



# STATE OF THE TAKIWĀ

## **He pūau awa**



## Cultural Health Assessment of the Mataura and Waikawa Catchments

Compiled by Craig Pauling

Maruaroa / June 2008



# Te Rūnanga o NGĀI TAHU

mō tātou, ā, mō kā uri ā muri ake nei

for us and our children after us

[www.ngaitahu.iwi.nz](http://www.ngaitahu.iwi.nz)



This report was produced using Takiwā 2.0 – a database developed by Te Rūnanga o Ngāi Tahu and Environmental Science & Research, and supported by the Ministry for the Environment

## Cover Photographs:

Top: Te Au Nui/Mataura Falls, Mataura River; and

Bottom: Māngai Piri/Niagara Falls, Waikawa River

(C. Pauling, 2007).

# Whakarāpopotanga / Executive Summary

---

This report outlines the results of a cultural environmental health assessment of the Maitara and Waikawa catchments undertaken by Te Rūnanga o Ngāi Tahu, in-conjunction with Ngā Rūnanga o Murihiku, between May and November 2007. This study was carried out for Manaaki Whenua Landcare Research as part of a wider research project being conducted with Te Ao Marama called 'He pūau awa – he ūngututanga mātauranga: Environmental reporting for a riverine system – a bicultural approach'.

The purpose of the study was to undertake a review of the cultural health of the catchments, through data collected at selected sites using the Takiwā cultural environmental monitoring and reporting tool.

Takiwā is an environmental monitoring system developed by Ngāi Tahu that is aimed at facilitating Tāngata Whenua to gather, store, analyse and report on information in relation to the cultural health of significant sites, natural resources and the environment within their respective takiwā (tribal areas). The approach uses a series of assessment forms to enable the quantification of cultural health scores based on a number of factors including suitability for harvesting mahinga kai, physical and legal access, site pressures, degree of modification and the identification of valued as well as pest species present. Other tools including the Cultural Health Index (CHI), Stream Health Monitoring and Assessment Kit (SHMAK), E.coli testing and electric fishing surveys are also used to complement the Takiwā assessments.

Overall, the monitoring results and subsequent analysis found the Maitara catchment to be in a state of poor cultural health, while the Waikawa Catchment was considered to be in good health.

For the Maitara catchment, the amount of pressure on the waterway from agricultural, urban and industrial land uses, including both point and non-point source pollution issues, as well as the loss of native vegetation buffers and habitat to aid water quality and biodiversity are significant problems. Investigating creative ways to deal with discharges and the lack of biodiversity, potentially through the use of native riparian vegetation management and restoration would be important.

In the Waikawa catchment, the good result was influenced largely by the presence of widespread remnant native riparian and catchment vegetation, being an important factor in maintaining a healthy system. The critical issue in this catchment however is ensuring adequate protection and buffering of waterways from agricultural land use, particularly due to unusually high E.coli results. Again, working with landowners and councils to either encourage or regulate active native riparian management will be important. Furthermore, developing strategies to investigate and deal with any direct sources of contamination, particularly E.coli, will be important into the future.

# Rārangi Ūpoko / Contents

---

Rārangi Ūpoko / Contents .....	ii
1 Te Whakatūwheratanga / Introduction.....	1
1.1 Tāhuhu Kōrero / Background .....	2
1.2 Ngā Whāinga / Study Aims and Objectives.....	4
2 Te Puna / Takiwā Monitoring Tool .....	5
2.1 What is State of the Takiwā? .....	5
2.2 The Takiwā Database .....	6
2.2.1 Site Assessment Module .....	6
2.2.2 Takiwā Monitoring Forms.....	7
2.2.3 Takiwā Reporting Functions.....	8
3 Ngā Kauneke / Methods.....	9
3.1 Kōrero Arotake / Monitoring Hui and Planning .....	9
3.2 Tāngata Arotake / Monitoring Team .....	9
3.3 Taputapu Arotake / Monitoring Equipment .....	10
3.4 Wāhi Arotake / Monitoring Sites.....	10
3.5 Kauneke Arotake / Data Collection & Assessment.....	12
3.5.1 Takiwā Site Assessments .....	12
3.5.2 E.Coli Water Testing.....	13
3.5.3 Cultural Health Index Waterway Assessment .....	14
3.5.4 Stream Health Monitoring (SHMAK) Assessment .....	15
3.5.5 Electric Fishing .....	17
3.5.6 Seine/Drag Netting .....	17
3.6 Data Analysis .....	17
4 Ngā Hua / Results .....	18
4.1 Takiwā Site Assessments .....	18
4.2 Cultural Health Index Assessments .....	19
4.3 SHMAK Assessments .....	20
4.4 E.coli Water Testing and Anti-biotic Resistance .....	20
4.5 Native Species Abundance .....	21
5 Te Whakamutunga / Conclusions.....	22
5.1 Recommendations.....	24
6 Tohutoro / References .....	25
Appendix A – Monitoring Plan for the Mātaura – Waikawa Cultural Health Study .....	36
Appendix B – Takiwā Monitoring Forms used within the Study .....	28
Appendix C – National Drinking, Recreation and Shellfish Standards for Water .....	46
Appendix D –Takiwā Assessment Data Set for the Study .....	48
Appendix E – CHI Assessment Data Set for the Study .....	50
Appendix F – SHMAK Assessment Data Set for the Study .....	52
Appendix G – E .coli Testing Data Set for the Ihutai Study .....	55
Appendix H – Site Photograph Record for the Study .....	57

# 1 Te Whakatuwheratanga / Introduction

---

The Maitara and Waikawa catchments are significant rivers in the Murihiku/Southland region for tāngata whenua, due largely to the occurrence of annual migrations of the kanakana or lamprey eel. Yet, as a consequence of the development of urban areas, industry and agriculture both catchments have undergone change and have impacted on the ability of tāngata whenua to continue to harvest kanakana and other native fish, as well as native bird and plant species.

While the significance of these catchments is well known, very little is known about the extent of change that has taken place for, or how the current health of the catchments is viewed by, tāngata whenua. This report therefore outlines the results of a cultural environmental health assessment study that marks the first attempt to quantify these issues from a tāngata whenua perspective.

The assessment was undertaken by Te Rūnanga o Ngāi Tahu, in-conjunction with members of Ngāi Tahu Papatipu Rūnanga o Murihiku, as part of a wider research programme being lead by Manaaki Whenua Landcare Research, supported by Te Ao Marama and funded by Ngā Pae o te Maramatanga.

The study collected data from 14 sites within the two catchments using the Takiwā cultural environmental monitoring and reporting tool. This included the use of the Takiwā site assessment, Cultural Health Index and Stream Health Assessment and Monitoring tools, E.coli and anti-biotic resistance testing as well as electric and drag net fishing surveys. The field-collected site data was subsequently loaded into the Takiwā database to enable a catchment analysis to be undertaken.

Specifically, the report is structured in the following way:

- Section 1 introduces the report with a brief background to the study, including major drivers, aims and objectives.
- Section 2 gives an overview of the State of the Takiwā Database and Monitoring tool used within the study and to produce this report.
- Section 3 gives an overview of the process and methods of data collection, including those of Takiwā and the other tools used during the study.
- Section 4 gives the results of the study, including site assessment data and a discussion of the current cultural health of the Maitara and Waikawa catchments.
- Finally, Section 5 concludes the report with a summary of major points and recommendations of the study.

## 1.1 Tāhuhu Kōrero / Background

The Maitara and Waikawa catchments are rivers of immense cultural significance to tangata whenua in the Murihiku/Southland region, due largely to the annual seasonal harvest of kanakana (lamprey eels) at Te Au Nui or Matuara Falls, on the Maitara River, and at Māngai Piri or Niagara Falls on the Waikawa River.

The Maitara River was also significant as a major trial between the coastal settlements of Murihiku and Te Ara a Kewa/Foveaux Strait to Lake Whakatipu and the Te Koroka source of pounamu (greenstone) at the head of the lake. The Waikawa catchment, including its estuary played a significant role in providing food and sustenance to the Ngāi Tahu settlements in and around the Waikawa area.



Due to their place in the history and traditions of Ngai Tahu Whānui both catchments were recognised in the Ngāi Tahu Claims Settlement Act 1998 through the placing of a Statutory Acknowledgement and a number of nohoanga sites on the Maitara River, and the creation of a nohoanga site at Māngai Piri on the Waikawa River.

Schedule 42 of the Act summaries the Ngai Tahu association with the Maitara River stating:

*The area of the Maitara River above the Maitara Falls was traditionally used by the descendants of the Ngati Mamoe chief, Parapara Te Whenua. The descendants of Parapara Te Whenua incorporate the lines of Ngati Kuri from which the Mamaru family of Moeraki descend. Another famous tupuna associated with the river was Kiritekateka, the daughter of Parapara Te Whenua. Kiritekateka was captured by Ngai Tahu at Te Anau and her descendants make up the lines of many of the Ngai Tahu families at Otakou....The Maitara was an important mahinga kai, noted for its indigenous fishery. The Maitara Falls were particularly associated with the taking of kanakana (lamprey).*

Since 1998, tangata whenua have also been successful in establishing New Zealand's first freshwater Mātaitai Reserve along a 10km stretch of the Maitara River centred around the Maitara Falls and developing a number of research initiatives to help manage the river mō tātou, ā, mō kā uri a muri ake nei.



The settlement of the wider Maitara area, and in particular the agricultural development of the catchment has had a visible impact on the river, particularly the Maitara Falls area. The townships of Gore, Maitara and Edendale have significant agricultural based industrial sites including meat works, dairy factories and timber mills, all discharging wastes into the river. The Maitara Falls is perhaps the most dramatic example of this, being surrounded on each side by industrial factories. Inputs from these factories, as well as sewage and stormwater discharges from the surrounding townships have had an historical impact on the catchment, its water quality, the abundance of mahinga kai species, as well as the ability of tāngata whenua to gather these species. The Maitara River is still however regarded as an important Trout fishery.



The Waikawa catchment has had a different history, being located away from the main agricultural and industrial centres of Southland. The catchment sits within the Catlins Region on Eastern Southland, a popular tourist area, and amongst the Catlins Forest Park, with forestry and agriculture being the major land uses in the catchment.



*Waikawa River at Niagara 1908*

Cultural monitoring has never been undertaken within these catchments to assess the current health of the catchment. This study and the wider research programme it is part of offers the first coordinated effort to understand these issues from a tāngata whenua perspective.

## 1.2 Ngā Whāinga / Study Aims and Objectives

The major aim of the study was to:

- undertake baseline assessments of the cultural health of the Maitara and Waikawa catchments through the gathering, analysis and reporting of data collected using the Takiwā cultural environmental monitoring and reporting tool and to provide data to complement other scientific data gathered as part of the wider 'He pūau awa' project.

This was supported by the following objectives, to:

- Identify monitoring sites and targets in the Maitara and Waikawa Catchments, important resources such as people and equipment needed and develop a plan for the gathering of data in conjunction with rūnanga monitoring team members (April 2007);
- Provide training to rūnanga monitoring team members in the use of the Takiwā software and other environmental monitoring processes (May 2007).
- Undertake the gathering of data from the selected sites and input the collected data into Takiwā (May and November 2007);
- Analyse the collected data and complete a summary cultural health baseline report for the Maitara and Waikawa catchments for inclusion in the wider He pūau awa reports (by June 2008);
- Present these findings back to Te Ao Marama (by June 2008).





## 2 Te Puna / Takiwā Monitoring Tool

---

The Takiwā Monitoring tool used within this study is an important factor in the development of this report. To fully appreciate and understand the data presented in this report, it is therefore important to outline how the Takiwā database and monitoring forms are structured and used. The following sub-sections therefore give an overview of the key features of the database and monitoring forms and how these helped to create this report.

### 2.1 What is State of the Takiwā?

State of the Takiwā is an environmental monitoring approach developed by Te Rūnanga o Ngāi Tahu as part of their Ki Uta Ki Tai - Mountains to the Sea Natural Resource Management framework (Pauling 2004) and outlined in the tribal vision, Ngāi Tahu 2025 (Te Rūnanga o Ngāi Tahu 2001). Its development has been partly funded by the Ministry for the Environment and supported by Environmental Science and Research, Manaaki Whenua Landcare Research, NIWA, Envirolink Southern Community Laboratories, Environment Southland and Environment Canterbury.

In simple terms, State of the Takiwā describes a cultural values based environmental monitoring and reporting system that is aimed at facilitating Tāngata Whenua to gather information, assess and report on the cultural health of significant sites, natural resources and the environment within their respective takiwā, that will in turn assist them in managing the environment into the future.

State of the Takiwā is a play on words from the conventional, largely western science based State of the Environment approach, but that takes into account Māori cultural values, such as mauri and mahinga kai, and that aims to complement standard scientific measures of environmental health.

Ngāi Tahu 2025 defines State of the Takiwā as “[a]n environmental monitoring and reporting approach that integrates Mātauranga Māori and Western Science to gather information about the environment and to establish a baseline for the creation of policy and improvement of environmental health. A programme developed as an alternative to conventional state of the environment reporting used by the Ministry for the Environment that takes into account Tāngata Whenua values” (TRoNT 2001, p47-48).

The major objective behind State of the Takiwā is to ensure that Tāngata Whenua can build robust and defensible information on the health of the environment, which can in turn be used to assess the effectiveness of both internal policy and practices as well as those of external agencies, including local councils who have statutory responsibilities to undertake monitoring and report on the state of the environment (Pauling 2003).

Central to the approach is the gathering of information on the health of the environment using specially developed data-forms and the collation of this information into a specifically designed database from which analysis is possible and reports can be prepared. An overview of the Takiwā forms and database is included below.

## 2.2 The Takiwā Database

Takiwā is a specially developed Microsoft Access 2002 runtime application linked to a physically separated database, which can be run on any PC by downloading it from an installation CD-ROM. The database is password protected, and all data entries are automatically stamped with the initials of who created it and when, and who last modified it. The database also has facilities for creating dated backup copies of the data tables, which can be stored remotely to ensure the safety of the data. It also includes an easy to use Helpfile and has a bi-lingual interface that can display key headings in either Te Reo Māori or English, depending on the current user's preference.

The primary aim of the Takiwā database is to facilitate data collection and make information available to Tāngata Whenua, to help them identify and quantify the current or changing quality of a particular site, and to be able to report this data in an easy, clear and repeatable way. This is achieved by the inclusion of a site assessment module for storing, analysing and reporting data collected on particular sites, and a print centre where monitoring forms for data collection and standard reports can be produced.

### 2.2.1 Site Assessment Module

The Site Assessment module identifies environmental monitoring sites and records details from both present-day visits by participants as well as historical information. Data gathered is in a combination of reasoned multi-choice evaluation of criteria (eg. access for harvesting: 1 = very poor -- 5 = very good), and ad-hoc comments of visitor impressions (see Figure 1 below). Within this module, details based on Takiwā Monitoring, Cultural Health Index and SHMAK forms can be entered to describe a geographically-defined site and the details of the visit as well as being able to assess environmental and other qualities in a consistent fashion over time.

The screenshot displays the 'Site Assessment Workbench' application. The 'Assessment' tab is selected, showing a form for an assessment conducted on 4 May 2007 by CP/TLMR/NTN. The form includes a 'Comment' field with the text 'While in a comment, Site #2 will enlarge it.' and a 'Number of people represented' field set to 4. The 'Site Assessment' section contains eight numbered criteria, each with a rating from 1 to 5. The 'Index Calculations' section shows the following values: Health Assessment Index (2.1), Abundance Index (14.0), and Cultural Health Index (A-0.150.0). The bottom of the window features a series of buttons for navigation and actions, including 'Ecosystems', 'Species', 'Lock tab', 'More buttons', 'Allow editing', 'Print Centre', 'For all Questionnaires', 'Recalculate', 'Show factors', and 'Edit Factors'.

Figure 1. Takiwā Site Assessment Module

The structure of the database ensures that, in the future, the data can be interrogated to answer such questions as:

- Has quality improved or deteriorated over the years?
- How many sites of interest exist in different areas?
- How much information is available on that area?
- Who has visited it (for assessment) and when?
- Have native birds, plants, etc improved or deteriorated over the years?
- At which sites have people seen kererū, totara, or other listed taonga?
- How have their presence changed over the years?

The Site Assessment module also includes a section labelled 'journal' where important historical information and references about a particular site can be stored. A further feature is the image portal where an unlimited number of photographs or other diagrams (.jpg, .gif or .bmp format) can be associated with the site.

In order to grade and compare sites and visits, index calculations have been included within the database. These include an overall site health assessment index, a species abundance index, and the Cultural Health Index for waterways (Tipa & Tierney 2003 & 2006). The Site Assessment module also includes a module to enter data from the Stream Health Monitoring and Assessment Kit (Biggs, Kilroy & Mulcock 2000) and to produce scores for stream habitat quality, and invertebrate and periphyton health. All indexes can be recalculated for either the current questionnaire, or for all questionnaires in the database (Mattingley 2005).

## **2.2.2 Takiwā Monitoring Forms**

Takiwā includes a series of specially developed monitoring forms which can be printed directly from the database, used to gather information about sites and facilitate the storage and reporting of data from the field. These include the Takiwā Site Definition, Visit and Assessment forms. Takiwā also currently includes forms for the Cultural Health Index and Stream Health Monitoring and Assessment Kit.

The aim of the Takiwā monitoring forms are to record observations and assessments by tāngata whenua for a particular site and at a particular time relating to key cultural values and indicators of environmental health, such as mahinga kai. The forms were developed through discussion with both tāngata whenua groups and monitoring experts and by reviewing previously developed monitoring tools.

Feedback dictated that the monitoring forms needed to be simple, rather than being overly complicated or abstract and that the forms should attempt to capture the cultural information and values about a site, which is normally internalised during mahinga kai (food gathering) or similar activities and often called 'anecdotal information'.

The overall goal of the data collection and storage achieved by the form and database was to make this important information more defensible, accessible, useable and quantitative.

Forms and indicators from other monitoring toolkits were investigated and used to identify relevant formatting as well as the type of questions that could be used to capture appropriate information in relation to cultural values and indicators. These included:

- Kaimoana Monitoring Guidelines (Otaraua Hapū 2003);
- Cultural Steam Health Index (Tipa & Tierney 2003);
- Iwi-Stream Health Monitoring and Assessment Kit (Ogilvie & Penter 2001);
- Māori Indicators Wetland Monitoring Tool (Harmsworth 2002);
- Forest Monitoring and Assessment Kit Site Assessment Kit (Handford & Associates Ltd 2003);
- NIWA Freshwater Fish Database Form (NIWA 2003).

From this analysis and discussion with Tāngata Whenua and other experts, the following indicators were identified as being most important to include in the main Takiwā monitoring form:

- Heritage/Site Significance;
- Amount of pressure on the site from external factors;
- Levels of modification/change at a site;
- Suitability of the site for harvesting mahinga kai;
- Access issues in relation to the site;
- Overall health/state of a site;
- Presence, abundance and diversity counts for native bird, plant and fish species, other culturally significant resources as well as exotic (including pest and weed) species; and
- Willingness to return to the site.

Other details that were seen as being important to record were in relation to general visit and site details (date, time, weather conditions, site location, legal protection etc). This was achieved by the development of two separate but interdependent forms – The Site Definition and Visit Details Form. The visit details form also includes prompts to ensure photographic references are recorded for a site.

Examples of all the forms included in Takiwā and used in this study are shown in Appendix A.

### **2.2.3 Takiwā Reporting Functions**

The final critical feature of the Takiwā database is the printable query and reporting function. This function allows users to print a range of reports by simply selecting the type of report (from a range of options) and pushing a print button within the database. These reports can also be exported to Word or Excel to assist in report writing or graphic representations of the data.

This is made possible through a 'Print Centre' that offers a range of different reports for sites, visits and questionnaires. The print centre is accessed through buttons on both the Takiwā Main screen and on the Site Evaluation screen. When a user is in the print centre, it already knows which Site, Visit and Questionnaire were last used on the Site Evaluation screen, and these are listed, with the last one viewed being already selected.

## 3 Ngā Kauneke / Methods

---

The data collection undertaken within this study was conducted on two separate occasions in May and November 2007 at 14 sites, 9 within the Maitara Catchment, and 5 within the Waikawa Catchment.

The study was initiated with a hui of Papatipu Rūnanga members on 12 April 2007 and resulted in the development of a monitoring plan to guide the fieldwork, data collection, analysis and reporting.

The monitoring team consisted of members from Ngāi Tahu Papatipu Rūnanga o Murihiku, and were supported by a Te Rūnanga o Ngāi Tahu coordinator as well as researchers and staff from Manaaki Whenua, Agresearch, Environment Southland, Envirolink Southern Community Laboratories and the Department of Conservation.

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 and electric fishing surveys at all river sites, seine netting and drag netting at estuary sites, and the collection and testing of water samples from all sites for the analysis of E.coli and antibiotic resistant E.coli.

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

### 3.1 Kōrero Arotake / Monitoring Hui and Planning

To initiate the study, a hui was held with Murihiku Papatipu Rūnanga on 12 April 2007 at the offices of Te Ao Marama in Invercargill to select sites and to discuss and refine the methods to be used.

From this meeting, 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.

This monitoring plan is included as Appendix B.

### 3.2 Tāngata Arotake / Monitoring Team

The following people were involved in the study and fieldwork:

- Rewi Anglem (Hokonui Rūnanga)
- Rodney Trainor (Te Ao Marama/Hokonui)



- Aaron Leith (Awarua Rūnanga/Environment Southland)
- Don Mowat (Te Ao Marama / Waihopai)
- Jamie Ataria, Louis Tremblay (Manaaki Whenua Landcare Research)
- John Aitken (EnviroLink Laboratories)
- Chris Arbuckle, Jane Kitson, Steve Leddington, Doug Keith (Environment Southland)
- Dave West (Department of Conservation)
- Craig Pauling (Te Rūnanga o Ngāi Tahu)

### 3.3 Taputapu Arotake / Monitoring Equipment

The following equipment was used during the study and fieldwork:

- Vehicles (Private)
- Takiwā forms, CHI forms, SHMAK Kit, manual and forms
- Electric Fishing Machine, Probe and Nets
- Seine nets, drag nets and fish buckets
- Waders and Protective Jacket/Gear
- E.coli kit (Vials, Chilly pads, Chilly Bin, Forms)
- Toughbook Laptop and Takiwā software
- Digital Camera, GPS unit and Binoculars
- Maps and Monitoring Plan
- Pens, folders and identification booklets
- First Aid Kit

### 3.4 Wāhi Arotake / Monitoring Sites

The following monitoring sites were selected and used for the study:

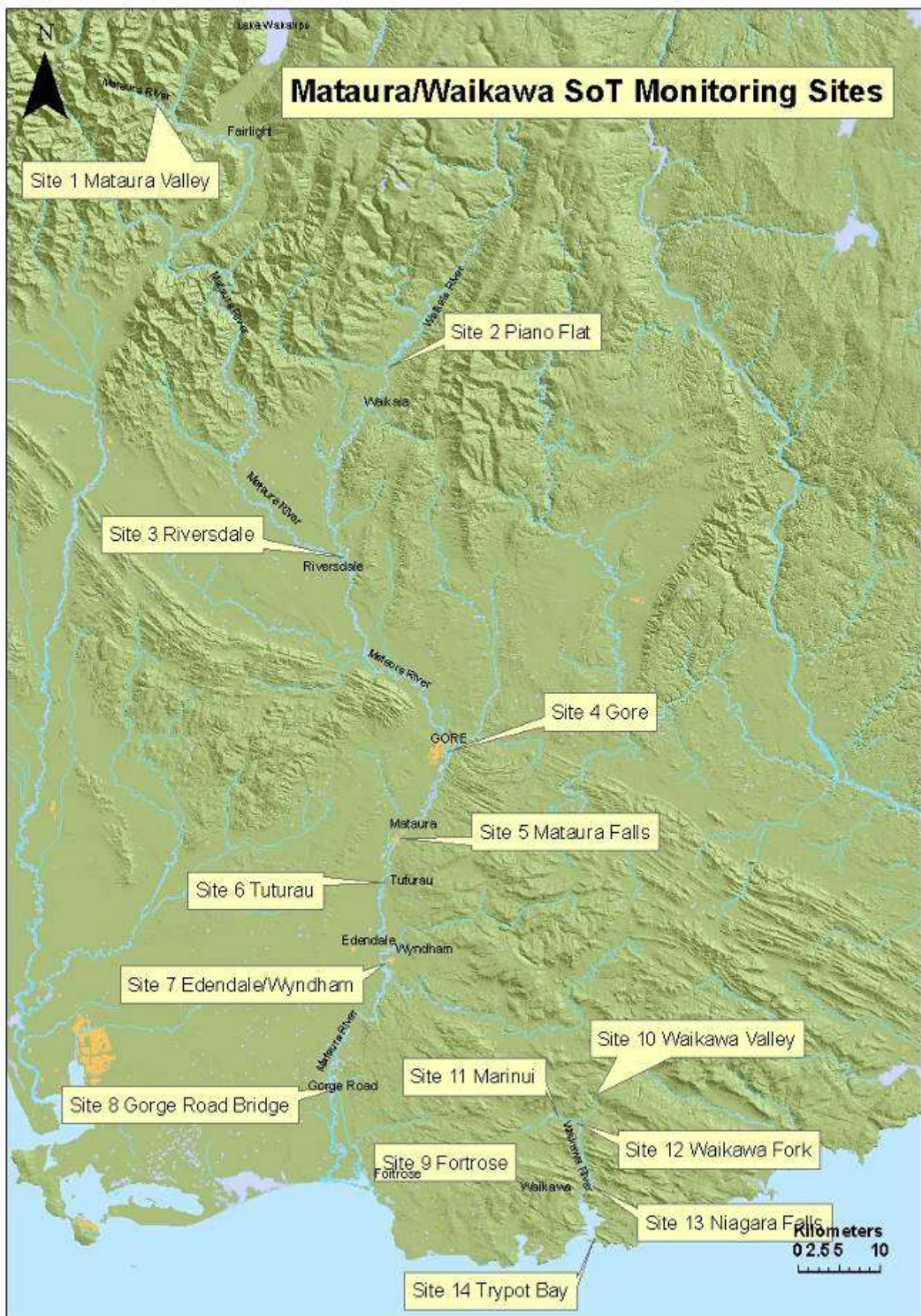
#### **Mataura River**

1. Upper Mataura Valley (Robert Creek)
2. Piano Flat/Waikaia River
3. Riversdale (Mataura/Waikaia Confluence)
4. Gore
5. Te Au Nui / Mataura Falls
6. Tukurau
7. Edendale/Wyndam
8. Gorge Road Bridge
9. Owi / Fortrose Estuary

#### **Waikawa River**

10. Upper Waikawa Valley/Forest
11. Marinui
12. Waikawa Fork
13. Mangai Piri/Niagara Falls
14. Waikawa Estuary/Trypot Bay

The location of these sites are shown on map 1 on the following page.



## 3.5 Kauneke Arotake / Data Collection & Assessment

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

1. Takiwā Site Assessments (all sites);
2. E.Coli Water Testing (all sites);
3. Cultural Health Index (CHI) Waterway Assessments (river & stream sites only);
4. Stream Health Monitoring (SHMAK) Assessments (river & stream sites only);
5. Electric Fishing Surveys (freshwater sites only) and Seine Net/Drag Net surveys (estuarine sites).

Further details of the methods for the different assessment methods used in the study are outlined in the following sub-sections. 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 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/seine netting/drag netting survey of the site/area.
- 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 Site Assessments

The first step of the Takiwā site assessment involved 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 involved 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;
- 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 (see section 3.4.5 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 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).
- Further laboratory analysis of the sample to identify the main source of any E.coli present in the river water, through antibiotic 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 delivered 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.

E.coli testing was not completed at the Avonhead and Westburn sites due to there being no water present in the streams at the time of monitoring.

#### **3.5.2.1 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 faecally contaminated water 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 antibiotic resistance. Antibiotic resistance in E.coli is a strong indication that the E.coli has previously been exposed to antibiotics, or has acquired the antibiotic resistance factor by association with an E.coli containing the factor. Specific antibiotics (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 antibiotics used solely by humans can therefore indicate contamination from human effluent and so on. Moreover, a sample showing no resistance or 'sensitivity' indicates the contamination is from a natural source, such as a bird or from the soil (Pauling et al 2005).

### **3.5.3 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):

1. 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.
2. 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.
3. Access to the site. *Do Tāngata Whenua have physical and legal access to the resources they want to gather?*
4. 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:

- |                             |                                |
|-----------------------------|--------------------------------|
| 1. Water quality            | 5. Riparian vegetation         |
| 2. Water clarity            | 6. Riverbed condition/sediment |
| 3. Flow and habitat variety | 7. Use of riparian margin      |
| 4. Catchment land use       | 8. 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)

## 3.5.4 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). SHMAK data was collected from all river and stream sites, except Avonhead and Westburn (no water), and Wigram Basin (incomplete data due to equipment failure).

### **3.5.5 Electric Fishing**

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).

Surveys were typically conducted over a 10-20 metre stretch of river at each monitoring site 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.

### **3.5.6 Seine/Drag Netting**

Seine and Drag netting were undertaken at the two estuary sites within the study. Seine netting was done using a 50 foot, 3/16 square inch mesh beach seine net by doing a number of sweeps, in semi-circular patterns across the front of the monitoring site. Any fish and other material caught (such as seaweed and shell fish) were recorded on the Takiwā forms for that site. Drag netting was done using a 30 metre, 114 millimetre mesh flounder drag net by doing a number of drags with the incoming tide (upon the turning low tide) in the upper and middle reaches of the estuary, above the monitoring sites. Again all fish and other material caught were recorded on the Takiwā forms for that site.

## **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. These scores 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.

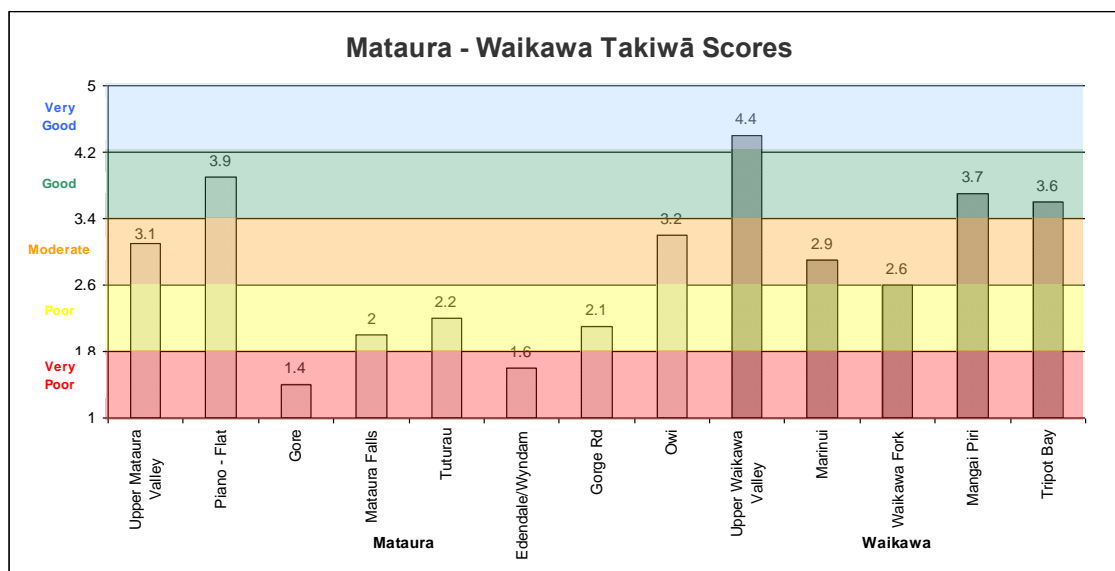
E.coli and anti-biotic resistance test results were obtained from Hills Laboratories and the data entered into excel. The data was then assessed against national drinking water, shellfish gathering and recreational standards for E.coli and graphed to show the percentage of samples that passed and failed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

These results are outlined and discussed in the following section.

## 4 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



#### 4.1.1 Mataura

Takiwā assessment results for the Mataura catchment were poor. Of the 8 sites assessed, 37% were found to be of poor health, with a further 25% being rated as very poor. 25% of sites were also rated as moderate with the remaining 13% being rated as good. No sites were rated as very good. The total average score for sites across the catchment was 2.4 out of 5.

Overall, the sites scored well on access, willingness to harvest and return indicators but poorly on pressure and modification, and very poorly on native species abundance indicators.

The highest ranking site was Piano Flat (3.9), followed by Owi/Fortrose (3.2) and Upper Mataura Valley (3.1). Positive features of these sites included the presence of remnant native vegetation, a lack of modification and/or intense land-use pressure on the river margins. It is interesting to note that these sites were at the extremes of the catchment – being the upper and lowermost sites.

Gore (1.4) was the lowest scoring site, followed by Edendale / Wyndham (1.6) and Mataura Falls (2.0), all mid-catchment sites. Negative features of these sites included a lack of native vegetation, particularly on the riparian margin, extreme modification and pressure on the margin and often noticeable direct and indirect pollution or discharges.

#### 4.1.2 Waikawa

Takiwā assessment results for the Waikawa catchment were good. Of the 5 sites assessed, 40% were found to be in good health, with a further 20% being rated as very good, while the remaining 40% were rated as moderate. No sites

were rated as poor or very poor. The total average score for sites across the catchment was 3.4 out of 5.

Overall the catchment scored extremely well on willingness to harvest indicators, while native species abundance indicators were moderate to poor.

The highest ranking site was the Upper Waikawa Valley (4.4), followed by Māngai Piri (3.7) and Tripot Bay (3.6). Positive features of these sites included the presence of remnant and intact native vegetation, both along the riparian zone and beyond, a lack of modification and/or intense land-use pressure on the river margins, as well as the presence of native fish species.

Waikawa Fork (2.6) was the lowest scoring site, followed by Marinui (2.9). These sites were both located in the middle of the catchment and were surrounded by modified farm land. While some native riparian vegetation existed, it was limited to the immediate edge and there was obvious pressure immediately beyond the riparian zone and throughout the surrounding catchment.

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

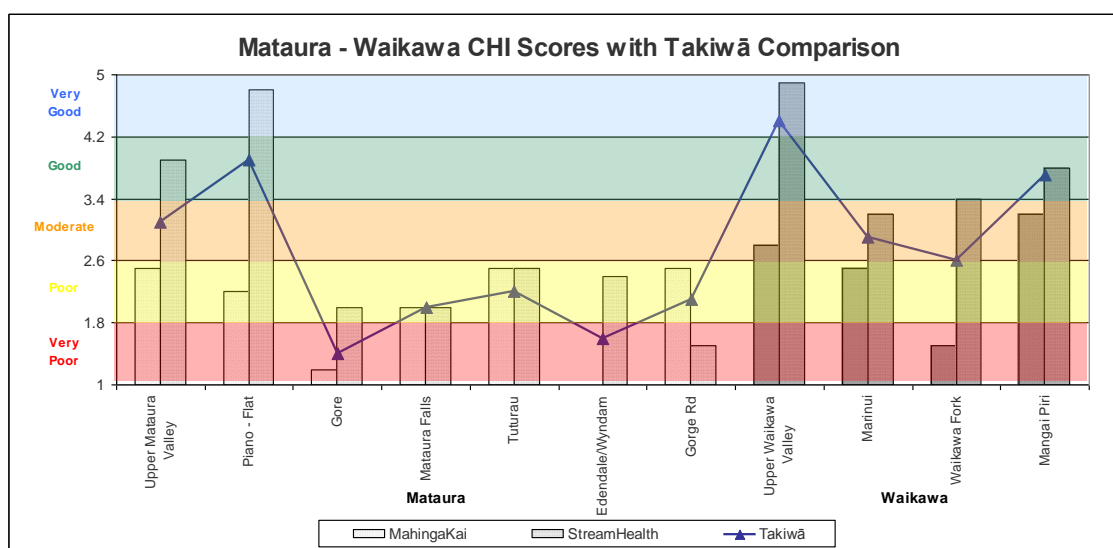
## 4.2 Cultural Health Index Assessments

CHI results supported the Takiwā assessments, with all but one site demonstrating higher stream health ratings scores and lower mahinga kai scores overall.

In the Maitara catchment 43% of sites were rated as poor, with a further 29% rated as very poor. Margin vegetation and river margin use indicators scored poorly, while water clarity, river modification and habitat variety scored well.

In the Waikawa catchment 50% of the sites were rated as good. Catchment and river margin landuse indicators were the most poorly rated, while river modification, water quality, water clarity and habitat variety indicators received high ratings.

The overall CHI results are shown in the graph below, along with a comparison to the Takiwā site scores.

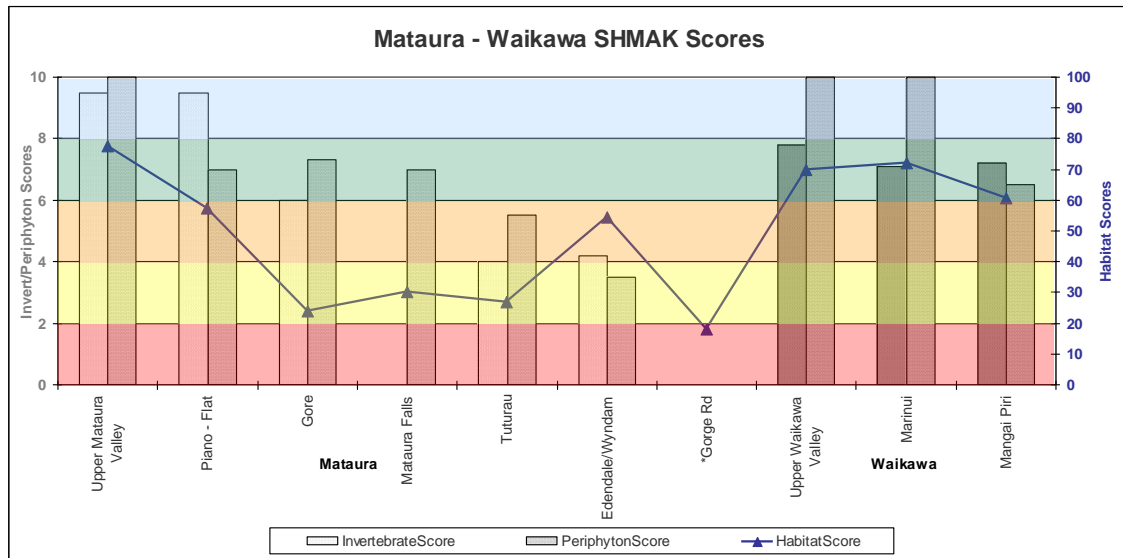




## 4.3 SHMAK Assessments

Only 10 sites were able to be tested using SHMAK, with the results being higher overall, but reflecting a consistent pattern with the Takiwā and CHI ratings across both catchments. Again the Waikawa catchment was considered healthier than the Matura catchment, and upper catchment sites being healthier than mid and lower catchment sites (excluding estuary sites).

The results are shown in the graph below.



\* Indicates an incomplete site record

In terms of the individual habitat indicators, bed, bank vegetation and deposit/sedimentation indicators scored poorly, while pH, temperature, conductivity and clarity indicators scored well in both catchments.

Full results for the SHMAK assessments are included as Appendix F.

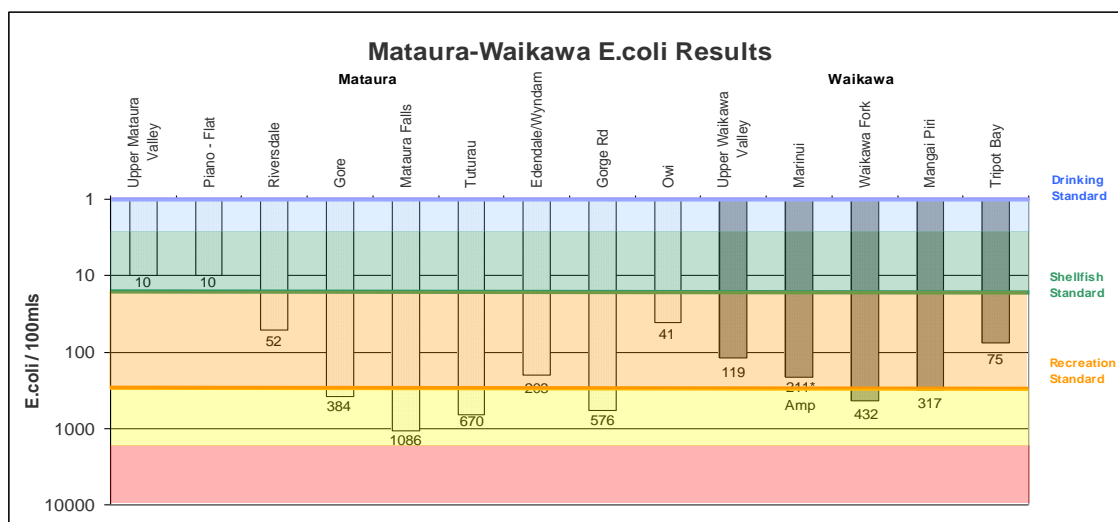
## 4.4 E.coli Water Testing and Anti-biotic Resistance

E.Coli results were the most surprising of all results, being poor across both catchments.

When considering the overall results within each catchment, the Waikawa catchment was worse than the Matura catchment. 60% of the results in the Waikawa catchment were considered poor, compared to 35% in the Matura catchment. Furthermore, the Matura catchment achieved the only results that passed the shell-fish gathering standard (Upper Matura Valley and Piano Flat). The Waikawa catchment also had the only anti-biotic resistant result (Marinui), for Ampicillin, an anti-biotic of the penicillin group most commonly used by humans to treat bacterial infections (Aitken, 2007). In saying this however, the Matura catchment showed the most extreme results, with a number of very poor, high E.coli counts, particularly the Matura Falls, Tuturau and Gorge Rd sites.

To add to the poor results overall, no sites were fit for drinking and almost half failed even the recreational standard for water quality.

These results are shown in the graph below.



## 4.5 Native Species Abundance

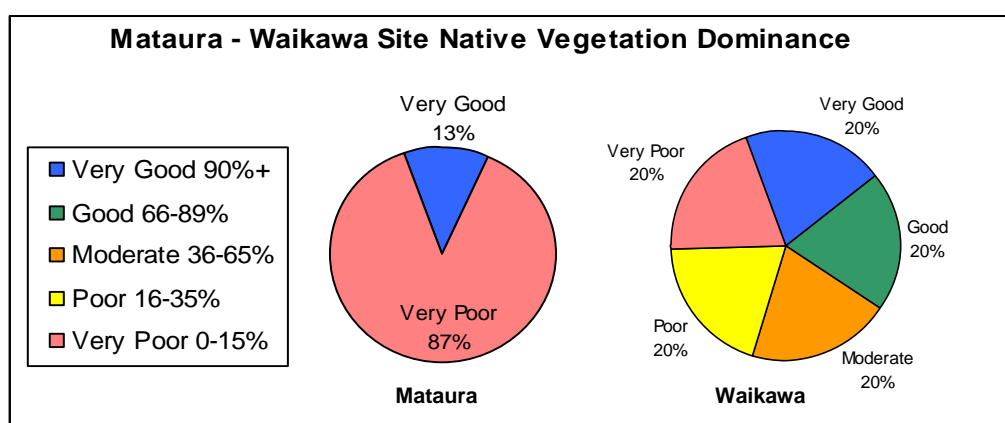
Native species abundance was very poor overall, particularly within the Mataura catchment, where 87% of sites had less than 15% native vegetation dominance. Only one site in the Mataura Catchment, Piano Flat, was ranked higher than very poor, and displayed an extreme with 95% native vegetation dominance. The Waikawa catchment was a mixed bag displaying a range of native vegetation dominance from very good (Upper Waikawa at 90%) to very poor (Marinui at 5%).

Koau/kawau or shags were the most common native bird encountered at Mataura sites (4/8 sites), while korimako/bellbirds and pukeko were the most common in the Waikawa catchment (3/5 sites).

Ti Kouka/Cabbage trees, coprosma species and toetoe were the most common native plant present at the Mataura sites (3/8 sites), while harakeke and totara were the most common in the Waikawa catchment (3/5 sites).

Native fish were found at 6/8 sites in the Mataura catchment and at all sites electric fished in the Waikawa catchment, however, not in great abundance or diversity in either catchment. Common bully, patiki and tuna were the most common across both catchments.

However, the most common and abundant of all species encountered in both catchments, across all sites were exotic, including Gorse, broom, willow, exotic grasses and weeds, as well as Brown Trout, which was the single most abundant and common fish species identified across both catchments.



## 5 Te Whakamutunga / Conclusions

---

This report outlines the results of a cultural health study for the Maitava and Waikawa catchments undertaken by Te Rūnanga o Ngāi Tahu in-conjunction with members of Ngā Papatipu Rūnanga o Murihiku and Manaaki Whenua Landcare Research that aimed at quantifying how tāngata whenua view the current health of the catchments, and to feed this information into the wider He pūau awa research programme that will intun assist future management.

When taking into account the results of all types of assessments undertaken, it is clear that the Maitava catchment is in a poorer state of cultural health than the Waikawa catchment. While the Maitava and Waikawa catchments are significant waterways for tangata whenua both catchments demonstrated obvious modification with the development of agriculture, industry and urban areas, particularly in the middle part of the Maitava catchment from Gore to Edendale.

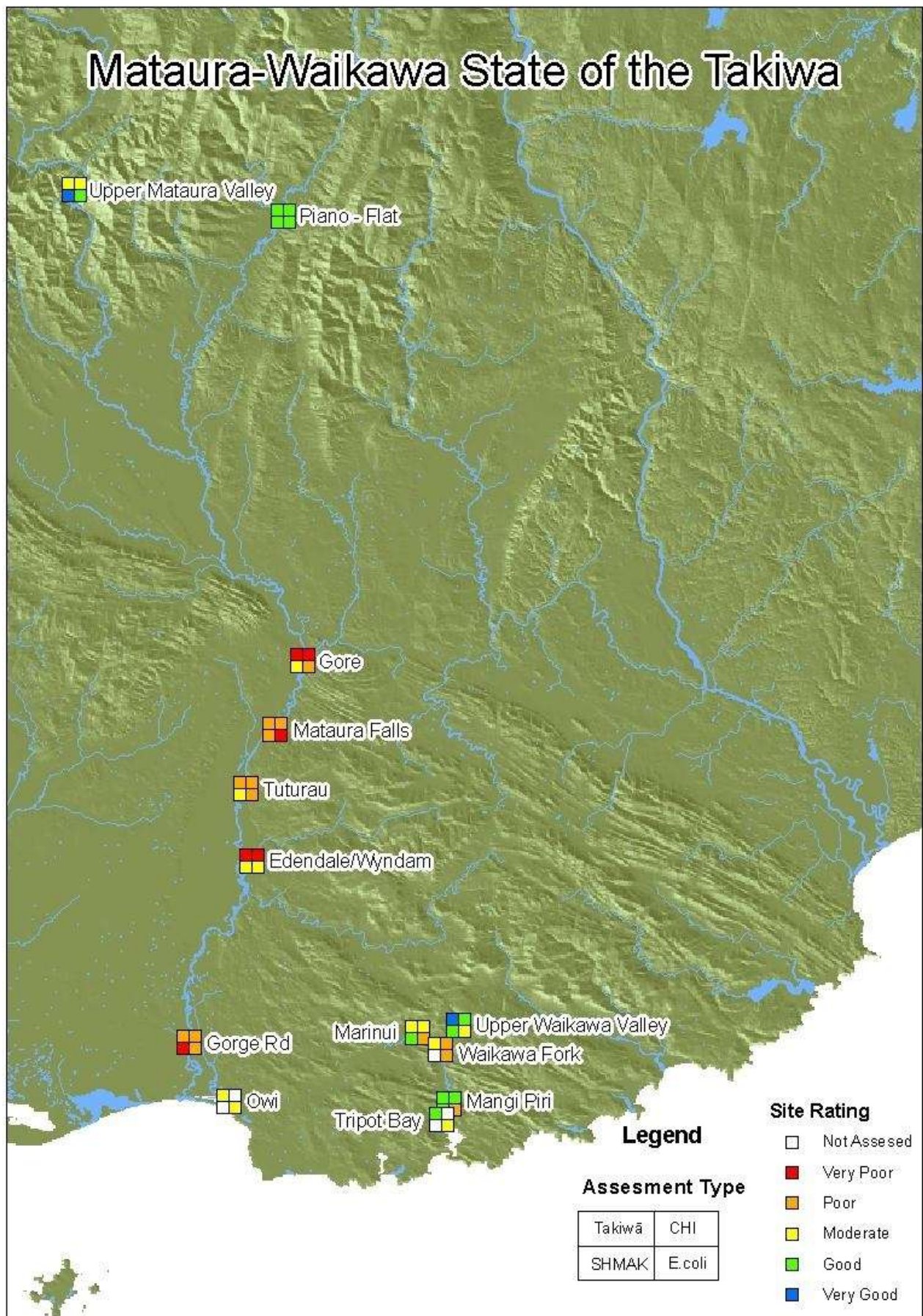
For the Maitava catchment, where results were poor overall, the critical issues relate to the amount of pressure on the waterway from agricultural, urban and industrial land uses, including both point and non-point source pollution. The loss of native vegetation buffers and habitat to aid water quality and biodiversity is also a significant problem. Upper catchment and estuary sites were markedly healthier than mid and lower catchment sites, with the estuary site being considered somewhere between due to the influence of 'fresh' sea water, the degree of separation from direct landuse and the opportunities and abundance of mahinga kai.

Finding ways to deal with the point and non-point source discharges will be critically important to the health of the Maitava going forward. In particular, investigating creative ways to deal with discharges, potentially through the use of riparian vegetation management and restoration in conjunction with productive land-uses, industry and urban development would be important. Such management, whether it be regulated or voluntary, is essential and can act as both habitat for valued native flora and fauna, but also provide a valuable eco-system service by buffering land-use impacts from the waterway.

In the Waikawa catchment, overall results were good, with some mid-catchment sites associated with agricultural land-use, being slightly worse than upper and estuary sites. The good result was influenced largely by the presence of widespread remnant native riparian and catchment vegetation, being an important factor in maintaining a healthy system. The critical issue in this catchment however is ensuring adequate protection and buffering of waterways from agricultural land use, as was noticeable in the mid-catchment sites, particularly at Marinui, and to some degree upstream of Māngai Piri.

Again, working with landowners and councils to either encourage or regulate active riparian management will be important. The unusually high e.coli results at the Upper Waikawa Valley site and throughout the catchment, indicates, however, an upstream source of e.coli that requires further investigation. Furthermore, anecdotal evidence from Waikawa whānau indicates that there may be issues with other contaminants in the upper catchment that could warrant further study. Therefore, developing strategies to investigate and deal with these sources of contamination, particularly e.coli will be important into the future.

# Mataura-Waikawa State of the Takiwa





## 5.1 Recommendations

1. Increased protection and enhancement of waterways in the catchment through the development of 'native riparian buffer zones' in all currently unplanted public/council owned areas. These buffer zones should be at least 20 metres wide, planted with appropriate native species and/or fenced where appropriate.
2. Greater education, advocacy and rates relief for native riparian buffer zones in currently unplanted areas on private land, in particular the mid catchment areas.
3. The development and strengthening of existing of policy in district and regional plans to require native riparian buffer zones, and on-site water treatment systems when any land adjacent to any waterway (including drains) is subdivided or converted from one land-use to another, including dairy conversions.
4. Identification and recording of all discharge inputs in the catchment and investigation into the effects of these inputs on water quality, including native fish, birds, insects and plants, and the ways to improve such discharges.
5. Specific investigation into the contamination issues within the Upper Waikawa catchment that inturn impact on water quality on the lower catchment.
6. The protection, enhancement and interpretation of the Ngāi Tahu nohoanga sites at Waikaia/Piano Flat (Mataura) and Māngai Piri (Waikawa).
7. Continued support of the Mataura Mātaitai and research into the kanakana runs/harvests at Te Au Nui (Matura) and Māngai Piri (Waikawa).
8. Continued regular monitoring, including cultural assessments, to understand the success, or otherwise, of future management and development of the catchment.
9. Development of a dedicated cultural monitoring tool for assessing estuarine environments, including methods for assessing fish and shellfish health in these environments.
10. Stronger adherence to shellfish gathering and cultural water quality standards and the development of a dedicated programme, run in-conjunction with local and central government agencies, to monitor these.



## 6 Tohutoro / References

---

- Aitken, J. (2007). *Anti-biotics*. Unpublished reference guide.
- Biggs, B.J., Kilroy, C. & Mulcock, C.M. (2000). *New Zealand Stream Health Monitoring and Assessment Kit*. Christchurch, NZ; NIWA.
- Handford, P.A. & Associates Ltd. (2003). *Forest Monitoring Assessment Kit*. Wellington, NZ: MfE. [www.formak.co.nz/default.aspx](http://www.formak.co.nz/default.aspx)
- Harmsworth, G. (2002). *Coordinated Monitoring of New Zealand Wetlands, Phase 2, Goal 2: Māori Environmental Performance Indicators for Wetland Condition and Health*. Palmerston North, NZ: Landcare Research.  
[www.landcareresearch.co.nz/research/social/maoriindicators.asp](http://www.landcareresearch.co.nz/research/social/maoriindicators.asp)
- Mattingley, B. (2005). *Takiwā User Documentation*. Christchurch, NZ; TRoNT & ESR.
- Ministry of Health. (2000). *New Zealand Drinking Water Standards*. Wellington, NZ: MoH.  
[www.moh.govt.nz/moh.nsf/0/70727db605b9f56a4c25696400802887?OpenDocument](http://www.moh.govt.nz/moh.nsf/0/70727db605b9f56a4c25696400802887?OpenDocument)
- Ministry for the Environment. (2003). *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas*. Wellington, NZ: MfE.  
[www.mfe.govt.nz/publications/water/microbiological-quality-jun03/index.html](http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/index.html)
- Ngāi Tahu Claims Settlement Act 1998.
- NIWA. (2003). *Freshwater Fish Database*. Retrieved 18 July 2003 [www.fbis.co.nz](http://www.fbis.co.nz)
- NIWA. (2007). *Electric Fishing Machines*. Retrieved 28 June 2007  
[www.niwasience.co.nz/rc/instrumentsystems/efish](http://www.niwasience.co.nz/rc/instrumentsystems/efish)
- Ogilvie, S. & Penter, B. (2001). *Stream Health Monitoring Assessment Kit for Māori*. Christchurch, NZ: NIWA [http://www.smf.govt.nz/results/1027\\_finalreport.pdf](http://www.smf.govt.nz/results/1027_finalreport.pdf)
- Otaraua Hapū. (2003). *Kaimoana Monitoring Guidelines for Iwi and Hapū*. Wellington, NZ: MfE. [www.mfe.govt.nz/publications/ser/kaimoana-oct03.html](http://www.mfe.govt.nz/publications/ser/kaimoana-oct03.html)
- Pauling, C. (2003). *Ki Uta Ki Tai – Mountains to the Sea Natural Resource Management: A scoping document for developing Mountains to the Sea Natural Resource Management Tools for Ngāi Tahu*. Christchurch, NZ; Te Rūnanga o Ngāi Tahu.
- Pauling, C. (2004). *State of the Takiwā - Cultural Monitoring and Reporting on the Health of our Environment: A scoping document for developing a culturally based environmental monitoring and reporting system*. Christchurch, NZ; Te Rūnanga o Ngāi Tahu.
- Pauling, C. (2007). *State of the Takiwā: Introducing a culturally based environmental monitoring and reporting system for Ngāi Tahu*. Christchurch, NZ; TRoNT.
- Pauling, C., Mattingley, B. & Aitken, J. (2005). *Te Ahuatanga o Te Waiiau – Cultural Health Baseline Report 2005*. Te Rūnanga o Ngāi Tahu, Chch / Ministry for the Environment, Wellington.
- Te Rūnanga o Ngāi Tahu. (2001). *Ngāi Tahu Vision 2025*. Christchurch, NZ: TRoNT.
- Tipa, G. & Tierney, L. (2003). *A Cultural Health Index for Streams and Waterways: Indicators for recognising and expressing Māori values*. Wellington, NZ: MfE.  
[www.mfe.govt.nz/publications/water/cultural-health-index-jun03/html/](http://www.mfe.govt.nz/publications/water/cultural-health-index-jun03/html/)
- Tipa, G. & Tierney, L. (2006). *Using the Cultural Health Index: How to assess the health of streams and waterways*. Wellington, NZ: MfE



## 7 Appendices

---

Appendix A – Takiwā Monitoring Forms used within the Study

Appendix B – Monitoring Plan for the Mataura-Waikawa Study

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

Appendix D – Takiwā Assessment Data Set for the Study

Appendix E – CHI Assessment Data Set for the Study

Appendix F – SHMAK Assessment Data Set for the Study

Appendix G – E .coli Testing Data Set for the Study

Appendix H – Site Photograph Record for the Study

## **Appendix A – Takiwā Monitoring Forms used within the Maitara – Waikawa Study**

## State of the Takiwā

## Site Definition Form

Site Code

Site Name

Defined by

on

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

Region of NZ

eg Otago

Catchment/Feature

eg Waiau River

Zone (tick one)

☐ Mountains☐ Hills☐ Upper Plains☐ Mid Plain☐ Lowland Plains☐ Urban☐ Coastal/marine☐ Other. Specify: .....

Ecosystem Types

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

Ownership:

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

Mana Whenua

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

Legal Protection:

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

Settlement Site:

☐ Nohoanga☐ Topuni☐ Tribal property☐ SA☐ Unsure

## SITE-SIGNIFICANCE DETAIL

Is this a traditional site? Yes No Unsure

Are there any signs of traditional use? Yes No

Significance of site:

☐ Urupa☐ Pā/Kāinga☐ Mahinga kai☐ Wāhi Pakanga☐ Other

Please explain site significance / List any observations:

## Traditional Abundance

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

## NGĀ MANU / BIRD SPECIES

## Abundance

	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots

## NGĀ IKA / FISH SPECIES

## Abundance

	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots

## NGĀ RAKAU / PLANT SPECIES

## Abundance

	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots

## OTHER TAONGA / Natural Resources

## Abundance

	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots
	Few	Some	Lots

Geographical  
Position

Area (sq m)

Altitude (m)

Map No (if 260 series)

East

North

Accuracy/Offset (m)

Photos taken? Yes No

Direction facing, Photo 1:

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, etc.

Describe these photos:

OFFICE USE ONLY

Entered into Takiwā database by:

Date:

Photo filed:

Filename:

Site mapped:

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)

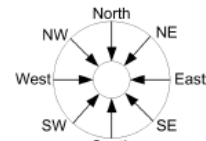
None  
Mist or fog  
Drizzle  
Light  
Moderate  
Heavy  
Hail  
Snow

### 4. Wind

If wind, circle its direction

(circle one)

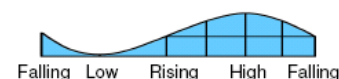
None  
Minimal  
Light  
Stiff or breezy  
Gusty  
Strong



### 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 ...

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

3. NGĀ IKA MĀORI / NATIVE FISH SPECIE	Abundance	MK	Notes (condition, habits, etc.)
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	

4. NGĀ TAONGA MĀORI / Other Natural Resources	Abundance	MK	Notes (condition, etc.)
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	

5. INTRODUCED PLANTS AND ANIMALS	Abundance	MK	Notes (condition, controls, signs, etc.)
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<input type="checkbox"/>	
	Few Some Lots <input type="checkbox"/>	<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 &gt;&gt; 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.	2.	4.	3.
5.	6.	7.	8.

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

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

## C. SITE ACCESS FOR HARVESTING MAHINGA KAI

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

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

Please explain your answer:

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

OFFICE USE ONLY Entered into Takiwa database by:

Date:

## State of the Takiwa

## SHMAK Assessment

Site Code

Use general assessment code if have one &gt;&gt; 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):    secondsDistance travelled:  metres Divide distance by the average time of  seconds... to get an average velocity of  m/seceg. For 10m in 38s  
Velocity = 0.26 m/s  
Score = 8

From velocity: Circle the Score:

Water pH

From the pH: Circle the Score:

Water temperature

 °C

Temp:

Time of day:

Score:

Water conductivity

 uS/cm

Cond:

Water clarity (Take 3 readings):

Calculate average clarity:  cm

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

Clarity:

Score:

## A2 Composition of the Stream Bed \*

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

Enter % Score

Bedrock		-10
Boulders > 25 cm		10
Large cobbles 12 - 25		20
Small cobbles 6 - 12		10
Gravels 0.2 - 6		0
Sand		-10
Mud or silt		-20
Man-made, eg concrete		-20
Woody debris		0
Water plants, rooted in stream bed		0

Check you have 100%

## 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			10
Wetland vegetation			10
Tall tussock grassland, not improved			8
Introduced trees (willow, poplar)			8
Other introduced trees (conifers)			5
Scrub			5
Rock, gravels			5
Short tussock grassland, improved			3
Pasture grasses and weeds			-10
Bare ground, roads, buildings			-10

Check you have 100%

## A4 Deposits

Tick best estimation of loose deposited material on the stream bed

Score

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

OFFICE USE ONLY    Entered into Takiwa database by:

Date:

## **Appendix B – Monitoring Plan for the Maitava – Waikawa Cultural Health Study**



# State of the Takiwā Monitoring Work Plan – Mataura/Waikawa Cultural Health Assessment: May 2007

---

This plan outlines the proposed process for undertaking the monitoring fieldwork and data gathering for the Mataura/Waikawa Cultural Health Assessment.

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

---

The proposed monitoring fieldwork outlined in this plan is being undertaken as part of two projects. The first is a Ngāi Tahu led SMF funded project called "State of the Takiwā - Te Waipounamu Freshwater Report 2007". The second is a joint project with Manaaki Whenua Landcare Research and Te Ao Marama called "He pūau awa – he ūngututanga mātauranga: Environmental reporting for a riverine system – a bicultural approach" that is funded by Ngā Pae o te Maramatanga. Both projects are further supported by ngā rūnanga o Murihiku, Envirolink laboratories and Environment Southland. The fieldwork also has broad links to a third project being lead by the University of Otago called "Tiaki Mahinga Kai" funded by Te Tipu o Te Wānanga (FRST) and Te Rūnanga o Ngāi Tahu.

The Mataura/Waikawa project is being jointly led by Craig Pauling (Te Rūnanga o Ngāi Tahu) and Rodney Trainor (Te Ao Marama contractor) and involves Papatipu Rūnanga representatives with support from Environment Southland Staff and Envirolink Laboratories.

The major purpose of the project is to undertake baseline assessments of the cultural health of the Mataura and Waikawa catchments through the gathering, analysis and reporting of data collected using the Takiwā cultural environmental monitoring and reporting tool.

The assessment will provide valuable baseline data for inclusion in the Te Waipounamu Freshwater Report 2007 as well as providing the cultural assessment data that will complement other scientific data gathered as part of the wider 'pūau awa' project. It can also provide baseline information for an ongoing monitoring regime for the Mataura Freshwater Mataitai, as well as culturally significant mahinga kai sites on the Waikawa River.

The data can therefore also begin to help measure the success of, and inform, the future management of these areas, being led by tangata whenua in-conjunction with councils and landowners. The data may also help to complement the ongoing work of monitoring resource consents, developments and other activities in the catchments into the future.

On 12 April 2007, a meeting was held at the offices of Te Ao Marama to introduce the Takiwā tool, the current project, and to discuss and plan the monitoring programme. Representatives from Te Ao Marama, Awarua, Waihopai, Hokonui and Oraka-Aparima Rūnanga, Manaaki Whenua, NIWA, University of Otago, Envirolink and Environment Southland were present. This plan outlines the agreed outcomes and milestones for the project from this meeting.

## Expected Outcomes from the Project

- Introduction, training and further testing of the Takiwā system by rūnanga/iwi members.
- Training and application of CHI, SHMAK and E.Coli testing by rūnanga.
- Collection of baseline Takiwā data, including the CHI, SHMAK and E.coli data for the Maitāwhiri and Waikawa catchments at various sites from the source to the sea (Ki Uta Ki Tai).
- Storage, analysis and reporting of this data to assist future management and planning and to contribute to the Te Waipounamu Freshwater, Pūau Awa and Tiaki Mahinga Kai project reports, as well as information for ongoing monitoring of the Maitāwhiri Mataitai.

## Project Milestones

The major steps of the project are to:

- Identify monitoring sites and targets in the Maitāwhiri and Waikawa Catchments, important resources such as people and equipment needed and develop a plan for the gathering of data in conjunction with rūnanga monitoring team members (10 May 2007);
- Provide training to rūnanga monitoring team members in the use of the Takiwā software and other environmental monitoring processes (17 May 2007).
- Undertake the gathering of data from the selected sites and input the collected data into Takiwā (17-19 May 2007);
- Analyse the collected data and complete a summary cultural health baseline report for the Maitāwhiri and Waikawa catchments including the gathering of historical information and complementary data (by July 2007);
- Present these findings back to Te Ao Marama (by Aug 2007).

## Area To Be Researched – Maitāwhiri and Waikawa Rivers

The Maitāwhiri and Waikawa catchments are rivers of immense cultural significance to tangata whenua, particularly due to the annual seasonal harvest of kanakana (lamprey eels) at Matuara Falls and Niagra Falls.

In particular, the Maitāwhiri river catchment was a major trial for the people of Murihiku to Lake Whakatipu and the Te Koroka source of pounamu (greenstone) at the head of the lake.

Due to its place in the history and traditions of Ngai Tahu Whānui the Maitāwhiri was included as a Statutory Acknowledgement Area in the Ngāi Tahu Claims Settlement Act 1998. Schedule 42 of the Act summaries the Ngai Tahu association with the Maitāwhiri River stating:

*The area of the Maitāwhiri River above the Maitāwhiri Falls was traditionally used by the descendants of the Ngati Mamoe chief, Parapara Te Whenua. The descendants of Parapara Te Whenua incorporate the lines of Ngati Kuri from which the Mamau family of Moeraki descend. Another famous tupuna associated with the river was Kiritekateka, the daughter of Parapara Te Whenua. Kiritekateka was captured by Ngai Tahu at Te Anau and her descendants make up the lines of many of the Ngai Tahu families at Otakou....The Maitāwhiri was an important mahinga kai, noted for its indigenous fishery. The Maitāwhiri Falls were particularly associated with the taking of kanakana (lamprey).*

The 1966 *Encyclopaedia of New Zealand*, edited by A. H. McIntock gives an overview of the catchment as well as an historical perspective of the condition of the Maitara River, stating:

*Rising on the east side of the Eyre Mountains, the Maitara flows south-eastward and then south for 120 miles and enters the sea at Toetoes Bay, 20 miles east of Bluff. A whaling station, Toitois (now Fortrose), was established at the mouth in the mid-1830s.*

*The catchment area is 281 sq. miles, and floods occurred in March 1913 of 177,000 cusecs and in June 1955 of 29,904 cusecs. A representative rate of flow for the upper reaches of the river was measured on 28 January 1955 at Parawa Bridge of 260 cusecs, and on 16 June 1955 at Gore Bridge of 8,370 cusecs.*

*The upper reaches of the river traverse a small inter-mountain basin at Garston and pass through a narrow, deeply incised gorge between Athol and Waikaia district. The remainder of its course passes through rolling and flat farm country in the Waimea Plains and the Maitara Valley.*

*Settlements along the river include the towns of Gore and Maitara, which were initially established at fords on the river in the early days of horse and bullock transport.*

*The Maitara River is a favourite resort of anglers and is the greatest brown trout water in New Zealand.*

*There have been many attempts to explain the meaning of the name Maitara. It may be an ancient name, as Maitara was an ancestor of Ngatoro-i-rangi, the priest of the Arawa canoe. It may possibly mean reddish, brown face, or glowing face (Bryce Leslie Wood, M.Sc., New Zealand Geological Survey, Dunedin [www.teara.govt.nz/1966/M/MaitaraRiver/MaitaraRiver/en](http://www.teara.govt.nz/1966/M/MaitaraRiver/MaitaraRiver/en))*

The settlement of the wider Maitara area mention by Wood (1996) above, and in particular the agricultural development of the catchment has taken a visible toll on the river, particularly the Maitara Falls area. The townships of Gore, Maitara and Edendale have significant agricultural based industrial sites including meat works, dairy factories and timbermills, all discharging wastes into the river. The Maitara Falls is perhaps the most dramatic example of this, being surrounded on each side by industrial factories (ad photo of falls). Inputs from these factories, as well as sewage and stormwater discharges from the surrounding townships have had an historical impact on the catchment, its water quality, the abundance of mahinga kai species, as well as the ability of tangata whenua to gather these species. The Maitara is however regarded as an important Trout fishery. (get reference?)

The Waikawa catchment has had a different history, being located away from the main agricultural and industrial centres of Southland. The catchment sits within the Catlins Region on Eastern Southland, a popular tourist area, and amongst the Catlins Forest Park, with forestry being a major land use in the catchment. A nohoanga site

Cultural monitoring has never been undertaken within the catchment to assess the current health of the catchment. Therefore it is proposed that a number of sites spread throughout the catchment (Ki Uta Ki Tai – from the source to the sea) are to be assessed as part of the project. These sites are listed in the following sub-section and shown on Map 1.

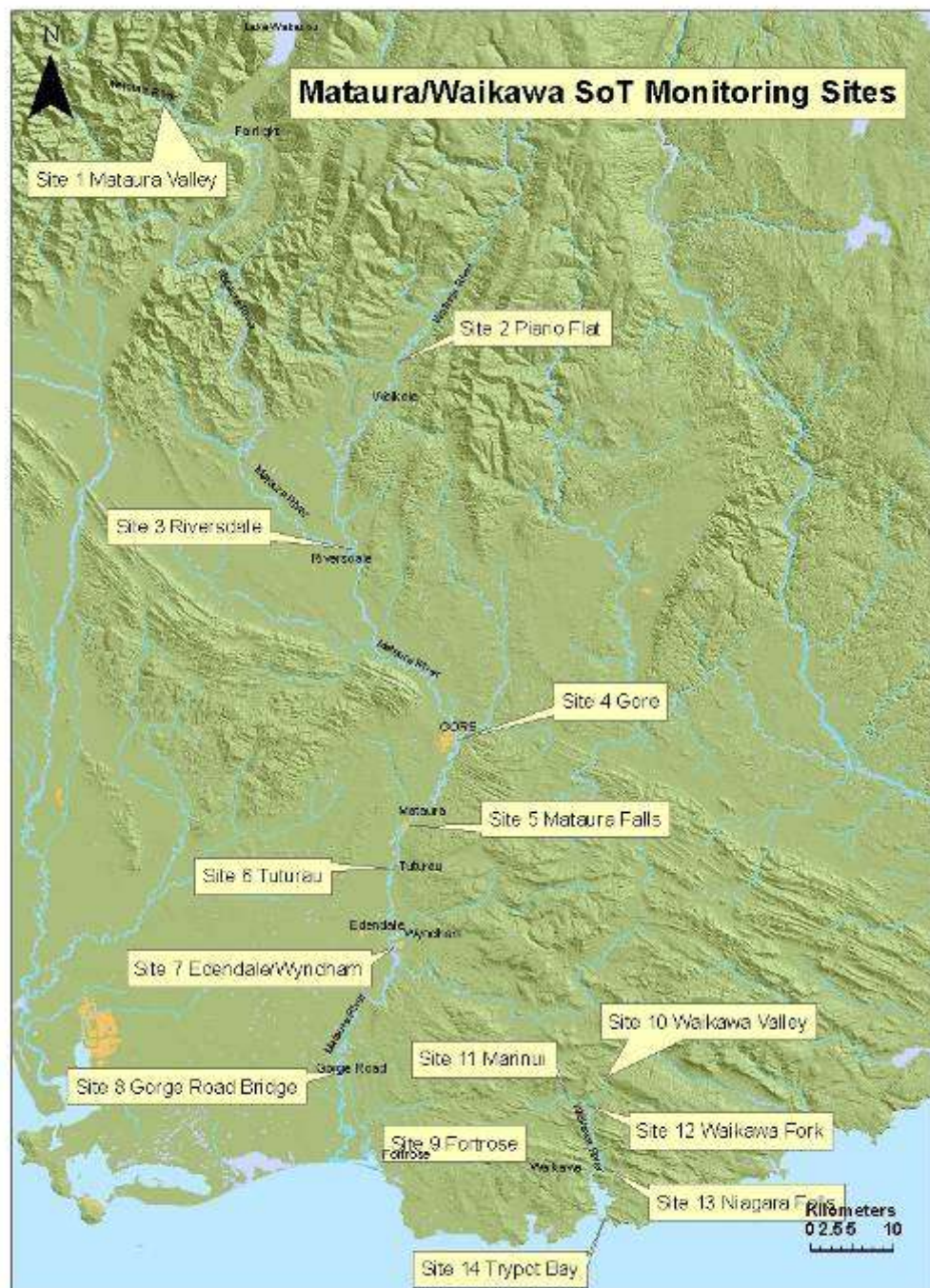
# Monitoring Sites

## Mataura River

1. Robert Creek (Mataura Valley)
2. Piano Flat/Waikaia River
3. Riversdale (Mataura/Waikaia Confluence)
4. Gore
5. Mataura Falls
6. Tukurau
7. Edendale
8. Gorge Road Bridge
9. Fortrose

## Waikawa River

10. Waikawa Valley/Forest
11. Marinui
12. Waikawa Fork
13. Mangaipiri/Niagara Falls
14. Waikawa Estuary/Tryptot Bay



# Monitoring Action Plan

## Monitoring Team

The following people will be involved in the monitoring:

- Craig Pauling (TRoNT)
- Rodney Trainor (Te Ao Marama)
- Aaron Leith (Awarua Rūnanga/Environment Southland)
- Don Mowat\* (Te Ao Marama / Waihopai Rūnanga)
- Environment Southland Staff\*

\* May not be present at all times

## Dates of Monitoring work

The monitoring/data collection will take place between 17-19 May 2007. A timetable of events and initial dates for are outlined in the table below.

## Timetable & Schedule of Work to be undertaken

	Day 1 – Thursday		Day 2 – Friday
	17 May 2007		18 May 2007
8.10am	Depart Chch-Invercargill Flight NZ 8071	8.00-8.30	Breakfast and Depart for next site
9.30am	Arrives Airport/Pick up cars/gear/kai	9.00am	Arrive/Assess site 5 – Mataura Falls
11.00am	Arrive Gore – pick up gear and lunch		Requirements: All
12.30pm	Arrive/Assess site 1 – Fairlight/Robert Creek	10.30am	Arrive/Assess site 6 – Tuturau
	Requirements: All (Lunch)		Requirements: Takiwa
2.30pm	Arrive/Assess site 2 - Riversdale	12.00pm	Arrive/Assess site 7- Edendale (lunch)
	Requirements: All		Requirements: All and Lunch
3.30pm	Arrive/Assess site 3 – Piano Flat	2pm	Arrive/Assess site 8- Gorge Road Bridge
	Requirements: All		Requirements: All
4.30pm	Arrive Assess site 4 - Gore	3.30pm	Arrive/Assess site 9 - Fortrose
	Requirements: Takiwa, CHI, SHMAK and E.coli		Requirements: Takiwā/E.coli
5.30pm	Kua mutu i tēnei ra – Finish for day	5.30pm	Arrive/Assess site 10 – Quarry Hills
	Accommodation: O Te Ika Rama Marae, Gore		Requirements: Takiwa/E.coli
6.00pm	Kai a te po / Dinner (self cater/restaurant)	6.30pm	Accommodation/Dinner: Waikawa (Leiths)

	Day 3 – Saturday 19 May 2007		
8.00-8.30	Breakfast and Depart for next site		
9.00am	Arrive/Assess site 11 – Mokoreta/Tahakopa Rd	12.00pm	Arrive/Assess site 14 – Niagra Falls (lunch)
	Requirements: All		Requirements: All
10.00am	Arrive/Assess site 12 – Waikawa Valley	1.00pm	Arrive/Assess site 15 – Waikawa Harbour
	Requirements: All (Lunch)		Requirements: All
11.00pm	Arrive/Assess site 13 – SH92	2.30pm	Kua mutu – Hoki atu ki Invercargill/Chch
	Requirements: All		Flight NZ 2634 Departs 4.10pm

# Equipment

The following equipment will be used during the monitoring work:

- 2 x 4WD Vehicles (Hertz)
- Pens and folders
- Takiwā forms (All sites), CHI forms (River/Stream sites only)
- SHMAK Kit, manual and forms (River/Stream sites only) (Hokonui Rūnanga)
- Electric Fishing Gear and Waders (TRoNT or DoC)
- E.coli kit (Vials, Chiller postage boxes/bags: River, stream and lake sites)
- First Aid Kits
- Didymo Cleaning Gear
- Digital Camera and Batteries
- GPS and Batteries
- Monitoring Plan and Maps
- Identification booklets
- Tea and Coffee

## 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. Electric Fishing \* (may not be used)

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 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 a main photographic reference 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 allow for comparisons with the E.Coli testing results and SHMAK measures.

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 used during the monitoring for all river/stream sites. The SHMAK form records river flow, pH, temperature, conductivity, clarity, stream bed composition, riparian vegetation, invertebrates, periphyton and catchment activity.

## **E.Coli Water Testing**

Where appropriate E.Coli water testing will be carried out at the monitoring sites. This involves the collection of a 100ml water sample and subsequent lab analysis. The results from the E.Coli testing will provide a useful comparison to the data collected through the takiwa, CHI and SHMAK forms.

## Electric Fishing

Where appropriate Electric Fishing will be undertaken to obtain data on the presence and absence of fish species at chosen sites. This data will be fed into the Takiwā assessments. Where electric fishing is not undertaken, relevant data from the New Zealand Freshwater Fish database will be extracted to feed into the process.

## Expenses and Resources to be used

<b>Kai/Provisions:</b>	
Day 1 Morning Tea (@ \$5 x 5 people)	\$25
Day 1 Lunch (@ \$10 x 5 people)	\$50
Day 1 Afternoon Tea (@ \$5 x 5 people)	\$25
Day 1 Dinner (@ \$15 x 5 people)	\$75
Day 2 Breakfast(@ \$5 x 5 people)	\$25
Day 2 Morning Tea (@ \$5 x 5 people)	\$25
Day 2 Lunch (@ \$10 x 5 people)	\$50
Day 2 Afternoon Tea (@ \$5 x 5 people)	\$25
Day 2 Dinner (@ \$15 x 5 people)	\$75
Day 3 Breakfast(@ \$5 x 5 people)	\$25
Day 3 Morning Tea (@ \$5 x 5 people)	\$25
Day 3 Lunch (@ \$10 x 5 people)	\$50
Day 3 Afternoon Tea (@ \$5 x 5 people)	\$25
<b>Sub-total</b>	<b>\$500</b>
<b>Transport:</b>	
Rental Vehicle (\$75/day x 3days x 2 vehicle)	\$450
Rūnanga Reps Vehicle (100kms @0.62c/km x 5)	\$310
Flights Chch-Invercargill	\$566
<b>Sub-total</b>	<b>\$1326</b>
<b>Accommodation:</b>	
Thursday 17 May - O Te Ika Rama Marae (\$75/person/night x 5)	\$375
Friday 18 May – Leith Whanau/Lodge (\$75/person/night x 5)	\$375
<b>Sub-total</b>	<b>\$750</b>
<b>Equipment Use and Hire:</b>	
Video Camera - @ \$50/day x 3 days	\$150
Video Camera Tapes - @ \$10 x 3	\$30
Digital Camera - @ \$50/day x 3 days	\$150
GPS - @ \$50/day x 3 days	\$150
AA batteries - @ \$2.50 x 10	\$25
Electric Fishing Gear @ \$100/day x 3 days	\$300
Waders @ \$25/day x 3 days x 2	\$150
SHMAK Kit @ \$50/day x 3 days	\$150
E.coli vials and testing (@ \$10/test x 15)	\$150
First Aid Kit @ \$15/day x 3	\$45
<b>Sub-total</b>	<b>\$1300</b>
<b>Administration &amp; Disbursements:</b>	
Printing of forms and other information - @\$0.10c x 500 copies	\$50
Maps	\$25
Folders	\$25
Sending E.coli samples to lab	\$50
<b>Sub-total</b>	<b>\$150</b>
<b>TOTAL</b>	<b>\$4026</b>

# Health and Safety Considerations

There are a number of risks associated with going into the field. The major risks and associated management measures are explained below.

## Car travel

The monitoring team will be travelling between sites in cars, 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).

Further, first aid kits will be carried in the cars.

## 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.

## Didymo Algae

The Southland Region is currently affected by the algae *Didymosphenia geminata* which poses a large biosecurity risk to other rivers. Precautions must be taken when undertaking sampling to stop the spread of this algae. All items that come into contact with river water must be disinfected before using in the river again. Guidelines produced by NIWA will be followed where any monitoring equipment comes into contact with the water.

Background information on the cleaning methods and appropriate cleaning gear will be taken in the field.

## 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 MetService website for the period of the fieldwork.

Appropriate steps will be taken depending on each forecast, including taking appropriate wet weather gear, sun protection etc.

## Other notifications, arrangements and consents required

N/A

## **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 Mataura–Waikawa Study**



## Takiwā Scores

## Mataura-Waikawa Cultural Health Study

Site Name	Site Order	Visit Date	Pressure	Modification	Access	Harvest	Return	Overall	Abundance	Species	Plant Species	Plant Score	Current Species	Trad Species	Current VsTrad	CvsT Score	Takiwā	T Score Rank	Takiwa Rating
Upper Mataura Valley	1	17-May-07	3	3	4	5	5	3	7	2	10	1	14	36	38.9	2	3.1	3	Moderate
Piano-Flat/Waikaia	2	17-May-07	4	4	3	5	5	4	16	3	95	5	10	36	27.8	2	3.9	4	Good
Gore	4	18-May-07	1	2	3	1	1	2	-11	1	1	1	8	34	23.5	1	1.4	1	Very Poor
Mataura Falls	5	17-May-07	1	1	2	4	5	2	2	1	1	1	6	38	15.8	1	2	2	Poor
Tuturau	6	18-May-07	2	2	3	2	5	2	4	1	10	1	10	34	29.4	2	2.2	2	Poor
Edendale/Wyndam	7	18-May-07	2	2	2	2	1	2	-9	1	1	1	4	35	11.4	1	1.6	1	Very Poor
Gorge Rd	8	18-May-07	2	2	4	3	5	0	-4	1	7	1	5	41	12.2	1	2.1	2	Poor
Owi/Fortrose	9	18-May-07	3	3	5	4	5	3	17	3	1	1	17	44	38.6	2	3.2	3	Moderate
Upper Waikawa Valley	1	19-May-07	5	5	4	5	5	5	22	4	90	5	16	37	43.2	2	4.4	5	Very Good
Marinui	2	07-Sep-07	3	3	4	5	5	3	-2	1	5	1	6	37	16.2	1	2.9	3	Moderate
Waikawa Fork	3	19-May-07	3	3	4	5	1	3	4	1	25	2	7	37	18.9	1	2.6	3	Moderate
Māngai Piri	4	19-May-07	3	3	5	5	5	4	11	2	60	3	26	45	57.8	3	3.7	4	Good
Tripot Bay	5	19-May-07	4	4	2	5	1	4	27	5	70	4	22	43	51.2	3	3.6	4	Good
<b>Total</b>			<b>2.8</b>	<b>2.8</b>	<b>3.5</b>	<b>3.9</b>	<b>3.8</b>	<b>2.8</b>	<b>6.5</b>	<b>2.0</b>	<b>28.9</b>	<b>2.1</b>	<b>11.6</b>	<b>38.2</b>	<b>29.6</b>	<b>1.7</b>	<b>2.8</b>		
<b>Total Mataura</b>			<b>2.25</b>	<b>2.38</b>	<b>3.25</b>	<b>3.25</b>	<b>4.00</b>	<b>2.25</b>		<b>1.63</b>	<b>15.75</b>	<b>1.50</b>	<b>9.25</b>	<b>37.25</b>	<b>24.71</b>	<b>1.50</b>	<b>2.44</b>		
<b>Total Waikawa</b>			<b>3.60</b>	<b>3.60</b>	<b>3.80</b>	<b>5.00</b>	<b>3.40</b>	<b>3.80</b>		<b>2.60</b>	<b>50.00</b>	<b>3.00</b>	<b>15.40</b>	<b>39.80</b>	<b>37.46</b>	<b>2.00</b>	<b>3.44</b>		

## **Appendix E – CHI Assessment Data Set for the Mataura–Waikawa Study**

## Cultural Health Index Scores      Mataura-Waikawa Cultural Health Study

Site Name	Site Order	Visit Date	CHI	Site Status	Return	Mahinga Kai	Stream Health	Catch LandUse	Margin Vege	Margin Use	Bed Cond	Channel	Water Quality	Water Clarity	Hab Variety	River Health	Combo Score	C Score Rank	C Score Rating
Upper Mataura Valley	1	17-May-07	A-1 2.5 3.9	A-1	1	2.5	3.9	3	2	3	4	5	5	5	4	4	3.2	3	Moderate
Piano-Flat/Waikaia	2	17-May-07	A-1 2.2 4.8	A-1	1	2.2	4.8	5	4	4	5	5	5	5	5	5	3.5	4	Good
Gore	4	18-May-07	B-0 1.2 2.0	B-0	0	1.2	2	1	1	1	2	3	2	3	3	2	1.6	1	Very Poor
Mataura Falls	5	17-May-07	A-1 2.0 2.0	A-1	1	2	2	2	1	1	3	1	1	4	3	2	2.0	2	Poor
Tuturau	6	18-May-07	A-1 2.5 2.5	A-1	1	2.5	2.5	2	2	2	2	4	2	3	3	2	2.5	2	Poor
Edendale/Wyndam	7	18-May-07	B-0 1.0 2.4	B-0	0	1	2.4	2	2	1	2	3	2	3	4	2	1.7	1	Very Poor
Gorge Rd	8	18-May-07	B-1 2.5 1.5	B-1	1	2.5	1.5	2	1	1	0	2	2	2	2	2	2.0	2	Poor
Upper Waikawa Valley	1	19-May-07	B-1 2.8 4.9	B-1	1	2.8	4.9	5	5	5	4	5	5	5	5	5	3.9	4	Good
Marinui	2	07-Sep-07	B-1 2.5 3.2	B-1	1	2.5	3.2	3	2	2	4	4	4	3	4	3	2.9	3	Poor
Waikawa Fork	3	19-May-07	B-0 1.5 3.4	B-0	0	1.5	3.4	3	3	3	3	4	4	4	3	3	2.5	2	Moderate
Māngai Piri	4	19-May-07	A-1 3.2 3.8	A-1	1	3.2	3.8	3	4	4	4	4	3	4	4	4	3.5	4	Good

<b>Total</b>	<b>2.2</b>	<b>3.1</b>	<b>2.8</b>	<b>2.5</b>	<b>2.5</b>	<b>3.0</b>	<b>3.6</b>	<b>3.2</b>	<b>3.7</b>	<b>3.6</b>	<b>3.1</b>	<b>2.7</b>
<b>Total Mataura</b>	1.99	2.73	2.43	1.86	1.86	2.57	3.29	2.71	3.57	3.43	2.71	2.36
<b>Total Waikawa</b>	2.50	3.83	3.50	3.50	3.50	3.75	4.25	4.00	4.00	4.00	3.75	3.16

## **Appendix F – SHMAK Assessment Data Set for the Mataura–Waikawa Study**

# SHMAK Scores (Habitat) Maitara-Waikawa Cultural Health Study

Site Name	Site Order	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
Upper Maitara Valley	1	17-May-07	77.4	Very Good	0.83	5	6	5	7	8	30	20	100	10	8	16.4	Fine	5	3.5
Piano-Flat/Waikawa	2	17-May-07	57.5	Good	0.00	1	6	5	5	8	30	20	0	0	10	3.5	None noticed	10	2.5
Gore	4	18-May-07	24	Moderate	1.25	3	6.5	10	7	8	100	16	80	8	-5.5	-15.5	Moderate	0	1.7
Maitara Falls	5	17-May-07	30	Moderate	1.82	3	9	5	6	8	80	16	82	8	-10	-5	Fine	5	1.8
Tuturau	6	18-May-07	26.8	Moderate	0.67	10	7	10	6	8	80	16	87	8	-4	-16.2	Moderate to thick	-5	1.8
Edendale/Wyndam	7	18-May-07	54.4	Good	0.69	10	7	10	5	8	90	16	83	8	3	-5.6	Fine	5	3.0
*Gorge Rd	8	18-May-07	18	Poor	0.00	1	7	10	9	8	110	16	45	3	-10	-10	-	0	1.3
Upper Waikawa Valley	1	19-May-07	70	Very Good	0.91	5	7	10	9	8	120	16	64	5	1	20	Fine	5	3.2
Marinui	2	07-Sep-07	72	Very Good	0.71	5	7	10	9	8	130	16	35	3	11	9	None noticed	10	3.4
Māngai Piri	4	19-May-07	60.7	Very Good	0.67	10	7	10	9	8	160	10	40	3	3	16.7	Moderate	0	2.9

**Total 49.1** 0.8 5.3 7.0 8.5 7.2 8.0 93.0 16.2 61.6 5.6 0.7 1.3 3.5 **2.5**

\*Incomplete record

Ave Score 53.0 85.0 80.0 162.0 56.0 6.5 13.3 35.0

5.3 8.5 8.0 16.2 5.6 0.5 1.0 2.5

**out of 5 2.7 4.3 4.0 4.1 2.8 0.2 0.5 1.3**

**Flow pH Temp Cond Clarity Bed Vege Deposits**

**Total Maitara 41.2** 0.8 **4.7** 6.9 **7.9** 6.4 **8.0** 74.3 **17.1** 68.1 **6.4** **-1.2** **-4.6** **2.9** **2.2**

**out of 5 2.4 3.9 4.0 4.3 3.2 -0.6 -2.3 1.4**

**Total Waikawa 67.6** 0.8 **6.7** 7.0 **10.0** 9.0 **8.0** 136.7 **14.0** 46.3 **3.7** **5.0** **15.2** **5.0** **3.2**

**out of 5 3.3 5.0 4.0 3.5 1.8 2.5 7.6 2.5**

**SHMAK Scores (Invert/Peri/Overall)**
**Mataura-Waikawa Cultural Health Study**

Site Name	Site Order	Visit Date	Invert Score	Invert Rating	Peri Score	Peri Rating	Stream Rating	Overall score/5	Ranking	Rating
Upper Mataura Valley	1	17-May-07	9.5	Very Good	10	Very Good	Excellent	4.4	5	Very Good
Piano-Flat/Waikaia	2	17-May-07	9.5	Very Good	7	Good	Excellent	3.6	4	Good
Gore	4	18-May-07	6	Good	7.3	Good	Moderate	2.8	3	Moderate
Mataura Falls	5	17-May-07	0	No Rating	7	Good	Outlier	1.8	2	Poor
Tuturau	6	18-May-07	4	Moderate	5.5	Moderate	Very Poor	2.2	3	Moderate
Edendale/Wyndam	7	18-May-07	4.2	Moderate	3.5	Poor to Moderate	Very Poor	2.3	3	Moderate
*Gorge Rd	8	18-May-07	0	No Rating	0	No Rating	Incomplete	0.4	1	Very Poor
Upper Waikawa Valley	1	19-May-07	7.8	Good	10	Very Good	Excellent	4.0	4	Good
Marinui	2	07-Sep-07	7.1	Good	10	Very Good	Good - Very Good	4.0	4	Good
Māngai Piri	4	19-May-07	7.2	Good	6.5	Good	Good - Very Good	3.2	4	Good

	<b>5.5</b>	<b>6.7</b>	<b>2.9</b>
*Incomplete record	55.3	66.8	
	5.0	5.1	
	<b>2.5</b>	<b>2.6</b>	
	<b>Inverts</b>	<b>Peri</b>	
	<b>4.7</b>	<b>5.8</b>	<b>2.5</b>
	<b>2.4</b>	<b>2.9</b>	
	<b>7.4</b>	<b>8.8</b>	<b>3.8</b>
	<b>3.7</b>	<b>4.4</b>	



## **Appendix G – E .coli Testing Data Set for the Mataura–Waikawa Study**

## E.coli Results

## Mataura-Waikawa Cultural Health Study

Site Name	Site Order	Visit Date	Ecoli / 100mls	Anti-biotic Resistance	Ecoli Test Comment	Sulph	Tet	Gent	Amp	Nalacid	Rank Score	Rating
Upper Mataura Valley	1	17-May-07	10	None	-	s	s	s	s	s	4	Good
Piano-Flat/Waikaia	2	17-May-07	10	None	-	s	s	s	s	s	4	Good
Riversdale	3	17-May-07	52	None	-	s	s	s	s	s	3	Moderate
Gore	4	18-May-07	384	None	-	s	s	s	s	s	2	Poor
Mataura Falls	5	17-May-07	1086	None	-	s	s	s	s	s	1	Very Poor
Tuturau	6	18-May-07	670	None	-	s	s	s	s	s	2	Poor
Edendale/Wyndam	7	18-May-07	203	None	-	s	s	s	s	s	3	Moderate
Gorge Rd	8	18-May-07	576	None	-	s	s	s	s	s	2	Poor
Owi/Fortrose	9	18-May-07	41	None	-	s	s	s	s	s	3	Moderate
Upper Waikawa Valley	1	19-May-07	119	None	-	s	s	s	s	s	3	Moderate
Marinui	2	07-Sep-07	211	Yes	Ampicillin	s	s	s	r	s	2	Poor
Waikawa Fork	3	19-May-07	432	None	-	s	s	s	s	s	2	Poor
Māngai Piri	4	19-May-07	317	None	-	s	s	s	s	s	2	Poor
Tripot Bay	5	19-May-07	75	None	-	s	s	s	s	s	3	Moderate

## **Appendix H – Site Photograph Record for the Mataura–Waikawa Study**



1a Mataura Valley



1b Mataura Valley



1c Mataura Valley



1d Mataura Valley



1e Mataura Valley



2a Piano Flat



2b Piano Flat



2c Piano Flat



2d Piano Flat



2e Piano Flat



4a Gore



4b Gore



4c Gore



4d Gore



4e Gore



5a Mataura



5b Mataura



5c Mataura



5d Mataura



5e Mataura



5f Mataura



5g Mataura



5h Mataura



5i Mataura



5j Mataura



6a Tuturau



6b Tuturau



6c Tuturau



6d Tuturau



6e Tuturau



7a Edendale



7b Edendale



7c Edendale



7d Edendale



7e Edendale





7f Edendale



8a Gorge Rd



8b Gorge Rd



8c Gorge Rd



8d Gorge Rd



9a OwiFortrose



9b OwiFortrose



9c OwiFortrose



9d OwiFortrose



9e OwiFortrose



10a Waikawa Valley



10b Waikawa Valley



10c Waikawa Valley



10d Waikawa Valley



10e Waikawa Valley



11a Marinui



11b Marinui



12a Waikawa Fork



12b Waikawa Fork



12c Waikawa Fork



13a MāngaiPiri



13b MāngaiPiri



13c MāngaiPiri



13d MāngaiPiri



13e MāngaiPiri



14a Tripot Bay



14b Tripot Bay



14c Tripot Bay



14d Tripot Bay



14e Tripot Bay



14f Tripot Bay



14g Tripot Bay



14h Tripot Bay



14i Tripot Bay



14j Tripot Bay