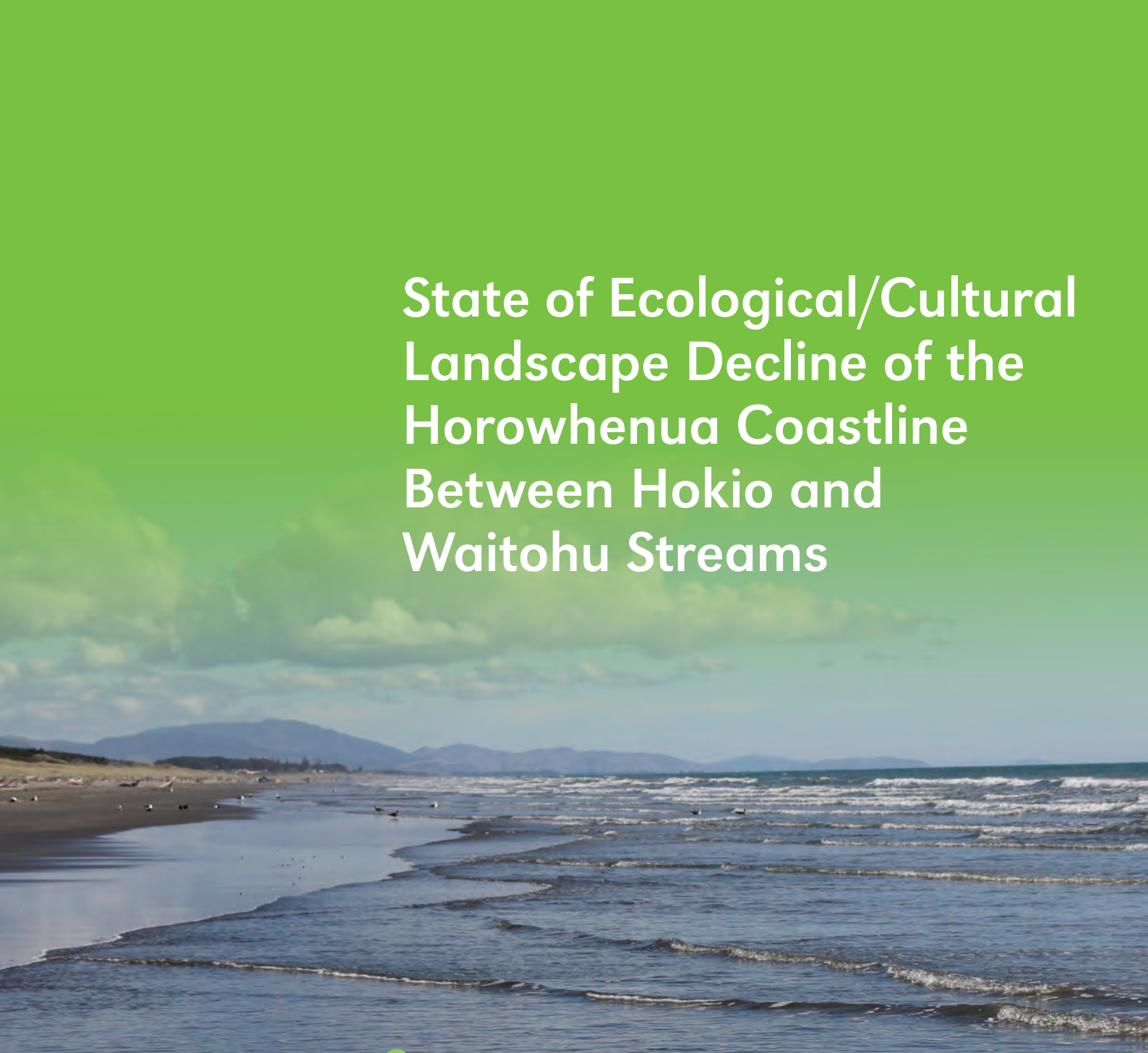
State of Ecological/Cultural Landscape Decline of the Horowhenua Coastline Between Hokio and Waitohu Streams



Manaaki Taha Moana

Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi

MTM Report No. 2
June 2011

State of Ecological/Cultural Landscape Decline of the Horowhenua Coastline Between Hokio and Waitohu Streams

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NGA MIHI

Tuia i runga, tuia i raro, tuia i waho, tuia i roto, tuia te here tangata, ka rongo te pō, ka rongo te ao. Ka tuku te ia o whakaaro kia rere makuru roimata atu ki te kāhui ngū kua hoki atu ki te waro huanga roa o te wairua, rātou kei tua o te ārai, takoto, okioki, e moe. Tātou ngā waihotanga o te reka ki a tātou, ā, e mihi kau atu ana mātou ki a kōutou i kotahi ai te whakaaro i raro i te korowai whakamarumaru o tēnei taonga, Manaaki Taha Moana (MTM).

Tihei Mauri Ora, ki a tātou katoa.

Ki ngā taniwhā hikurauroa i putaputa mai ai i ngā rua kōniwhaniwha, ngā whare maire, ngā whare wānanga me ngā whare whakahuruhuru manu ā pūtea nei o te motu, tēnā koutou. Ki ngā manu tioriori e karangaranga ana te taha wairua ki te taha tangata i runga i ngā marae mahamaha o Rongomaraeroa, whātoro atu ana ki ngā unaunahi nunui e pīataata mai rā i te nuku o te ika, te mata o te whē,

Tēnā hoki koutou, oti rā, tēnā tātou katoa.

Published by the Manaaki Taha Moana Research Team
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New Zealand

EXECUTIVE SUMMARY

Manaaki Taha Moana (MTM) is a collaborative, multi-entity, six-year research programme being conducted in two research areas: Tauranga Moana and Horowhenua coast. It is funded by the Ministry for Science and Innovation (MSI) until 2015. The Horowhenua case study and research programme builds upon Massey University's research with Ngāti Raukawa in the lower north island: 'Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and Hapu' (MAUX0502). MTM is a collaborative, action and kaupapa Māori research project. It uses Mātauranga Māori or Māori knowledge systems and cultural indicators alongside Western science to determine the ecological and cultural landscape decline issues facing these coastal systems for whenua (lands), awa (waterways), repo (wetlands) and moana (seas and harbours).

Te Reo a Taiao Ngāti Raukawa Environmental Resource Unit (Taiao Raukawa) and MTM research team are linked in this project to Waka Taiao Ltd and their research team, who are supported by Te Manaaki Taiao Trust. All entities are linked to Ngāti Ranginui, Ngāi Te Rangi and Ngāti Pukenga of Tauranga harbour and Ngāti Raukawa ki te Tonga, their Iwi and Hapū affiliates and the neighbouring Iwi and Hapū (including Muaūpoko) for the Horowhenua case study. The case study is bounded by the Tasman Sea and stretches from the Hokio Stream in the North, to the Waitohu Stream, wetland and estuary at Ōtaki in the South. It extends inland to encompass back dune systems with dune lakes, river meanders, wetlands with streams into riverine estuaries, and streams into the sea.

This *State of Ecological/Cultural Landscape Decline of Horowhenua Coastline Between Hokio and Waitohu Streams* report goes someway towards identifying the key decline issues for species and ecosystems within the Hokio to Waitohu Streams area and their associated systems across dunes, wetlands and peatlands into the marine, and particularly for areas held in Māori land tenure. In these areas Iwi and Hapū have evaluated and defined preferred options with their research collaborators for actively enhancing and restoring coastal and once culturally significant ecosystems in this distinct tribal area. Over time hands-on action research and rehabilitation programmes for valued ecosystems have taken place as kaitiaki (environmental guardians) respond to the severe environmental decline of ancestral lands and waterways in their areas of kaitiakitanga responsibility. Various kaitiaki in the Horowhenua to northern Kapiti rohe have engaged in action, kaupapa Māori and oral archiving research to collate knowledge about the decline of species. They have also devised enhancement activities for ecosystems that are more meaningful and relevant to their local Māori communities. They use tikanga based approaches when exacting research. They also ground the collaboration with other entities through relevant exercise of tikanga and protocols at marae within the case study. The MTM team also acknowledges land holdings in the case study region that are not in non-Maori ownership, therefore permission is sought from land owners for access to waterways or ecosystems. Each participant is kept up to date with all reports and data as they come to hand, including this report.

The central research question is: "How can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to Iwi and Hapū identity, survival and welfare in the case study regions?" Over the course of the research activities the MTM team aim to restore and enhance coastal ecosystems and their services of importance to Iwi and Hapū. The team is evaluating options based on collated data that will be assisted by the development of innovative Information Technology and decision support tools like simulation modelling, interactive mapping, 3D depiction and real-time monitoring as led by Waka Digital Ltd based in Tauranga. A recent collaboration (activated in 2011) with 4th Year Landscape Architecture Design students, from Victoria University, Wellington is another use of innovative technologies, theories and understanding human relationships to place. The collaboration works two ways: one, enhances the student knowledge base on Māori relationships to whenua and resources and two: offers capacity raising opportunities for Māori to engage in technologies fashioned to suit Māori needs. Action Plans and recommendations will also be produced for improving coastal ecosystems in each rohe. The research programme is cross-cultural; interdisciplinary; applies problem solving techniques; is technologically innovative; and integrates the ecological, environmental, cultural and social factors associated with coastal restoration for human wellbeing.

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1. INTRODUCTION

What is Manaaki Taha Moana (MTM) and who is involved in it?

Manaaki Taha Moana (MTM) is a six-year programme, running from October 2009 to September 2015, with research being conducted primarily in two areas: Tauranga Moana and the Horowhenua coast. This programme builds upon Massey University's research with Ngāti Raukawa in the lower north island: 'Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and Hapū' (MAUX0502). Professor Murray Patterson, of School of People, Environment and Planning at Massey University is the Science Leader of MTM (M.G.Patterson@massey.ac.nz).

A number of different organisations are contracted to deliver the research: Waka Taiao Ltd with support of Te Manaaki Taiao Trust in the Tauranga moana case study; Te Reo a Taiao Ngāti Raukawa Environmental Resource Unit (Taiao Raukawa) and Dr Huhana Smith (Research Leader Māori) in the Horowhenua coast case study; WakaDigital Ltd; Cawthron Institute, and Massey University. The MTM research activity described in this report centers on an interrelated tribal area, within a south-west coastal plain in the Horowhenua region that was once extensive coastal forest, with streams, rivers, estuaries, a series of lakes, lagoons and dune wetlands. Taiao Raukawa Environmental Resource Unit (on behalf of Ngāti Raukawa ki te Tonga) is linked with other Iwi and groups, particularly Muaūpoko who have tangata whenua status in the Hokio to Waiwiri case study area. The research team tries to engage extensively with Iwi and Hapū, and kaitiaki (environmental guardians) enduser groups, who have been set up in each case study region. The MTM programme website is: http://www.mtm.ac.nz and readers are encouraged to visit the website to read more about this research programme.

MTM is a collaborative, action and kaupapa Māori research project that uses and bolsters Mātauranga Māori or Māori knowledge systems within whenua (lands), awa (waterways), repo (wetlands) and moana (seas and harbours). The case study encompasses back dune systems with their associated dune lakes, river meanders, wetlands with streams into riverine estuaries, and streams into the sea. In recent years hands-on action research and rehabilitation programmes for valued ecosystems have taken place in the context of Māori lives experienced within a contemporary Māori society. Kaitiaki have responded to the severe environmental decline of ancestral lands and waterways through ecological restoration programmes for ecosystems, by engaging in research on decline of species and by devising activities that are more meaningful and relevant to their local Māori communities.

The coastal region of cultural landscape for the Horowhenua case study is bounded by the Tasman Sea and extends from the Hokio Stream in the North, to the dynamic Waitohu Stream, wetland and estuary at Ōtaki in the South. Taiao Raukawa and MTM research team are also linked in this project to Ngāti Ranginui, Ngāi Te Rangi and Ngāti Pukenga who focus efforts on their rohe (region) of Tauranga harbour. Each team accesses sophisticated technology and robust data collation systems to assist the research groups and Iwi and Hapū to evaluate and define their preferred options for actively enhancing and restoring coastal ecosystems in these two distinct tribal areas. The research project accesses western science to assess the decline issues facing ecosystems in this area. This *State of Ecological/Cultural Landscape Decline of Horowhenua Coastline Between Hokio and Waitohu Streams* report is one in a series that will sit alongside other outputs from the research programme currently underway. It goes someway towards identifying the key ecological decline issues for species and ecosystems within the case study between the Hokio to Waitohu Stream, Ōtaki and systems into the marine.

In recent years, local kaitiaki have reinstated relationships to land and waterways to enhance and revitalise the natural environment. To deal directly with local environmental degradation certain connections have been drawn between the themes and ideas present in customary knowledge. Contemporary kaitiaki are concerned with how once intricate relationships to cultural and natural areas are restored and sustained for Hapū, for their mana as authority, for tribal identity and for activities in the present, especially when only fragmented natural references

exist within landscape.[1] Over the last 40 years it has become obvious to kaitiaki that water quality between the streams in the case study area has been affected by intensified dairying, effluent disposal management regimes, forestry and coastal subdivision. Water quality in key food gathering waterways such as the Waiwiri and Waitohu Streams have been highly compromised, so the next stage of MTM will aim to identify water quality testing and shellfish monitoring.

The research team is keen to understand if shellfish supplies increase, drop in numbers or stay the same with adjacent forestry and subdivisions. In conducting a series of hikoi of the case study rohe, it was noted that recent subdivisions in sand dunes have increased other complex ecosystems decline issues. This includes increases in vehicle movement via four wheel bikes and vehicles using the spinifex-covered dunes as personal recreation areas. There are also rare stands of sand coprosma [*Coprosma acerosa*] and sand daphne [*Pimelea villosa*] present. It is well noted when beaches north of the case study region dis-encourage trail bikers, they are finding new places to wreck havoc within this case study rohe!

While hard data is hard to come by for shell fish health and associated decline in numbers, there is considerable anecdotal evidence and knowledge of ecosystems decline from kaumātua and resource gatherers, who well understand that supplies are not plentiful and the health of waterways is obviously compromised. The MTM research team wants to understand how ecological health has changed. There is also the associated cultural affects of the decline of species and ecosystems with loss of ability to manaaki (care and host) guests at the marae with local delicacies. For example, with the dramatic decline of one species such as toheroa or tohemanga, there are concerns that this culturally important resource will not ever recover sufficiently for sustainable harvest.

What is the main purpose of Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū (MTM)?

The central research question is: "How can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to Iwi and Hapū identity, survival and welfare in the case study regions?"

Figure 1.1: Hokio dunes and wetland, 2009
Aerial Photo by Lawrie Cairns, Palmerston North

Our research aims to restore and enhance coastal ecosystems and their services of importance to Iwi and Hapū, through a better knowledge of these ecosystems and the degradation processes that affect them. We utilise both Mātauranga Māori and western science to assist Iwi and Hapū to evaluate and define preferred options for enhancing and restoring coastal ecosystems. This evaluation of options will also be assisted by the development of innovative Information Technology and decision support tools (such as, for example, simulation modelling,

1 Susan, M. Smith., 2007, *Hei Whenua Ora: Hapū- and Iwi and Hapū approaches for re-instating valued ecosystems within cultural landscape,* Unpublished PhD thesis, Massey University, Palmerston North.

interactive mapping, 3D depiction, real-time monitoring) by Waka Digital Ltd. Action Plans will also be produced for improving coastal ecosystems in each rohe.

The research team are working closely with Iwi and Hapū (and others) in the case study regions to develop tools and approaches to facilitate the uptake of this knowledge and its practical implementation. Mechanisms will also be put in place to facilitate uptake amongst other Iwi and Hapū throughout New Zealand. The MTM team acknowledges that areas within the case study region are in non-Maori private ownership, therefore permission is sought from these land owners for access to waterways or ecosystems. Each participant is kept up to date with all reports and data as they come to hand, including this report. The key features of this research are that it is: cross-cultural; interdisciplinary; applied problem solving; technologically innovative; and integrates the ecological, environmental, cultural and social factors associated with coastal restoration.

What are the Specific Objectives or Stages of MTM?

The specific research objectives are:

* *Objective 1: Develop a Knowledge Base of Coastal Ecosystems and their Services in the two case study regions.*

This objective focused on determining the extent of critical coastal ecosystems and their services in both of our case study regions (Tauranga Moana and the Horowhenua coast). The relevant research questions are: What are they? Where do they occur? How can they be measured in biophysical, cultural and other terms? How culturally significant are they? How much are they worth or valued?

* *Objective 2: Determine how to Enhance and Restore Specified Coastal Ecosystems and their Services in the case study regions.*

We work directly with Te Manaaki Taiao Trust, Taiao Raukawa and other agencies in the local communities to harness and build on the knowledge from Objective 1 to answer the central research question of: 'how can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to Iwi and Hapū identity, survival and welfare in the case study regions?'

This will be achieved through detailed case studies in both regions on topics of most importance to local Iwi and Hapū in ascertaining how to go about restoring coastal ecosystems and their services. We will work in with other groups and local councils who may also be undertaking complementary-focussed research.

Figure 1.2: Waiwiri to Waitohu Streams coastal environment from the marine and associated waterways into inland back dune systems, 2009
Aerial Photo by Lawrie Cairns, Palmerston North

** Objective 3: Implementation and Benefit Transfer to other Iwi and Hapū.*

A condition of involvement of both Tauranga Moana Iwi and Hapū of Ngāti Raukawa ki te Tonga in this research programme, is that the research be implemented to cause real change in the state of coastal ecosystems in their rohe. Both Tauranga Moana iwi and Ngāti Raukawa ki te Tonga (and Muaūpoko) have catalogued the poor state of many coastal ecosystems in their rohe, recalling for example, accounts from tribal elders of the abundant kaimoana found at least 30-40 years ago, but not today. Both Iwi and Hapū groups in the case study regions are committed to arresting these trends and keen, through this research programme, to put in place Action Plans and other mechanisms to improve the quality of the coastal environment.

How does this report fit into the other work going on in MTM at the moment?

The initial research activities for this first phase of MTM have focussed on Objective 1, 'Building Up a Knowledge Base of Coastal Ecosystems and their Services', in both case study regions. In summary, we have been engaged in a cultural and ecological stocktake of what is already known about the state of coastal ecosystems in each rohe including both Mātauranga Māori and western science knowledge; creating a mediated model of Tauranga Harbour and the interrelationships between the various factors that contribute to its health; and the development of initial information technology tools to help us capture and use this critical knowledge and information, to actually restore coastal ecosystems. Collectively, these components helped inform the research team and tangata whenua in the selection case studies for more in-depth study and tool development in subsequent stages of MTM. Thus, this initial "stocktake" phase has involved a number of interrelated components:

A) Ecological 'Stocktake' of the Tauranga Moana and Horowhenua coast (from the Hokio Stream to Waitohu Stream)

The purpose of this ecological stocktake was to summarise all data and information on the past and current state of the ecological health of the Tauranga Harbour and the Horowhenua coast case study regions. This stocktake was undertaken to provide platform for selecting the case studies for Objective 2. It is also a mechanism to communicate our assessment of the ecological health of the respective coasts to our stakeholders. The results of this ecological stocktake will be made available in two main formats – written reports (such as this report for Horowhenua coastal case study, and a searchable on-line data repository on the MTM website) that anyone can use to discover what reports and other information exists about the state of coastal ecosystems in the case study regions.

B) Mātauranga Māori and Western Science

In the MTM programme, we endeavour to find appropriate ways of using both Mātauranga Māori and Western Science knowledge to solve ecological problems in the case study regions, hence the importance of having a robust Mātauranga Māori research framework.

C) Mediated Modelling

At present the Horowhenua case study is not engaged in Mediated Modelling as the focus has been on the complex interrelationships with Tauranga Moana. It is a tool whereby stakeholders can be involved in the model development and eventually use the model to identify and solve problems. Whilst one of the first world wide applications of 'mediated modelling' in a cross-cultural research programme has been undertaken in Tauranga, the Horowhenua case study will look into the opportunity. More information can be found on our website: http://www.mtm.ac.nz/mediated-modelling/.

D) *Information Technology (IT) tools.*

One of the key aspects of MTM is the development of IT tools to better communicate the research results and to support decision-making by Iwi and Hapū end-users and other stakeholders. This IT development is being undertaken and led by Wakadigital Ltd, with the other partners in MTM.

The initial focus has been on developing the web-based central information repository where our Digital Library can be accessed here: http://www.mtm.ac.nz/client/knowledge_centre-digital_library.php); a communication

portal/website, and updating the eFish database to include new data. Future IT development is likely to involve simulation modelling (what would happen in 20-30 years if we implemented 'xyz' management option), interactive mapping, 3D depiction (where are the problems occurring), real time monitoring (e.g., water quality) and illustration software. The Horowhenua research team are working with Victoria University School of Architecture and Design and Wraight Associates (WA), a Landscape Architect firm in Wellington on a Design Studio for a fourth year paper LAND 411. One of the features in applying these IT tools is to critically assess their efficacy and appropriateness in the context of Māori-focused research.

What Happens Next?

The culmination of the above activities helped inform MTM research teams about what knowledge gaps exist regarding the state of the coastal ecosystems and their services in the case study areas. This includes what the most critical areas are for ongoing investigation. In close collaboration with local tangata whenua, the teams will now engage in detailed case study research in both Tauranga Moana and the Horowhenua coast. Further reports will be produced outlining these case studies.

Purpose

The purpose of this report is to scope the key ecological and associated cultural decline issues for the coastline for Iwi and Hapū based on relevant literature, research, initial field work and resources currently available. This report assisted in prioritising case studies and action research projects that will enhance and/or restore ecosystems and peoples' relationships to whenua (lands), waterways and in time, freshwater to marine resources again. The Horowhenua research project builds on previous research work conducted overtime.[2]

The Research

The research focuses on whānau and hapū and how as Māori communities, they come together to exercise kaitiakitanga (active guardianship) over their fragmented ecosystems within agricultural and cultural landscapes. The research centers on key areas within an ancestral coastline remaining predominately in tribal tenure, between the Hokio and Waitohu Streams in the South-west coastal region of Horowhenua, North Island. The region was once an extensive coastal forest, a series of dune lakes, lagoons and dune wetlands within a larger tribal region under the guardianship of many hapū from Raukawa ki te Tonga, alongside related Iwi and neighbouring Iwi and Hapū.

The research investigates intricate and complex environmental problems, assesses the extent of ecological decline in the case study area, and considers how well kaitiaki (as caretakers of the natural environment and their cultural landscapes) are dealing with the impact of fragmented systems with associated effects on their human condition. As acknowledged in previous endeavours, action research methods are grounded in a kaupapa and tikanga Māori epistemology of knowledge development supported by cross-indigenous perspectives and international standards for ecological and human wellbeing. These methodological considerations aim to achieve ecological and cultural restoration goals in a whole-of-person, whole-of-system context. The use of these methods suggest that restoration of fragmented ecological systems is interdependently related to the healing of coastal communities, by reconnecting them with their fresh waterways and resources into the marine, within their natural and cultural landscapes.[3]

Since 2001, interdependent healing and support for participants has been achieved with *Hei Whenua Ora: Te Hākari Dune Wetland Restoration* project near Ōhau River estuary, (supported by the Tahamata Incorporation and Te Iwi o

2 Other research reports that have supported local initiatives include the hydrological surveys for Te Hākari Wetland Hydrological Assessment, 2005-2006 conducted with Phreatos Ltd, Wellington; Te Hākari Wetland Water Quality Investigation, 2007 by Dr Oliver Ausseil, and Ahi Kaa Roa: Mapping Cultural Landscape. This activity took place within the Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and (MAUX0502) of 2007-2009.

3 Susan, M Smith., 2007, *Hei Whenua Ora: Hapū- and Iwi and Hapū approaches for re-instating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North, 21-23.

Ngāti Tukorehe Trust). In 2011 the neighbouring Māori farming operation, Ransfield Incorporation and another Ahu Whenua Trust known as Pekapeka Taratoa have both ratified Nga Whenua Rahui covenants for the interconnected and extensive dune wetlands. The whole wetland area including Te Hākari Dune Wetland stretches to the marine, via stream or subsurface reservoirs to the West, and to the Waikawa River in the South. It is extremely important to the MTM research team to collate concerns for the loss of local biodiversity from the region and the effects this has on the human condition. Much work has been done on the loss of tuna in this area by Māori researchers Rachel Selby, Caleb Royal and Pātaka Moore.[4] The ongoing oral archive project for MTM will also draw more narratives of biodiversity loss based on the cultural memory of elders and whānau of resource gatherers. As well recognised by agencies like Nga Whenua Rahui, the biodiversity of Aotearoa is an important source of knowledge, where conservation covers more than just looking after, preserving or restoring areas. The Mātauranga Kura Taiao fund (as administered through Nga Whenua Rahui) support initiatives for tangata whenua to revive, use, and bolster customary Māori knowledge and practices associated with biodiversity management within cultural landscape. It fully affirms that spirituality and cultural history are inseparable in Māori conservation and biodiversity initiatives. Even though Nga Whenua Rahui and Mātauranga Kura Taiao function within the Department of Conservation, they both actively maintain Māori accounts and understandings around lands and waterways that may have been under utilised or vulnerable to further knowledge erosion. The agencies help rebuild relationships with the natural environment and cultural landscapes based on localised cultural memories and experiences. Funding support also broadens community effort in the management of indigenous biodiversity on tribal lands. With the level of financial aid that can be sourced, share-holders and tribal members as kaitiaki are inspired to improve the conditions of remaining biodiversity. Mātauranga Kura Taiao support helped capture an understanding of bio-cultural diversity[5] by oral archiving aspects of remaining knowledge of kaumātua and key resource users. The archive partially remedies the loss of local Māori understandings and practices, once fundamental to the management of biodiversity on lands and waterways in the region.

Other research reports that have supported local initiatives include the hydrological surveys for *Te Hākari Wetland Hydrological Assessment*, 2005-2006 conducted with Phreatos Ltd, Wellington; *Te Hākari Wetland Water Quality Investigation*, 2007 by Dr Oliver Ausseil, and *Ahi Kaa Roa: Mapping Cultural Landscape*. This activity took place within the Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and (MAUX0502) of 2007-2009. The beneficial outcomes of such combined exercises have been expanded in this research endeavour. The MTM team and kaitiaki enduser group take in the wider case study region to encompass greater ecosystem dynamic that stretches from Hokio to Waitohu streams, including related estuaries, dune wetlands and lakes and their relationships to the marine. All previous restoration work aims to improve the quality of water bodies to the marine to bolster associated ecosystems' services for overall enhanced human well-being.

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4 http://envirohistorynz.wordpress.com/2010/08/28/lake-horowhenua-and-hokio-stream-a-hapus-story/

5 Tove Skutnabb-Kanga, 2000, *Linguistic Genocide in Education-or Worldwide Diversity and Human Rights?* Lawrence Erlbaum Associates Inc: Mahwah, New Jersey, p. 65.

Customary Māori society valued knowledge that was generated through integrated ways of knowing. The notion of bio-cultural diversity in landscape recognises inter-linkages between linguistic, cultural and biological diversity. Māori embraced this integrated bio-cultural system as a means of maintaining the mana or authority of peoples to place and enhancing the quality of life within healthy, sustained environments. Bio-cultural knowledge had been apparent throughout human history, especially amongst indigenous, minority, and local societies who maintained close material and spiritual ties with environments. Over generations different indigenous communities around the world accumulated wisdom about their environments and its functions, management, and sustainable use. See (Smith, 2007, p. 70).

2. DESCRIPTION OF THE COASTLINE AND RELATIONSHIPS TO IWI AND HAPŪ.

The physiography and landforms that are encompassed within the wider Ngāti Raukawa ki te Tonga tribal boundaries,[6] have evolved over long periods, hundreds of thousands and millions of years.[7] The case study region chosen for MTM is a length of coastline on the Horowhenua to Kapiti Coast, from Hokio Stream in the North to the Waitohu Stream in the South at the Horowhenua and Kapiti Boundary (Figures 1.1 and 1.2). It is a much younger physiographic region approximately 17 kilometres in length that stretches approximately 3 kilometres into the sea and 3 kilometres inland. In geological terms, this coastal area is a relatively new sand dune belt with a number of small streams, rivers, dune lakes, lakes and wetland areas. It contains knowledge about the natural and cultural processes that once operated in the dune belt during the early period of Māori occupation.[8]

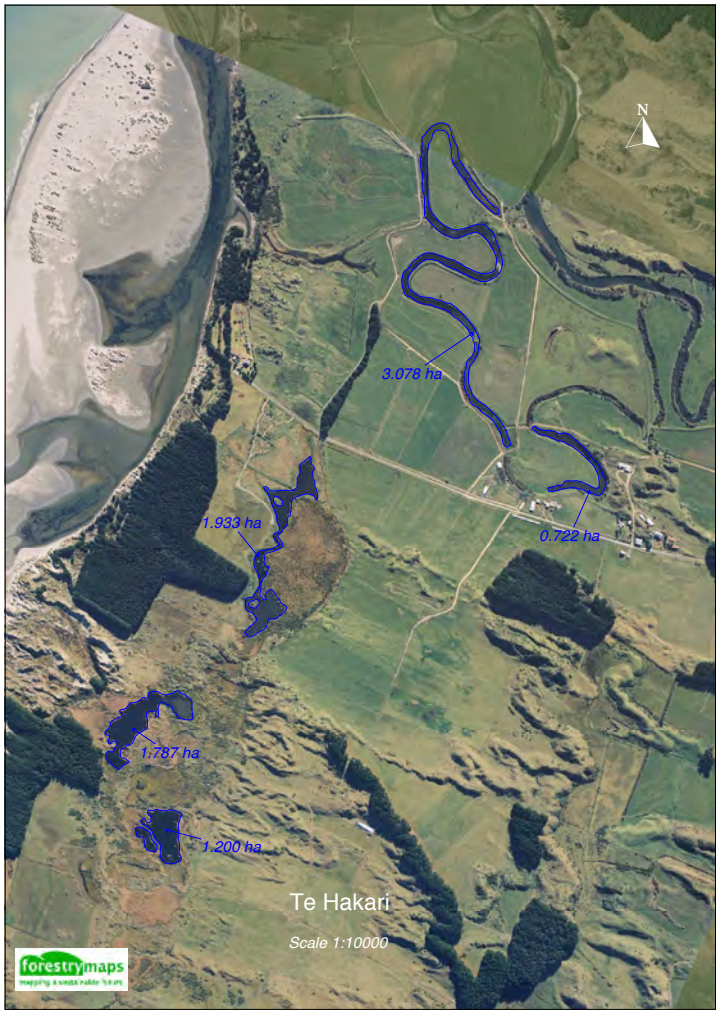

Figure 2.1: Ōhau 'loop', Te Hākari Dune Wetland (undergoing restoration) extending into Pekapeka and Ransfield Incorporation wetlands, 2011.

The coastal sand country is linked to extensive flat to undulating alluvial plains. They are generally low lying < 15 m above sea level. Coastal sand country is characterised by a complex of sand plains, sand dunes, inter-dune and extensive swamps, drained dune lakes and wetlands. For example, the Waitohu to Ōtaki dune sand has been dated by geologists to be Awatea Lignite, >45,000 B.P, marine sand.[9] Landforms in the area also influence the ecosystems types and the services they provide.[10]

Alluvial plains and low terraces are formed mainly from sands, silts, and clays, which have been deposited by fluvial processes. Such young landforms are associated with rivers and streams like the Ōhau River and Kuku Stream. Coastal country is formed mostly on windblown and alluvial sands and silts, with organic peats and clays in the interspersed and underlying swamp areas. Coastal sand dunes are

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6 From the Waitapu Stream (Rangitikei region) to Kūkūtauāki stream (south of Te Horo), bounded by the Ruahine and Tararua Range into the Tasman sea. Ōtaki Māori Land Court Minute Book 1A - Akapita Te Tewe for Ngāti Raukawa Owners by Conquest - with two small land block exceptions, Muāupoko and Rangitāne. Also a reference to Ngāti Toa and Ngāti Awa interests, 176-178

7 Nancy Golubiewski, 2008, *Ecosystems Services Inventory of the Natural and Managed Landscapes within the Greater Ngäti Raukawa area*, Ngä Märamatanga-ä-papa (Ecosystem Services' Benefits in Terrestrial Ecosystems for Iwi and(MAUX 0502), 3-4.

8 Bruce McFadgen, 1997, *Archaeology of the Wellington Conservancy: Kapiti-Horowhenua. A prehistoric and palaeoenvironemtnal study*, Department of Conservation, Wellington, 23.

9 Keating, E.C., 1978, *The Geology of New Zealand*, Government. Printer: Wellington, 594.

10 Nancy Golubiewski 2008, *Ecosystems Service Inventory of the Natural and Managed Landscapes within the Greater Ngäti Raukawa area*, Ngä Märamatanga-ä-papa (Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and(MAUX 0502), 4.

very young and unstable, while inland sand plains and dunes are much more stable and represent older landforms.[11]

From rain and snow that falls on the Tararua Mountain range, rivers flow through foothills, terraces and rich alluvial plains. As they reach the coast they meander (where unmodified) across the sand plains to sea. Smaller streams flow from the large coastal dune lakes to the sea. The Waikawa and Ōhau are the two main rivers in the case study area, and many tributaries, springs or modified water races flow into them at a range of points.

According to Mark Gyopari in *Te Hākari Wetland Hydrological Assessment* by Phreatos Hydrological Research & Consulting Ltd Wellington, sediment continues to be added to the coastline from inland erosion. The coastline prograded as the most recent dunes formed. These dunes are divided into an older set called the Motuiti Dunes (<1000 years BP) and a younger set called the Waitarere Dunes (<100 years BP, still accumulating). These two younger dune building phases are considered to have been triggered by the destruction of vegetation on stabilised older dunes near the coast that followed the arrival of Māori (Motuiti Dunes) and Europeans (Waitarere Dunes). Gyopari noted how Te Hākari dune wetland lies within this complex of dunes deposited over the last 6,000 years. The dunes lie parallel to the coast and become progressively older inland. Te Hākari dune wetland is classified as a groundwater depression swamp, which forms part of a much larger complex extending southwards to Waikawa Beach (Figure 2.2). It is presumed to be a former course of the Ōhau River. The remaining area of the wetland complex to the South, is highly fragmented and has suffered more severely from land drainage activities that took place in 2004.

Important Dune Wetlands, Dune Lakes, River meanders, Streams and Lakes in the case study region

To expand on what has been determined by previous research and emphasise the importance of coastal wetlands of significance, Te Hākari dune wetland was once part of a contiguous wetland and dune lakes system. The larger system stretched south to incorporate dune wetland lakes such as Pekapeka, Manga Pirau, and further onto other dune lakes such as Huritini, Kahuwera through to Waiorongomai near Ōtaki. (See Figure 1.2) To the North, Te Hākari dune wetland formed part of the shared lake and wetland systems of Waitaha, Ōrotokare at Waiwiri, Lake Waiwiri (or Papaitonga) and Lake Waipunahau at Levin. From 1842 to 1855 a series of recorded seismic activities, with associated uplifts of land drained the lagoons and shallowed the watercourses. In 1878 a major storm that forced the deliberate grounding of the Hydrabad vessel onto Waitarere Beach further north. This storm was possibly responsible for changing the shared and navigable common mouth of the Ōhau and Waikawa Rivers.

Some 6,000 years ago dune accumulation and coastal progradation began at the end of the last glaciation. Dune wetlands in this coastal case study occupy a linear inter-dunal swale where the groundwater table is located near to the ground surface. Te Hākari dune wetland may have originally been a shallow sandy coastal lagoon or estuary in which organic material has accumulated. The high groundwater table permits the organic wetland substrate to remain wet through the summer months, and allows mounding of water levels to occur through rainfall recharge during wetter periods. The wetland and connected wetland towards Waikawa River are therefore perceived to be groundwater dependent ecosystems.[12] When first subjected to intensive drainage, Te Hākari dune wetland (like the other dune lakes or wetlands in the wider district) became a captured, groundwater fed and rainfall enriched system, with a barraged stream that flowed west to meet the Ōhau River in its changed course. By 1935 Te Hākari lagoon was greatly diminished in size, choked with raupo 'with the central open water covered in a green weed.'[13]

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11 ibid. 10-11.

12 Data sourced from collaborative research projects that determined the water quality and sources of point pollution to Te Hākari Dune wetland. Michael Gyopari, 2006, *Te Hākari Wetland Hydrological Assessment,* Phreatos Hydrological Research & Consulting Ltd, Wellington, 2 and Dr. Olivier Ausseil, 2007, *Te Hakari Wetland: Water Quality Investigation*, Horizons Regional Council, Palmerston North.

13 G. Leslie Adkin, 1948, *Horowhenua: its Māori Place Names and their Topographic and Historical Place Names*, Department of Internal Affairs: Wellington, 48.

By 2001, it was reported that most wetlands in Aotearoa New Zealand had been drained,[14] with those remaining, many were small where their natural character and habitat quality had been lost or degraded by drainage, pollution, animal grazing, introduced plants, subdivision and other developments. Leading authors in ecological history, have confirmed that there has been an 85 percent decline in Aoteaora New Zealand's wetlands since European settlement. The decline is one of the most dramatic known anywhere in the world, far higher than the countries in which modern agriculture began large-scale draining of swamps and marshes.[15] While drainage to Te Hākari dune wetland was reversed in 2003, drainage and modification of wetlands continued unmonitored (and illegally in certain areas) where valuable ecosystem services were affected. However, some seven years later when first trying to address the issues facing the related coastal wetlands to Waikawa River, Ransfield Incorporation's shareholders have resolved to now incorporate the wetland into a kawenata with Nga Whenua Rahui, passed on 16th June 2011.

Despite modification and damage exacted overtime what emerges from action research grounded in a kaupapa and tikanga Māori epistemology of knowledge development, is that the restoration of these fragmented ecological systems in a cultural landscape of narratives and significance, is interdependently related to the healing of a community. When local kaitaiki emphasised protective mechanisms based on former customary information and experience about cultural and spiritual areas in landscape at the coast, they forged necessary safeguards to protect against inappropriate use and development. Furthermore these kaumātua accounts relayed a range of experiences with natural resources and the river and beach environs. They recalled how fresh fish, eel and white-bait were plentiful in the dune lakes, in the Ōhau River, and that different shellfish or patiki or flounder could be found in the backwashes of the Blind Creek. Flounder were also found in ephemeral wetlands near to Te Hākari dune lakes, south of the current Tahamata Incorporation pine forest. Shoals of whitebait went up Te Hākari Stream from the Ōhau river on spring tides. Sacks of thick eels were gathered from Te Hākari wetland. The whole area was regarded as a significant mahinga kai or a food gathering area literally regarded as 'the feast'.[16]

Figure 2.2: Cows in Lake Waiorongomai, 12 March 2011

Photo by James Putullo, 4th Year Landscape Architect student, Victoria University, 12 March 2011.

Similar mahinga kai and mahinga mataitai accounts regard Waiorongomai as a historic and culturally significant site, a place of abundance in eel, freshwater species and shell fish to sea. According to the current Waiorongomai Trustees and reports compiled as part of its rehabilitation strategies[17], Lakes Waiorongomai and Kahuwera, their interconnecting streams and Waiorongomai stream to sea are intermittent flowing water bodies suffering ill effects of non-point source pollution due to extensive drainage and intensive grazing of cattle. The area these systems occupy is leased by the Māori owners, who then lease it to a related farmer who grazes cattle. In recent

14 Parliamentary Commissioner for the Environment, 2001, *Boggy Patch or Ecological Heritage? Valuing wetlands in Tasman*, Parliamentary Commissioner for the Environment Te Kaitiaki Taiao a Te Whare Pāremata: Wellington, 43.

15 Geoff Park, 2003, 'Swamps which might doubtless easily be drained': Swamp Drainage and its impacts on the indigenous', in Pawson, E & Brooking , T., *Environmental Histories of New Zealand*, Oxford University Press: Melbourne , 5.

16 These combined recollections were collated with Mr Gary Wehipeihana (1943-2006), Mr Horace (Cooky) Lawton, Mrs Jane Poetsch and Mrs Ruhia (Buddy) Martin at the Wānanga Harakeke, 8 March 2005.

17 Lake Waiorongomai Trustees, 2011, Lake Waiorongomai Restoration Project Plan: Final Phase Report, Te Runanga O Raukawa Inc: Ōtaki

months Trust members and more kaitiaki have rallied again for the health of Waiorongomai in serious decline. Aroha Spinks (MTM researcher) has completed a report for the current trustees.[18] She will also pursue a PhD study, entitled *Restoring Coastal Lakes and Ecosystems for Cultural Survival: the Case Study of Waiorongomai*.

As far as early water quality reports are concerned, four lakes in the Horowhenua case study area were surveyed in the summers of 1949-1950 and in 1976-1977. These surveys included Lakes Waiwiri (Lake Papaitonga), Waitawa, Waiorongomai and Kopureherehere (Forest Lakes). The latter 1976-77 survey covered Lakes Horowhenua (Waipunahau), Waiwiri, Waitawa and Waiorongomai. In 1998, *Lake Horowhenua and Hokio Stream Catchment Management Strategy* assessed the condition of Lake Horowhenua (Waipunahau) and the extent of its degradation.[19] This is an area that requires more comprehensive and updated assessment. It should build on the important research work of Horowhenua Lake Trustees from past to present, and the timely research work of Rachel Selby, Pātaka Moore[20] and others.

Today, Lake Horowhenua (Waipunahau) is in an advanced eutrophic state where nutrient enriched waters create excessive algae and weed growth. Large amounts of sediment have accumulated due to natural and unnatural processes. The unnatural processes or human interventions overtime include: disposal of nutrient rich wastewater including Levin's human sewage that was discharged into the lake between 1952-1987; deforestation; drainage of wetlands and change of land use to farming (with more recent intensification in dairying); increased subdivision; water abstraction, and straightening of streams and removal of riparian vegetation. There has also been a recent and invasive outbreak of Purple loosestrife (*Lythrum salicaria*) at Lake Horowhenua (Waipunahau) and along the Hokio Stream. This is a semi-aquatic plant native to Europe, probably introduced as an ornamental plant in gardens. According to the DOC website, 'Purple loosestrife has been a sought after plant for cottage-style gardens. Its showy spikes of pink-purple flowers can grow up to three metres high on tall stems. This pretty, yet dangerous plant is threatening to take over lakes, wetlands and waterway margins. Because purple loosestrife produces many seeds, it spreads rapidly to form dense stands. It takes over shallow lakes and river margins; clog drains and irrigation ditches. It crowds out native plants, and changes habitat for wetland birds and fish.'[21]

While some management strategies have been put in place to help combat the many problems the region faces, nutrients continue to run-off from farms or market gardens. Water abstraction and drainage continues to lower lake levels, with added pressures of residential subdivision around the lake intensifying. The activities listed all contribute to the lake's highly eutrophic, degraded and compromised state.[22]

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18 Greater Wellington Regional Council is backing this project as well.

19 A summary of a range of report findings and news paper articles on Lake Horowhenua (Waipunahau) are detailed in the Appendix 5.

20 See Rachel Selby and Pātaka Moore, "Nöku te whenua ö öku tupuna: Ngäti Pareraukawa Kaitiakitanga" in Selby, R., Moore, P. & Mulholland, M., 2010, *Māori and the Environment: Kaitiaki,* Huia Publishers: Wellington, 37-57.

21 http://www.doc.govt.nz/conservation/threats-and-impacts/weeds/docs-weed-work/purple-loosestrife/

22 Manawatu-Wanganui (N.Z.) Regional Council et al, 1998, *Lake Horowhenua and Hokio Stream Catchment Management Strategy,* Manawatu-Wanganui Regional Council, Palmerston North, 12

Hornwort (*Ceratophyllum demersum L*) as pictured right, was introduced to New Zealand as an aquarium and garden pond plant. It first appeared in Lake Ōhakuri in the Waikato in 1963 and has been steadily spreading south ever since, wrecking entire ecosystems. It has reached epidemic proportions in the Lake Wairarapa wetlands, to the alarm of DOC, Fish and Game and local farmers.[23] In March 2011 and pictured in Figure 2.1, areas of water were calculated to determine amounts of liquid endothal required to spray by helicopter onto the areas infested by hornwort in Te Hākari Wetland, neighbouring wetlands and in the Ōhau River "loop".

Figure 2.3: Hornwort infestation in Ōhau 'Loop', 23 February 2011

Photo by Huhana Smith

The MTM research team and active kaitiaki acknowledge that there are pest weed management regimes required for coastal waterways in each case study project. In April 2011, Nga Whenua Rahui funded the aerial spraying of hornwort in dune wetland systems, particularly for Te Hākari Wetland and the neighbouring Pekapeka Taratoa and related wetlands within Ransfield Incorporation.

Figure 2.4: Hornwort spraying over Te Hākari, 29 April 2011

Photo by Moria Poutama

The MTM research focuses on coastal river and stream systems to sea, such as dune lakes, wetlands and peaty regions, by investigating interrelated subsurface water quality and its directional flows to the marine. Invasive weeds are a key indicator of decline with affects on water. Aquatic pest weed management is another major concern due to costs of eradication. Since the spraying of hornwort, regular monitoring has determined that the weed has been significantly knocked back. Monitoring continues with both the NWR teams and Horizons Regional Council assisting.

The MTM research team is assessing water bodies like the Waiwiri Stream, which drains from Lake Waiwiri (Lake Papaitonga) and Waiorongomai Stream from Lake Waiorongomai. These larger lakes are categorised as basin lakes, which form behind a barrier of sandy dunes. Water accumulates from rain, run off and spring fed sources. These basin lakes tend to be shallow and are often oval or elongated in shape.[24] Behind younger sand dunes[25] are

23 Department of Conservation, 2002, *Footnotes Newsletter*, Issue 176, May 2002, Department of Conservation, Wellington

24 Cunningham, B.T., Moar, N.T., Torrie, A.W & Parr, P.J., 1953. 'A Survey of the Western Coastal Dune Lakes of the North Island, New Zealand', *Australian Journal of Marine and Freshwater Research*, CSIRO, Vol 4, 346.

25 Bruce McFadgen, 1997, *Archaeology of the Wellington Conservancy: Kapiti-Horowhenua. A prehistoric and palaeoenvironemtnal study*, Department of Conservation, Wellington, 23.

sets of inter-dunal wetlands that are hydrologically linked to others in the North and South[26] of the case study rohe. As mentioned, there are a range of ground spring-fed waterways, artesian waterways and underground lakes that hydro-logically connect fragmented natural wetland ecosystems and dune lakes on the surface.[27]

It is recorded that the beach or coastline is pro-grading or advancing toward the sea as a result of gradual accumulation of waterborne sediment. Although the sea floor undulates out, there are few major geological features. The area is made up of mostly sand and in some areas, gravel. The gravel is carried by way of rivers and streams from the Tararua Ranges, and ground down as it approaches the sea. The Ōhau and Ōtaki Rivers and the larger streams between them deposit large quantities of gravel onto the flood plains.[28] Other reports describe the western dune belt as a dynamic arena of coastal accretion and erosion, where dune advances have overwhelmed forest and places of human use and habitation. Local kaitaiki are concerned about the loss of former ancestral indicators of occupation and presence.

When the Manawatu Catchment Board and Regional Water Board commissioned a report called *Processes of Coastal Change Manawatu-Horowhenua* in 1985, it recommended that serious future consideration be given to the physical forces that operate within the coastal zone from Manawatu to Paekakariki. The report highlighted the effects of inappropriate fore dune or land activities on physical processes that aggravate destructive shoreline responses. On the Kapiti Coast mistakes have long been (and continue to be) made by locating developments on hazardous sites without due consideration for the long-term stability and sustainability of the unique and dynamic dune coastline. As adjacent coastlines and inland uses are interconnected through wave action, wind, tides, currents and sediments, sustainable peri-urban development should respect fore dunes as natural buffers against erosion, especially during periods of storm activity. A beach absorbs wave energy and to do this efficiently it adjusts its form and position. If wave action changes then the beach area compensates with a new pattern of surf energy in put. Sand is transported onshore by wave action, blown inland to form dunes, and is also transported offshore and alongside depending on wave conditions.[29]

The pressures of proposed peri-urban subdivision within the coastal case study raises considerable concern over the lack of wider methodical or detailed Māori 'archaeological' or cultural landscape assessment in the expansive area, especially when there have been discussions and plans for expanding coastal settlements. In 2007 these were outlined in a Boffa Miskell /Horowhenua District Council collaboration, known as the *Horowhenua Development Plan 2007-2027*. In that proposal, expansion of the Waikawa and Hokio Beach developments (amongst others outside the case study region) would not only exacerbate predictions of negative physical and ecological affects on waterways and waterbodies, but will also surely obliterate remaining unique areas, which contain knowledge about the natural, ecological and cultural processes that once operated in the dune belt during the early period of Māori occupation.[30] Increased relocation and movement of people are also likely to increase accessibility to the wider sensitive coastal regions such as the Ōhau estuary environment and the sensitive and already vehicle compromised Waikawa Dunefields.

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26 Huhana Smith (S.M.Smith), 2007, *Hei Whenua Ora: Hapū and Iwi andApproaches for Reinstating Valued Ecosystems within Cultural Landscape*, Unpublished PhD Thesis, Te Putahi a Toi, School of Māori Studies, Massey University, Palmerston North, 102.

27 ibid, 198.

28 Frances Duguid., 1990, 'Botany of Horowhenua Lowlands, North Island, New Zealand,' *New Zealand Journal of Botany*, Vol 28, 383.

29 M.K. Holland & L.D. Holland, 1985, *Processes of Coastal Change Manawatu-Horowhenua*, Manawatu Catchment Board and Regional Water Board Report, Palmerston North.

30 Bruce McFadgen, 1997, *Archaeology of the Wellington Conservancy: Kapiti-Horowhenua. A prehistoric and palaeoenvironemtnal study*, Department of Conservation, Wellington, 23.

Figures 2.5: Strathnaver Drive subdivision and proximity to coastal processes, Waikawa

Photo by James Putullo, 4th Year Landscape Architect student, Victoria University, 12 March 2011.

In the last decade the actions of local councils and property developers have increased pressures for multiple subdivisions in coastal areas. This is particularly alarming for kaitiaki in the wider coastal area as this is where original settlements, papa kainga or pā of related neighbouring tribes (including those of the Te Ātiawa, Raukawa and Toarangatira alliance) were once located; where ancestors were interred; where battles and other events took place or where the vanquished were buried in proximity.

There are puna wai or freshwater springs where water was collected or used for propitiation to atua Māori and for healing purposes. Across the expansive dunelands and seascape there is evidence of generations of harvest with extensive shell, bone and stone middens, comprising sensitive information about a peoples' dynamic interaction with local biodiversity sourced from fresh waterways and the sea. So many activities took place within the wider region of mobile sand dune areas that once supported dune system grasses and sand binders, coastal forests or dune lakes and wetlands. There is vital information contained in former mahinga kai areas overwhelmed by sand movement. While there has been some archeological site investigation between the Waiwiri Stream and the Waikawa River, the total area has not been comprehensively assessed for Iwi and Hapū values of its original occupants or for later mana whenua settlements and resources used. The western dune belt is a dynamic arena of coastal accretion and erosion, where dune advances have overwhelmed forest and places of human use and habitation. Local kaitaiki are concerned about the loss of former ancestral indicators of ancestral presence that remain in whenua (lands).

The Horowhenua coastal region has not experienced peri-urban development on its coastal areas, except for Waikawa developments at Strathnaver Drive (Figures 2.4 -2.5) and to a limited degree with Hokio Beach settlement. Any other expanded or new subdivisions are likely to have adverse affects on cultural landscape, coastal rural landscape amenities and waterbodies, both surface and subsurface. Subdivision developments should not stabilise the unique coastal dynamic dune systems, dune wetlands and lakes, and their capacities as natural buffers to protect the Horowhenua coastline. Unfortunately, unsustainable peri-urban development on fore dunes or dune systems increases drainage and runoff of fine sediments. This causes higher water tables in sandy beaches and the clogging of beach pore spaces with fines.

These factors aggravate beach erosion by creating impervious surfaces that increase the scouring effect of wave backwash.[31] As the effects of different periods of urban development along the Kapiti coast have worsened shoreline erosion (that stretches south to Paekakariki) such damage requires considerable conservation, engineering or other expensive mitigating measures. With pending climate change the severity of storms and sea surges are more likely to affect proposed housing developments on dune systems especially unsustainable subdivisions proposed on adjacent fore dunes to sea. In allowing more widespread and fragmented coastal subdivision, this also simultaneously destroys vital evidence and identifiers of former Māori settlements held within lands, wetlands and waterways of the region. As a related factor for local Māori, wāhi tapu strategies aim

31 M.K. Holland & L.D. Holland, 1985, *Processes of Coastal Change Manawatu-Horowhenua, Manawatu Catchment Board and Regional Water Board* report, Horizons Regional Council, Palmerston North, 38.

to comprehensively reassess 'archaeological' and cultural areas within coastal landscape before any activities or excavation for any type of development takes place. Tangible reminders of Māori interaction with place need to remain in situ and undisturbed. In direct relation to subdivision pressures regional, territorial and tribal authorities need to reexamine how they sanction their 'accidental find' scenarios. Sanction becomes a management mechanism for archaeological site destruction,[32] which is a paradoxical form of site preservation.

Figure 2.6: Size of houses and suburban street layout at Strathnaver Drive upon sensitive sand dune systems

Photo by James Putullo, 4th Year Landscape Architect student, Victoria University, 12 March 2011.

32 Diane Lucas, June 2007, An Appeal Against the Decision of the North Shore City Council on Proposed Plan change 6 and Variation 66 to the North Shore City District Plan under clause 14(1) of the first Schedule of the RMA between Appellants, respondent and Section 274 parties, ENV-2006-304-000-000404, Environment Court, Auckland Registry, Auckland

Hydrology research

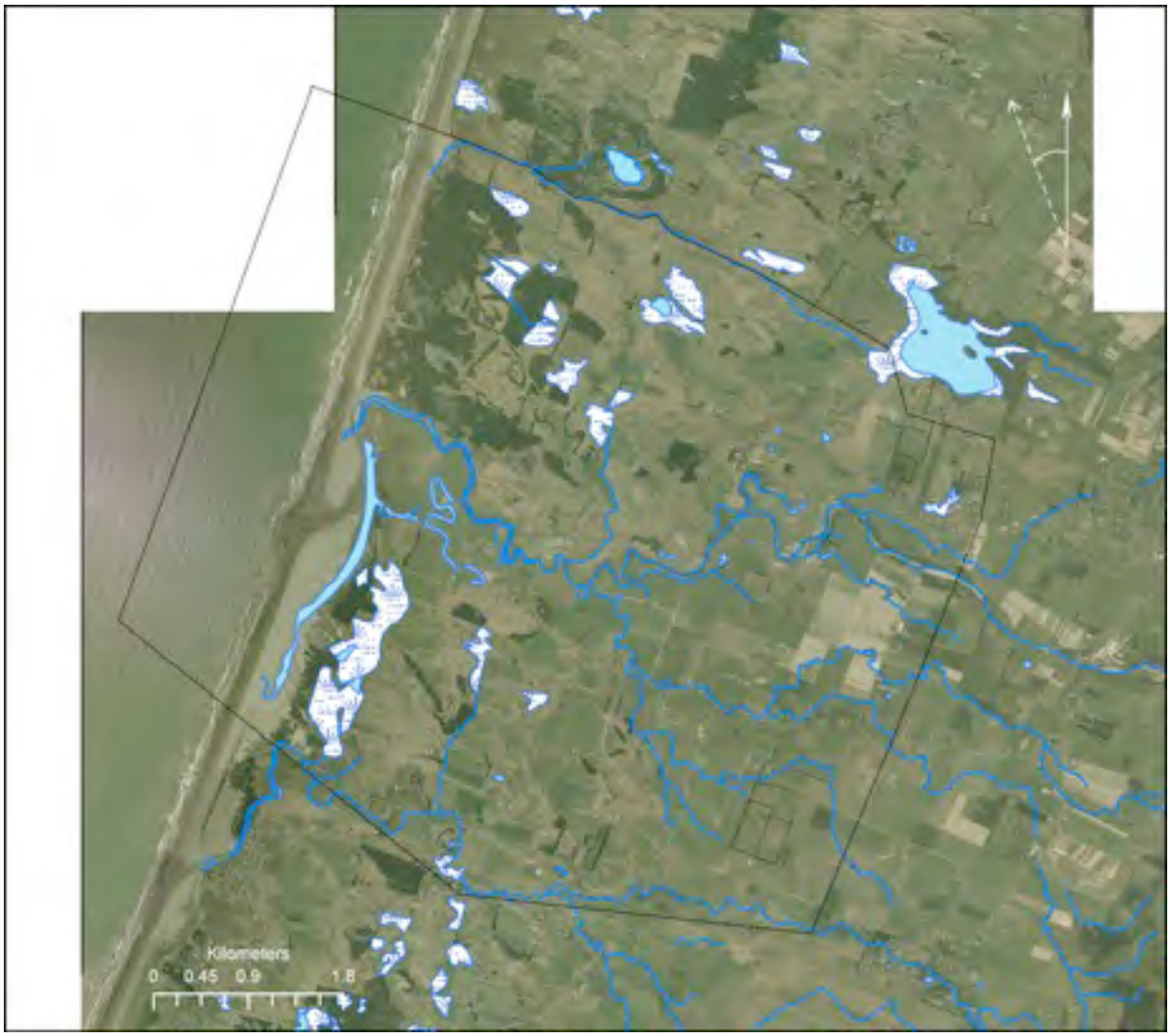

Figure 2.7: Hydrology of rivers, streams, wetland area between Waiwiri stream to the dune lakes systems near Waikawa River. [33]

Whilst the study concentrates on freshwater decline issues, there are a series of interrelated concerns over the loss of cultural significance due to a range of pressures and the historic movement of water in the dune coastal regions. Hydrology and subsurface waterways to sea are very important for this case study region. Between 2005 and 2006, hydrology research was conducted for Te Hākari Dune Wetland, which resulted in two reports *Te Hākari Wetland Water Quality Investigation* by Dr. Olivier Ausseil, former Senior Scientist – Water Quality at Horizons Regional Council, Palmerston North and *Te Hākari Wetland Hydrological Assessment,* by Mark Gyopari of Phreatos Ltd, Wellington. These reports had a list of recommendations on how farming incorporations might better manage effluent regimes, irrigation, nutrient and farm run off.

Water sampling research has determined that wetlands require a reliable continuous or seasonal source of water, which is usually a combination of rain falling directly onto the wetland, run off from surrounding land and from under ground as ground water inflow. Previous research has found that water was lost through evaporation from open water; transpiration from plants; flows out of drains and streams, and groundwater outflow. The water

33 This map was compiled as part of Ahi Kaa Roa: Mapping Cultural Landscape project from 'Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and Hapū' (MAUX0502) funded by FRST, 2007-2009.

balance of a wetland describes the balance between the sources and discharges of water. Therefore, wetlands like Te Hākari are dynamic hydrological systems where the flows and levels of water can vary substantially, both seasonally and from year to year. When averaged over a long time-period, the wetland's water inflows balance the outflows. At anytime one or more components of the balance may dominate, and water levels will rise or fall depending upon whether the dominant water budget components are inflows or outflows. For example, a heavy rainfall event would cause water levels to temporarily rise.

Alternatively, a seasonally depressed groundwater level may cause the wetland to dry because groundwater inflows decrease. The groundwater level monitoring data provided information on how the wetland interrelates with the underlying water table, and how this relationship may change through the year. The monitoring data illustrated and calculated the direction of groundwater flow around the wetland during the summer and winter seasons.

The hydrological data generated in the Gyopari report found that the general direction of groundwater flow is from the farmland to the east of the wetland, towards the coast where the subsurface water flows in a northwesterly direction. The groundwater flows within an unconfined sand aquifer with occasional peaty lenses is recharged from rainfall. The recharge area is the sand dune and flat paddock area to the east of Te Hākari dune wetland. During the winter the wetland level sits at about 2.m (above mean sea level). The water table is much higher than the wetland level, which indicates that there is an upward flow gradient from the water table into the wetland. This occurs because the base of the wetland is lined with low permeability of organic silts and clays. They restrict the upward flow of groundwater and slightly pressurizes (or confines) the aquifer. Groundwater seeps upwards at a slow rate into the entire wetland area. During the summer months, the groundwater-wetland relationship changes slightly. The wetland level is about 2.0m above sea level and the water table lies above this only on the eastern side of the swamp. On the western or seaward side, the water table is lower than the wetland level, lying just beneath the ground surface. This suggests that during the summer, groundwater is entering the wetland, through slow seepage, along the eastern side. The seasonal wetland level fluctuated by about 0.3m over the year, reflecting underlying groundwater levels. The levels dropped during summer when there was less rainfall recharge. The levels rose again during the winter rainfall infiltration to the east of the wetland.The water table was measured as being generally higher than the wetland level. This indicated an upward flow from the water table into the wetland. The groundwater flow varied depending upon the groundwater levels. In summer, the upward flow appeared to be restricted to the central and eastern side of the wetland.

There are strong interrelationships between the groundwater and wetland surface levels, suggesting that the wetland is vulnerable to nearby groundwater abstractions and to any contamination of groundwater by farming and nutrient pollutants in the recharge areas to the East. During the research period, the wetland water balance indicated that rainfall provided around 50% of the recharge to the wetland. The remaining 50% was accounted for by groundwater inflow. Evapotranspiration of water accounted for about 40% of wetland water loss with the remainder draining into Te Hākari Stream or out of the northern drain under Kuku Beach Road.[34]

Hydrological investigations conducted in this research from 2005 to 2006 have characterised both the surface water and groundwater environments. In participating in this research, kaitiaki learnt how to control water levels with temporary weirs, replant native vegetation and address the adverse effects of non-point source and point source contamination of water flowing into the wetland. The water quality testing took place before the first series of mechanical excavations of the wetland. The nutrient status and likely nutrient stores in the wetland sediment indicates that monitoring nutrient in put into the wetland alone, will not be sufficient to maintain the open water areas. With time (and if no monitoring takes place) the lakes are likely to be replaced by raupo. To maintain open water, active management is required to eradicate hornwort and harvest the raupo.

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34 Michael Gyopari, 2006, Te Hākari Wetland Hydrological Study, Phreatos Hydrological Research & Consulting Ltd, Wellington.

Dr. Olivier Ausseil, 2007, Te Hākari Wetland: Water Quality Investigation, Horizons Regional Council, Palmerston North

Recommendations for water quality in dune wetland regions

The Ausseil and Gyopari reports (alongside kaumātua and kaitiaki concerns) recommended how critical it is to keep improving the overall mauri and health of wetland regions. Water levels must be maintained as close to their natural levels as possible. A permanent weir plan with costs is ready for Te Hākari Stream.[35] This weir will allow for fish passage and for farm vehicles and trucks to traverse over and can be used for other areas in the research project as well. Monitoring results have indicated (and will likely indicate further) that the wetlands of the region have a very high nutrient status, worsened by continuous nutrient input from adjacent land, via the groundwater. Our coastal Māori farming incorporations need to actively reduce nutrients and undertake further changes to on-farm practices.

Before May 2005 the bacteriological results in the wetland indicated that at times, there was a significant health risk to people if there was any prolonged contact with the water in the wetland and stream, especially for swimming or food gathering. In fencing off the main open water area of the wet delta are, this significantly improved the bacteriological water quality of the wetland. Since May 2005, the wetland water quality is now safer for swimming and food gathering most of the time, although it is recommended that food is cooked before eating. Drinking water directly from the wetland remains inadvisable.[36] When hydrology results registered an overall unsafe level of faecal or e. coli contamination from non-point source pollution Tahamata Incorporation began to mitigate these problems.

In 2006 the following combined actions were recommended to reduce nutrient in put to the wetland. Water quality results for Te Hākari well indicated that farm management needed to:

- Evenly spread dairy shed effluent at the paddock scale and over all paddocks
- Maintain traveling irrigators so that they do not stall and create effluent ponding
- Favour irrigation during dry weather times and effluent storage during wet weather. In simply deferring irrigation this can reduce nitrogen leaching by up to 80%
- Monitor effluent application as no more than what is required for grass growth, which aids in nutrient and water budgeting
- Monitor bore into the farm area (bore 4) to measure changes to the effluent management regime and to check if the nitrate levels are back to normal
- Develop and implement a comprehensive nutrient management plan
- Split fertiliser application into lighter loads such as 3-4 smaller applications per year rather than one large application.

Since these reports were finalised, it is far more common practice that farm businesses like Tahamata Incorporation take on board new and updated methods recommended and required by Horizon's Regional Council for managing farm effluent. There will be another series of hydrological tests and monitoring undertaken at Te Hākari and adjoining wetlands south to update the state of health for these water bodies, wetlands and subsurface waterways by Massey University Student Te Rina Marsh under the supervision of Dr. Nick Roskruge in 2011. Additionally, more comprehensive monitoring of subsurface water quality is vital for Lakes Waiorongomai, Kahuwera and their associated stream systems to sea.

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35 Gary Williams, a local water engineer of Manakau has completed a planned and costed fish pass weir for Te Hākari Stream. He also worked on a water level control system for Te Hākari dune wetland, September 2007.

36 Dr. Olivier Ausseil, 2007, Te Hākari Wetland: Water Quality Investigation, Horizons Regional Council, Palmerston North, 4.

Archaeo-seimological Research for Faulting and Liquefaction

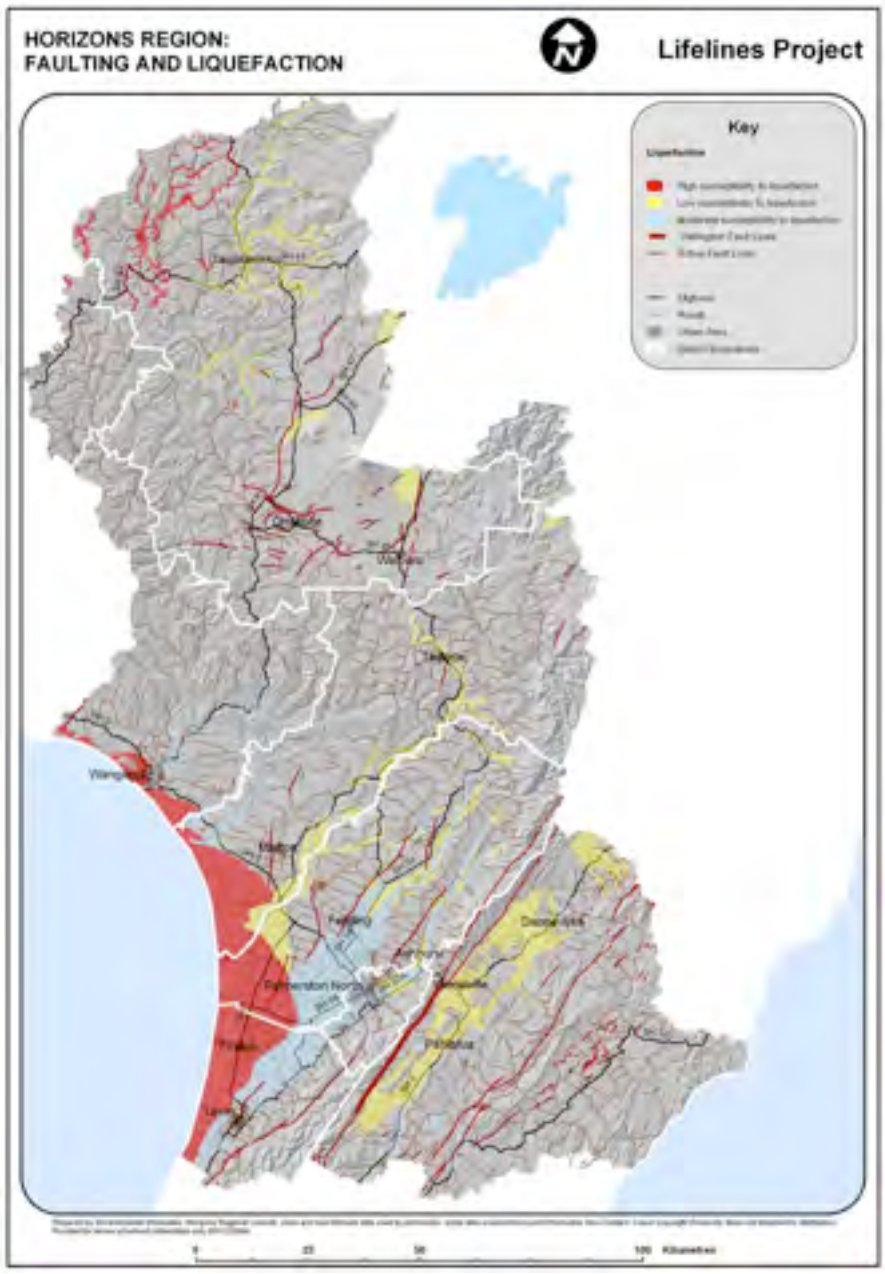

Figure 2.8: Faulting and Liquefaction in Manawatu Whanaganui

Key: High susceptibility to liquefaction, Moderate susceptibility to liquefaction, Low susceptibility to liquefaction

There are concerns for any proposed coastal developments located in:

Zone 1: High susceptibility to liquefaction. This zone contains most of the known sites of liquefaction-induced ground reported from historical earthquakes (post 1840) in the Manawatu-Wanganui region. Also included are areas of sand dunes, stream alluvium and swamp deposits. [37]

The MTM Horowhenua research team recognise that the case study falls within an area formerly affected by earthquakes tsunami, and therefore water movement. The case study is within a recorded, high susceptibility to liquefaction area, where lands, waterways and coastal settlements are likely to be affected again, especially if an earthquake is centred around Wellington or Masterton regions. The coastal region is made up of underlying soft sediments. In recent months the liquefaction in Christchurch is a warning for all. Liquefaction is due to

37 Manawatu-Wanganui Region Lifelines Project, 2005, Hazards of the Manawatu-Wanganui Region, Report. Appendix 4.

earthquake activity and loss of strength of unconsolidated materials during shaking with the expulsion of water. With settlements, heavy objects such as tanks may sink, list or float if liquefaction of their foundations or surrounding materials occurs. Sandy layers, up to several metres below ground may liquefy provided there is sufficient confining pressure, and may cause sand and water fountaining at the ground surface. Liquefaction is commonly responsible for lateral spreading along riverbanks.[38]

According to Bruce McFadgen, an active archaeo-seismologist is willing to come and help MTM with archaeo-seismological research in late 2011. He writes that not only is climate change a significant risk to coastal communities, but that:

'It is in the interests of Local Councils to understand the hazards to which their coastal populations are exposed. Planners and Surveyors need to be aware of what can happen, and has happened on the coast, when planning residential development. Having access to data on which to judge the hazard is essential. Fifty years ago (there was) the need for data on fault movement to better understand tectonic processes. In 2010, archaeo-seismology is a source, largely untapped, of what seismic events can do at the coast... Coastal development affects archaeological sites... Archaeologists are working on many parts of the coast, usually wherever coastal development is taking place. There is therefore an opportunity to find out a lot more about past seismic events at the coast by recording and interpreting the evidence contained in archaeological sites and their surroundings... It still remains that people and infrastructure at the coast will be affected by future seismic events, and that some events will have catastrophic consequences for many people. The more that is known, the better prepared future communities will be."[39]

Figure 2.9: Bruce McFadgen and Aroha Spinks on Hikoi #1, 13 November 2011

Photo by Huhana Smith

38 Manawatu-Wanganui Region Lifelines Project, 2005, *Hazards of the Manawatu-Wanganui Region Report*, Palmerston North, 11.

39 Bruce McFadgen, 2010, *Archaeoseismology- A New Zealand Perspective*, September 2010.

A paper prepared to celebrate the 100th Birthday of Emeritus Professor J.B.Mackie, 3 September 2010. Compiled by his friends, former students and colleagues from the University of Otago School of Mines and Department of Surveying and presented by Dr Bruce McFadgen, 97-98.

3. MĀORI VALUES: KAITIAKITANGA

The exercise of kaitiakitanga arises from the Māori worldview where concepts concerning long-term occupation, authority and title over lands are regarded as expressions of rangatiratanga and mana whenua. Spiritual beliefs appropriately honour a sense of sacredness, prohibition, and protection of the energy or life-force within everything. Kaitiakitanga is expressed through everyday environmental activities from the most sacred or tapu aspects of Māori spirituality, to simple acknowledgement of codes of behaviour associated with manaaki, tuku and utu as respect, reciprocity and obligation to the natural world. Kaitiaki may be human but the term is also used for spiritual beings (including the higher gods) for tribal guardians or spiritual keepers.[40]

Within the research case study area, kaitiakitanga is expressed in many ways by various Iwi and Hapū groups. To exercise kaitiakitanga concise interpretations stem from an ancient philosophy. For this, the following definitions of kaitiakitanga are considered:

> The term 'tiaki' whilst it's basic meaning is 'to guard', has other closely related meanings depending on the context. Tiaki may therefore also mean to keep, to preserve, to conserve, to foster, to protect, to shelter, to keep watch over. The prefex 'kai' with a verb denotes the agent of the act. A 'kaitiaki is a guardian, keeper, preserver, conservator, foster-parent and protector. The suffix 'tanga' added to the noun means guardianship, preservation, conservation, fostering, protecting, sheltering.[41]

Figures 3.1: Local kaitiaki coming back from tree planting at Te Hākari Dune Wetland Restoration project, 21 August 2010
Photo by Huhana Smith

Therefore, kaitiaki is the Māori word commonly used for a guardian – and in a broad sense this means someone who takes responsibility for the care and protection of children, treasured objects, natural places and buildings.[42] Within the Resource Managment Act 1991, kaitiakitanga is defined as guardianship and/or stewardship. Stewardship is an inappropriate term when considering the holistic world view of Māori that valued interwoven connections (or whakapapa ties) that were intrinsic to survival in the times of tūpuna or ancestors. In the pre-contact era ownership of property was a foreign concept to old-time Māori. The closest idea to ownership was that of the private use of a limited number of personal items such as garments, weapons and head combs. Apart from these few possessions, all other uses of land, waterways, forests and fisheries entitlements was communal and involved the exercise of tribal rights. All natural resources belonged or originated in Mother Earth as Papatūānuku. As the resources themselves did not find their origins in humankind

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40 Research by Joan Ropiha (2005) for exhibition *Blood Earth Fire Whangai Whenua Ahi Kaa: Transformations of Aotearoa New Zealand*, a long term exhibition at Museum of New Zealand Te Papa Tongarewa, which opened on 29 April 2006.

41 Rev. Māori Marsden & T.A Henare, 1992, *A Definitive Introduction to the Holistic Worldview of Māori*, Ministry for the Environment Manatū Mō Te Taiao: Wellington, 9.

42 Huhana Smith, 2011, *E Tü Ake: Māori Standing Strong*, Te Papa Press: Wellington, 144.

but rather originated from source, they predate humankind, therefore 'ownership' was not even considered. From a Māori perspective, the earth does not belong to humankind but rather, humankind belongs to the earth. All species of animals, birds, and fish could harvest the bounty of mother earth's resources, but they did not own them. In other words, human kind had user rights.[43] With user rights comes user responsibility. From this perspective holistic synergies exist worldwide therefore the decisions made in lifetimes should positively affect descendants up to, and beyond seven generations to come. With this guideline, the institution of rāhui was designed to establish rules and tikanga (protocols) that would enhance, locally and nationally, the viability and on-going use of resources. As Rev. Māori Marsden highlights:

> 'The institution of rāhui was designed to prohibit exploitation, depletion, degeneration of a resource and the pollution of the environment to the point where the pro-life processes latent within the biological and ecosystems of Papatūānuku might collapse.'[44]

In reviewing the Māori Land Court Minutes for the region for the central repository, the team is aware of a range of rahui processes exacted by ancestors in the nineteenth century. More recently an example of resource use precaution at Kuku Beach or the Ōhau estuary included a rāhui or ban on cooking any catches of shellfish such as tuatua or kahitua [*Amphidesma subtriangulatum*] on the foreshore of the beach. These protocols issued from an ecological worldview where humans were just one aspect of a larger family that extended to animals and plants in an all-encompassing genealogy. In this way ancestors were not only human ancestors but also the antecedents of the entire natural world.[45] Codes of behaviour for resource use at the beach noted how inappropriate or disrespectful it was to cook the related catch near the inter-tidal zone, where other shellfish remained in the sand. This caused the residual shellfish to sense the situation, to move away and not return.[46] One elderly informant ran into trouble with her father when as a young girl she and her sisters cooked their catch of whitebait, on the Ōhau River beach area. With the anger and distress levelled at them for their transgression, they vowed never to do so again. Such experiences were regarded as an external knowing or being present in the moment of experience,[47] which then informed their understandings and respect for the beach and environs for ever.

For the MTM project more opportunities exist to collate and map further recollections like these from informants and resource users. A brief inspection of the Hokio Stream and Lake Horowhenua by Ogle and West (1997) revealed species hitherto unknown or not recently seen in the area. Duguid (1990) also noted that a native grass, swamp millet (*Isachne globosa*) that had not been seen at the lake, and was last recorded there by Neville Moar in 1949. It was not recorded by Ravine (1992) but in May 1993, Tipene Hoskins and others saw that it as a common and conspicuous part of swamp vegetation adjoining Hokio Bush. Such a find of a regionally rare plant on only a

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43 Rev. Māori Marsden & T.A Henare, 1992, *A Definitive Introduction to the Holistic Worldview of Māori*, Ministry for the Environment Manatū Mō Te Taiao: Wellington.

44 ibid. 70

45 Charles Te Ahukāramu Royal, 2004, *Mātauranga Māori and Museum Practice*, Discussion paper prepared for National Services Te Paerangi at the Museum of New Zealand Te Papa Tongarewa, 26.

46 Like many others referred to as 'the old people', Rameka [Tumeke] Wehipeihana (1879-1968) also relayed to his grand daughters Ruhia Martin (nee Holder) and Netta Smith (nee Holder) the need to respect resources during their summer bach stays. They stayed in a whānau bach south of Te Hākari stream outlet during the seasonal shellfish harvest excursions they took as young children to young adults with their parents and grandparents, during the 1930s into the early 1940s.

47 Manulani Aluli Meyer, 2003, *Ho'oulu Our Time of Becoming: Hawaiian Epistemology and Early Writings*, 'Ai Pōhaku Press Native books: Hawai', 63.

During the course of the research endeavour, these forms of encounter were deemed valid ways of knowing place. By speaking about such relationships again and recording them, their capture helped rebuild relationships with natural and cultural resources and renewed awareness to the environmental concerns facing the region.

brief visit showed how important comprehensive botanical surveys will help augment the restoration of native vegetation at Lake Horowhenua and surrounds. Such activities should:

(a) Give better knowledge of the species available for restoration work

(b) Identify areas with rare or threatened species (locally or even nationally) which might need special protection before and during any sort of restoration project.

Historically, all resources in the case study region were used by Iwi and Hapū in one way or another. Food could be sourced from the sea, forests, lakes and waterways. Shelter from elements and rongoā (medicine) was attained from nearby trees, in order to heal natural ailments. The aim of the groups involved in this research programme is to improve the overall quality of water and the life supporting capacity of the water as an integral exercise of kaitiakitanga.

The focus of kaitiakitanga in the MTM project is about guardianship and enhancement and how this value relates to the natural environment and social well-being. In the journey towards tino rangatiratanga or self-determination over environmental health for waterways, kaitiakitanga is the principle that connects whakapapa (genealogies) and the energy of mana (prestige and authority) to the places and situations where Māori live and draw their resources from.[48] Māori tribal identity and well-being are inextricably intertwined with place – the features and forms of the land that families and tribal groups are associated with, the natural resources and species of that land and its waterways, the cultural structures like communal centres, and all the histories and knowledge that are part of a place. The mana of place resides in all these things. The people of the place, or tangata whenua, inherit this mana through their ancestral connections. The mana of place gives substance to the responsibilities of kaitiakitanga, which the ancestors have passed down to the present generations. In a very basic way, kaitiakitanga is how people sustain their lives and maintain their well-being and security. Another definition of kaitiakitanga stems from Hohepa Kereopa, who was a noted healer and spiritual leader of Ngāi Tūhoe. He was regarded as a fount of mātauranga Māori, or knowledge. Here is what he said about the role of the kaitiaki:

> [Kaitiakitanga is] to keep the things of creation safe. The return from this is the relationship you get with the thing you are protecting and the knowledge and learning that comes from that. When the world was created, everything was given full wairua [spirit] and mana, like the trees for example, so that everything is its own master … if people want to exercise kaitiaki, they will first need to understand the value of all things, and the wairua of all things … they will know the effects and consequences of doing things to trees, or whatever. For us this does not mean being in charge … you don't go and tell the pipi [shellfish] how to live, you allow it to have the opportunity to live the way it knows best, and that is what kaitiaki is … it is about knowing the place of the things in this world, including your place in this world. When you get to that point, you realise that the thinking of all things is the same.[49]

Today in this case study region, customary harvest and associated tikanga is maintained however in a much more limited capacity, due to extensive agricultural modification and changes in peoples' socio-economic circumstances. Karakia, whaikōrero, waiata, whakairo, taha toi, the ability to harvest resources from mahinga kai or mahinga mataitai, are all components that reflect mātauranga Māori initiatives that tangata whenua strive to keep alive. Environmentally, to be the conscious mind of Papatūānuku means that human kind is indebted, obliged and appreciative of the pro-life processes of recovery and regeneration. By aiding the rehabilitation and regeneration of degraded mauri (life-force) the tohunga of old would conduct appropriate ritual, focusing on and concentrating the mauri of a particular species in the area to the benefit of the associated or targeted species. In this way, the leading scholar Reverend Māori Marsden comments that:

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48 Huhana Smith, 2011, *E Tü Ake: Standing Strong*, Te Papa Press: Wellington, 144.

49 Paul Moon, 2003, *Tohunga Hohepa Kereopa*, David Ling Publishing Ltd: Auckland, 3

> "Mauri is a form of energy and energy is a form of radiation. From this source, the aura of the mauri would radiate outwards both to the environment and more specifically to the species for which it was intended."[50]

Thus mauri creates benevolent conditions within the environment, both to harmonise the processes within the Earth's ecosystem and to aid regeneration of immediate locales. If the aforementioned tact was found to be insufficient, the process of rāhui was instigated. This often involved prohibiting access to a particular resource for a number of months and often years. Rāhui was also used when there was a death by drowning or if blood had been spilt in the waterways. In this instance, the main cause of rāhui was to protect the living from coming across unhealthy or dead mauri and subsequently becoming contaminated by association.[51] If pollution, contamination or desecration have an impact on the mauri or life vitality of revered places within the natural environment, then this influences the communities who were reliant on the land, often manifesting in disquiet, disunity or fragmentation amongst them.[52]

During these studies the decline in the mauri or environmental health of a region, has been perceived as a source of manifested dysfunction between related peoples. The role for Māori includes individual and collective responsibilities. The impetus for active kaitiaki is to *exercise kaitiakitanga* for both present and future generations. When working in cross-Iwi and cross-cultural partnerships, common goals are necessary and apparent. Considerable respect is also shown to associated Iwi and Hapū within this case study. All research participants will gain better understanding of how kaitiakitanga as recalled by kaumātua functioned, and how it is exercised and maintained by those involved with the project.

50 Rev. Māori Marsden & T.A Henare, 1992, A Definitive Introduction to the Holistic Worldview of Māori, Ministry for the Environment Manatū Mō Te Taiao: Wellington. 70

51 Esteemed kaumātua Ruka Broughton in a private manuscript held by Tipene Hoskins.

52 Derived from a presentation by Professor Robert Jahnke, 2005 for Taonga Tuku Iho: Heritage Aotearoa paper, Massey University, Palmerston North.

4. INDIGENOUS KNOWLEDGE SYSTEMS: MĀTAURANGA MĀORI

The MTM research project expands upon kaumātua interpretations of place within the case study rohe, according to what had been transposed to them or garnered from their own cognitive maps of reasoning, intuition and perception over time. The research project uses this indigenous, customary or traditional knowledge that was rooted in local culture where knowledge is a source of 'knowing' cosmology as inseparable from the 'multiple tasks of living well in a specific place, over a long time.'[53] Indigenous ideas towards ecological sustainability supports systems of understanding that were location-specific, where experiences about place were arrived at through unique relationships between particular social and ecological arrangements.

The work required for ecosystem revitalisation projects within the case study area relies on the potential that remains within local knowledge about place, and how it contributes towards environmental change for ecosystems. When elders retell stories of experiencing local taniwha, spiritual guardians or the protocols observed around special places within the case study region, they highlight a value system that speak volumes in-terms-of respectful interaction with the natural and cultural environment. Quite simply, concurrent respect required to sustain resources, in turn sustained the collective. Māori values are fundamental for forming principles and guiding philosophies for culturally based sustainable development.[54] Future practical environmental projects will help re-edify closer relationships with lands and waterways. Current generations then re-enhance their understanding about how significant the cultural landscape they are dealing with, is.

Mātauranga has been described as knowledge that is intrinsically Māori by nature. Mātauranga Māori needs to encompass knowledge, comprehension and understandings of all things visible and invisible, of what is tangible and intangible across the universe. Mātauranga Māori incorporates all knowledge pertaining to the origin of everything. It permeates through the ages and find ties with the present and the future. In a contemporary context, this refers to Māori research, science and technology principles, practices and philosophies. Mātauranga Māori is distinct from western science, however neither is necessarily more valid than the other. In pre-contact times, Māori had an extensive genealogy of all flora and fauna that existed in the immediate environment. Whakapapa reference systems also relate a person's right to utilise land, sea, waterways and associated resources. Within the whakapapa link and peoples' place within it, Māori developed the Kaitiaki role, which then led to understanding responsibilities pertaining to our original parents, the Earth Mother and Sky Father. With humankind firmly entrenched in the universal whakapapa (before birth and throughout childhood into adult-hood) the importance and value of the environment becomes obvious. Whakapapa allows Māori to define the various relationships and explain natural phenomenon. As outlined by noted kaumātua, the old-time Māori could differentiate between at least 50 different types of soil. They knew the moods of the sea intimately and knowledge of appropriate seasons and propitious times to collect food. Guidelines and responsibilities towards the environment was the focus of ancestors.

The MTM project encourages the resurgence of these values. Māori had an all-encompassing view of the world and understood extensive genealogies that linked people to immediate environs. Māori codified the natural world, which resembles modern biological classification systems.[55] Māori considered living things in relation with environmental issues, rather than to what things are in the singular. As outlined in the WAI 262 claim this

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53 Madhu Suri Prakash, 1999, 'Indigenous Knowledge Systems-Ecological Literacy through Initiation into People's Science', in Semali L. M. & Kincheloe J. l. (eds.). *What is Indigenous Knowledge? Voices from the Academy*, Indigenous Knowledge and Schooling Series, Falmer Press: New York, 66.

54 Garth Harmsworth, 2002, *Preservation of Ancient Cultures and the Globalisation Scenario*, School of Māori and Pacific Development and International Centre for Cultural Studies (iccS), India 22-24 November 2002. Te Whare Wananga o Waikato, University of Waikato, Hamilton, 5.

Garth Harmsworth, 2003, *Māori perspectives on Kyoto Policy: Interim Results Reducing Greenhouse Gas Emissions from the Terrestrial Biosphere* (CO9X0212), Discussion Paper for Policy Agencies, Landcare Research Manaaki Whenua, Palmerston North.

55 The Waitangi Tribunal Te Rōpu Whakamana i Te Tiriti o Waitangi, 2006, *WAI 262 the Flora and Fauna and Cultural Intellectual Property Claim*, Statement of Issues, July 2006, The Waitangi Tribunal: Wellington. WAI 262, 1.

methodology is now promoted in western environmental science, and is known as the ecosystem approach.[56] Mātauranga Māori is what underpins this intrinsically Māori world view. Mātauranga Māori relates to knowledge, whilst Māramatanga (wisdom) integrates that knowledge into life practices[57]. Again, Rev. Māori Marsden summarises his understanding of the two principles;

> …Knowledge and wisdom are related but different in nature. Knowledge is a thing of the head, an accumulation of facts. Wisdom is a thing of the heart. It has its own thought processes. It is there that knowledge is integrated for this is the centre of one's being.[58]

When one seeks knowledge, integrating that awareness into life practice leads the seeker towards deeper understanding. The pursuit of understanding is essentially a spiritual experience designed to reconnect peoples of the present with cosmological and genealogical narratives for the benefit of future generations. Mātauranga Māori is the vehicle of choice to aid, enable and to achieve this goal.

A Māori person's identity is closely linked to both place and ancestry, therefore tenure rights of Māori communities along the coastline are equated with occupation over many generations - a state known as ahi kā or the keeping of metaphorical home fires burning on the land. In this way tribal places have been identified with the deeds of ancestors, frequently recalled in local place names, and knowledge of the landscape and resources of the ancestral estate. Imbued within this world-view was a sense of custodial occupation, that the environment should be maintained in a fit state for the next generations to come.[59] If custodians in tribal areas did not maintain a relationship with land, they risked losing ownership rights, ahi kā was extinguished. Their relationship to land could become ahi tere[60] or unstable. If more time elapsed the absent owner's rights of occupation could become ahi mataotao[61] or the cold or extinguished fire. To extinguish use rights by ahi kā custom, the rights of ownership had to be absent for about three generations. The absent owner(s) had to reach a point of no return, before their fires became mataotao. He, she or they could rekindle an ahi tere fire and thus their relationship to lands and resources, by returning to live in the tribal area. This meant that some balance was required between new owners and others who lost their rights.[62]

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56 The Waitangi Tribunal Te Rōpu Whakamana i Te Tiriti o Waitangi, (2006). WAI 262 the Flora and Fauna and Cultural Intellectual Property Claim, (p. 1). Statement of Issues, July 2006, The Waitangi Tribunal: Wellington. 1

For further updates on WAI 262 findings see www.taiaoraukawa.co.nz

57 H. Tatana. Interview with Tipene Hoskins, 2010

58 Charles Te Ahukaramū Royal, (ed.), 2003, *The Woven Universe - Selected writings of Rev. Māori Marsden*, Estate of Rev. Māori Marsden, Te Wānanga ō Raukawa: Ōtaki, 59

59 Evelyn Stokes, 2004, 'Contesting Resources Māori, Pākehā, and a Tenurial Revolution', in Pawson, E & Brooking, T., *Environmental Histories of New Zealand*, Oxford University Press: Melbourne, 36.

60 Toitu Te whenua, 1959, 'The Struggle Against Fragmentation', *Te Ao Hou*, No 28, 43.

61 ibid, 43.

62 ibid, 43.

Figure 4.1: Sign erected at beach, January 2001 (Later moved to entrance of beach in April 2001).

Relations, elders and Tukorehe Marae committee members at the newly erected sign for beach. From left to right, Mrs Yvonne Wehipeihana Wilson, Mrs Ruhia Martin, Ms Huhana Smith (in hat), Mrs Apia Heke, Te Huaki o Te Rangi Kamariera (baby with blue hat), Mrs Fiona Kamariera, Mr Sean Ogden, Mrs Pauline Moffat with her father Mr Harold Rowland (1915-2001), Mr Witana Kamariera, Mr Philip Putu, Carla (Unaiki) Johns and her grandmother Mrs Maire Johns. Children in front of sign are Suitsinaan and Isaac Heke.

Photo by Susan Forbes

The legacy of Māori land fragmentation juxtaposed with the complexities of tribal land succession has eroded once robust and intricate genealogical relationships between related peoples. In a customary context where whakapapa was the essential expression of whānaungatanga or familial relationships between a wider cosmology, peoples, environmental properties and lands, all entities are therefore interrelated and interdependent. Even though a whakapapa reference system orders and makes sense of such a complex mix of relationships, kaitiaki have had to actively address disjunctures experienced between genealogically related peoples.

It is therefore incumbent on kaitiaki to protect cultural landscape, resources and the natural environment, to ameliorate the effects of pollution over the state of water health and ease the difficulties experienced between whānau and hapū members over associated decline issues, which are caused by a legacy of land tenure changes and changes in use rights. Within the pūmahara or recollections of kaumātua there lives a memory and sense of place based on distinct and special, cultural and natural environment. As resource users' relationships with natural resources developed over time, understandings and relationships emerge. Through the teaching of essential everyday tasks as day-to-day activities, individuals and families learnt through observation and practical experience the skills essential to the welfare of people.[63] They referred to a system, which codified knowledge according to its relatedness to environmental and life issues. When fishing at the coast, kaumātua or resource gatherers were guided by the maramataka or Māori lunar calendar and associated star observations. They dried and stored shark, shellfish and eel. They distributed fresh fish after 'hauling' to feed the elderly and the community. They showed their manaaki or care to their visitors, represented by plentiful local catches or gathered delicacies at the marae.

Kaumātua and key resource users realise the impact of loss and disappearance of once bountiful fish, animal and shellfish supplies. Elders including Harold Rowland (1915-2000) (pictured in 4.1) spoke of life long interests in

63 Waitangi Tribunal, 1999, "Māori Education in New Zealand: A Historical overview," *The Wānanga Capital Establishment Report*, Waitangi Tribunal, GP Publications, GP Print: Wellington, New Zealand.

URL http://www.waitangi-tribunal.govt.nz/reports/viewchapter.asp?reportiD=39e3093-2f4d-497-aca0-28e8572755&chapter=4

waterways and their resources, and a desire that one day the whole coastline would be protected from inappropriate use.[64]

> I have fished at the mouth of the Ōhau River for as long as I can remember. My grandmother was Maraara Koronīria[65]... There were middens out on the corner of the river you can see the shells really high up... where Māori used to heat rocks to cook them. The peraro was the Māori oyster and we used to get it often, but since the 'cut', I think it has disappeared. But who knows it may still be somewhere. The blind creek is where it used to be.

Figure 4.2: Blind creek to the left of Ōhau loop long before the 'cut'
Cropped aerial photograph taken between 1942-1948
Aerodrome Services Public Works Department, National Publicity Studio, Prime Minister's Department, 1946, National Archives, Wellington.
Reference: AAQT 6404 WA2175

64 Personal communication with Harold and Joy Rowland's daughter, Mrs Pauline Moffat.

65 Daughter of tohunga Koronīria and his wife Turuhira of Manakau. (Koronīria may also have been referred to as Koronīria Rangiwhākaripa, a son of warrior chief Rangiwhākaripa and Mirika Powhirihau.)

5. NARRATIVES OF SETTLEMENT

The MTM research activity centres on interrelationships between peoples and their environment within a south-west coastal plain in the Horowhenua region that was once extensive coastal forest, with streams, rivers, estuaries, a series of lakes, lagoons and dune wetlands. The area falls under the guardianship of Hapū of Ngāti Raukawa ki te Tonga, Iwi and affiliates and neighbouring Iwi and Hapū of Muaūpoko. This coastal region of cultural landscape is bounded by the Tasman Sea and extends from the Hokio Stream in the North, to the dynamic Waitohu Stream, wetland and estuary at Ōtaki, in the South. Prevailing north-westerly winds blow across expansive sandy fore dunes populated with marram grass (*Ammophila arenaria*), remnant sand binders like spinifex (*Spinifex sericeus*) and pīngao (*Desmoschoenus spiralis*), ground covers like sand coprosma (*Coprosma acerosa*) and more endangered dune plants such as sand sedge *(Carex pumila)* as pictured below.

Figure 5.1: Sand sedge (*Carex pumila*) where the Waiorongomai Stream reaches the beach, 12 November 2010
Photo by Huhana Smith, 2010

The coastal plain then stretches inland around 3 km to the inland dune systems (refer to Figure 3.2). The coastal land includes the Hokio stream, the dynamic sand dunes area to the Waiwiri Stream flowing from Lake Waiwiri (Papaitonga). The area incorporates the Ōhau River meander known locally as the 'loop' and southwards to Te Hākari dune wetland system within Tahamata farming area. The contiguous dune wetland extends south to the Waikawa River, where the coastal area is managed by different Māori Land trusts. They may lease lands to the neighbouring Ransfield Incorporation, which is another Māori dairy farming operation. Case study includes Waikawa dunes region, the Waikawa beach settlement, the coastal subdivisions in dunes, the dune lakes Kahuwera and Waiorongomai and onto the Waitohu estuary, dunes and stream systems/wetlands.

The early occupants of the case study region would have witnessed quite different ecological systems between the coastal plain, stream and river systems to sea[66] than what is experienced today. They would have seen an area of dune land streams, dune wetlands and water courses where pukio, upoko tangata, wīwī or sea rush, oioi or jointed wire rush, raupo and kapungawha or lake club rush softened the wet edges of deep, meandering waterways.[67] As the dunes increased with age further inland, the soils matured accordingly. Ancestors would have walked back and forth along walking tracks between damp raised grounds of wind resistant trees growing on older dunes with developed soils, across moist flats with frost resistant species, through to a dune land cover

66 These tribal groups range from Kāti Mamoe, Rangitāne to Muaūpoko existence within the region. Through rights of take raupatu, others can assume mana whenua to regions as has been the case for Ngāti Raukawa and affiliated Iwi in areas of this case study region.

67 Pukio [*Carex secta*], Upoko-tangata or umbrella sedge [*Cyperus ustulatus*], wīwī and or sea rush [*Juncus gregiflorus*], oioi or jointed wire rush [*Leptocarpus similis*], raupo as bull rush [*Typha orientalis*] and kapungawha or lake club rush [*Schoenoplectus validus*].

of kowhai, ngaio, koromiko, maukoro or scented broom, tree tutu and toetoe.[68] In passing through this low level forest on the way to sea, they would have passed through shrub land on dunes, over grasslands to the fore dunes, and into the sea. Between the dunes there were often flat sand plains and hollows created by wind scouring where the soil was damp.[69] These damp raised grounds would have been cloaked in lush cloaks of manuka, koromiko, karamū, hukihuki or swamp coprosma, toetoe, tī kouka and harakeke, with stands of kahikatea in peaty regions. Inland, resplendent lowland terraced forests comprised large tōtara, titoki, with groves of kohekohe and matai. They too were interspersed with smaller trees like manuka, poataniwha, makomako, kaikomako, mapou, kowhai, kawakawa, mahoe or whitey wood, wharangi and kohuhu.[70] Each forested area teemed with a diversity of birds including kereru, kaka, tui, and parakeets.[71] Walking tracks linked the younger dunes and the dry sand plains. Tracks led to papa kainga with extensive gardens that were cultivated in clearings in the dune land to lowland terrace forests. The papa kainga were organised and located in proximity to abundant resources from sea, rivers, streams and forests.

In occupying these areas, hapū generated an intimate closeness with the environment and shaped the landscape through their human actions and influences overtime. They lived, procreated, died and sustained themselves by their seafaring, fishing, gardening and housing skills using natural resources, consistent with their Pacific Island origins adapted over many generations to suit the temperate climates of Aotearoa New Zealand. They entreated spiritual entities and their associated environmental properties. They supported themselves with knowledge systems based on generations of understanding caused from talking about place, observing place and developing place in a detailed way.[72] These ways of knowing were prerequisites for maintaining a healthy environment and its customary knowledge rights.

Their interactions with resources through shellfish gathering, freshwater fishing for eels and fresh water fish species, fishing at sea, and for gardening were essential activities that made sense of their local world. They used the Māori moon calendar or maramataka and star lore as an illuminating ecological knowledge guide for symbiotic environmental care and sustainable resource use. They seasonally harvested to the lunar cycle, then dried and stored abundant resources from the sea, the coastal dunes, the rivers, streams and wetlands for sustenance over the non-seasonal months. They snared birds within the coastal forests and from the foothills and mountain forest regions. Their activities for human wellbeing were integral within an epistemology of knowledge development that provided the means to nurture, sustain and protect hapū in their region.[73]

It has been well noted in scholarly text, that Māori tribal identity and the wellbeing of Iwi and, hapū and whanau was inextricably intertwined with the natural environment, through cultural places and landforms, natural

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68 Kowhai [*Sophora microphylla*], ngaio [*Myoporum laetum*], koromiko [*Hebe stricta*], maukoro or scented broom [*Carmichaelia odorata*], tree tutu [*Coriaria ruscifolia*].

69 Kapiti Coast District council, 1999, *A Guide to Growing Native Plants in Kapiti,* Natural textures Information Graphics: Paraparaumu, 5.

70 Manuka [*Leptospermum scoparium*], koromiko [*Hebe stricta*], karamū [*Coprosma robusta*], hukihuki or swamp coprosma [*Coprosma tenuicaulis*], toetoe [*Sortaderia toetoe*], cabbage tree [*Cordyline australis*], harakeke [*Phormium tenax*], kahikatea [*Dacrycarpus dacrydioides*], tōtara [*Podocarpus tōtara*], titoki [*Alectryon excelsus*], kohekohe [*Dysoxlum spectabile*], matai [*Prumnopitys taifolia*], poataniwha [*Melicope simplex*], makomako/wineberry [*Aristotelia serrata*], kaikomako [*Pennanatia corymbos*e], mapou [*Myrsine australis*], kowhai [*Sophora microphylla*], kawakawa [*Macropiper excelsum*], mahoe/whitey wood [*Melicytus remiflorus*], wharangi [*Meleicope ternata*], kohuhu [*Pittosporum tenuifolium*].

71 Bruce McFadgen, 1997, *Archaeology of the Wellington Conservancy: Kapiti-Horowhenua A prehistoric and palaeo-environmental study,* Department of Conservation: Wellington, 16.

72 Tove Skutnabb-Kangas, 2000, *Linguistic Genocide in Education or Worldwide Diversity and Human Rights?* Lawrence Erlbaum Associates Inc: Mahwah, New Jersey, 94

73 Maui Solomon, 1998, *Understanding Indigenous Cultural and Intellectual Property Rights: Implications for Environment Risk Management,* Conference presentation at ERMA New Zealand 1998 conference, Thursday 18 June 1998, Waipuna International Hotel, Auckland, 5.

resources and taonga species.[74] These land, sea and water based taonga signified both value and relationships, where natural or cultural taonga in landscape were treasured because of the associations they accumulated. In this way, 'any ecosystem with particular species that were significant for food or other purposes, and which were known to have qualities considered to be vital to those species' life-sustaining processes, were likely to have had taonga status in the customary Māori landscape. A swamp or coastal foreshore ecosystem that possessed such qualities, or a river ecosystem, or a forest, could be considered, with the people it sustained, to be a living being and be termed a taonga.'[75] Hapū inherited their mana for lands through their close associations with the intrinsic power that the land produced. This sustained their lives and contributed to their well being and security.[76]

This expansive coastal, riverine and palustrine region has witnessed a complex Māori history of warfare and conquest due to consequences over land that arose from the migrations from Kāwhia Harbour by Ngāti Toarangatira that began in 1819.[77] A later series of induced migrations south for Ngāti Raukawa also translocated Iwi and hapū from their original homelands around Maungatautari, Waikato.[78] Around 1823, affiliates and supporters to Ngāti Raukawa were allocated lands in the Horowhenua region at the behest of other related and significant leaders.[79] To this day, Māori shareholders have retained ancestral lands in tribal tenure where persistent, embedded cultural markers still exist (albeit tenuously) within agriculturally modified landscape.

Early European Presence in Ōhau river region

According to local literature and accounts[80] it was during the early European settler period that ships anchored in harbours that were once present at the mouths of the Ōtaki, Waikawa and Ōhau Rivers. They are no longer present today due to land upheavals from the 1855 Wairarapa/Wellington earthquake. This event was the biggest known quake in the region and had a magnitude of 8.2. On an international scale this earthquake was of major significance, especially as it affected a large area and the amount of fault movement. About 5000 km^2 of land was shifted vertically during the quake. The maximum uplift was 6.4 metres near Turakirae Head, east of Wellington while at Kuku, Ōhau it was around 2 metres. As mentioned earlier, it is anticipated that Dr Bruce McFadgen will lead an archaeo-seismological assessment of earthquake and tsunami events within the case study region in summer 2011-2012.

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74 Ronda Cooper & Rachael Brooking, 2002, "Ways Through Complexities" in Kawharu, M. (ed.) *Whenua Managing our Resources*, Reed Publishing Ltd Books: Auckland, 195.

75 Geoff Park, 2002, *Effective Exclusion? An Exploratory Overview of Crown Actions and Māori Responses concerning the Indigenous Flora and Fauna, 1912-1983*. Waitangi Tribunal Report: Wellington, 181.

76 Wharehuia Hemara, 2000, *Māori Pedagogies: A View from the Literature*, New Zealand Council for Educational Research: Wellington, 78.

77 Charles Te Ahukaramū Royal, 1994, *Kāti au i konei: A Collection of Songs from Ngāti Toarangatira and Ngāti Raukawa*, Huia Publishers: Wellington, 17. Ngāti Toarangatira began a long and arduous journey south, via Taranaki, Whanganui and Rangitīkei, known in Maniapoto country as 'Te Heke tahuta-hunui', and after Taranaki 'te Heke Tātaramoa', a name coined after the bramble bush that commemorated the difficulty of the journey experienced.

78 Particular migrations of relevance to Ngāti Raukawa affiliates included 'Te Heke Whirinui', 'Te Heke Karitahi' and 'Te Heke Mairaro'. The names for each migration respectively refer to the unusually large weaving on the edges of woven mats; the people on the next migration carrying single cartridge rifles, (as kariri means cartridge) and the third migration literally meaning the migration from below.
ibid, 19-20.

79 Waitohi (Ngāti Raukawa and Ngāti Toarangatira) was the sister of Te Rauparaha and Nohorua. She was a leader in her own right. She was influential in allocating lands for people. Her views were heeded by Te Rauparaha during the troubled times of the southward migration and the resettlement that followed it.
Oliver, W. H. & Teremoana Sparks. 'Waitohi ? - 1839'. Dictionary of New Zealand Url: http://www.dnzb.govt.nz/

80 Deb and Laraine Shepherd., 1999, *Bitter Water: A Story of Waikawa*, Catch 22, Wellington.

Figure 5.2: Ōhau Estuary at coast , Ōhau "loop" and Kuku Stream confluence to the Ōhau River.
Lawrie Cairns Aerial photo, 2005

When the Ōhau River formerly shared a common mouth with the Waikawa River, the watercourses were navigable and convenient for sailing vessels.[81] When Iwi and Hapū occupied lands at Ōhau pā or Pā Harakeke on the Ōhau River, their trading with whalers and traders supplemented their food resources from the sea and forest. A range of introduced crops, included 'honey, pumpkins, melons, marrows, cucumbers and other gourds, onions, wheat and maize; they grew choice varieties of fruits, quinces, apples, cherries, grapes and peaches'.[82] Ōhau pā became an important fortified enclave near to a meander of the Ōhau River. It was situated near the once extensive Te Hākari dune wetland region. It was a large pā with accessible sea-trading links with whalers some of who had been stationed at nearby Kapiti Island since 1820s. When hapū settled into the region from 1823-1825 pigs were bred and other tradable foodstuffs like potatoes were cultivated. A burgeoning trade of produce developed up and down the coastline when the New Zealand company settler ship "Tory" landed the first settlers at the Port of Wellington in August 1839. This new settlement would 'create a market for produce of the tribes' of the West coast of the North Island, including Ngāti Tūkorehe of Kuku. Local pigs were driven down the coast and sold in Wellington. Itinerant white traders assumed roles of middle-men, between Māori and the colonists.

Ngāti Te Mateawa and Ngāti Kapumanawawhiti were hapū of Ngāti Tūkorehe where occupation of interrelated areas extended into regions around Waitohu, Waitawa, Pukekaraka, and Mangapouri areas of Ōtaki. When

81 Thomas Bevan Senior, 1907, *Reminiscences of an Old Colonist*, Ōtaki Mail: Ōtaki, 24.

82 John Wehipeihana, 1964, *Sequent Economies in Kuku: a study of a rural landscape in New Zealand*, Unpublished thesis, Masters of Arts in Geography, Victoria University, Wellington, 6.

Pukekaraka was occupied as part of the conquering expeditions of Te Rauparaha, other related tribes also settled in the region. Like their relations in adjoining northern coastal regions, the fertile grounds within forest cover were well under cultivation at Pukekaraka from the 1840s. Ngāti Kapumanawawhiti (like Ngāti Tūkorehe) readily adopted the new economies introduced by Europeans into the area. With rival missions operating in the Ōtaki district, British Anglicans founded their mission in 1839 and the French Catholics in 1844. The Mangapouri stream at the southern edge of Pukekaraka block 5 became a form of boundary between these Christian spheres of influence. The French Catholic missionary, Jean Baptiste Comte (Pa Kometa) arrived in 1844 to promote Christian religious instruction as a guide to material and spiritual change for Iwi and Hapū. By the time he left the district in 1854, Ngāti Kapumanawawhiti had substantial grain cultivations, a shop, a mill, flax rope walks, orchards,[83] as well as a merchant schooner for transporting produce to the markets in Wellington. The wheat crops grown by a bend in the Ōhau River by Ngāti Tūkorehe and at Waikawa by Ngāti Wehiwehi were transported and milled in the Catholic Pukekaraka mill at Ōtaki. It was alleged that the massive 1855 earthquake destroyed the grain mill,[84] and that the Ngāti Kapumanawawhiti schooner ran aground on the Ōtaki bar. The commercial ventures of Ngāti Kapumanawawhiti finally petered out when the market conditions for harakeke collapsed. With this downturn their ropewalk mill and shop went out of business. When Comte left the district, a somewhat disillusioned Ngāti Kapumanawawhiti abandoned Catholic religious instruction.

From the 1860s, Pukekaraka became a stronghold for the Māori King movement, the important political interest group for Māori self-assertion where...

> 'Kingite flags were flown, armed men drilled and patrolled and large meetings debated options which alarmed Pākehā settlers... Māori too lived in constant tension from the threat of armed intervention by the government. In the mid sixties other notable politico-religious ideas were introduced by preachers of the Paimarie (Hauhau) faith. Between the attractions of Pai Marire and lack of instruction in Catholicism, the flock built up my Comte had greatly diminished by the time the next resident priest Delphine Moreau S.M, arrived.' [85]

83 Notes from St Mary's Church, *Pukekaraka file no 2004-50*, Vol 2, New Zealand Historic Places Trust, Wellington

84 ibid

85 Patricia Adams, 1987, 'For the Salvation of the Māoris': The Catholic Mission of Pukekaraka, in J.Wilson (ed) *The Past Today*, New Zealand Historic Places Trust, 28-29.

6. THREATS TO THE COASTLINE AND MĀORI VALUES AS IDENTIFIED BY IWI AND HAPŪ

The following points are some of the key decline issues acknowledged by Iwi and Hapū and collated over time. They are regarded as having a social, cultural or ecological effect on the well-being of the coastal case study area.

Social/Cultural Threats:

- Loss of mātauranga or knowledge about coastal waterways, stream, rivers, dune wetlands to marine environments and the health of these systems and resources as key Māori informants in generations pass away
- Associated decline in the mātauranga or knowledge, observations and experience of place that results in current generations becoming increasingly separated from once intricate relationships to ancestral, coastal places into the sea.
- Concerns from kaumātua, resource users and interested others who have observed, sensed, felt and experienced the decline in environmental integrity of ancestral and coastal landscape into the sea
- Concerns for once ecologically important and resource rich areas as well as associated original occupation and harvest areas, special burial areas and related spiritual entities in natural waterways and other sites adjacent to the sea.
- Loss of inter-generational protocols observed to protect special coastal waterways, dune wetlands and stream systems and resources into the sea.
- Associated capacity issues for better resource management processes for the coast and the marine. This indicates shortfalls in capability that can inhibit progress and protection of areas, especially those areas no longer in Māori land tenure.

Ecological Threats:

- Within twenty to forty years in different areas, intensified agricultural activities, and local and regional authorities' modifications to natural water way systems have combined to create tenuous balances between the cultural and spiritual needs of Hapū and Iwi as shareholders of Māori lands and waterways to sea, the economic operations of leased lands, and tribally based, large-scale, dairying operations or pine forestry blocks, and the remaining ecological integrity of the coastal region.
- Indigenous resources or local delicacies have disappeared from coastal waterways, streams, lagoons and dune wetlands once considered vital to the tribe. By the 1990's last vestiges of other natural food resources have deteriorated so rapidly from ongoing inappropriate or unsustainable actions, that they are now virtually non-existent.
- Worries about white baiting in unsuitable areas or non-compliant areas, and before season, affects breeding stocks of inanga or whitebait for others.
- Concerns extend to those avoiding fees at public refuse tips, and using for example, the Ōhau River beach environs to sea as private dumping grounds for inorganic or domestic refuse. Such activities suggest a disregard for natural integrity and a shift away from the kawa or sustainable resource use protocols once strictly observed and unchanged.
- Wider environmental threats to waterways to sea include the direct effects of reactive nitrogen on ecosystems. Acidification and de-oxygenation effects on forest, soils and fresh water systems; eutrophication in lakes and coastal ecosystems to sea; nitrogen saturated soils; biodiversity losses; invasions of nitrogen loving weeds such as hornwort and changes in abundance of beneficial soil organisms, all contribute to ecological decline and destruction of mauri in the marine environment.
- Unsafe levels of faecal or e-coli contamination from non-point source pollution (due mainly to ineffective farm nutrient management regimes) affects on coastal waterways, dune wetland systems, hydrological health of subsurface waterways, and affects on the estuarine and marine environments.
- Groundwater abstraction for farming around dune wetlands and lakes increasing their vulnerability to groundwater pollution in their rainfall recharge areas.
- Non-point source pollution from farming systems still remains the most significant risk to the coastal

environment and to the future of coastal farming itself. Nutrient management, faecal contamination from animals, the fresh water quality decline with flows into the marine region, requires significant and immediate focus.

- Increased pressures from proposed coastal developments affecting sensitive coastal dune systems and dune wetland areas, their special qualities, as well as archaeological and archaeo-seimological information and areas of spiritual significance within cultural landscape. This is coupled with ongoing and unsustainable impacts such peri-urban development has on coastal processes into the marine environments.
- There is more recent concern for a consented coastal subdivision within the case study region on coastal land between Waiwiri Stream and Ōhau River that is marked as high risk for liquefaction in earthquake events. Not only is there concern for lack of comprehensive archaeological assessment but research is also uncovering the need to conduct archaeo-seimological assessment of the past earthquake and tsunami events. Research is uncovering former experiences of kaumātua who recall the 1933 earthquake that liquefied farmlands at Soldiers Road, Kuku. (These kuia are now 85 and 86 respectively however the elder Aunty Buddy Martin passed away on 14 January 2011.)
- Threats to terrestrial biological diversity on the coastal margins include increased access to the beach environs, which leads to greater numbers of larger, recreational 4 x 4 vehicles or trail bikes. These vehicles mount risks to oystercatcher and black-backed gulls' nests in the foreshore sand dune systems. Such increased vehicular access compresses the wet inter-tidal sands, which put toheroa [*Amphidesma ventricosum*], tuatua or kahitua [*Amphidesma subtriangulatum*] beds in the foreshore region and kokota [*Amphidesma australe* or *Paphies novaezealandiae*] under pressure.
- Heavy 4 x 4 vehicles contribute to an over-extraction of shellfish and the lighting of fires for domestic or inorganic rubbish disposal.
- Increased pressures from vehicular access also affects native estuarine covers like Māori or native musk [*Mimulas repens*] and ureure or glasswort [*Salicornia quinqueflora*], carpets of sea primrose or shore pimpernel [*Samolus repens*].
- Beyond the river estuary into the fore dunes, remnant stands of stabilisers like pīngao [*Desmoschoenus spiralis*] and spinifex [*Coprosma acerose*], tauhinu [*Cassinia letophylla*], and shore bindweed [*Calystegia soldanella*] that have survived amongst the marram grass are under pressure from trail bike access.
- Other plants such as rengarenga as climbing New Zealand spinach [*Tetragonia trgyna*] help clothe the littoral dunes. These plants compete with pervasive marram grass.
- Increased erosion of dune areas is due to the prevailing north-westerly winds trapping sand around the base of marram grass, which builds up steep sand dunes that inevitably erode and collapse.

7 . PROJECTS INVOLVING CAWTHRON INSTITUTE, NELSON AND OTHER OPPORTUNITIES

From the hikoi experiences, information collated from previous reports and discussions with local elders and kaitiaki, the research team has identified a number of priorities for further research. Furthermore the kaitaiki/enduser team discussed the options during the hui on February 20th 2011, at Tukorehe Marae.

In the Horowhenua coast case study the MTM collaborative will be engaged in water quality and shellfish monitoring, and other research, including:

1. Catchment analysis and Microbial Source Tracking tests, focusing on the Waiwiri Stream, to determine faecal bacteria levels and where such pollutants are coming from.

2. Review of factors affecting shellfish populations.

3. A scoping study to determine restoration options for the Ōhau Loop.

4. Integrative dynamic modelling of the key factors that impact on the coastal region.

5. Work with local Iwi and Hapū and environmental groups to further examine issues surrounding the degradation of dune wetlands/lake systems and identify restoration options.

6. Collection and analysis of Mātauranga Māori, Oral Histories and assess affects of (re)-engagement in coastal restoration on mana and wellbeing.

7. Continue work on valuation of coastal ecosystem services.

8. Spatial modelling of key ecosystems and ecosystem services.

9. Further analysis and modelling of the economic activity in the rohe and its environmental effects on the coast.

From all of the above objectives the team encourages as much capability development and local Iwi and Hapū participation as possible in data collection, water testing and shell fish monitoring.

1. Waiwiri Stream

AIM: To identify sources of poor water quality and to rehabilitate habitat in the Waiwiri stream in areas that are considered to be of high cultural value for seasonal harvest of kai moana (specifically toheroa, tuatua and kahitua), and freshwater species such as tuna (eel).

Figure 7.1: Waiwiri Stream mouth
Photo Huhana Smith, 13 March 2011

Study contributions:

- Review of historical water quality data and reports.
- Water quality monitoring: Faecal indicating bacteria (FIB) and microbial source tracking (MST) on shellfish.
- Make recommendations and/or oversee stream restoration.
- Align this work with the Muaūpoko Tribal Authority (MTA) and their Integrated Freshwater Solutions Research project.

The Waiwiri Stream flows westward from Lake Waiwiri (Papaitonga) near Levin, for approximately 5-6km to its coastal outlet, just north of the Ōhau River

mouth. There is anecdotal evidence that the stream has suffered ecological degradation in the past 35 years, with exacerbated decline noted by kaitiaki/resource gatherers in the last 8-10 years. The source of pollutants remains unclear but it is possible that treated effluent from the 'Pot' part of Horowhenua District Council's Levin Wastewater Treatment Plant, MAY be a contributor. The Levin plant uses primary sedimentation followed by secondary treatment via a trickling filter, contact stabilization and clarification (Wally Potts, pers. comm. with Craig Allen 01/03/2011). Effluent is then pumped to a large unlined artificial pond, known as the 'Pot', before being irrigated onto sand dunes planted with *pinus radiata* (approximately 1 km from the coast). There is a significant area of dairy pasture within the relatively small catchment. A thorough investigation will determine if streams are fenced and/or planted from week of 20th June 2011.

The study involves an assessment of the water quality between Lake Waiwiri (Papaitonga) and the stream's coastal outlet. Additionally a review of existing water quality data is proposed. The MTM team utilise Cawthron's microbial source tracking technology to identify key pollutants and their likely source. With the help of local Iwi and Hapū, shellfish and water samples will be collected from specific stream locations and sent to Cawthron for assessment. Samples will be taken from approximately ten locations up to six times per year and will attempt to capture changes in water quality following heavy rainfall. It is not anticipated that the study will take longer than 1 year.

The methodology is similar to that used in a Northland oyster study (available at http://www.envirolink.govt.nz/PageFiles/176/708-nlrc100.pdf). The output will be a report on the source (human or bovine) of faecal contamination of the stream. A study such as described above is expected to cost between $40,000 and $55,000. This may vary however, depending on the level of participation of Iwi and Hapū in the data collection process.

2. Factors influencing the health of Toheroa (and other shellfish)

AIM: To identify the factors most likely to be affecting toheroa (and other shellfish) populations in the coastal zone from Waitohu to Hokio Stream region in order to design targeted habitat quality investigations to identify sources and how to address them.

Research Questions:

- What are the known stressors for toheroa/razor clam species?
- What are the habitat requirements of toheroa/razor clam?
- Of the stressors present on Horowhenua beaches, which are most likely to be affecting toheroa populations?

This literature review is intended to inform the design of an investigation into habitat quality in the surf zone (see case study below) to identify sources of stressors on shellfish. Prior to undertaking that study it is important to first identify what the most significant stressors are likely to be, so that the habitat quality sampling can target the most relevant parameters.

Toheroa were selected because of their cultural significance as a delicacy species. Considered the ultimate expression of manaakitanga to your visitors, it is regarded as 'kai o te rangatira' or the food of chiefs. Like several other shellfish and fish species found in areas of mahinga mataitai (food gathering locations in coastal freshwater, brackish water and coastal foreshore areas) they are endangered species and/or under threat from a range of affects. Cawthron is currently developing research proposals with a group of Taitokerau (Northland) Maori who are working on Toheroa restoration. There is potential to work collaboratively on toheroa with this group. Initial discussions have been started with Patrick Nicholson based in Tauranga, who worked with the kaitaiki from Taitokerau.

Figure 7.2: View of the 'loop' lined with willows from sand dune ridge-line overlooking Tahamata farm
Photo by Huhana Smith, February 2011

3) Ōhau 'Loop'

AIM: To restore aquatic ecosystem functions and services in the Ōhau 'loop' or river remnant.

Study contributions:

- Assess aquatic ecosystem functions and their significance to whanau, Hapū and Iwi and, as well as factors impairing these functions.
- Make recommendations and/or oversee the rehabilitation of the loop; including restoring part or all of the flow from the Ōhau River down through the loop; riparian planting; weed removal and other activities.
- Monitor indicators of ecosystem and cultural health.

Flood protection works in 1972-1974 on the Ōhau River saw a 3.5km meandering stretch of the river removed from the main passage of flow. The meandering section that was cut out and is known as the Ōhau 'Loop'. It still receives tidal flow, via culverts from the main river but this is insufficient to maintain healthy ecosystems. Intensive dairying in the immediate vicinity is likely to have contributed to the 'Loop's' current state, which is characterised by poor water quality, weed invasion and poor biodiversity. Local Iwi have made efforts to improve the state of waterways in the area, but it is thought that the best solution would be to reinstate the natural passage of flow through this section of the Ōhau River.

This would be a multi-year project. The first year may be spent looking at the existing aquatic ecosystems, cultural significance and constraints on the system. This would involve fish surveys, invertebrate sampling, aquatic plant surveys, water quality analysis, and interviews on cultural aspects. With this information, the team will recommend what could be done to restore the system, for example:

- Reinstate all or a portion of the flow from the Ōhau River through the 'loop'
- Remove willows and other invasive species
- Change the flood gates to allow fish passage
- Undertake extensive riparian planting.

It is hoped that Horizons Regional Council (or some other agency) would pay for the extensive earthworks necessary to divert the river through the loop, as the cost of this is beyond the scope of the MTM budget. The survey would be repeated for several years following the rehabilitation efforts, documenting changes in water quality and aquatic values. The report could potentially produce guidelines on how to re-instate river remnants like this. There may be some synergies with similar work currently being conducted on the Waikato River.

4. Coastal wetlands of cultural significance

AIM: To restore specific coastal wetlands.

Study contributions:

- Assess the hydrology and water quality of the wetlands (Waiorongomai, Kahuwera and wetlands south towards Waikawa River).

- Determine the value of the wetlands compared to the land value as dairy pasture.
- Conduct a GIS analysis of wetland area and habitat.
- Assess implications for both farming and habitat of alternative water regimes.
- Make recommendations on and / or oversee the wetland restoration, including raising water levels at Waiorongomai / Kahuwera, fencing, riparian planting, weed removal and other required tasks.

Figure 7.3: (Above) From Ōhau 'Loop', Te Hākari Dune wetland, Pekapeka Taratoa Ahu Whenua Trust and shareholders within Ransfield Incorporation wetlands and other Trusts that stretch towards the Waikawa River.

Figure 7.4: (Below) Lake Waiorongomai, Photo courtesy of Tim Park, Greater Wellington Regional Council, Wellington

Coastal wetlands such as Waiorongomai and Kahuwera have been severely degraded in the past 100 years due largely to vegetation clearing and drainage, to make way for pastoral farming, as well as direct effects caused by grazing stock. The Manawatu/Wairarapa region is estimated to have lost 97.4% of its wetlands (since 1900), with just 1% of swamp areas still intact. As discussed in this report the Waiorongomai wetland area is historically and hence is targeted for restoration. This would be a multi-year project. The first year or stage would look at the existing aquatic ecosystem functions, cultural significance and constraints on the system. This would involve hydrological surveys (including the construction of new piezometers), water quality analysis, and interviews on cultural aspects (possibly conducted by Taiao Raukawa). GIS technologies could be used to determine the extent of wetland area and habitat given proposed increases in wetland water level at Lake Waiorongomai / Kahuwera wetland. The economic value of the wetland will be calculated and compared to the value of the land as dairy pasture, in line with similar studies that have been done in the Waikato region. This valuation work will be completed by Massey University.

5. Surf zone water quality: the influence of local streams and river plumes on shellfish/ toheroa populations

AIM: To estimate the current abundance of shellfish/toheroa and to examine the influence of habitat quality as influenced by local streams and larger river plumes

Research Questions:

•Historically, where were shellfish/toheroa

likely to be located?
- How many shellfish/toheroa are currently present and what is their spatial distribution?
- What is the relative contribution of contaminants in the surf zone from local streams vs river plumes?
- What effect does habitat quality in the surf zone have on shellfish distribution?

The study design has two components, one sampling shellfish and the other sampling habitat and water quality. Cawthron scientists will then use statistical analysis to assess the impacts of surf zone habitat quality on shellfish populations. The survey design will depend on the outcomes of the case study on the physiological stressors to Toheroa, which will give insight as to the influence of habitat type and habitat quality variables.

We will sample habitat quality in the surf zone to determine the relative contributions of small streams, subsurface flow and river plumes (e.g. to assess the impact of fine sediments from the Manawatu River plume), as well as the presence of microalgae food sources. We may be able to assess the size and location of the Manawatu River plume at various flows and climatic conditions using satellite imagery, and the conditions under which the plume is thought to contaminate shellfish beds could be identified.

Sampling of shellfish and habitat quality will be conducted by local Hapū trained by Cawthron staff. Data will be sent to Cawthron for analysis and abundance of shellfish will be estimated. With this abundance estimate and other biological parameters of the shellfish species sustainable yield can be estimated.
Apart from an abundance estimate of the shellfish, we propose to identify the spatial pattern of shellfish distribution and possible environmental factors, such as habitat quality variables, which may drive this spatial pattern.

Given more funding, the study could be extended to include the following:
- Attempting to grow spat at the Cawthron hatchery and, if successful, assess spat tolerance to inorganic suspended sediment, other contaminants and salinity levels.
- If spat production is possible then growing spat to seed at the study sites may be worthwhile to try to re-establish natural populations and/or help assess the reason for population decline.

In the future, another possible case study is **Waitohu Stream** (this investigation links with Waiwiri Stream project).

AIM: To identify sources of poor water quality in the Waitohu Stream that pollute shellfish beds at the coast.

Study contributions:
- Review of historical water quality data and reports.
- Water quality monitoring: Faecal indicating bacteria (FIB) and microbial source tracking (MST) on shellfish.
- Make recommendations andor oversee stream restoration.

The lower reach of the Waitohu stream is characterised by poor water quality. Water from the Mangapouri Stream, a tributary that receives storm water from Ōtaki township, is especially poor. Water quality has been monitored in the Waitohu Stream since 2003 by Wellington Regional Council and there has been at least one study of water quality since then.

In a similar study, Cawthron used microbial source tracking to examine episodes of poor water quality in the Maitai River, which runs through urban areas of Nelson. Very high faecal coliform counts were tracked to their source, which turned out to be an incorrectly assembled sewerage outflow where a black water outflow pipe was connected to a town storm water pipe. This study will include a review of existing water quality data and reports. It is also proposed that we utilise Cawthron's microbial source tracking technology to identify key pollutants and their probable source. This can be done in a similar way as is described for the Waiwiri Stream study. This project is slightly more expensive than the Waiwiri Stream study because of the larger catchment size hence more sam-

pling would be necessary. It may be possible to run the Waiwiri and Waitohu Stream studies at the same time, so that shellfish can be compared between sites. Shellfish from the Ōtaki River mouth (where water quality is considered to be relatively high) and the MTA / Massey University Hokio Stream research project could also be included and compared, although this extra sampling would add (approximately $300 per sample).

Figure 7.5: Waitohu Estuary and stream to coast
Photo courtesy of Tim Park, Greater Wellington Regional Council, Wellington

8. CONSULTATION/DISCUSSION/PARTICIPATION MEETINGS AND METHODOLOGICAL RESEARCH APPROACHES WITH IWI AND HAPŪ AND OTHER COLLABORATORS.

As at May 2011, the MTM team have met with the following groups listed in Table 8.1, with the very last of the meetings to come marked in blue. The table includes a brief update on groups' responses and the listed end users/kaitiaki who have come forward to assist the project according to terms of reference in brief below. Email contact has been maintained in most instances and kaitiaki are happy to be led by MTM research team.

The MTM team are keen to build the confidence and capacity of kaitiaki through out the case study region. MTM team keep the wider Māori communities informed through the quarterly and monthly reports tabled with Te Rūnanga o Raukawa. This form of communication works in keeping people informed on progress, as does the hui schedule at different marae, email communications, the Taiao Raukawa website www.taiaoraukawa.co.nz and the www.mtm.ac.nz websites.

Figures 8.1 and 8.2: Meeting with Nga Whenua Rahui and Ransfield looking over wetland site on 18th February 2011]

The MTM team provide regular feed back particularly via these means through the arranged Hikoi and hui such as those held on 12-14th November 2010, 19-20th February 2011 and 12-13th March 2011.

In a Māori world, consultation is a very dynamic and time consuming process but is vital to communicate regularly to ensure the research proceeds, well. The following table outlines the start dates for consultation over the MTM project.

Table 8.1: Consultation with the range of Iwi and Hapū groups (Names, emails and contact numbers removed)

Meeting with:	Date / Time	Where	MTM team member attending
Te Hono ki Raukawa Treaty Claims Group Positive response from group with ongoing dialogue and updates to this group from Taiao Raukawa Project Manager Dennis Emery	Wednesday 24th Feb 2010, 6.00pm	TWOR, Ōtaki	Huhana Smith, Dennis Emery, and TR trustees…
Ngati Pareraukawa, Ngatokowaru Very positive response from a proactive group of kaitiaki. Group to be kept up to date on progress. **End users/kaitaiki: 2**	Sunday 28th Feb, 2.00pm	Ngatokowaru Marae	Huhana Smith, Dennis Emery, and TR trustees…
Muaupoko Co-operative Society Excited by the potential of MTM, the action research and kaupapa Māori based projects that will eventuate. MCS interested in protecting the dune regions of Hokio from sea and inland. **End users/kaitaiki: 1**	25th June 2010		Huhana Smith, Moira Poutama
Horowhenua Lake Trustees **End users/kaitaiki: 2**	24thAugust 2010	Massey University	Huhana Smith, Dennis Emery, Aroha Spinks
Waka Digital Very productive hui that explained the MTM website. The central repository capacity for all research data/info is a well protected/ restricted access site.	Thursday 20th May, Levin- 3.00pm TR staff 4.00pm Researchers MTM 5.30pm Tea 6.00pm TR meeting	Te Runanga o Raukawa, Levin	Huhana Smith, Dennis Emery, Shar Gardiner and TR trustees…
Muaupoko Tribal Authority Very positive response with full MTA support. **End users/kaitaiki: 2 +**	Thursday 15th April 10.00 am, MTA offices	Muaupoko Tribal Authority	Huhana Smith, Dennis Emery, and TR trustees…
Kikopiri Marae Very positive meeting with Kikopiri. **End user/kaitaiki: 2 +**	Sunday 9th May 2010 11.00 am	Kikopiri Marae	Huhana Smith and Tipene Hoskins
Ngati Hikitanga Very positive meeting **End user/kaitaiki: 2 +**	Saturday 19th-Sunday 20th February 2011	At Waiwiri Stream and Tukorehe Marae, Kuku	Huhana Smith, Dennis Emery, MTM researchers
Whakahoro Trust Positive response so far. **End users/kaitaiki: 2 +**	Saturday 6th November, 2010	Kikopiri Marae, Muhunoa	Moira Poutama, Huhana Smith
Tahamata Incorporation After good discussion there is positive support for the project. **End users/kaitaiki: 2 +**	Monday 12th April 6.30pm, 2010	Tukorehe Marae, Kuku	Huhana Smith, Dennis Emery, and TR trustees…
Tukorehe Kaumatua Council **End users/kaitaiki: 2 +**	Friday 27th August 2010	Tukorehe Marae, Kuku	Huhana Smith, Aroha Spinks,

Wehiwehi Marae **End users/kaitaiki: 3 +**	Tuesday 6th April, 2010	Wehiwehi Marae, Manakau	Huhana Smith, Dennis Emery, and TR trustees…
Taratoa- Pekapeka Trust **End users/kaitaiki: 2 +**	Meeting 29th June 2010	658 State Highway One	Huhana Smith
Ransfield Incorporation Positive meeting to extend the kawenata around the whole wetland region that links to Te Hākari wetland project to the Waikawa River **End users/kaitaiki: 2 +**	Friday 18th Feburary 2011		Huhana Smith, Richard Anderson (NWR)
Waiorongomai Lake Trustees **End users/kaitaiki: 3+**	Te Waari Carkeek and Caleb Royal are supporting all research material and reports supplied by Aroha Spinks. Aroha Spinks is processing Waiorongomai as her topic for PHD		Huhana Smith, Aroha Spinks, Dennis Emery, and TR trustees…
Te Pou o Tainui Marae **End users/kaitaiki: 3+**	31st May 2010, 1.00pm at Tainui Marae.	Te Pou o Tainui Marae, Ōtaki	Huhana Smith attended, apologises from Dennis
Hokio A Trust **Part Hokio A Trust** (Chair Bradley Taueki)	Initial discussions had but there are collaborative activities happening with Waiwiri Stream testing	Hokio Beach	Huhana Smith, Moira Poutama, Dennis Emery, and TR trustees…
Te Mana o Ihaka Trust	Meeting required		Huhana Smith, Dennis Emery, and TR trustees…

Exercising Tikanga

In this research project tikanga or the exercise of customary protocol is extremely important. For example, new researchers, experts and visitors to the case study region are welcomed through the waharoa or front entranceway of relevant marae. Exercising the tikanga of powhiri or whakatau as ritualised encounter between peoples also acknowledge Māori rights of tino rangatiratanga over their processes for active kaitiakitanga.

In March 2011, Te Pou of Tainui Marae at Ōtaki hosted final year Landscape Architecture students from Victoria University's School of Architecture and Design department, alongside Wraight & Associates, a Landscape Architect firm based in Wellington and the MTM team. This collaboration between the MTM research team, MTM Kaitiaki Endusers Group, students, landscape architecture firm and university has enabled a positive working relationship between the groups and their expertise where IT mapping and illustration software tools have been used to critically assess their efficacy and appropriateness in the context of Māori-focused research. The focus of the student exercise was the area between the sea and dunes lakes at Waiorongomai and the Ōhau River, and inland to the foothills of the Tararua. The students were welcomed to Te Pou of Tainui Marae at Ōtaki on 12 March 2011. Their visit coincided with the hau kainga (home people) celebrated their 150th anniversary of the historic flagpole on their marae (that is mentioned earlier on page 36-37). The students were treated to local narratives and cultural histories of the region, which was critically important to their understanding of a Māori world view of ongoing relationships with whenua, lands and resources. There was another powhiri for Forest and Bird for their bird monitoring work in and for a Massey Masters researcher and Horizons Regional Council

representative at Tukorehe Marae for their hydrology research work being conducted for Te Hākari Dune wetland.

Figure 8.3: Student powhiri at Ngāti Kapumanawawhiti Flag pole celebration, Te Pou o Tainui Marae, Ōtaki, 12 March 2011

Photo by Moira Poutama

We remind ourselves of the central research question and how we can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to Iwi and Hapū identity, survival and welfare in the case study regions. The research explores how Iwi and Hapū-led initiatives for ecological systems has encouraged collective movement towards constructive change on the ground, so that tribal knowledge and interrelationships between peoples, in their broadest sense, might be enhanced, and aspects of the natural environment might be restored. There have been other regional projects that investigated pro-active strategies based on local knowledge for assessing and rehabilitating stream ecosystems, addressing the depleted state of eel stocks in wetlands and waterways from Manawatū to Horowhenua, and to Kapiti coastal regions[86] conducted through Te Wānanga o Raukawa, Ōtaki.[87] Similarly, there is ongoing work by Hapai Ltd with Caleb Royal and Pātaka Moore for freshwater species monitoring in the Ōhau River and its tributaries.

Methodological Considerations and Approaches

The MTM research initiative is platformed on the previous research work that was funded by FRST through the *Ecosystem Services' Benefits in Terrestrial Ecosystems for Iwi and Hapü* (MAUX 0502). It has been expanding its activities to actively restore the mauri of degraded local ecosystems and the catchment landscapes that support them. However, this report has endeavoured to show that the wellbeing of natural and cultural landscapes are inextricably interrelated. This report also presents a model that re-emphasises linkages between linguistic, cultural, and biological diversity and seeks to catalyse necessary activities for reinstating mauri or vitality to valued ecosystems. This outcome has been facilitated and to a certain extent mediated by research methods drawn from a Kaupapa Māori epistemology that is grounded in local oral and knowledge traditions.

The following Table 8.2 represents a research kete or toolkit that lists and briefly describes the different types of aims, theory, resources, and methods employed in this research. The tools listed have emerged primarily from a Māori epistemology, but many are similar to methods, resources, and aims used by western trans-disciplinary researchers. Indeed, trans-disciplinary researchers involved in what they term joint-problem-solving research also

86 The area covered was from Bulls to Ōtaki. Sourced from PHD thesis by Dr Huhana Smith, 2007, p 29.

87 Ngāti Raukawa researchers Mr Caleb Royal and Mr Pātaka Moore received Foundation for Research Science and Technology research funds to assess state of eel stocks across the tribal region.The three pronged project involved collecting narratives from elders about the customary eel resource, assessing current stocks and habitats and producing a management plan for the lower North Island region. Sourced from PHD thesis by Dr Huhana Smith, 2007, p 29. See more of unpublished Royal & Moore research work:

Caleb Royal, 2003: *Stream monitoring and the development of Māori cultural water quality indicators: a project of Te Wänanga o Raukawa.* Unpublished report for Greater Wellington Regional Council. Also URL
http://www.gw.govt.nz/assets/Our-Environment/Ecosystem-Restoration--Protection/3351_WaitohuEnvironme_s6696.pdf

recognise the highly context dependent and dynamic manner in which research methods of this kind are applied. As developed throughout the project there have been attempts to highlight how the research process has not been linear, and has avoided clearly defined starting and endpoints. This reflects not only a philosophical perspective related to a Māori conception of continuous time, but a deeper respect for the highly dynamic nature of the complex socio-bio-cultural-ecological system that forms the focus of this study.

Another important characteristic of this research approach is that it follows a Mātauranga Māori approach to science, so it is not based on the dualistic assumptions of a western scientific epistemology. The distinction or separation between professional scientist, technologist or technician and non-scientific stakeholder, theory and practice, subject and object, start and finish, subjective and objective, and past and present are subsumed by a holistic approach that considers a whole-of-person and a whole-of-system theory of knowing. There is a need to regenerate the role of human interdependencies and interrelationships to each other and to the natural, spiritual, and cultural elements of landscapes, and to allow dynamic movement between them. Such thinking is central to a Māori environmental worldview. The research process may be described as being premeditated and resulting from a series of sequential events that give the appearance of a starting and ending point. However, such thinking indicates a partial focus on individual system parts. In complex reality it is never possible to exhaustively trace cause and effect relationships. However, we can respond to the needs of the present in its highly dynamic unfolding, and the kaupapa and tikanga of a Māori worldview provide a culturally mediated and value-based selection of tools for doing this.[88]

Table 8.2: Kete of research tools

Aims	Theory	Method	Resources
Focus on inter-dependencies	Augmented by environmental ethics	Oral narratives	Digital documentary images, aerial Photos
Focus of inter-relationships	Recognised localised systems of knowledge	Whakapapa	Digital documentary images, aerial Photos
	Place-based education through hikoi methodology	Dialogue	Conceptual aids (metaphor, allegory)
		Assessments	Local knowledge archive
		Active revitalisation of fragmented ecosystems	Reports on progress
		Co-created solutions	Objective documentary and visual evidence
		Co-intelligence strategies of related people	Creation of support projects (i.e. propagation nursery)
		Encouragement of constructive working relationships between all participants	Kaupapa
		Restoration of symbiotic Relationships	Tikanga

88 Sourced from Hei Whenua Ora ki Te Hākari: Reinstating the Mauri of valued ecosystems—history, lessons and experiences from the *Hei Whenua Ora ki Te Hakari/Te Hākari Dune Wetland Restoration Project* research report by Dr Huhana Smith, 2007, pp 29-32.

		Tangible hands-on activities	Other supporting agencies
		Re-creating healthy ecosystems	
		Collective planning	Hikoi methodology
		Collective decision making	
		Knowing of place	Hikoi methodology Tikanga
		Articulation and capture of cognitive maps	
		Reasoning	Hikoi methodology
		Intuition	Hikoi methodology
		Sharing of perceptions	Hikoi methodology
		Narrative	
		Consultation	Tikanga
		Participation	Hikoi methodology
		Cultural memory	Local knowledge archive
		Hui	
		Oral interviews	Local knowledge archive
		Subjective contextual interpretation of visual resources	
		Environmental education	Hikoi methodology
		Cultural heritage meetings	
		Wānanga	
		Collaborative research	Hikoi methodology
		Oral interpretation of visual media	
		Synthesis	
		Complex activities	
		Action research context	

The series of culturally mediated or value-based tools that have emerged through research activity have also catalysed and implemented expanded ecological and Māori cultural landscape restoration projects particularly for water quality testing and shellfish monitoring. The kete of tools attempts to strengthen tribal authority and autonomy and to elicit more collaborative practices among related people over their environmental and cultural landscape needs. By rebuilding local contexts of identity with place through environmental activities in the present, the combined action also encouraged more sustainable practices for the coastline and for the wider tribal

region. Practical action revitalises bio-cultural interrelationships among people and ecosystems; helps overcome people's disassociation with the significance of place; and discourages local and wider communities' disregard (at times) for a unique and treasured coast. Coming together to heal the natural and cultural landscape also alleviates dysfunctional interactions among related peoples.[89]

Ongoing challenges revolve around how professional, community groups, environmental and cultural agencies find ways to negotiate and collaborate effectively with each other. In the case study area public and local and regional government support is tantamount to preserving a contiguous coastal dune wetland, a dynamic coast line, and adjacent dune lands as ancestral landscape. These areas are at imminent risk from sharply increasing development pressures, waterways pollution, and climate change. Conducive protection requires appropriate recognition and management based on meaningful partnerships, understanding, and mutual respect between all parties. Success in protecting landscape certainly requires a generosity of spirit that acknowledges how different places matter to different groups, and that sometimes the same place will have different kinds of significance. Therefore, kaitiaki seek to record and safeguard site information according to their models and alternatives. Kaitiaki aim to monitor inter-related areas in cultural landscape, both as part of proposed wāhi tapu and cultural landscape protection strategies. Shared cultural landscape bases at the coast have long been integral to inter-related Iwi and, hapū, or whānau narratives. Maintenance of constructive dialogue and positive action between neighbouring Iwi and hapū over environmental and cultural landscape enhancement is crucial. With Iwi and hapū leading the way, local authorities must also carefully consider the coastal landscape from an integrated, valued, cultural landscape perspective.[90]

Figures 8.4 and 8.5: First hikoi at Waitohu Stream on 12 November 2010, and second hikoi near Ōhau River on 19 February 2011 (below).

Photos by Huhana Smith

Hikoi Methodology

The MTM team have developed a highly useful and meaningful research approach whereby the entire collaborative of entities was invited to 'hikoi' or walk (and camp within) the case study region so that each participant could get a first hand 'look and feel' of the extensive area of investigation.

The hikoi methodology also produced visual resources to use at hui. Photographs were complied into a book to commemorate the first phase of the walking/talking meetings for the Horowhenua case study. Key kaitiaki from Muaūpoko, Raukawa ki te Tonga and other affiliates are working with key specialists to complete the assessment of environmental issues facing the coast from Waitohu to Hokio Streams. An action plan, with accompanying restoration projects will activate solutions to overcome decline.

89 ibid.

Sourced from S. M. Smith PhD thesis and FRST report on experiences of Te Hakari project.

90 ibid,

Three hikoi opportunities have been completed, starting with the successful first hikoi on 12-14 November 2010 walking from Waitohu to Ōhau River, followed by another to complete the stretch to Hokio on 19-20 February. The student hikoi took place on 12-13 March 2011. The hikoi methodology is highly recommended as all active participants and kaitiaki get an opportunity to talk about their relationships to place, especially when talking about past interactions with mahinga mataitai (food gathering areas) when on food gathering excursions as children to young adults or as active environmentalists working to protect ecological significance. A range of local narratives have also been shared with the wider research team so that they understand the intricacies and complexities of spiritual and cultural Māori relationships to whenua and resources.

An amended extract from the picture book explains the objectives of the hikoi.

> Local kaumatua Uncle 'Rowdy' Akuhata blessed the walking/talking research meeting with a protective karakia. The MTM Research Management Group, kaitiaki and guardians then learnt first hand of the wetland, stream and dune restoration work underway with the Waitohu Stream, Wetland and Dunes Care group, where rare biodiversity is being propagated in, and planted from, their dune nursery into Waitohu dunes systems and adjacent wetland.
>
> The Group then walked onto Waiorongomai stream and heard about ancestral relationships to the region. Te Waari Carkeek also offered childhood recollections of seasonal, summer harvests, the drying of shellfish and fish at a papa kaainga by the Waiorongomai stream. The Group then assessed ecological decline issues, land use and water quality issues for the stream, Lakes Waiorongomai and Kahuwera. They camped behind the pines for the night.
>
> Next day the Group walked to the Waikawa Beach settlement, past Strathnaver Drive dune subdivision and noted contradictory notions of coastal environmental care and issues arising for future sustainability. A comprehensive archaeo-seismological assessment of the coastline was muted and discussed. The group then stopped to enjoy lunch at the local park before proceeding through the expansive and outstanding Waikawa dune systems. They walked on to the Pekapeka Taratoa Ahuwhenua Trust sand blow region, which overlooks Te Hākari Dune Wetland Restoration project within Tahamata Incorporation. This wetland project is part of the same contiguous wetland system towards the Waikawa River that belongs to related Māori owners and other Māori Trust shareholders, who lease lands to the neighbouring Māori farming enterprise, Ransfield Incorporation. That night the Group camped at 658 SH1, Kuku for the evening and were treated to home-style cooking and comforts.
>
> On Sunday the remaining group walked to the Ōhau River. Due to recent rain, an unusually high tide and unsafe crossing they walked along the river to the Ōhau "loop" region within Tahamata Incorporation coastal farm. By early afternoon they recounted the highlights of this successful walking hui, before packing up their gear and heading to respective homes.

Opportunities with Landscape Architecture students to Harness Creative Potential to Drive Change in Landscape Planning and Design

Another important background to this research project has been the concern that whilst almost all the environmental laws in New Zealand include both natural and historic significance in their definitions, provisions within these laws for protecting historic or cultural places within landscape have proved weak compared to other countries. In particular, Māori cultural and spiritual values in landscape have often been over ridden, with incentives for protection almost entirely lacking.[91] While Iwi and Hapū representatives in tribal areas may be connected to ancestral lands with close links to the landscapes and resources around them, their memories and

91 New Zealand Historic Places Trust /Pouhere Taonga, 2003, *Heritage Landscapes Think Tank: Report On Proceedings*, Think Tank held at the Museum of New Zealand/Te Papa Tongarewa, Cable Street, 7 April 2003, Wellington, 19.

associations within such areas are in danger of evaporating as the population ages, and as stories, memories and associations are not passed on.

Iwi and Hapū of the region, have become disassociated from cultural significance within landscapes for a variety of reasons – the legacy of colonial regimes, alienation of lands, migrations, reinterpreted histories, or other disturbances that occur when ancestral landscapes are appropriated for development. In recent years, conversely and alarmingly are archaeology consultancies who operate on behalf of developers. Their efforts have all contributed to site destruction of significant sites and regions in coastal areas south of Ōtaki and in Waikawa Dune areas in Manakau. Territorial authorities' inaction in dealing better with issues[92] facing Iwi and Hapū also compounds the difficulties that face contemporary kaitiaki, when attempting to protect what remains of cultural significance in landscape. Kaitiaki today navigate considerable complexity in the resource management process to maintain or restore cultural and spiritual values in landscape. Only where these attributes are recognized, reconciled with, and respected can they be protected. Our project recognises the multiple pressures facing the case study region. We aim to drive change towards best practice, policy and ultimately, legislation. As well as accessing surveys and downloading relevant information, the project has also contributed to a reference file of high-definition aerial photos of the case study of interest.

There are important drivers of ecosystem change that will increase in the 21st century. Climate change and excessive nutrient loadings will become more severe[93] and this has been well noted more recently, with the Manawatu River Leaders Accord and Action Plan. More localised extremes of climate change for the south-west coastal region of Kapiti to Horowhenua are predicted as well as wide-ranging meteorological hazards listed as: threats from frequent heavy rainfall and associated floods; sea level rises increasing the impact of high tides and storm adding to coastal erosion; aquifers near the coastline vulnerable to saltwater intrusion from flooding and changes in temperature and rainfall causing problems for pest-eradication programmes.[94]

Climate change scenarios, the nitrification of water from intensified agricultural activities, and proposed increase in localised coastal subdivisions combine to create complex realities for kaitiaki. In the coastal case study, Iwi and Hapū, public, local and regional government support is tantamount for preserving contiguous coastal dune wetland systems, and a dynamic coastline as significant cultural landscape. With this in mind, a series of sea level rise maps based on the latest data from many entities were created for the Kuku/Ōhau coastline to tackle future scenarios.

In recent years, the actions of local councils and developers in the Horowhenua coastal region have alarmed kaitaiki. Their actions have catalysed Iwi and Hapū to create projects that draw more minds together to collate, map, record and protect intricate and interrelated layers of bio-cultural diversity and cultural significance in landscape – and create new alternative opportunities, quickly. If authorities really respected Iwi and Hapū to lead in their regions (with beneficial outcomes for the wider community) then agencies *should* devolve more environmental management functions to them. However to date, no local council has undertaken a transfer of powers to tangata or mana whenua under RMA Section 33, adding to a lack of progress in realising local Māori aspirations. If local councils question capacity and skills or encounter difficulty in ranking responsibility for Iwi and Hapū, then practical arrangements are harder to realise. By developing partnerships any perceived

92 Ibid, 5.

93 Millennium Ecosystem Assessment Core Writing Team, 2005, *Millennium Ecosystem Assessment Synthesis Report*, Pre-publication Final Draft Approved by MA Board on March 23, 2005, United Nations Environment Programme, Millennium Ecosystem Assessment Secretariat, World Resources Institute, Washington, DC.17.

94 National Institute of Water and Atmospheric Research, 2005, *Climate Change flyer*, NIWA: Wellington.

deficiencies in capacity and responsibility can be readily overcome.[95] However, local or regional authorities differ in standards and consistency of approach when addressing their statutory obligations over Māori landscape issues. Protection of significant sites is often non-prioritised[96] with destruction, loss and modification of cultural importance continuing at alarming rates.[97] The MTM research project has sought to find solutions to the ongoing lack of national and local direction for more robust natural and cultural landscape protection mechanisms in different regions, and to acknowledges the challenges that face coastlines.

In March 2011, the MTM research leader and team implemented a relationship between the School of Architecture and Design, Victoria University and the MTM research project. This came out of conversations that started in 2008 with Penny Allen, Associate Professor in Landscape Architecture at Victoria University, Megan Wraight, Director of Wraight Associates, Wellington and Research Leader Māori of MTM Horowhenua case study.

During the first semester the MTM research team and key kaitiaki endusers assisted in offering lectures, expertise and support to the course and students. The LAND 411 paper has wanted to increase Māori input and knowledge to enhance the students understanding of Māori cultural and spiritual relationships to whenua and natural resources for sometime. For the MTM project, ongoing relationships would look for ways to encourage Māori students to take up the course. As described by the course, Landscape Architecture is:

> "inevitably a physical manifestation of ideas and beliefs held by the people that make them. Ideas and beliefs are contained within materials, processes, shapes, spaces, circulation paths, adjacencies and detail. Abstract ideas are embedded in landscape architecture because their physical attributes are the result of decisions made about the intention of the design; who will use it; how those users are expected to relate to each other and their environment; the relationship between built form and landscape; the relationship to site, and so on, and those decisions are inevitably based on values. In the case of most landscape architecture, these abstract ideas are reflected by expedient use of form, material and planning techniques. The best landscape architects are conscious of these ideas and use them to strengthen the work itself, and its environmental and cultural significance. This course is therefore, as important as the need for any civilisation to produce significant landscape architecture, however large or small: that critiques, develops, inspires, and challenges that civilisation, or a small part of it, to be everything it can be."[98]

The aim of the LAND 411 course is to:

- Develop an understanding, through design, of current ecological, cultural and social issues in a local context and the way these issues could be mitigated or remediated
- Encourage students to understand how and why they design and inspire the development of new forms and methods of practice that will establish a solid foundation for the design masters programme of study
- Create an opportunity for students to understand and work with Māori values, and interpret solutions that cross cultural barriers.

The course learning objectives are, that students should be able to:

- Develop a discipline of reflective design practice through the interactive processes of speculation, testing and reflection

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95 Ronda Cooper & Rachael Brooking, 2002, 'Ways Through complexities' in Kawharu, M. (ed.) *Whenua: Managing Our Resources*, Reed Publishing Ltd books: Auckland, 97.

96 Cabinet Agreements, *Review of Protection Mechanism: Protection of Sites of Significance to Mäori (Wahi Tapu)*, Reference CAB (96) M 8/15.

97 Sourced from *Ahi Kaa Roa: Mapping Cultural Landscape* report to FRST in 2008.

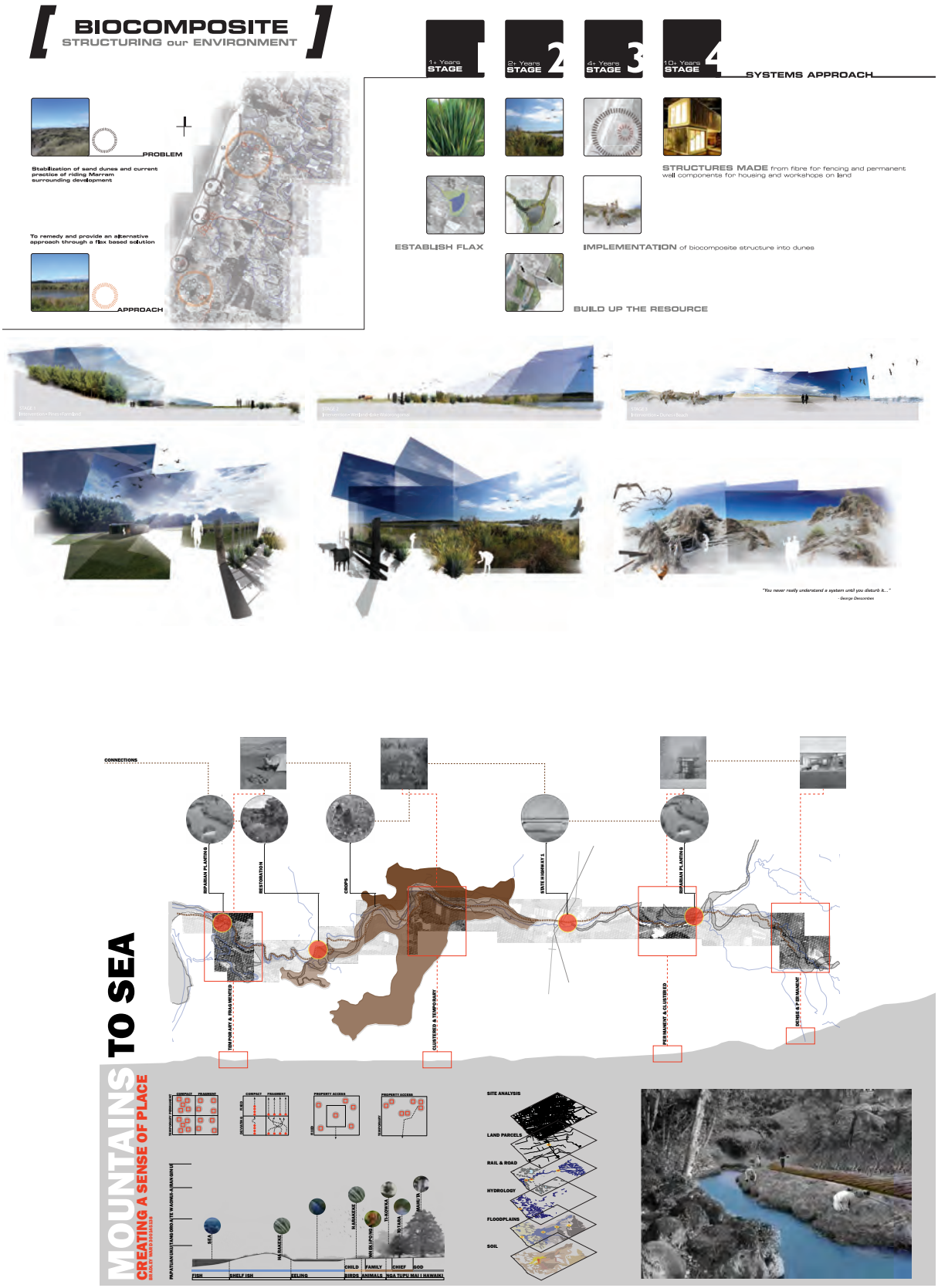
98 Sourced from Land 411 paper outline.

- Explore, through design and rigorous testing a theoretical position, in relation to indigenous culture and Tangata Whenua narratives, open systems theory and coastal settlements
- Synthesise these and other influences to develop a strong backbone or idea that will support your design work through all stages (sketch design to design development) and at all scales (1:1000 to 1:10)
- Expand upon and rigorously test this core idea to generate an appropriately sited coastal settlement with associated land uses that will allow the local Iwi and community to live and work in a sustainable way
- Develop part of a conceptual design proposition to a refined degree of detailed resolution
- Present innovative verbal, written and visual work of a professional quality to a range of stakeholders.

The potential of kaitiaki Māori contributing knowledge about place (within tikanga guidelines) and working with landscape architecture students and their course, creates more positive activities that can enhance environmental changes for the coastline. Our researchers knows from experience that when kaumātua inform us of their or their elders' encounters with local taniwha or spiritual guardians in landscape, they highlight a value system based on sustainable resource use and protection of place, in the belief that spiritual entities within specific areas and dialogue around them, guide their practice. Kaumātua were taught to respect resources within the natural environment. Such reciprocated respect for what sustained them as part of the collective, are fundamental Māori values for forming principles and guiding philosophies for culturally based sustainable management strategies, and for underpinning such place-based learning endeavors as arranged with Victoria University.

As mentioned earlier, an holistic approach to research and projects should consider a whole-of-person and a whole-of-system theory of knowing. On Thursday 2 June, 2011 the students presented their final projects to members of the kaitiaki enduser group and lecturing staff at Victoria University. The students had been encouraged to seek human interdependencies and interrelationships to the material, natural, spiritual, and cultural elements of landscapes. They produced inspiring opportunities founded on the dynamic movement that takes place between these elements.[99]

99 A more comprehensive overview of the ten best projects shall be exhibited with students' presentations taking place at Tukorehe Marae on weekend of 30-31 July 2011.



Figures 8.6: Examples of Draft Summary of Project Posters by David Sullivan and Bradley Ward, May 2011.

9. FISH AND SHELL FISH SPECIES (MARINE AND FRESH WATER)

Although some species such as hapūku and paua are not caught or gathered within the case study area, it was common practise of tangata whenua from these shores, to paddle out to these grounds and rocks just off Kapiti Island, and barter and trade with the relations down the coast.[100]

Table 9.1: Shell Fish Species

SHELLFISH		
Tohemanga (medium-sized bivalve) Toheroa (large sized bivalve)	Tuangi (cockle)	Tuatua (cockle)
Pipi (cockle)	Whetiko/Titiko/Pupu (perIwi andnkles)	Tipitipi
Paua (abalone)	Pipi awa (cockle)	Pupu (periwinkle)
Peraro (freshwater oyster/bivalve mollusc) *Angulus gaimard*i	Kakahi (fresh water mussel)	Kaikaikaroro (bivalve mollusc) *Prototothaca crassicosta, Spisula aequilateralis*
Kokata (fresh water pipi)		

Table 9.2: Marine Fish

MARINE FISH			
Kahawai	Maroro (flying fish)	Wheke (squid)	Manga (barracouta)
Hapūku (groper)	Para (frost fish)	Mango/mako (sharks)	Korowhawha (anchovy)
Rawara (red cod)	Hokarari (ling)	Tamure (snapper)	Kuparu (john dory)
Tamatama	Patiki (flounder)	Kumukumu (red gurnard)	Haku (kingfish)
Moki	Kokiri (leather jacket)	Ngoiro (conger eel)	Takeke (garfish)
Kanae (grey mullet)	Araara (trevally)	Mohimohi (pilchard)	Whai (sting ray)
Aua (yellow-eyed mullet)	Papaka (crab)	Taumaka	Patiki rori (sole)
Tarakihi	Tuere (blind eel)	Tohora (southern right whale)	Ngaore
Kupae (sprat)	Tikiheemi (common smelt)	Hoki (whiptail)	

Ngāti Raukawa Trustees also reference the following categories of eel species found in the area between Waimeha stream (in Waikanae) and Hokio stream as: [101]

100 *Submission Report to Māori Members of the Joint Working Party on Māori Fisheries*, presented by Ngä Kaitiaki O Raukawa, Ngäti Toarangatira, Ati Awa ki Waikanae, Ki te Au o te Tonga, 2002, 90.

101 ibid, 90

Table 9.3: Tuna (Eel) Species

TUNA (EEL) SPECIES	
Hao	Mud eel, large flesh eel, dark brown in colour.
Pango	Very similar to Hao except it is dark black colour
Puhi	Slim eel with tapering head and body. Excellent eating
Papaka	Yellowish coloured eel found in the Waikawa River
Paraharahara	Short stock eel
Pehipehi	A yellow bellied eel

The Hokio stream, Lake Horowhenua (Waipunahau), Lake Papaitonga (Waiwiri), Waiwiri stream, Ōhau estuary and 'loop' system, Te Hākari Dune Wetland; Waikawa River and estuary, Manga Pirau, Lakes Kahuwera and Waiorongomai were some of the well known areas for their abundance of tuna (eel); patiki (flounder); inanga (adult whitebait, Galaxias maculatus); ngaore (immature whitebait) and kakahi (freshwater mussel, Hydridella menziesii).[102]

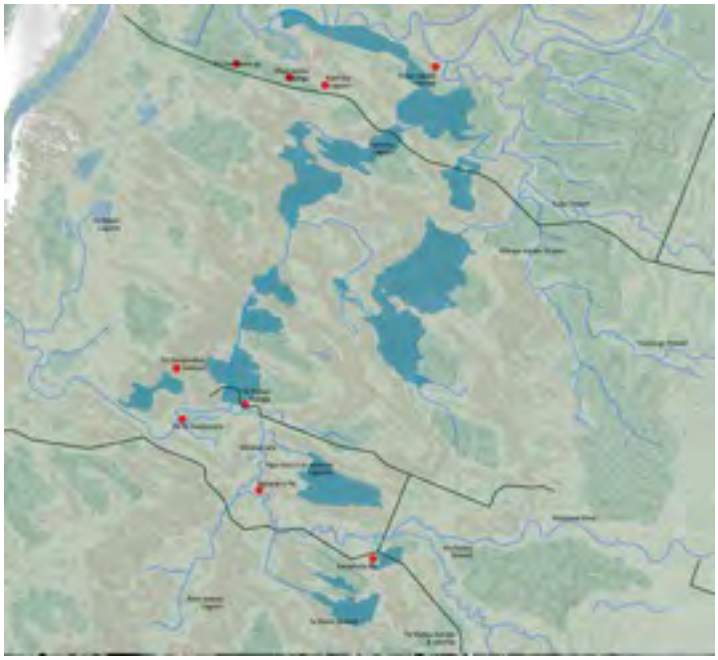


Figure 9.1: Bridget Law, Landscape Architecture student from Victoria University compiled a map of key eeling areas known to local Māori between Kuku Beach Road and Waikawa Beach Road.

Te Waari Carkeek, key representative on Kaitiaki Enduser group notes in a report on Inanga (whitebait) the different species and their common Māori name, "the fish migrating from the sea to rivers were called inanga, at which time the sub-species were identical in appearance. On attaining adult form Māori were able to distinguish the various subgroups and identify them. The first group were the Matua Iwi and (*Galaxias maculatus*), the second were Koara (*Galaxias brevipinnis*) and the third group Kokopu of which the three adult appearances are similar except for slight pigmentation changes (*Galaxias fasciatus, argenteus, and postvectis*)."[103]

102 Manawatu-Wanganui (N.Z.) Regional Council et al, 1998, *Lake Horowhenua and Hokio Stream Catchment Management Strategy*, Manawatu-Wanganui Regional Council, Palmerston North, 18

103 *Submission Report to Māori Members of the Joint Working Party on Māori Fisheries*, 2002, Ngä Kaitiaki O Raukawa, Ngäti Toarangatira, Ati Awa ki Waikanae, Ki te Au o te Tonga.

10. BIRD SPECIES ASSOCIATED WITH COASTAL DUNES, WETLANDS, SHRUB LANDS AND POTENTIAL SPECIES

Figure 10. 1: (Above) Rare matuku or Australasian bittern sited at Te Hākari Dune Wetland, 8 October 2010

Table 10.1: Bird Species

BIRD SPECIES		
Coastal Dunes torea, Variable oystercatcher [*Haematopus unicolor*]	torea, South island Pied oystercatcher [*Haematopus ostralegus*]	Spur-winged Plover [*Vanellus miles novaehollandiae*]
tuturiwhatu, banded Dottere, [*charadrius bicinctus*]	ngutu parore, wrybill [*Anarhynchus frontalis*]	Asiatic whimbrel [*Numenius phaeopus*]
kuaka, eastern bar-tailed godwit [*Limosa lapponica*]	greenshank [*Tringa nebularia*]	Poaka, Pied Stilt [*Himantopus himantopus*]
karoro, Southern blackbacked gull [*Larus dominicanus*]	taranui, caspian tern [*Sterna. Caspia*]	kahawai, white fronted tern [*Sterna. Striata*]
Wetlands weweia, New Zealand Dabchick [*Poliocephalus rufopectus*]	kawau, black Shag [*Phalocrocorax carbo*]	kawaupaka, little Shag [*Phalacrocorax sulcirostris*]
white-faced heron [*Ardea novaehollandiae*]	kōtuku, white Heron [*Egretta alba modesta*]	little egret [*Egretta garzetta immaculate*

BIRD SPECIES		
Matuku, Australian brown bittern [*Botaurus stellaris poiciloptilus*]	kōtuku Ngutu-Papa, royal Spoonbill [*Platalea leucorodia regia*]	black swan [*Cygnus atratus*]
Canada goose, [*Branta canadensis*]	putangitangi, Paradise Shelduck [*Tadorna variegate*]	Mallard duck [*Anas platyrhynchos*]
Grey duck [*Anas superciliosa*]	tete, grey teal [*Anas gracilis*]	kuruwhengi, New Zealand Shoveller [*Anas rhynchotis variegate*]
papamango, New Zealand Scaup [*Aythya novaeseelandiae*]	kahu, Harrier [*Circus approximans*]	californian quail [*Callipepla californica*]
pheasant [*Phasianus colchicus*]	puweto, Spotless crake [*Porzana tabuensis*]	Marsh crake [*Porzana pusilla*]
Australian coot [*Fulica atra australis*]	Pukeko [*Porphyrio porphyrio*]	
Shrub lands pipiwharauroa, Shining cuckoo [*Chrysococcyx lucidus lucidus*]	ruru, Morepork [*Ninox novaeseelandiae*]	kōtare, New Zealand kingfisher [*Halcyon sancta*]
Skylark [*Alauda arvenis*]	welcome Swallow, [*Hirundo tahitica neoxena*]	piwakawaka, fantail
matata, grey warbler [*Bowdleria punctata*]	song thrush, [*Turdus philomelos*]	black bird
hedge sparrow, [*Prunella modularis*]	pihoihoi, New Zealand pipit [*Anthus novaeseelandiae*]	tauhou, Silvereye [*Zosterops lateralis*]
greenfinch [*Chloris chloris*]	goldfinch [*Carduelis cardeulis*]	redpol
chaffinch [*Fringilla coelebs*]	yellowhammer [*Emberiza citronella*]	cirl bunting [*Emberiza cirlus*]
House Sparrow [*Passer domesticus*]	Starling [*Sturnus vulgaris*]	white backed Magpie [*Gymnorphina tibicen hypoleuca*]
Potential Species kereru, New Zealand Pigeon [*Hemiphaga novaeseelandiae*]	Matata, grey warbler [*Bowdleria punctata*]	tui, New Zealand honeyeater
korimako, bellbird [*Anthornis melanura*]		

11. FINAL COMMENTS

Since starting to write this report considerable progress has been made to collate relevant literature and reports for the central online repository, and to well identify the case studies. Particular highlights of the research activity have been the success of the hikoi methodology; the coming together of neighbouring Iwi and Hapū groups; the Waiorongomai project getting going; PhD students submitting topic and applying for scholarships; kaitiaki undertaking project management work; taking Horowhenua District Council, councillors and planning teams on a special bus trip of the case study; the collaborative made active between Victoria University and the landscape architecture students, and the regularised monitoring underway with Forest and Bird. All these fruitful actions have created more opportunities for collaboration and more tasks on the ground; have raised capacity in research methodologies, approaches and technologies for kaitiaki; have provided Iwi and Hapū groups with potential visualised projects that are plausible and achievable, and sparked new ways of Iwi and Hapū envisioning more sustainable ways of enhancing and managing the coastline between Hokio and Waitohu.

There is a definite need for a comprehensive shell fish and biological plant survey of the case study region to create an index of decline in species, which the teams hope to delegate to those of the Kaitiaki Enduser advisory group with expertise and ability to return information to the project. Similarly the MTM team have only just begun conversations with Toheroa shellfish specialists. Opportunities for locating seeding stock and working with knowledgeable kaumātua on the rangatira of shell fish species in the region, are getting underway.

For the research project so far the MTM team have dedicated considerable time and effort to launch the activities required to secure answers to the central research question where "how can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to Iwi and Hapū identity, survival and welfare in the case study regions?" Each active participant has this in mind to ensure the teams actualise this for the health and well-being of future generations.

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12. APPENDICES

APPENDIX 1:

The following tables are included to provide an earlier, historical context for water quality decline and the presence of weeds and invasive species.

Results of the 1949/1950 Horowhenua Lake Surveys.

Table 12.1: Percentage of oxygen saturation

Lake	Depth 0m	Depth 2m	Depth 4m	Depth 6m	Depth 8m	Depth 10m
Horowhenua	118	65				
Papaitonga	93	63				
Kopureherehere	110	102	100	29	25	13
Waitawa	150	10				

Table 12.2: Physical and chemical 1950

Lake	Seechi (m)	Silica (ppm)	Phosphate (ppm)	pH
Kopureherehere	1.5	2.0	Trace	6.2

Table 12.3: Physical and chemical 1949

Lake	Seechi (m)	Silica (ppm)	Phosphate (ppm)	pH
Horowhenua	0.75	10.0	0.015	8.4+
Papaitonga	0.75	5.0	0.03	8.4+
Kopureherehere	0.75	-	-	-
Waitawa	0.8	4.0	0.025	7.9

Table 12.4: Indigenous and Introduced Fish Captured

Lake	Long finned eel	Short finned eel	Galaxias sp.	Retropinna sp.	Gobiomorphus sp.	Trout (intro)	Carp (intro)
Horowhenua	L	S	-	-	P	R	P
Papaitonga	S	L	-	-	P	-	P
Kopurehere-here	S	S	-	-	P	R	-
Waitawa	L	D	P	P	P	-	-

KEY for eels: S = 1 or 2 caught, L = 3-10 caught, D = above 10 caught.

KEY for fish: P = present, R = reported but not verified.

Table 12.5: Waterfowl presence

Lake	Mallard Duck	Black Shag	Pukeko
Kopureherehere	presence	>25 seen	observed
Waitawa	presence	>25 seen	

Results of the 1976/1977 Horowhenua/Kapiti Lake Surveys.

Table 12.1.1 Lake Conditions

Lake	Depth at site	Description	Observations
Papaitonga	0.8m	Very shallow for the area.	Float plants, *Azolla rubra*.
Waiorongomai	0.8m	Very small and shallow lake.	The water in the lake is a very peat red-brown colour.
Kopureherehere	11.8m	Much deeper.	Algae in the surface water *Anabaena*. Frog porridge (lemma sp) floating on lake.
Waitawa	7m	Moderate depth for coastal lake.	Small amount of blue green algae *microcystis*.

Table 12.1.2 Chemical water results

	BOD mg/l	pH	S.S mg/l	NH3-N mg/l	NO3-N mg/l	Total P mg/l	D.O mg/l	Temp oC	Seechi disc M
Papaitonga 21/10/76	8.5	9.4	13.4	0.08	0.04	0.38	13.5	16	0.75
Papaitonga 19/01/77	4.9	9	12.2	0.11	0.07	0.1	6.8	17.2	0.7
Papaitonga 18/05/77	13.8	7.6	32.8	0.08	0.03	0.31	9.9	5.8	0.35
Waiorongomai 21/10/76	7.4	7.95	29.0	0.13	0.07	0.8	10.8	20.5	0.3
Waiorongomai 19/01/10	5.5	8.25	15.6	0.15	0.07	0.19	8.3	16.9	0.7
Waiorongomai 18/05/77	5.2	7.45	73.1	0.35	0.07	0.51	11.8	7.1	0.15
Kopureherehere 21/10/76	1.9	7.4	3.3	0.31	0.11	0.21	6.1	11.8	2.16
Kopureherehere 19/01/77	1.7	7	1.3	0.35	0.25	0.5	4.3	14.7	1.4
Kopureherehere 18/05/77	1.7	7.1	4.7	0.35	0.07	0.51	10	8.8	1.65
Waitawa 21/10/76	8.1	8.3	17	0.13	0.1	0.33	4.8	13.4	0.45
Waitawa 19/01/77	7.0	7.49	10.2	0.25	<0.02	0.1	5.0	17	0.7
Waitawa 18/05/77	2.0	7.05	6.8	0.1	0.07	0.05	10.4	8.1	0.9

APPENDIX 2:

Bird Monitoring at Kuku Estuary 2010-2011.

The local group of Forest and Bird Society members monitor for birds first Wednesday of every month at the Kuku estuary and in Te Hakari Dune Wetland . They are a dedicated crew who assist the Manaaki Taha Moana Research project overall. Their bird monitoring group also includes the Waitohu Dune and Stream Care members as well. As members of the the Kaitiaki Enduser advisory group, they will help the project further by comprehensively assessing the natural plant life that exists within the case study region.

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Tide	High	High		High	High	High	
Weather (1 or 2)	Clear	Overcast	Overcast	Overcast	Overcast	Overcast	
	Breeze	Breeze		Breeze	Breeze	Breeze	
Time of Observation					11.00am	11.30am	11.20am
Species							
NZ Dabchick							
Australasian Gannet							
Black Shag			4	1	1		
Pied Shag							
Little Black Shag							
Little Shag				1	2		
White Heron					2		
White Faced Heron		3	2			2	2
Australasian Bittern							
Royal Spoonbill	5						
Black Swan	2						
Canada Goose							
Paradise Shelduck							
Mallard				52	35		
Duck					50-100	50+	50+
Grey Duck						1	1
Australasian Shoveller		2					
Grey Teal							
New Zealand Scaup							
Australasian Harrier	3				1		

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Pheasant							
Pukeko							
Pied Oystercatcher							
Variable Oyster-catcher	2	1	8	7	4		
Spur Winged Plover		7	6				
Pied Stilt	2	12 (1 imma-ture)	33	14	9	17	17
Banded Dotterel							
New Zealand Dot-terel							
Black Fronted Dot-terel							
Bar Tailed Godwit	23	26	30	15			
Black Backed Gull	numer-ous	numerous	numerous	numerous	numerous	100+	100+
Red Billed Gull					1		
Black Billed Gull							
Caspian Tern			3	2	4		
White Fronted Tern					15		
Rock Pigeon		1			1		
Barbary Dove							
Eastern Rosella							
Morepork							
Kingfisher						1	1
Welcome Swallow		56	40			10	10
Silvereye							
Grey Warbler							
Blackbird							
Song Thrush							
Dunnock							
Skylark							
NZ Pipit							

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Fantail							
Tui		1					
House Sparrow			1				
Chaffinch		1 (heard)	1 (heard)				
Goldfinch							
Green Finch	1						
Yellowhammer		2					
Starling		3	1			3	3
Magpie							
Unusual sightings:							
Shining cuckoo							

Bird Monitoring at Te Hākari Dune Wetland

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Tide	**High**	**High**		**High**	**High**		
Weather (1 or 2)	**Clear**	**Overcast**	**Overcast**	**Overcast**	**Overcast**		
Wind		**Breeze**		**Breeze**			
Time of Observation							**10.20am**
Species							
NZ Dabchick	1	4 (2 chicks)		2	1	1	
Australasian Gannet							
Black Shag	1	1		1	1		1
Pied Shag							
Little Black Shag							
Little Shag						1	1 (pied phase)
White Heron							
White Faced Heron			2			1	
Australasian Bittern							
Royal Spoonbill							
Black Swan	1		1	1			

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Canada Goose	5	47 (4 families)	24	3			3
Paradise Shelduck		2			2		2
Mallard	21	29	13	8	11	18	20-50
Grey Duck							
Australasian Shoveller	1				2		
Grey Teal	2		4		2		
New Zealand Scaup	2						
Australasian Harrier	2	2	1	2	2		
Pheasant	1 (heard)	1 (heard)					
Pukeko		1	2	1	1		
Pied Oystercatcher							
Variable Oystercatcher							
Spur Winged Plover			2		1		3
Pied Stilt				2			
Banded Dotterel							
New Zealand Dotterel							
Black Fronted Dotterel					Wetland time of observation		
Bar Tailed Godwit	1						
Black Backed Gull			5	2	1	6	
Red Billed Gull							
Black Billed Gull		2					
Caspian Tern							1
White Fronted Tern	2						
Rock Pigeon			2			22	7
Barbary Dove		3		2	3		
Eastern Rosella							
Morepork							
Kingfisher	2			1			1

DATE	3/11/10	2/12/10	5/01/11	2/02/11	2/03/11	6/04/11	4/05/11
Welcome Swallow		3	3	13	1	3	
Silvereye	3?			4		4	
Grey Warbler	1 (heard)				heard		1 heard
Blackbird			1		heard		
Song Thrush							
Dunnock	1						
Skylark		3	2	2			
NZ Pipit	2						
Fantail		1	1	5	1 heard. 2 seen		
Tui		1	1	1			1
House Sparrow	1 (heard)	4		20? Flock			
Chaffinch		2		heard			2
Goldfinch	1		4		1		
Green Finch	1	10	2				2
Yellowhammer		2	2	2	1		11
Starling	2	4	19				7
Magpie		1	2	4	4		5
Unusual sightings:							
Shining cuckoo		1 (heard)					
Unidentified							1

APPENDIX 3:

Recommendations for the future monitoring and application of MST technology in Houhora Harbour Oyster fishery, Northland (from McCoubrey et al. 2009).

To better understand the mechanisms leading to high levels of faecal bacteria in oyster harvesting areas, we recommend continuation of faecal indicating bacteria (FIB) monitoring with integration of MST markers to assist in identifying the source(s) of the contamination. A number of approaches exist for microbial source tracking (e.g. faecal sterols, optical brighteners, antibiotic resistance profiling etc.); however, no method has proven more promising for future research directions than library-independent methods based on polymerase chain reaction (PCR) (Stapleton et al. 2007). There are a number of validated markers currently available that can identify presence/absence of human and ruminant faecal contamination and methods for quantifying the amount of marker present within samples also exist (e.g. real-time PCR, which provides an indication of the relative contribution of different sources in a contaminated sample). Markers for birds, including waterfowl, exist. However, one of them is not carried by a large portion of the swan/geese population (Devane et al. 2007) and others have not been validated in New Zealand. It would be advantageous to first assess the presence/absence of dominant sources in the catchment (e.g. ruminant) and sources that pose the greatest health risk (e.g. humans).