches in currently poor or un-vegetated or un-fenced areas on private land.
4. Specific restoration, pest and weed eradication and exotic species control in and around all lakes, including the use of tī kouka, houhi, kowhai, maukoro, mikimiki, beech and aruhe and other native plants that prove to compete well with, or can be planted underneath willow and other exotic species invading lakes and wetlands. This should consider the removal of pest fish from specific areas.

The following lakes and sites should be a priority:

- Ō Tū Wharekai (East) / Lower Māori Lake
 - Kirihonuhonu / Lake Emma
 - The Oliver Stream area of Ō Tū Roto / Lake Heron
 - The Swin river access area of Ō Tū Roto / Lake Heron
 - Te Puna a Taka / Lake Clearwater; and
 - Ōtautari / Lake Camp.
5. Specific measures to control siltation/sedimentation and e.coli contamination of Ō Tū Wharekai (East) / Lower Māori Lake and further protection of Ō Tū Wharekai (West) / Upper Māori Lake, including the potential purchase of surrounding land, the control of exotic species, and the development of better buffers, particularly around the road edge corner of Lower Māori Lake and incoming water ways of both lakes.
 6. Consideration for the complete and ongoing removal of exotic fish from the Māori Lakes and work towards making the lake complex a native fish only area.
 7. Further tuna/eel monitoring surveys and investigation to understand the potential of an annual cultural harvest, particularly at the Māori Lakes.
 8. Further investigation and control of human and agricultural pollution at Te Puna a Taka / Lake Clearwater and the Oliver Stream area of Ō Tū Roto / Lake Heron.
 9. Support for future wānanga and hui to reconnect tangata whenua with the Ō Tū Wharekai / Ashburton Lakes Area, particularly around future interpretation and cultural harvest opportunities of both tuna, raupō (for mokihi), hua kaki anau (black swan eggs) and other mahinga kai.
 10. Investigation into the habitat requirements of, and future possibilities (including specific sites), for the reintroduction of eastern buff weka into the area.
 11. Greater research into the impacts of, and solutions for, treating and dealing with non-point and point source pollution of waterways in the area.
 12. Continued regular monitoring, including cultural assessments, to understand the success, or otherwise, of future management and development of the catchment.

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7.0 ĀPITIHANGA - APPENDICES

Appendix A - Monitoring Work Plan for the Ō Tū Wharekai Cultural Health Assessment

Appendix B - Monitoring Forms used within the Ō Tū Wharekai Cultural Health Assessment

Appendix C - National Drinking, Recreation and Shellfish Standards for Water

Appendix D - Takiwā Assessment Data Set for the Ō Tū Wharekai Cultural Health Assessment

Appendix E - CHI Assessment Data Set for the Ō Tū Wharekai Cultural Health Assessment

Appendix F - SHMAK Assessment Data Set for the Ō Tū Wharekai Cultural Health Assessment

Appendix G - E .coli Testing Data Set for the Ō Tū Wharekai Cultural Health Assessment

Appendix H - Fyke Netting Data Set for the Ō Tū Wharekai Cultural Health Assessment

Appendix I - Site Photograph Record for the Ō Tū Wharekai Cultural Health Assessment

APPENDIX A: MONITORING WORK PLAN FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

STATE OF THE TAKIWĀ MONITORING WORK PLAN – Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT 2009

This plan outlines the proposed process for undertaking the monitoring fieldwork and data gathering for the O Tū Wharekai Cultural Values and Health Assessment project. The plan begins with a brief background to the project and the purpose for the monitoring. The plan also includes a description of the area to be researched and a detailed action plan for the monitoring fieldwork. This action plan includes the proposed dates of the monitoring, a timetable and schedule of activities, the data collection methodology, expected outcomes, resources and costs, and health and safety provisions. The plan also includes an appendix of monitoring forms and other relevant information to assist the monitoring fieldwork.

TĀHUHU KŌRERO/BACKGROUND

Te Rūnanga o Arowhenua is working in partnership with the Department of Conservation to restore the O Tū Wharekai / Ashburton Lakes area as part of a national initiative to protect and enhance wetlands and waterways of outstanding significance. To begin this work, Te Rūnanga o Arowhenua and the Department have agreed to undertake an assessment of the cultural values and health of the O Tū Wharekai area, including monitoring of area using the State of the Takiwā methodology.

The major purpose of the O Tū Wharekai Cultural Values and Health Assessment project is to identify, compile and record the traditional and contemporary cultural values of tangata whenua associated with O Tū Wharekai / Ashburton Lakes to assist the future management, development and restoration of the area.

To complete this project Te Rūnanga o Arowhenua has engaged Takerei Norton to bring together the traditional cultural values of the area, and Craig Pauling to facilitate the gathering of contemporary cultural health information of the area.

This plan outlines the methods and proposed work programme involved with the gathering of cultural health monitoring and assessment data led by Craig Pauling.

EXPECTED OUTCOMES FROM THE PROJECT

The major outcomes of the project are to:

- Involve Te Rūnanga o Arowhenua in the management of the O Tū Wharekai / Ashburton Lakes area.
- Undertake research, hold hui and complete a GIS map/layer and report of the traditional cultural values associated with the O Tū Wharekai / Ashburton Lakes area.
- Complete a monitoring plan, undertake monitoring and assessment hīkoi, analyse results and report on the cultural health of the O Tū Wharekai / Ashburton Lakes area.
- Hold a hui to discuss recommendations for the future management of the O Tū Wharekai / Ashburton Lakes area based on the reports.

Other outcomes include:

- Introduction, training and further testing of the Takiwā system by rūnanga/iwi members;
- Training and application of CHI, SHMAK, Electric fishing and E.Coli testing by rūnanga;
- Collection of baseline Takiwā data, including the CHI, SHMAK, Electric Fishing and E.coli data for the O Tū Wharekai area at various sites; and
- Storage, analysis and reporting of this data to assist future management and planning and to contribute to the wider O Tū Wharekai / Ashburton Lakes Restoration Project.

PROJECT MILESTONES

The major steps of the project are to:

1. **Cultural/Historical Inventory and Mapping** (due 31-09-2009)
 - Undertake review of available literature and information sources on cultural and historical information relating to O Tū Wharekai and develop draft report on findings.
 - Assist Te Rūnanga o Arowhenua in organising hui with appropriate rūnanga and tribal representatives to discuss findings and map sites.
 - Compile a GIS map/layer and report of the traditional cultural values associated with the O Tū Wharekai / Ashburton Lakes area.
2. **Monitoring Planning** (due 30-12-2009)
 - Assist Te Rūnanga o Arowhenua in organising hui with rūnanga reps to establish monitoring sites, targets and processes.
 - Develop and complete monitoring plan to guide a cultural health assessment of the O Tū Wharekai / Ashburton Lakes area.
3. **Baseline Monitoring Fieldwork/Data Collection** (due 30-03-2010)
 - Assist Te Rūnanga o Arowhenua in organising and facilitating the gathering and storage of cultural health assessment data for the selected O Tū Wharekai monitoring sites.
4. **Data Analysis and Report** (due 30-06-2010)
 - Assist Te Rūnanga o Arowhenua in analysing data, reviewing results and completing a baseline cultural health assessment report from the sites monitored and data collected.
5. **Follow Up Hui and Future Projects** (due 30-06-2010)
 - Assist Te Rūnanga o Arowhenua in holding a hui between rūnanga participants and DoC staff to present report and discuss findings and recommendations for future work and projects in the O Tū Wharekai / Ashburton Lakes area.

AREA TO BE RESEARCHED – O TŪ WHAREKAI /ASHBURTON LAKES

The O Tū Wharekai / Ashburton Lakes area is of immense cultural significance to Ngāi Tahu, being an area of extensive use and occupation stretching back over 600 years.

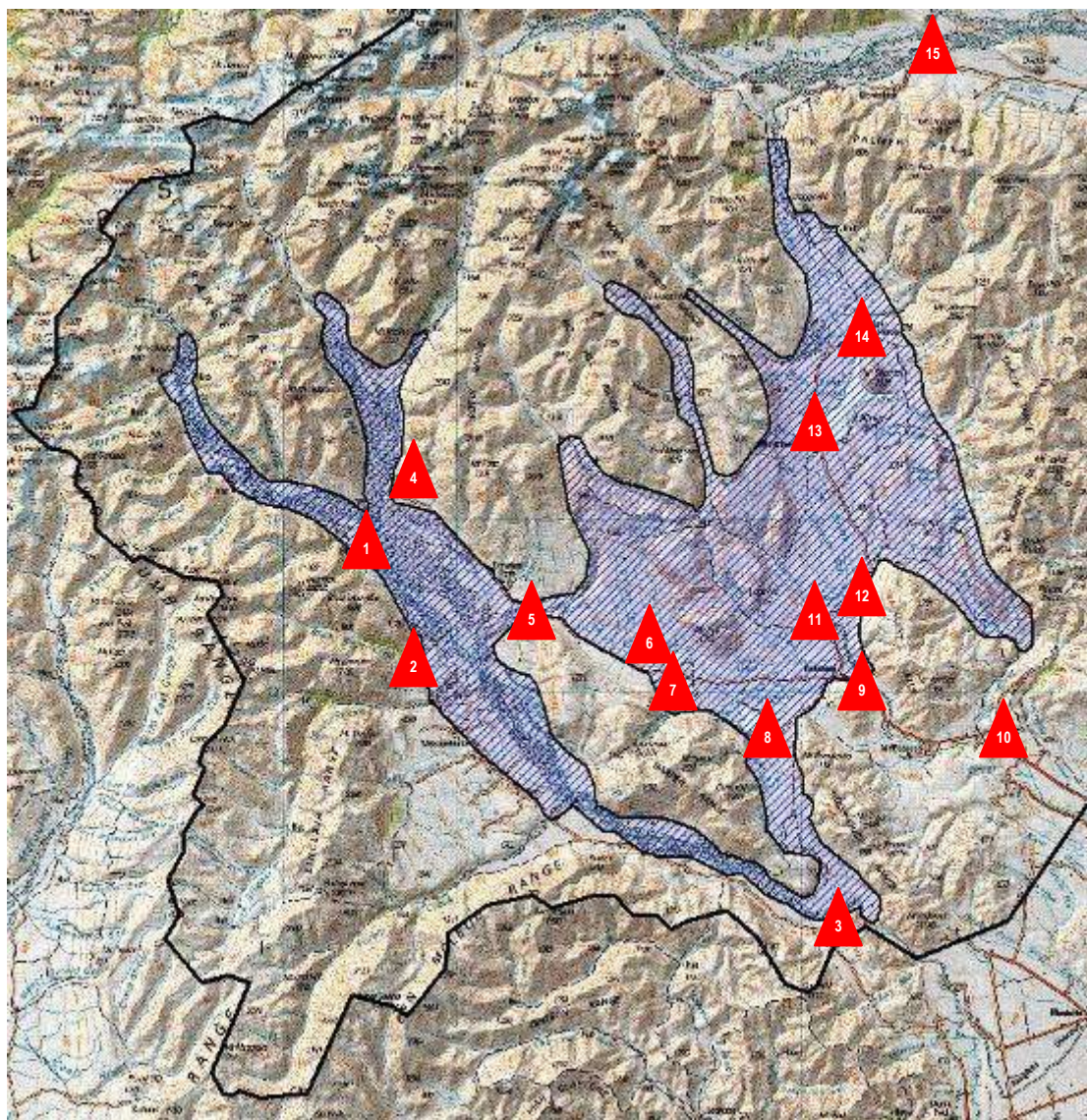
The area provided vital access to the various passes across Kā Tiritiri o Te Moana / The Southern Alps from Kā Pākihi Whakatekateka o Waitaha / The Canterbury Plains to Te Tai o Poutini / the West Coast and was a major mahinga kai providing a range of important seasonal foods including weka, tuna and aruhe.

A number of sites in the lakes area are recorded in the Ngāi Tahu 1880 reports of HK Taiaoroa and a number of archaeological findings support the presence of Ngāi Tahu mahinga kai and kāinga in the area.

The area is also of unique ecological and conservation value particularly in relation to the various high country lake ecosystems and rare native vegetation habitats.

The arrival of European pastoral farming into the area in the nineteenth century, and recreation use of the lakes since this time have led to a number of ecological and cultural landscape issues, including a loss of native riparian and catchment vegetation, the local extinction of native fish and bird species and growing threats to lake water quality.

A comprehensive cultural values and health assessment have never been undertaken to understand the extent of change within the area and/or the current health of the area to Ngāi Tahu. Therefore it is proposed that a number of sites spread throughout the area be assessed as part of the project. These sites are listed in the following sub-section and shown on Map 1.



MONITORING SITES

A total of 25 sites have been identified for assessment as part of the study. The sites are listed below along with an indication of the type of site and monitoring that will be undertaken. Please note that some of these sites may not be able to be assessed, due to access and other issues.

Te Rakitata / Rangitata River

1. @ Black Birch Stream = Takiwa/CHI/SHMAK/E.coli/Efish*
2. @ Mesopotamia = Takiwa/CHI/SHMAK/E.coli/Efish
3. @ Pudding Valley Stream = Takiwa/CHI/SHMAK/E.coli/Efish
4. @ Erewhon = Takiwa/CHI/SHMAK/E.coli/Efish*
5. Potts River @ Hakatere Potts Road Bridge = Takiwa/CHI/SHMAK/E.coli/Efish

Te Puna a Taka / Lake Clearwater

- 6a. Clearwater Settlement = Takiwa/E.coli + Hinaki/Taukoura
- 6b. Craddock Steam Inlet = Takiwa/CHI/SHMAK/E.coli/Efish
- 6c. Outlet = Takiwa/CHI/SHMAK/E.coli + Hinaki/Taukoura

Ōtautari / Lake Camp

- 7a. Outlet = Takiwa/CHI/SHMAK/E.coli + Hinaki/Taukoura
- 7b. Western End = Takiwa/E.coli + Hinaki/Taukoura

Kirihonuhonu / Lake Emma

8a. Outlet = Takiwa/CHI/SHMAK/E.coli + Hinaki/Taukoura

8b. Inlet = Takiwa/CHI/SHMAK/E.coli/Efish

Hakatere / Ashburton River

9. Hakatere Corner (outflow of southern lakes) = Takiwa/CHI/SHMAK/E.coli/Efish

10. Otua Tākou ki Hakatere (at Stour River) = Takiwa/CHI/SHMAK/E.coli/Efish

11. Hakatere Heron Rd Bridge = Takiwa/CHI/SHMAK/E.coli/Efish

O Tū Wharekai / Māori Lakes

12a. Outlet to Hakatere = Takiwa/CHI/SHMAK/E.coli/Efish

12b. Lower Māori Lake = Takiwa/E.coli/Efish/Hinaki/TauKoura/Seine/Rama

12c. Upper Māori Lake = Takiwa/E.coli/Efish/Hinaki/TauKoura/Seine/Rama

12d. Johnstone Stream Inlet = Takiwa/CHI/SHMAK/E.coli/Efish

12e. Clent Hill Stream inlet = Takiwa/CHI/SHMAK/E.coli/Efish

O Tū Roto / Lake Heron

13a. Swin River Inlet = Takiwa/CHI/SHMAK/E.coli/Efish

13b. Oliver Stream Inlet = Takiwa/CHI/SHMAK/E.coli/Efish + Hinaki/Taukoura

13c. Dunbar Stream Inlet = Takiwa/CHI/SHMAK/E.coli/Efish + Hinaki/Taukoura

Rakaia River

14. Lake Stream Outlet = Takiwa/CHI/SHMAK/E.coli/Efish + Hinaki/Taukoura

15. Tokinui = Takiwa/CHI/SHMAK/E.coli/Efish*

* May be difficult to assess due to access issues

MONITORING ACTION PLAN

MONITORING TEAM

The following people will be involved in the monitoring, subject to confirmation of dates:

- Mandy Home
- Carl Russell
- Wayne Anglem
- Rawiri Reihana
- Craig Pauling
- Takerei Norton
- Te Marino Lenihan
- Makarini Rupene
- Iaeen Cranwell

DATES OF MONITORING WORK

The monitoring/data collection will take place in February 2010 (over one week between 8-26 February). A timetable of events for monitoring are outlined in the table below.

TIMETABLE & SCHEDULE OF WORK TO BE UNDERTAKEN

Day 1 – Monday		Day 2 – Tuesday	
8.00am	Leave Ōtautahi / Arowhenua	Breakfast	7.00am
9.30am	Meet at Peel Forest – Morning Tea	Arrive/Assess site 4 – Erewhon	9.30am
	Requirements: Katoa	Requirements: katoa (Morning Tea)	
12pm	Arrive/Assess site 1 – Black Birch Stream	Assess site 5 – Potts River	11am
	Requirements: Katoa (Lunch)	Requirements:	
2pm	Arrive/Assess site 2 – Mesopotamia	Assess site 6- Lake Clearwater (Intake, mid and outlet)	12am
	Requirements: katoa	Requirements: Lunch. Take up nets/Clean	
3pm	Arrive/Assess site 3 – Pudding Hill	Assess site 7- Lake Camp (Upper and Outlet)	2pm
	Requirements: Takiwa, CHI, SHMAK and E.coli	Requirements: katoa	
4pm	Drive to Mt Somers	Assess site 8 – Lake Emma (Inlet and Outlet)	4pm
	Requirements: (Post water samples x3)	Requirements: katoa	
6pm	Arrive Castleridge Station - Dinner	Arrive Back Castleridge Station - Dinner	6pm
8pm	Undertake Rama Assessment and Set Nets for Lakes Clearwater/Camp/Emma	Undertake Rama Assessment and set nets for Lower and Upper Maori Lake	8pm

Day 3– Wednesday		Day 4 – Thursday	
7.00am	Breakfast	Breakfast	7.00am
8am	Assess site 9 – Hakatere Corner	Arrive/Assess site 12e – Clent Hill Stream	8.00am
	Requirements: Takiwa/E.coli		
9.30am	Arrive/Assess site 10 – Stour River	Arrive/Assess site 13a – Lake Heron Swin River Inlet	9.30am
	Requirements: Katoa	Requirements: katoa	
11am	Arrive/Assess site 11 – Hakatere Bridge	Arrive/Assess site 13b – Lake Heron Oliver Stm	11am
	Requirements: Katoa (Morning tea)	Requirements: Morning tea	
12.30pm	Arrive/Assess site 12a/b – Lower Maori Lake (outlet and inlet) (LUNCH)	Arrive/Assess site 13c – Lake Heron Dunbar Stm	12.30pm
	Requirements: Takiwa, CHI, SHMAK and E.coli		
3pm	Arrive/Assess site 12c/d – Upper Maori Lake (Inlet 1, inlet 2, outlet)	Arrive/Assess site 14 – Lake Stream	3pm
	Requirements:		
5pm	Arrive Castleridge Station - Dinner	Arrive Castleridge Station - Dinner	5pm
7pm	Undertake Rama Assessment and set nets for Lake Heron		

Day 5– Friday			
7.00am	Breakfast/Clean Up	Depart for Hinepaaka (via Rakaia River)	1pm
9am	Depart for Tokinui (via Lake Stream)	Arrive Hinepaaka / Alford Forest	2.30pm
		Meet David / Trevor / Jimmy / Mat – Afternoon Tea	
11am	Arrive/Assess site 15 – Tokinui	Depart for Christchurch/Arowhenua	4.30pm
	LUNCH		
		Home	7pm

EQUIPMENT

The following equipment will be used during the monitoring work

- 4WD Vehicles
- Boat/Waka
- Takiwa forms (All sites), CHI forms (River/Stream sites only)
- SHMAK Kit, manual and forms (River/Stream sites only)
- Electric Fishing Machine/Gear
- Fyke nets, set nets, seine nets, weights and stakes
- Vials, labels and bags for fish samples
- Spotlight gear and torches for night fish spotting
- Knives and tweezers for sample collection
- Fish scales and ruler
- Chilly bins, fish bins and bags
- E.coli water vials (100mls) and ice packs
- Digital Camera/Video Camera
- GPS unit and Maps
- Panasonic Toughbook Laptop
- Pens and folders and Monitoring Plan
- Identification booklets
- First Aid Kit / Weather Reports
- Satellite Phone/Cellphone

DATA COLLECTION METHODOLOGY

It is proposed to undertake five types of assessment during the fieldwork.

1. Takiwā Site Assessments
2. Cultural Health Index – Water Quality Assessment
3. Stream Health Monitoring Assessment
4. E.Coli Water Testing
5. Fish Surveys: Electric Fishing and Netting

The specific details of each type of assessment are outlined in the subsections below.

At each site, the monitoring team will gather together initially so that an appropriate mihi, karakia and/or kōrero can be given. Following this, members of the monitoring team will collectively complete their Takiwā forms, followed by the CHI and SHMAK assessments, collection of water samples and finally electric or other fishing if applicable. Before departing, a kōrero will be held about the travel details for the next site and/or activity.

Takiwā Assessments

The basis for the project will be the assessment of sites using the Takiwā assessment forms. These forms are based on the forms developed for the Cultural Health Index, FORMAK, SHMAK, Kaimoana Guidelines, and Wetland Indicators.

The Takiwā forms aim to record observations and assessments of rūnanga/iwi members for a particular site and at a particular time. The form attempts to capture cultural information and values about the site to turn what is more commonly described as 'anecdotal evidence' into something more defensible.

Therefore the form includes general visit and site details (date, time, weather conditions, site location, legal protection etc) as well as indicators of site significance and an overall 'state' assessment.

The state assessment indicators include:

- levels of modification/change at the site,
- suitability for harvesting mahinga kai,
- access issues; and
- abundance and diversity counts for taonga bird, plant and fish species, other resources as well as pest and weed species.

The methodology for the Takiwā form also includes capturing photographic references of the site, along with recording the exact geographical (GPS) details of this reference for repeatability and comparison with future records taken.

Cultural Health Index – Water Quality Assessment

At all river/stream sites, the team will answer the questions from the Cultural Health Index form to capture this important information and to complement the E.Coli testing and SHMAK results.

The CHI records observations and assessments that are specific to the cultural and biological health of waterways. The CHI is made up of three linked components including:

- The status of the site (whether it is traditional or not and whether tangata whenua would return to the site or not);
- Mahinga Kai values, including;
 - Identification of mahinga kai species present at the site.

- Comparison between the species present today and the traditional mahinga kai sourced from the site.
- Assessment of access to the site.
- Assessment of whether tangata whenua would return to the site in the future as they did in the past.
- Stream Health, including;
 - Catchment land use
 - Riparian vegetation
 - Use of the riparian margin
 - Riverbed condition/sediment
 - Channel modification
 - Flow and habitat variety
 - Water clarity
 - Water quality

SHMAK Assessment

The SHMAK kit will also be utilised during the monitoring for all river/stream sites. The SHMAK Kit records river flow, pH, temperature, conductivity, clarity, stream bed composition, riparian vegetation, invertebrates, periphyton and catchment activity. The use of SHMAK for this project will focus on gathering invertebrate and periphyton data, and other information as required.

E.Coli Water Testing

At lake, river and stream sites (where appropriate), E.Coli water testing will be carried out to understand levels and potential sources of E.coli contamination. This involves the collection of a 100ml water sample and subsequent lab analysis, including anti-biotic resistance testing. The results from the E.Coli testing will also complement the data collected through the Takiwā, CHI and SHMAK forms.

Fish Surveys: Electric Fishing and Netting

At river/stream sites, electric fishing will be undertaken to obtain data on the presence, absence and abundance of fish species at chosen sites. This data will be fed into the Takiwā assessments. At lake sites, other forms of fish surveys will be undertaken to obtain data on the presence, absence, abundance and catch effort of the fish species at chosen sites. This includes the use of fyke nets and siene nets, as well as recording by torchlight (rama). Size, weight and even age data may also be collected for the tuna (eels) collected. All of this data will be fed into the Takiwā assessments for the particular site.

Where electric fishing or any other fish survey is not able to be undertaken, relevant data from the New Zealand Freshwater Fish database will be extracted to feed into the reporting to complement collected data.

EXPENSES AND RESOURCES TO BE USED

Kai/Provisions:	
Day 1 Morning Tea (@\$5 x 8people)	\$40
Day 1 Lunch (@ \$10 x 8 people)	\$80
Day 1 Afternoon Tea (@ \$5 x 8 people)	\$40
Day 1 Dinner (@ \$10 x 8p)	\$80
Day 2 Breakfast (@\$5 x 8p)	\$40
Day 2 Morning Tea (@\$5 x 8 people)	\$40
Day 2 Lunch (@ \$10 x 8 people)	\$80
Day 2 Afternoon Tea (@ \$5 x 8 people)	\$40
Day 2 Dinner (@ \$10 x 8p)	\$80
Day 3 Breakfast (@\$5 x 8p)	\$40
Day 3 Morning Tea (@\$5 x 8 people)	\$40
Day 3 Lunch (@ \$10 x 8 people)	\$80
Day 3 Afternoon Tea (@ \$5 x 8 people)	\$40
Day 3 Dinner (@ \$10 x 8p)	\$80
Day 4 Breakfast (@\$5 x 8p)	\$40
Day 4 Morning Tea (@\$5 x 8 people)	\$40
Day 4 Lunch (@ \$10 x 8 people)	\$80
Day 4 Afternoon Tea (@ \$5 x 8 people)	\$40
Day 4 Dinner (@ \$10 x 8p)	\$80
Day 5 Breakfast (@\$5 x 8p)	\$40

Day 5 Morning Tea (@\$5 x 8 people)	\$40
Day 5 Lunch (@ \$10 x 8 people)	\$80
Sub-total	\$1240
Transport & Accommodation:	
Hire of 4WD Vehicle (\$100/day x 5 days) x 2	\$1000
Petrol / Mileage for Vehicle (\$50/day x 5days x 2)	\$500
Castleridge Station (@\$20pp x 4 night x 8people)	\$640
Sub-total	\$2140
Equipment Use and Hire:	
Video Camera - @ \$50/day x 4 days	\$200
Digital Camera - @ \$50/day x 4 days	\$200
GPS - @ \$50/day x 4 days	\$200
Laptop/Toughbook - @ \$50/day x 4 days	\$200
Electric Fishing Gear @ \$50/day x 4 days	\$200
Fyke nets - @ \$50/day x 4 days	\$200
Seine nets - @ \$50/day x 4 days	\$200
Sub-total	\$1400
Administration & Disbursements:	
Printing of forms and other information - @\$0.10c x 500 copies	\$100
Water Samples/Testing (@\$50/sample x 20 sites)	\$1000
Postage/Courier of Samples	\$120
Sub-total	\$1220
People:	
Monitoring Team (@\$75/hr x 4 people x 40 hrs)	\$12000
(x4 people x 16hrs)	\$4800
Sub-total	\$16800
TOTAL	\$22,800

HEALTH AND SAFETY CONSIDERATIONS

There are a number of risks associated with going into the field, and specifically around the use of electric fishing machines. The major risks and associated management measures are explained below.

Car travel

The monitoring team will be travelling between sites in vehicles, which brings with it the normal risk of road accidents. Before departing, all drivers will be well briefed about the best route and conditions of the road to the next site.

All cars will have dedicated/designated drivers who will be selected due to their knowledge and capabilities in the area (eg 4WD experience where appropriate).

Small first aid kits will be carried in the cars, as well as a main kit in one vehicle and a satellite phone. At least two members of the team will be trained in first aid.

All accidents will be attended to by first aid in the first instance, followed by an emergency call if required.

Site Risks

Each site that will be visited may have a number of risks associated with it. For example, a fast flowing river, approaching tide, cliff face or sudden drop, pollutants, etc.

These will be discussed prior to going to each site as well as being introduced when arriving at each site.

Any accident will be attended to by first aid in the first instance, followed by an emergency call if required.

Weather Conditions

The weather conditions for the fieldwork pose another risk to survey participants and need to be considered when going into the field.

Weather reports will be reviewed each day, with regional forecasts printed from the Met-service website for the period of the fieldwork.

Appropriate steps will be taken depending on each forecast, including taking appropriate wet weather gear, sun protection as well as the changing of plans due to flooding or extreme weather.

Fish Sampling

Electric Fishing carries with it a number of risks to both those operating the machine as well as any other people in the water or on the bank.

The machine itself has a number of in-built features that make it safe to operate, these include: waterproof casing, hand operated 'dead man' automatic cut off/on switch on wand, alternative cut off shoulder switch and an automatic 'tilt' kill switch.

As would be expected, the major risk from electric fishing is from electric shock due to someone touching the water, without adequate protection, while the machine is operating. In most cases, the shock will be minor however a major shock can occur in the event of someone putting two hands in the water at the same time.

To manage such a risk, having at least 3 people involved in the use of the electric fishing machine at any one time is required. Two of these people must be experienced and trained operators (in the water) and the other person must be watching and supporting from the bank. Adequate and clear communication between those involved about when the machine is 'live' and 'off' is also required. This starts with the lead operator, to the net holder, to the bank and back to the operator.

Other types of fish sampling carry some risks that will be minimised by setting nets from the lake edge, rather than by wading into the lakes.

A defibrillator will be carried to treat any severe electric shock. All other accidents will be attended to by first aid in the first instance, followed by an emergency call if required.

OTHER NOTIFICATIONS, ARRANGEMENTS AND CONSENTS REQUIRED

Access may be required to the following stations:

- | | |
|---------------------------------|---------------------------|
| - Glenfalloch (Tokinui) | - Mt. Potts (Potts River) |
| - Double Hill (Tokinui) | - Erewhon |
| - Upper Lake Heron (Lake Heron) | - Mesopotamia |
| - Mt Arrowsmith (Lake Heron) | - Tenahaun |
| - Clent Hills (Lake Heron) | |

Concessions from the Department may be required to set nets for native freshwater fish collection in the Ashburton Lakes area, including:

- Lake Clearwater
- Lake Camp
- Lake Emma
- Maori Lakes
- Lake Heron

Both of these issues will be worked through with Kennedy Lange at the Raukapuka Office of the Department of Conservation.

APPENDIX B: MONITORING FORMS USED WITHIN THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

State of the Takiwā		Site Definition Form		Site Code																			
Site Name		Defined by		on ____/____/____																			
Assessment type: (tick one) <input type="checkbox"/> New site <input type="checkbox"/> Update																							
Region of NZ	<input type="text"/> eg Otago	Catchment/Feature	<input type="text"/> eg Waiau River																				
Zone (tick one)	<input type="checkbox"/> Mountains <input type="checkbox"/> Hills <input type="checkbox"/> Upper Plains <input type="checkbox"/> Mid Plain <input type="checkbox"/> Lowland Plains <input type="checkbox"/> Urban <input type="checkbox"/> Coastal/marine <input type="checkbox"/> Other. Specify:																						
Ecosystem Types	<input type="checkbox"/> Alpine <input type="checkbox"/> Native forest <input type="checkbox"/> Exotic forest <input type="checkbox"/> Tussock/dryland <input type="checkbox"/> Farm/agrisystem <input type="checkbox"/> River/Stream <input type="checkbox"/> Lake/Wetland <input type="checkbox"/> Estuary/Lagoon <input type="checkbox"/> Coastal/Dune <input type="checkbox"/> Marine <input type="checkbox"/> Other. Specify:																						
Ownership:	<input type="checkbox"/> Private <input type="checkbox"/> Council <input type="checkbox"/> DOC <input type="checkbox"/> Maori <input type="checkbox"/> LINZ <input type="checkbox"/> Crown <input type="checkbox"/> Unknown <input type="checkbox"/> Other. Specify:																						
Mana Whenua	<input type="text"/>																						
Site Description (100m radius. Including site issues, pressures and general notes):																							
Legal Protection:	<input type="checkbox"/> Informal/none <input type="checkbox"/> Reserve <input type="checkbox"/> NZAA site/silent file <input type="checkbox"/> Legal covenant <input type="checkbox"/> Conservation <input type="checkbox"/> Other. Specify:																						
Settlement Site:	<input type="checkbox"/> Nohoanga <input type="checkbox"/> Topuni <input type="checkbox"/> Tribal property <input type="checkbox"/> SA <input type="checkbox"/> Unsure																						
SITE-SIGNIFICANCE DETAIL Is this a traditional site? Yes No Unsure Are there any signs of traditional use? Yes No Significance of site: <input type="checkbox"/> Urupa <input type="checkbox"/> Pā/Kāinga <input type="checkbox"/> Mahinga kai <input type="checkbox"/> Wāhi Pakanga <input type="checkbox"/> 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																					
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NGĀ RAKAU / PLANT SPECIES		Abundance																					
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OTHER TAONGA / Natural Resources		Abundance																					
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Geographical Position Area (sq m) <input type="text"/> Altitude (m) <input type="text"/> Map No (if 260 series) <input type="text"/> East <input type="text"/> North <input type="text"/> Accuracy/Offset (m) <input type="text"/>																							
Photos taken? Yes No Direction facing, Photo 1: <input type="text"/> Photo 2: <input type="text"/> Photo 3: <input type="text"/> Photo 4: <input type="text"/> 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: <input type="text"/> Date: ____/____/____																							
Photo filed: <input type="checkbox"/> Filename: Site mapped: <input type="checkbox"/> TUMONZ/GIS code:																							

State of the Takiwā

Visit Form

Site Code

Use a separate form for Questionnaire

Visit Code

VISIT DETAILS

Site Name:

No. in Group:

Visit date:

Time:

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

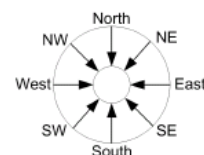
3. Precipitation

(circle one)
None
Mist or fog
Drizzle
Light
Moderate
Heavy
Hail
Snow

4. Wind

If wind, circle its direction

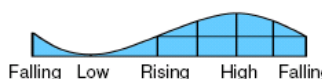
(circle one)
None
Minimal
Light
Stiff or breezy
Gusty
Strong



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

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:

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 pressure 1 2 3 4 5 Minimal pressure

Details (including recreational access, surrounding landuse, discharges, etc.):

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):

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

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

Details:

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.

☐ Interpretation / Signage

☐ Consideration of ownership/purchase by tribe/rūnanga.

☐ Restoration of native species

☐ Protection / Access arrangement for significant sites with landowner

☐ 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 ...

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.)

	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	

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.)

	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	

3. NGĀ IKA MĀORI / NATIVE FISH SPECIE **Abundance** **MK** **Notes** (condition, habits, etc.)

	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	

4. NGĀ TAONGA MĀORI / Other Natural Resources **Abundance** **MK** **Notes** (condition, etc.)

	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	

5. INTRODUCED PLANTS AND ANIMALS **Abundance** **MK** **Notes** (condition, controls, signs, etc.)

	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	
	Few	Some	Lots	<input type="checkbox"/>	

OFFICE USE ONLY Entered into Takiwa database by:

Date:

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

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

1. <input type="text"/>	2. <input type="text"/>	4. <input type="text"/>	3. <input type="text"/>
5. <input type="text"/>	6. <input type="text"/>	7. <input type="text"/>	8. <input type="text"/>

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

OFFICE USE ONLY Entered into Takiwa database by:

Date:

State of the Takiwa

SHMAK 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. STREAM HABITAT

Please enter answers in boxes. You can do the calculations and circle the scores if you want, or leave that task to be done automatically later in the database.

A1 Habitat Quality

Flow velocity Time an object travelling down the centre of the stream (do 3 times): seconds

Distance travelled: metres Divide distance by the average time of seconds

... to get an average velocity of m/sec

eg. For 10m in 38s
Velocity = 0.26 m/s
Score = 8

From velocity: less 0.1 0.3 0.7 1.0 more
Circle the Score: 1 8 10 5 3

Water pH From the pH: less 5.5 6.5 8 9.5 more
Circle the Score: -5 5 10 5 -5

Water temperature °C Temp: less 5 10 15 20 25 30 more
Time of day: Score: 5 8 10 8 5 1 -5

Water conductivity uS/cm Cond: less 50 150 250 400 more
Score: 20 16 10 6 1

Water clarity (Take 3 readings): cm Calculate average clarity: cm

Note: for ease of use, scale is in opposite order to that in SHMAK doc.

Clarity: less 35 55 70 100 more
Score: 1 3 5 8 10

A2 Composition of the Stream Bed *

Estimate materials making up the stream bottom (to nearest 10%).

	Enter %	Score
Bedrock	<input type="text"/>	-10
Boulders > 25 cm	<input type="text"/>	10
Large cobbles 12 - 25	<input type="text"/>	20
Small cobbles 6 - 12	<input type="text"/>	10
Gravels 0.2 - 6	<input type="text"/>	0
Sand	<input type="text"/>	-10
Mud or silt	<input type="text"/>	-20
Man-made, eg concrete	<input type="text"/>	-20
Woody debris	<input type="text"/>	0
Water plants, rooted in stream bed	<input type="text"/>	0
Check you have 100%	<input type="text"/>	

A3 Bank Vegetation *

True left = left bank looking downstream

Estimate vegetation within 5 metres of the banks (to nearest 10%)

	%, true left	%, true right	Score
Native trees	<input type="text"/>	<input type="text"/>	10
Wetland vegetation	<input type="text"/>	<input type="text"/>	10
Tall tussock grassland, not improved	<input type="text"/>	<input type="text"/>	8
Introduced trees (willow, poplar)	<input type="text"/>	<input type="text"/>	8
Other introduced trees (conifers)	<input type="text"/>	<input type="text"/>	5
Scrub	<input type="text"/>	<input type="text"/>	5
Rock, gravels	<input type="text"/>	<input type="text"/>	5
Short tussock grassland, improved	<input type="text"/>	<input type="text"/>	3
Pasture grasses and weeds	<input type="text"/>	<input type="text"/>	-10
Bare ground, roads, buildings	<input type="text"/>	<input type="text"/>	-10
Check you have 100%	<input type="text"/>	<input type="text"/>	

A4 Deposits

Tick best estimation of loose deposited material on the stream bed

	Score
None noticed <input type="checkbox"/>	10
Fine, mainly by edge thickness < 1 mm <input type="checkbox"/>	5
Moderate, edge & elsewhere 1 - 3 mm <input type="checkbox"/>	0
Moderate to thick, patchy, most of bed 3 - 5 mm <input type="checkbox"/>	-5
Thick, most horizontal surfaces > 5 mm <input type="checkbox"/>	-10

* NOTE: For A2 and A3 the relative scores are shown but percentage-weighted calculations can't be calculated here. Use the database to automatically do this and get an overall score for each.

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
Crane fly 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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Date:

APPENDIX C: NATIONAL DRINKING, RECREATION AND SHELLFISH STANDARDS FOR WATER

Microbiological Water Quality Guidelines for Marine & Freshwater Recreational Areas: Ministry for the Environment - 2003

Freshwater Contact Recreation:

No single sample greater than 260 E. coli/100 mL.

Marine Water Contact Recreation:

No single sample greater than **140 enterococci/100 mL**.

Shellfish Gathering:

The median faecal coliform content of samples taken over a shellfish-gathering season shall not exceed a Most Probable Number (MPN) of 14/100 mL, and not more than 10% of samples should exceed an MPN of 43/100 mL (using a five-tube decimal dilution test).

New Zealand Drinking Water Standards: Ministry of Health - 2000

E. coli

The indicator organism chosen to indicate possible faecal contamination of drinking-water is E. coli.

Thermotolerant coliforms (faecal coliforms) and total coliforms (which include both faecal and environmental coliform bacteria) may also be used to monitor water quality, but the results are harder to interpret than those from E. coli. If total coliforms or faecal coliforms are used for drinking-water monitoring to demonstrate compliance with the Standards instead of E. coli, a positive result shall be treated as though it were an E. coli result.

E. coli should not be present in drinking-water in the distribution zones.

However, unlike the drinking-water leaving the treatment plant, whose microbiological quality is under the control of the treatment plant management, the quality of drinking-water in the distribution zones may be subjected to contamination from a variety of influences.

Some of these may arise from poor management practices, such as faulty reservoir construction and maintenance, or poor sanitary practices by water supply workers.

Other contamination sources arise from the water users themselves, such as poor sanitation while making connections to the service or inadequate backflow prevention.

E. coli may, therefore, occasionally be found in the reticulation. The presence of E. coli must always be followed up.

If more than 0.2mg/L free available chlorine (FAC) is maintained in the drinking-water supply reticulation, coliform bacteria and E. coli are rarely, if ever, found. For this reason it is permissible to substitute monitoring of FAC for some (but not all) of the E. coli monitoring.

APPENDIX D: TAKIWĀ ASSESSMENT DATA SET FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

Feature Name	Site Name	Visit Date	Pressure	Modifi- cation	Access	Harvest	Return	Overall	Abundance	Species	Plant Species	Plant Score	Current Species	Trad Species	Current VsTrad	CvsT Score	Takiwā	T Score Rank	Takiwa Rating
Rakitata	Erewhon	09-Feb-10	4	4	3	4	5	4	11	2	60	3	10	38	26.316	2	3.4	4	Good
Rakitata	Potts River	09-Feb-10	4	4	4	2	1	3	2	1	50	3	7	38	18.421	1	2.6	3	Moderate
Rakitata	Mesopotamia	08-Feb-10	4	3	4	4	1	4	0	1	15	1	4	38	10.526	1	2.6	3	Moderate
Rakitata	Pudding Valley	08-Feb-10	4	4	2	4	1	4	2	1	30	2	6	38	15.789	1	2.6	3	Moderate
Hakatere	Te Puna a Taka (In)	09-Feb-10	4	3	4	4	5	4	8	2	80	4	9	38	23.684	1	3.4	4	Good
Hakatere	Te Puna a Taka (S)	09-Feb-10	3	3	4	3	5	4	1	1	50	3	3	38	7.8947	1	3.0	3	Moderate
Hakatere	Te Puna a Taka (Out)	09-Feb-10	4	3	4	4	5	4	10	2	90	5	5	38	13.158	1	3.6	4	Good
Hakatere	Lambies Stream	09-Feb-10	3	3	4	3	1	4	-8	1	40	3	4	38	10.526	1	2.6	3	Moderate
Hakatere	Ōtautari (NthSide)	09-Feb-10	2	2	3	2	1	3	-5	1	30	2	5	38	13.158	1	1.9	2	Poor
Hakatere	Ōtautari (SthSide)	09-Feb-10	3	2	3	2	1	3	-2	1	30	2	7	38	18.421	1	2.0	2	Poor
Hakatere	Kirihonuhonu	09-Feb-10	4	4	4	5	5	4	19	3	90	5	12	38	31.579	2	4.0	4	Good
Hakatere	Ōtūwharekai (West)	10-Feb-10	3	4	4	5	5	4	14	3	75	4	7	38	18.421	1	3.7	4	Good
Hakatere	Ōtūwharekai (East)	10-Feb-10	2	2	4	5	5	3	8	2	40	3	6	38	15.789	1	3.0	3	Moderate
Hakatere	Hakatere ki te Toka	10-Feb-10	5	5	3	2	1	4	4	1	90	5	4	36	11.111	1	3.0	3	Moderate
Hakatere	Ōtaua-takou-ki-Hakatere	10-Feb-10	4	2	2	2	1	3	-10	1	0	1	1	32	3.125	1	1.9	2	Poor
Rakaia	Ōtūroto (Swin)	11-Feb-10	4	3	4	5	5	4	13	3	50	3	12	38	31.579	2	3.7	4	Good
Rakaia	Ōtūroto (Oliver)	11-Feb-10	2	3	4	4	5	3	-2	1	0	1	3	38	7.8947	1	2.7	3	Moderate
Rakaia	Ōtūroto (Dunbar)	11-Feb-10	3	3	4	5	5	4	9	2	40	3	9	38	23.684	1	3.3	3	Moderate
Rakaia	Lake Stream	12-Feb-10	4	3	4	5	5	4	3	1	50	3	5	38	13.158	1	3.3	3	Moderate
Rakaia	Tokinui	12-Feb-10	4	3	5	5	5	4	2	1	50	3	6	43	13.953	1	3.4	3	Good

APPENDIX E: CHI ASSESSMENT DATA SET FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

Feature Name	Site Name	Visit Date	CHI	Site Status	Return	Mahinga Kai	Stream Health	Catch Land Use	Margin Vege	Margin Use	Bed Cond	Channel	Water Quality	Water Clarity	Hab Variety	River Health	CHI Comb	C Score Rank	C Score Rating
Rakitata	Mesopotamia	08-Feb-10	B-0 1.5 4.0	B-0	1	1.5	4	2	3	4	4	4	5	5	5	4	2.8	3	Moderate
Rakitata	Potts River	09-Feb-10	A-0 1.5 3.6	A-0	1	1.5	3.6	4	4	4	2	4	3	5	3	3	2.6	3	Moderate
Rakitata	Pudding Valley	08-Feb-10	A-0 1.0 3.6	A-0	1	1	3.6	3	3	3	3	5	4	4	4	4	2.3	2	Poor
Hakatere	Lambies stream	10-Feb-10	B-0 1.5 2.9	B-0	1	1.5	2.9	3	4	2	2	4	3	2	3	3	2.2	2	Poor
Hakatere	Hakatere ki te Toka	10-Feb-10	A-0 1.2 3.6	A-0	1	1.2	3.6	3	4	4	3	4	4	4	3	4	2.4	2	Poor
Hakatere	Ōtaua-takou-ki-Hakatere	10-Feb-10	A-0 1.0 3.5	A-0	1	1	3.5	2	3	4	4	4	4	4	3	3	2.3	2	Poor
Rakaia	Ōtūroto (Oliver)	11-Feb-10	B-1 2.5 3.0	B-1	5	2.5	3	2	3	2	4	3	3	4	3	3	2.8	3	Moderate
Rakaia	Ōtūroto (Dunbar)	11-Feb-10	A-1 2.5 3.4	A-1	5	2.5	3.4	3	4	3	3	4	3	3	4	3	3.0	3	Moderate
Rakaia	Lake Stream	12-Feb-10	A-1 2.5 3.9	A-1	5	2.5	3.9	3	3	3	4	4	5	4	5	4	3.2	3	Moderate
Rakaia	Tokinui	12-Feb-10	A-1 2.8 3.8	A-1	5	2.8	3.9	4	3	4	4	4	4	4	4	4	3.4	4	Good

APPENDIX F: SHMAK ASSESSMENT DATA SET FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

Feature Name	Site Name	Visit Date	Habitat Score	Habitat Rating	Flow	Flow Score	pH	pH Score	Temp	Temp Score	Cond	Cond Score	Clarity	Clarity Score	Bed Score	Bank Veg	Bed Deposit	Deposit Score	Hab Ave/5
Rakitata	Mesopotamia	08-Feb-10	68.65	Very Good	0.66667	10	6	5	16	8	50	16	100	10	8	6.65	Fine	5	3.3
Rakitata	Potts River	09-Feb-10	60.2	Very Good	1.25	3	5.5	5	18	8	50	16	100	10	13	5.2	Moderate	0	2.7
Rakitata	Pudding Valley	08-Feb-10	35.5	Moderate	0	0	6	5	18	8	60	16	75	8	-8.5	7	Moderate	0	2.0
Hakatere	Hakatere ki te Toka	10-Feb-10	62.6	Very Good	0.83333	5	5.5	5	14.5	10	60	16	79	8	10	8.6	Moderate	0	2.8
Hakatere	Ōtaua-takou-ki-Hakatere*	10-Feb-10	56.5	Good	0	1	0	0	13	10	70	16	79	8	5.5	16	Moderate	0	3.1
Rakaia	Oliver Stream*	11-Feb-10	57.2	Good	0	0	5.5	5	12	10	20	20	100	10	7	5.2	Moderate	0	2.9
Rakaia	Dunbar Stream	11-Feb-10	45	Good	0	0	5.5	5	13	10	30	20	89	8	3	4	Moderate to thick	-5	2.3
Rakaia	Lake Stream*	12-Feb-10	36.3	Moderate	0	0	5.5	5	23	5	60	16	89	8	-8	10.3	Moderate	0	1.9

Feature Name	Site Name	Invert Score	IS/5	Invert Rating	Peri Score	PS/5	Peri Rating	Stream Rating	Overall score/5	Ranking	Rating
Rakitata	Mesopotamia	7.5	3.75	Good	1	0.5	Very Poor	Good - Very Good	2.5	3	Moderate
Rakitata	Potts River	8	4	Very Good	4	2	Moderate	Good - Very Good	2.9	3	Moderate
Rakitata	Pudding Valley	7.4	3.7	Good	7	3.5	Good	Outlier	3.1	4	Good
Hakatere	Hakatere ki te Toka	6.7	3.35	Good	1	0.5	Very Poor	Good - Very Good	2.2	3	Moderate
Hakatere	Ōtaua-takou-ki-Hakatere*	6.7	3.35	Good	0	0	No Rating	Good - Very Good	3.2	4	Good
Rakaia	Oliver Stream*	7.5	3.75	Good	0	0	No Rating	Good - Very Good	3.3	4	Good
Rakaia	Dunbar Stream	6	3	Good	1	0.5	Very Poor	Good	1.9	2	Poor
Rakaia	Lake Stream*	0	0	No Rating	0	0	No Rating	Outlier	1.9	2	Poor

APPENDIX G: E.COLI ASSESSMENT DATA SET FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

Site		Date	Time	E.coli MPN/100ml	Comment	Code	Sample	tetracycline	apramycin	streptomycin	gentamicin	sulphamethoxazole	ampicillin
Rakitata	Mesopotamia	08-Feb-10	1:15pm	1		765637-1							
Rakitata	Pudding Valley	08-Feb-10	2:30pm	15		765637-2	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Rakitata	Mt. Potts	09-Feb-10	12:10pm	< 1	#Sample >24hrs	766004-1	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Rakitata	Potts River	09-Feb-10	1:30pm	3	#Sample >24hrs	766004-2	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Te Puna a Taka	Lambies Stream	09-Feb-10	3:20pm	10	#Sample >24hrs	766004-3	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Te Puna a Taka	Upper	09-Feb-10	2:20pm	11	#Sample >24hrs	76004-4							
Kirihonuhonu	Lake Emma	10-Feb-10	7:15am	11	#Sample >24hrs	766004-5	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otaua takou	Stour River	10-Feb-10	8:15am	166	#Sample >24hrs	766004-6	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Hakatere ki te toka	Hakatere Corner	10-Feb-10	8:05am	291	#Sample >24hrs	766012-1	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Te Puna a Taka	Clearwater Settlement	10-Feb-10	7:35am	3	#Sample >24hrs	766012-2	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otautari	Lake Camp	10-Feb-10	7:40am	1	#Sample >24hrs	766012-3							
Te Puna a Taka	Clearwater Outlet	10-Feb-10	7:30am	16	#Sample >24hrs	766012-4	1	sensitive	resistant	intermediate	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	resistant	intermediate	sensitive	sensitive	sensitive
							4	sensitive	resistant	intermediate	sensitive	sensitive	sensitive
Otuwharekai	Upper Maori Lake	10-Feb-10	6:55am	39	#Sample >24hrs	766012-5	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Hakatere ki te toka	Hakatere Bridge	10-Feb-10	7:05am	225	#Sample >24hrs	766012-6	1	resistant	sensitive	sensitive	sensitive	sensitive	resistant

							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otuwharekai	Maori Lakes Outlet	10-Feb-10	6:45am	59	#Sample >24hrs	766012-7	1	sensitive	resistant	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otuwharekai	Lower Maori Lake	10-Feb-10	6:45am	37	#Sample >24hrs	766012-8	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otuwharekai	Jacobs Stream (Castleridge)	12-Feb-10	9:20am	79	#Sample >24hrs	766172-1	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Otuwharekai	Clent Hill Stream	12-Feb-10	9:24am	66	#Sample >24hrs	766172-2	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Oturoto	Oliver Stream	12-Feb-10	9:35am	272	#Sample >24hrs	766172-3	1	sensitive	sensitive	resistant	sensitive	sensitive	resistant
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	resistant	sensitive	sensitive	resistant
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Oturoto	Dunbar Wetland	12-Feb-10	9:45am	31	#Sample >24hrs	766172-4							
Oturoto	Lake Heron (off Campsite)	12-Feb-10	9:35am	88	#Sample >24hrs	766172-5	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Oturoto	Swin River	12-Feb-10	9:30am	57	#Sample >24hrs	766172-6	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Oturoto	Dunbar Stream	12-Feb-10	9:45am	66	#Sample >24hrs	766172-7	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Oturoto	Lake Stream	12-Feb-10	9:50am	4	#Sample >24hrs	766172-8	1	sensitive	intermediate	sensitive	sensitive	sensitive	sensitive
							2	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							3	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
							4	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive
Rakaia	Tokinui	12-Feb-10	12:15pm	1	#Sample >24hrs	766172-9	1	sensitive	sensitive	sensitive	sensitive	sensitive	sensitive

APPENDIX H: FYKE NET ASSESSMENT DATA SET FOR THE Ō TŪ WHAREKAI CULTURAL HEALTH ASSESSMENT

Feature	Site	Net	Desc.	In	Out	Species	LF	SF	Other	Length (mm)	Weight (gm)
Clearwater	Settlement	1		20:30	7:45	Longfin	1			720	1230
	Outlet	1	In Lake	20:00	7:00	Shortfin		1		500	360
		2	Entrance	20:00	7:00	Longfin	1			500	360
						Longfin	1			540	330
						Cockbully			1		
		3	Upcreek	20:00	7:00	Shortfin		1		730	890
						Longfin	1			790	1370
						Longfin	1			710	870
						Perch			4		
Otautari/Camp	Northside	1		20:30	8:00	0					
		2		20:30	8:00	0					
		3		20:30	8:00	0					
	Southside	1	off point	20:45	8:30	Longfin	1			1530	11400
		2		20:45	8:30	0					
		3		20:45	8:30	0					
Kirihonu/Emma	Inlet	1	Left			Shortfin		1		700	800
		2	Centre			Longfin	1			420	310
						Longfin	1			610	610
		3	Right			0					
Otuwharekai E	Front Edge	1	Left/raupo	21:00	8:00	Shortfin		1		650	680
								1		620	520
								1		700	810
								1		700	850
								1		600	690
						Longfin	1			500	400
							1			530	390
							1			620	690
							1			740	1170
							1			750	1270
		2	Centre			Shortfin		1		600	650
								1		330	470
								1		600	650
								1		670	730
								1		640	700
								1		950	2090
								1		660	600
								1		790	1230
								1		640	700
								1		780	1120
								1		750	860
						Longfin	1			670	1010
							1			720	1190
							1			990	3090
							1			790	1500
							1			800	2090

							1			560	660
							1			520	550
							1			510	560
							1			550	610
							1			410	310
							1			530	530
							1			520	510
		3	Right			Shortfin		1		820	1570
								1		690	890
								1		520	510
								1		640	830
								1		530	490
						Longfin	1			670	990
							1			680	1140
							1			430	420
							1			600	690
							1			520	560
							1			620	830
							1			510	500
							1			520	540
							1			480	480
							1			440	540
	East Side	4	Mid			Shortfin		1		860	1160
								1		600	560
								1		640	650
						Longfin	1			1000	3130
							1			780	1420
							1			700	1050
		5	Raupo			Shortfin		1		740	890
								1		490	290
						Longfin	1			650	620
							1			490	240
		6	Midraupo				0				
		7					0				
		8					0				
		9	Willow			Longfin	1			700	860
		10	Streaminlet			Longfin	1			820	1660
							1			860	1660
		11	Westraupo			Shortfin		1		730	820
								1		650	790
						Longfin	1			490	380
							1			520	320
							1			730	1190
							1			740	1200
							1			880	1940
							1			700	1100
							1			660	840
							1			700	1160
							1			640	690
							1			470	320
							1			450	330
						Total	46	28	0		

	Outlet	12				Longfin	1			650	820
Otuwharekai W	BackSwamp	1				0					
	FrontEdge	2				Longfin	1			840	1800
							1			760	1280
		3				Longfin	1			1080	4170
	WestCorner	4				Longfin	1			1400	7210
		5				0					
	WestBay	6	Leftbay			0					
		7	Midbay			Shortfin		1		1040	2400
		8	farbay			Shortfin		1		1320	5180
	Farend	9	raupo			0					
	FrontRaupo	10	Watene			0					
Oturoto/Heron	SwinRiver	1	Leftouter			Longfin	1			670	650
		2	Left			0					
		3	Stream			0					
		4	Right			Longfin	1			670	740
		5	Middle			0					
	Noho/OliverS	1	DunbarSt			Longfin	1			650	720
							1			920	2740
						BrownTrout			5		
		2				Longfin	1			700	1320
							1			690	830
							1			480	210
							1			460	220
							1			520	380
							1			520	400
							1			470	230
							1			600	590
							1			570	480
							1			450	260
							1			430	200
							1			390	170
		3				Longfin	1			720	1060
							1			620	700
							1			520	450
							1			630	680
		4				Longfin	1			460	290
							1			580	540
							1			360	160
							1			480	310
							1			420	250
							1			490	250
							1			370	150
							1			440	270
		5				Longfin	1			610	750
						BrownTrout			2		
	DunbarStream	1	Westclose			Longfin	1			640	680
							1			530	450
							1			600	590
							1			750	1190
							1			740	1170
							1			390	160

							1			500	350
							1			690	920
							1			570	440
							1			460	220
							1			600	670
							1			510	290
							1			430	170
							1			470	220
							1			580	440
		2	Westpoint			Longfin	1			780	1190
							1			710	1060
							1			800	1460
						Waikakahi			7		
		3	Eastout			0					
		4	Eastclose			Longfin	1			640	750
LakeStream	Outlet/Bridge	1	LiveWillow			Longfin	1			540	460
							1			600	480
		2	Carex			Longfin	1			570	390
		3	DeadWillow			0					
		4	UnderBridge			0					
		5	Otherside			Longfin	1			520	310

APPENDIX I: PHOTOGRAPHIC RECORD OF Ō TŪ WHAREKAI SITES

Te Rakitata / Rangitata River



Site 1. Erewhon/Mt. Sunday (looking upstream)



Site 1. Erewhon/Mt. Sunday (looking downstream)



Site 2. Potts River (from bridge)



Site 2. Potts River (above the bridge)



Site 3. Mesopotamia (looking upstream)



Site 3. Mesopotamia (looking downstream)



Site 4. Pudding Valley Stream

Te Puna a Taka / Lake Clearwater



Site 5. Clearwater Upper (Craddock Stream Wetland)



Site 6. Clearwater Settlement



Site 7. Clearwater Outlet



Site 8. Lambies Stream (Clearwater Outlet)

Ōtautari / Lake Camp



Sites 9 & 10. Otautari southside (left) and northside (right)

Kirihonuhonu / Lake Emma



Site 11. Northern Wetland/Inlet

Hakaterere / Ashburton River



Site 12. Hakaterere ki te Toka (Heron Rd Bridge – looking downstream)



Site 12. Hakaterere ki te Toka (Heron Rd Bridge – looking upstream)



Site 14. Otaua Tākou ki Hakatere (Stour/Ashburton River Confluence)

O Tū Wharekai / Māori Lakes



Site 15. Upper Maori Lake



Site 16. Lower Maori Lake

O Tū Roto / Lake Heron



Site 20. Swin River Access Carpark



Site 22. Dunbar Stream Inlet (left), Mt Sugarloaf (mid) & Oliver Stream inlet (right)

Rakaia River



Site 23. Lake Stream (Heron Outlet)





Site 24. Tokinui (looking upstream to Rakaia headwaters (left), Manuka Point (mid) & Mathias River (right)).



Site 24. Tokinui (looking downstream)



Rakaia River (looking upstream back towards Tokinui)



Rakaia River (looking downstream)