

HE TIROHANGA WHĀNUI:

An Overview of Ecosystems Undergoing Rehabilitation with
Manaaki Taha Moana Research Project and the Horowhenua Case Study



MTM Report No. 19
October 2014

HE TIROHANGA WHĀNUI :

An Overview of Ecosystems Undergoing Rehabilitation within Manaaki Taha Moana Research Project and the Horowhenua Case Study.

Dr Huhana Smith, Aroha Spinks and Moira Poutama.

Published by the Manaaki Taha Moana (MTM) Research Team
Funded by the Ministry for Business Innovation and Employment (MBIE)
Contract MAUX0907
Main Contract Holder: Massey University
www.mtm.ac.nz

Reviewed
by:



Jessica Kereama, Trustee,
Taiao Raukawa Environmental
Resource Unit

Approved
for release
by:



MTM Science Leader,
Professor Murray Patterson

Issue Date: October 2014

RECOMMENDED CITATION: Smith, H., Spinks, A. & Poutama, M., 2014, *HE TIROHANGA WHĀNUI : An Overview of Ecosystems undergoing Rehabilitation within Manaaki Taha Moana, Horowhenua Case Study*, Manaaki Taha Moana Research Project, Massey University: Palmerston North/Taiao Raukawa Environmental Resource Unit: Ōtaki. 92 pages

© COPYRIGHT: Apart from any fair dealing for the purpose of study, research, criticism, or review, as permitted under the Copyright Act, this publication must not be reproduced in whole or in part without the written permission of the Copyright Holder, who, unless other authorship is cited in the text or acknowledgements, is the commissioner of the report.

Cover image: Whanau from
Ngāti Tukorehe whitebaiting at mouth of Kuku Ōhau Estuary, August 2014.

MIHIMIHI

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 whakamarumarū 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 mairi, 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

© Manaaki Taha Moana Research Team

Published by the Manaaki Taha Moana Research Team
MAUX 0907 Contract Holder:
Massey University
Private Bag 11052
Palmerston North
New Zealand

Disclaimer

While the author(s), the MTM research team, and their respective organisations, have exercised all reasonable skill and care in researching and reporting this information, and in having it appropriately reviewed, neither the author(s), the research team, nor the institutions involved shall be liable for the opinions expressed, or the accuracy or completeness of the contents of this document. The author will not be liable in contract, tort, or otherwise howsoever, for any loss, damage or expense (whether direct, indirect or consequential) arising out of the provision for the information contained in the report or its use.

EXECUTIVE SUMMARY

Manaaki Taha Moana (MTM) is a six-year programme, running from 1 October 2009 to 30 September 2015, with research being conducted in two areas, namely Tauranga Moana region and Horowhenua coastline between Hōkio and Waitohu Streams, just north of Ōtaki Beach, on the southwest coast of Te Ika a Maui/North Island, Aotearoa New Zealand.

This programme of research activities has built upon previous research with Ngāti Raukawa ki te Tonga in the lower Te Ika a Maui / North Island through 'Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and Hapū' (MAUX0502), led by Massey University and Landcare Research/Manaaki Whenua. 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). A number of different organizations are contracted to deliver the research: Massey University's School of People, Environment and Planning provides integrative ecological economics and project management expertise, with Professor Murray Patterson being the MTM Science Leader (M.G.Patterson@massey.ac.nz); Manaaki te Awanui Trust in Tauranga, with Caine Taiapa as the Research Leader Māori for the Tauranga moana case study; Te Reo a Taiao, the Ngāti Raukawa environmental resource unit that trades as Taiao Raukawa, with Dr Huhana Smith as Research Leader Māori in the Horowhenua coastal case study; Cawthron Institute, based in Nelson, provide coastal and freshwater ecological expertise; and WakaDigital Ltd, based in Tauranga, provide information communication and technology expertise for both case studies.

The Horowhenua MTM research activities center on an area of interrelated Hapū (collective of multiple whanau groups), within a southwest coastal rohe (region) that was once extensive coastal forest, with streams, rivers, estuaries, a series of lakes, lagoons and dune wetlands that teemed with freshwater food and fibre resources and kaimoana (tidal and marine resources). The coastal, cultural landscape is bounded by the Tasman Sea and extends from the Hōkio Stream in the North, to the dynamic Waitohu Stream, wetland and estuary at Ōtaki Beach in the South. The case study includes awa and awa iti (rivers and streams), repo (wetlands), roto (dune lakes) and moana (seas and estuaries) within the coastal region.

This report focuses on the Horowhenua case study where six collaborative, action research projects are currently underway. To assist the research groups in developing these actions each team in the two distinct tribal areas, accessed technology such as data collation systems, system dynamic modeling and use of the Kapowai (dragonfly/drone camera) for taking aerial, visual overviews of key, interest areas within the case study area. Both research projects accessed western science to define decline issues facing ecosystems in each area. More importantly, each research group drew heavily on embedded knowledge of place from a Whanau, Hapū and Iwi perspective. Each team concentrated on taking practical action, not unlike how respective and interrelated ancestors rallied against social, cultural, spiritual change, dis-ease and disruption during 19th and 20th century colonization and assimilation periods. Therefore, any residual local knowledge that kaumātua retained about

indigenous biodiversity was re-edified to catalyze the action in projects and benefit future generations.¹



Figure 1: Cawthron Institute, Horizons Regional Council, Kaitiaki/White baiters and Nga Whenua Rahui staff coming together for assessing whitebait spawning areas on Ōhau River Loop. From left to right: Dave Taylor (Caw), Lucy Ferguson (HRC), Richard Anderson and Rangi Markua Heke (NWR), Kati Doehring (Caw), Janette Gregory, Anna Deverall (HRC), Yvonne Wilson Wehipeihana, Alesha Cooper (HRC) and Pat Seymour (Tahamata). (Photograph by Huhana Smith, 8 March 2014.)

The selected ecosystems and required activities around them are grounded by kaupapa Māori methodologies. Whilst customary narrative from a historical perspective and maintenance of ancestral relationships to whenua and awa are vital for ongoing cultural and spiritual survival, the projects were also activated within complex Māori lives experienced within contemporary Māori society. Therefore, Hapū kaitiaki respond to the decline of species and environmental health in their respective rohe, by devising activities that are meaningful and relevant for their local Māori communities. The range of support from different entities has also enabled the teams to evaluate and define preferred options that aim to return health to specific coastal ecosystems.

What follows is a series of key actions taken for a variety of selected coastal ecosystems. The report starts with Te Hākari dune wetland's series of projects and the range of holistic values restored to that region since 2002. The report then overviews the Waiwiri Stream from Lake Waiwiri/Papaitonga with:

- Microbial source tracking activities

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

- Freshwater and shellfish sampling along the stream length
- Poor water quality results at particular areas from Lake to sea
- Concerns for effluent contaminated shellfish gathered at the Waiwiri mouth.

The *Waiwiri Stream: Sources of Poor Water Quality and Impacts* (Allen *et.al* 2012) provides key details and wider, related concerns for shellfish health between Hōkio and Ōtaki. Initial actions in Waiwiri led to the more comprehensive shellfish survey, which clearly showed how poor water quality impacts on the tidal zone with effluent contaminated shellfish sourced from various sites after different rainfall conditions. The fuller report, *Kaimoana on beaches from Hōkio to Ōtaki, Horowhenua* (Newcombe *et.al* 2014), investigated land use changes and coastal land cover, which also highlighted associated impacts on freshwater input to beaches. There are numerous factors that possibly affect toheroa and other shellfish populations in this case study region. The MTM team characterized the current land use and changes in key landscape features (primarily wetlands) from historical information. They then sought relationships between land cover and current shellfish populations.²

Further results in the *Faecal Contamination of Shellfish on the Horowhenua coast* report (Newcombe *et.al* 2014), not only highlighted how bivalve shellfish such as toheroa, tuatua, and pipi are important kaimoana species for Māori, but also that their depletion in quantity and degradation in quality is of immense concern to them. Degradation can be caused by toxins (*e.g.* heavy metals) and / or biological (*e.g.* faecal bacteria) contamination, either of which can make kaimoana unfit for human consumption. Additionally as highlighted in that report,

Faecal contamination of kaimoana is of concern to Māori both as a health issue — because of the presence of pathogens — and because contact of faecal material with food sources is offensive. Sources of faecal contamination in the coastal marine environment include human sewerage / wastewater infrastructure, farmed animals, and wild animals such as possums and birds. Faecal contamination of coastal waters is higher after rainfall, when effluent deposited on the land during dry periods, is washed into rivers and the sea.³

The Ōhau ‘Loop’ project is based on two phases of activities. The *Ōhau Loop Phase 1: Existing Status for Improvement* (Allen *et. al* 2011) assessed the existing ecological state of the Loop before any rehabilitation measures could be carried out and provided a list of recommendations on ecological rehabilitation, including further research options for the Loop and adjacent ecosystems, such as the coastal foreshore, the estuary and nearby wetlands. In 2014, additional IBook funding feedback reports to Te Ohu Kai Moana and Ministry for Primary Industries documented Phase 2, which included:

2 Emma Newcombe, Huhana Smith, Moira Poutama, Craig Allen, Javier Atalah, Aroha Spinks, Joanne Ellis, Jim Sinner, 2014. *Kaimoana on beaches from Hōkio to Ōtaki, Horowhenua*. Manaaki Taha Moana Research Report No. 22.

3 Emma Newcombe, Huhana Smith, Moira Poutama, Dana Clark, Aroha Spinks, Joanne Ellis, Jim Sinner, 2014. *Faecal contamination of shellfish on the Horowhenua coast*. Prepared for Taiao Raukawa and Manaaki Taha Moana. Manaaki Taha Moana Research Report No. 23, p 1.

- Searching for inanga egg-laying habitat and quantifying existing inanga egg abundance
- Assessing potential measures to improve existing spawning habitat
- Installing artificial inanga egg-laying habitat in straw bales along the lower reaches of the Ōhau 'Loop'.

This taonga species project relied on local Māori inter-generational knowledge of place and science coming together respectfully and meaningfully, to determine solutions. Improving spawning habitat along the lower reaches of the 'Loop' is expected to make a significant contribution to restoring the whitebait freshwater fishery.

An overview of ideas towards healing or denitrifying waterways using the creative potential of a renewed Harakeke industry is highlighted, whereby this pilot scheme on farms aims to produce muka fibre (New Zealand flax fibre) for fine fabric.

The key objectives of the Kuku Ōhau Estuary frontage re-vegetation project grew as a related project to the Ōhau River Phase 1 results. It gained funding support from He Tini Awa Fund (managed by Horizons Regional Council) and the Department of Conservation. The estuary site was identified as necessary for environmental health and protection of coastal, taonga species within the MTM case study.

Finally, the report offers ideas towards a unique way of disseminating knowledge findings, through the *Kei Uta: Compelling Alternatives* idea for a large-scale, multi disciplinary exhibition, is an idea based on the MTM research findings and a contemporary movement to actively build resilience between cities and their hinterlands.

Table of Contents

	EXECUTIVE SUMMARY	7
	TABLE OF CONTENTS	11
	LIST OF FIGURES	13
	LIST OF TABLES	15
1.	INTRODUCTION	16
2.	TE HĀKARI DUNE WETLAND AND RELATED DUNE WETLANDS TO WAIKAWA RIVER	18
2.1	Aspects of ownership	18
2.2	Dependence on wetlands and coastal estuaries as food and sources of material	20
2.3	Historic control	23
2.4	Loss of natural integrity	24
2.5	Cultural, spiritual identity and tikanga	29
2.6	The capacity for correction	33
2.7	Specific research objectives of MTM for Horowhenua case study	35
2.8	Concerns for local environmental health	38
2.9	Local, Regional Councils and water health	39
2.10	Subdivisions and access ways on coastlines	42
2.11	Associative landscapes	42
2.12	Methods of Hīkoi–Wānanga	43
3.	ACTIONS FOR EACH MTM PROJECT WITHIN THE HOROWHENUA CASE STUDY	44
3.1	Waiwiri Stream, from Lake Waiwiri (Papaitonga) to sea	44
3.2	Microbial Source Tracking (MST)	46
3.3	Press release for Waiwiri report, October 2012	48
3.4	Taking action for listed recommendations	50
3.5	Waiwiri stream mouth	51
3.6	Collaborating with Department of Conservation for buffering Lake Waiwiri and Stream	53
3.7	Collaborating with School of Architecture and Design, Victoria University, Wellington	54
3.8	Our Methodologies	55
4.	THE RATIONALE FOR THE SHELLFISH SURVEY FROM HŌKIO TO WAITOHU STREAMS	57
4.1	The Sampling Methodology	58
4.2	Success of Shellfish Survey, April to May 2014	60
4.3	Results of Shellfish Survey	61
4.4	Proposed Solutions with New Research	62

5.	ŌHAU RIVER ‘LOOP’, FOR INANGA (WHITEBAIT) IN THE RELATED COASTAL ENVIRONMENT	64
5.1	Programme of activities for Inanga/Whitebait	66
5.2	Maintaining, enhancing the dialogue and raising capacity	69
6.	THE RENEWED HARAKEKE INDUSTRY	70
6.1	Soil analysis from Horizons Regional Council	72
7.	HAPAITIA TE NGUTU AWA O KUKU ŌHAU/ REVITALISING THE KUKU ŌHAU ESTUARY FRONTAGE.	80
7.1	Rationale for Kuku Ōhau Estuary frontage area	80
8.	LAKE WAIORONGOMAI REHABILITATION	83
	Ngā Hapū of Ōtaki will report on the extent of this project when Aroha Spink’s completes her PhD thesis.	
9.	KEI UTA: COMPELLING ALTERNATIVES FOR FRESHWATER WITHIN HINTERLANDS: A MAJOR EXHIBITION?	83
10.	FINAL COMMENTS	87
	REFERENCES	90

List of Figures

Figure 1: Cawthron Institute, Horizons Regional Council, Kaitiaki/White baiters and Nga Whenua Rahui staff coming together for assessing whitebait spawning areas on Ōhau River Loop. From left to right: Dave Taylor (Caw), Lucy Ferguson (HRC), Richard Anderson and Rangi Markua Heke (NWR), Kati Doebling (Caw), Janette Gregory, Anna Deverall (HRC), Yvonne Wilson Wehipeihana, Alesha Cooper (HRC) and Pat Seymour (Tahamata).

8

Figure 2.1.1: Te Hākari Dune Wetland in larger cultural landscape (above pine forest) adjacent to dunes and Ōhau Estuary, 2009.

20

Figure 2.2.1: Important ahu otaota (middens) within coastal landscape on northern side of Ōhau River, on land that is currently not owned by Iwi or Hapū.

21

Figure 2.2.2: Wetland in 2002 (left) and after raising water levels from 2003-2005 (right).

22

Figure 2.3.1: Pekapeka Taratoa Ahu Whenua Trust lands, where Ōhau and Waikawa Rivers shared a harbour or mouth.

23

Figure 2.4.1: Pre 1840s Wetlands in region. Map sourced from *Ahi Kaa Roa: Mapping Cultural Landscape Report* for Te Iwi o Ngāti Tukorehe Trust, 2009.

26

Figure 2.4.2: Waterways in Muhunua, Kuku to Waikawa region, including dune lakes, wetlands and stream confluences. Sourced from *Ahi Kaa Roa: Mapping Cultural Landscape Report* for Te Iwi o Ngāti Tukorehe Trust, 2009.

27

Figures 2.4.3: Processes of transformation from paddock to wetland forest from December 2002 to August 2011.

28

Figure 2.5.1: Wīwī in wet delta region surrounding Te Hākari Stream.

31

Figure 2.5.2: Rare and endangered Matuku feeding on whitebait in reeds at Te Hākari Dune Wetland.

32

Figure 2.7.1 Dynamic Kuku Ōhau estuary coastline.

36

Figure 2.7.2. An historic perspective of the case study region that shows major waterways between mountains to sea, from north of Hōkio Stream to Waitohu Stream, just north of Ōtaki.

37

Figure 2.9.1: Supportive Horowhenua District Council officials from the Planning team, Conservation Corp volunteers (organized through Landcare New Zealand) and kaitiaki planting along Ōhau River “Loop” on Tahamata farm.

40

Figure 3.1.1 Waiwiri Stream mouth choked with nutrient enriched celery weed, with former mahinga mataitai (customary food gathering area) on right near pole and area under macrocarpa.

46

Figure 3.2.1: Microbial Source tracking from 2011-2012. Sampling locations for microbial tracking effluent in the Waiwiri Stream. Red markers indicate shellfish samples; cyan and blue markers indicate surface water samples from the Waiwiri Stream or a direct tributary, and white markers indicate surface water samples taken from Lake Waiwiri (Papaitonga).

47

Figure 3.8.1: On a rainy day, Clint Purchase, (DOC) Vina Quartermain, Winston Dewhirst, and Larry Parr (his back), part of Landscape Architecture group overlooking Lake Waiwiri (Papaitonga) and area to be re-vegetated as part of DOC's plans for the region.

55

Figure 3.8.2 Students at 2014 Wānanga, walking around Lake Waiorongomai.	56
Figure 3.8.3 Bruce Mcfadgen and students at 2013 Wānanga.	57
Figure 4.1.1: Local kaitiaki [left to right], Iritana Bennett-Ogden, Brieahn Heke and Janette Gregory participating in shellfish survey.	59
Figure 4.2.1: Local kaitiaki counting shellfish at Waitohu Beach.	61
Figure 4.4.1: Toheroa, [M.280325/13]. Aroha Spinks holds a toheroa shell collected 20 March 1986 between Hōkio, Kuku and Ōtaki beaches, held at Museum of New Zealand Te Papa Tongarewa.	64
Figures 5.1.1: Results of habitat and egg quantification in March and April 2014.	66
Figure 5.1.2: Results of habitat and egg quantification in May 2014 and location of straw bales for artificial habitat.	67
Figure 5.1.3: Setting up artificial whitebait spawning areas on Ōhau River loop region near the fish friendly flood gate at low tide.	68
Figures 6.1: Rangi Te Kanawa, Harakeke agent at MTM Landscape Architecture student Wānanga, Kikopiri Marae.	71
Figure 6.1.1: Avoiding pugging in wet areas.	74
Figure 6.1.2: Potential to retro-fit a former cow shed and milking shed into a Harakeke Hub by the Kuku Stream	74
Figure 6.1.3: The Harakeke Hub in situ to be potentially developed around Kuku Stream towards the Ōhau River, as a pilot on Tahmata farm.	74
Figure 6.1.4: Drainage class of soils on Tahamata Farm. The most suitable sites for planting harakeke to remove nitrogen on Tahamata Incorporation farm, are therefore the easily spotted – they are the wettest and are most prone to pugging.	75
Figure 6.1.5: Soil Series within the sand country on Tahamata farm with potential to denitrify wetlands, particularly for Hōkio peaty sandy loam (H4), Omanuka peat (Om) and Pukepuke peaty loam (Pp).	76
Figure 6.1.6: Within the river silts: (potential to denitrify the Ōhau 'Loop') on Parewanui silty clay loam or Kairanga silty clay loam.	77
Figure 6.1.7: Areas that are most suitable for harakeke planting with added areas in pale green for extended plantings too, (approximately 40 hectares).	78
Figure 6.1.8: Developing a Harakeke hub around Kuku Stream towards Ōhau River, off Kuku Beach Road. Small green circles are harakeke plants.	79
Figure 7.1.1: The completed car park, gate, bollards and protective fence for Kuku Ōhau Estuary frontage. The 2.2 hectare area on the estuary is planted from April 2015.	81
Figure 7.1.2: Te Hākari Stream flowing into Ōhau River Estuary makes up part of the 2.2 hectares to be planted out in coastal estuarine and back dune plants.	83
Figure 8.1: Lake Waiorongomai in drizzle.	83

Figures 10.1: Despite appealing for respect for the coastal frontage and tidal Te Hākari stream to estuary during low summer flows, a barrier has now been erected to stop destructive access (top image). 89

The kaitaiki teams planted out a former track but drivers persisted by going up the stream (near gorse at left top of image) and turned into this area planted in 2013 and 2014. 89

List of Tables

Table 2.4.1. This table indicates the alterations to natural cover with subsequent forest-cover removal and swamp drainage in Kuku from 1840-1963 24

1. INTRODUCTION

1.1 BACKGROUND AND CONTEXT

Manaaki Taha Moana builds upon previous FRST-funded research with Ngāti Raukawa ki te Tonga in the lower Te Ika A Maui / North Island through 'Ecosystem Services Benefits in Terrestrial Ecosystems for Iwi and Hapū' (MAUX0502), led by Massey University and Landcare Research/Manaaki Whenua from 2005-2009. 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). A number of different organizations are contracted to deliver the research: Massey University's School of People, Environment and Planning provides integrative ecological economics and project management expertise, with Professor Murray Patterson being the MTM Science Leader (M.G.Patterson@massey.ac.nz); Manaaki te Awanui Trust in Tauranga, with Caine Taiapa as the Research Leader Māori for the Tauranga moana case study; Te Reo a Taiao, the Ngāti Raukawa environmental resource unit that trades as Taiao Raukawa, with Dr Huhana Smith as Research Leader Māori in the Horowhenua coastal case study; Cawthron Institute, based in Nelson, provide coastal and freshwater ecological expertise; and WakaDigital Ltd, based in Tauranga, provide information communication and technology expertise for both case studies.

MTM is also built on many actions led by Iwi and Hapū in various areas of the Raukawa ki te Tonga rohe. To name some early projects of significance to the region, Te Ripo o Hinemata wetland restoration at Koputaroa near Levin began in 1995 and was covenanted in 1999⁴. The activities around this project were similar to work undertaken for the Ōhau River 'Loop' region with hui held between interested parties undertaken from 1996,⁵ with a dedicated follow up report *Kuku-Ōhau Situation and Opportunities for the Lower Reaches of the Ōhau River* by Lucas Associates in 1997–1998. The Lucas report highlighted certain issues that related to the complexities of the coastal plain including the diverse effects that flood mitigation, drainage and farming practices had on a meander of the Ōhau River, which accelerated decline within cultural landscape. At that time too, it was due to the 'Loop' being prioritized for ongoing flood protection that there was general reticence from Regional Council and Tahamata farm to make any changes to that site.

The neighbouring Te Hākari Dune Wetland restoration project then became the focus, first initiated with Nga Whenua Rahui in 2000 with a covenant finalised through Ngā Whenua Rahui and Tahamata Incorporation in 2002. More concerted support came from the Ngāti Tukorehe tribal committee with Patumakuku Incorporated private training establishment setting up a Kaitiakitanga/Putaiiao/Whakaruruhau course where Te Hākari was a key

4 <http://www.te-ripo-o-hinemata-wetland.org/background.php>

5 In 1995-1996, a local healing group called Te Raukawakawa o te Ora, affiliated to the Ikaroa region of Māori traditional healers and Ōtarere Limited, instigated the first rounds of necessary dialogue around ecosystem decline in the coastal region. Their work began to reveal why local Māori and indigenous symbiotic relationships to the natural and cultural environment were important, and why local peoples' previous interdependency and relationship with the natural environment had to be revitalised for ultimate cultural, spiritual and physical health. This healing group (supported by interested others) began to develop plans and visions for the potential and future management of the lower reaches of the Ōhau River. As greater detail generated around the Ōhau River's 'Loop', there were concerns about the serious decline in water quality and the ongoing biodiversity loss within the former river meander on Tahamata farm. From the activities of healers and environmentally minded others, an opportunity arose to commission a report that combined those initial conversations or worries about decline and loss of vitality, with necessary investigation conducted by external specialists.

practicum from 2003-2006. In 2014, a kawenata or covenant for the adjoining wetlands within neighbouring Incorporation of Ransfield's farming operation towards the Waikawa River has now been finalised.

The MTM team readily acknowledges Hapai Whenua Consultants for the range of projects they lead in the rohe too, including the Mangapouri Stream health assessment in Ōtaki, their shellfish and water quality health reports for Horizons Regional Council over a range of water bodies in the region. The research team engages extensively with all Iwi and Hapū, kaitiaki (environmental guardians) and other end user groups, who have been set up in each case study region. Key groups include: Te Rūnanga o Raukawa; Raukawa ki te Tonga Trust (Mandated Iwi Organisation for Fisheries); Ngā Hapū o Ōtaki; coastal farms such as Incorporation of Ransfield's and Tahamata Incorporation; Te Iwi o Ngāti Tukorehe Trust; Ngā Kaitiaki o Ngāti Kikopiri; Ngā Kaitiaki o Ngātōkōwaru; Ngā Hapū o Hīmatangi; Ngā Kaitiaki o Ngāti Kauwhata, and Muaūpoko Tribal Authority, amongst others.

Additional players within the MTM collaborative include: Taiao Raukawa Environmental Resource Unit; School of Architecture and Design, Victoria University, Wellington; Te Iwi o Ngāti Tukorehe Trust, Kuku; Tahamata Incorporation, Kuku; Incorporation of Ransfield's, Waikawa; Ngā Hapū o Ōtaki, Ōtaki; Greater Wellington Regional Council, Wellington; Kāpiti Coast District Council, Paraparaumu; Waitohu Stream Care Group, Ōtaki; Royal Forest and Bird Society, Horowhenua; Horowhenua District Council, Levin; Hōkio Progressive Association, Hōkio; Horizons Regional Council, Palmerston North; Department of Conservation, Palmerston North; local residents and landholders as relevant between Hōkio and Ōtaki. Taiao Raukawa and its MTM research team are linked to Iwi and Hapū within the Horowhenua case study region, and to Iwi and Hapū of Ngāti Ranginui, Ngāi Te Rangi and Ngāti Pukenga of the Tauranga Moana case study.⁶ More players are building on the interrelatedness basis of our research projects and are joining the mauri enhancement force as well.

Since 2012, the Māori owners of Lake Waiorongomai have been leading the rehabilitation of their lake, wetlands and stream systems to sea with their neighbouring leaseholders. The shareholders actively reinforce intergenerational responsibilities to this unique locale for the sake of future generations.

Therefore, the main purpose of this report is to provide a detailed understanding of the increasing numbers of active hapū participants who are now more aware of the issues facing their unique environmental, cultural landscape with associated spiritual values. The report highlights how the projects become vehicles or hubs for other physical, environmental, economic, and cultural welfare projects⁷ not only for the case study, but also for other Raukawa ki te Tonga regions.

6 C. Taiapa et.al, 2014 *Ko te Hekenga i te tai a Kupe: A Cultural Health Review of the Health of Te Awanui*, Tauranga Harbour for related report of details of Iwi and Hapū affiliations to their region.

7 H.Smith, (2008, 2012) *Hei Whenua Ora ki Te Hākari: Reinstating the Mauri of valued ecosystems—history, lessons and experiences from the Hei Whenua Ora ki Te Hākari/Te Hākari Dune Wetland Restoration project*, Ngā Māramatanga-ā-Papa (Iwi Ecosystem Services), Research Monograph Series, (FRST MAUX 0502), 33.

2. TE HĀKARI DUNE WETLAND AND RELATED DUNE WETLANDS TO WAIKAWA RIVER

The rehabilitation activities for Te Hākari dune wetland within cultural landscape are bound by the Tasman Sea where it meets the Ōhau River and estuary and where prevailing north and north-westerly winds blow across adjacent sandy fore dunes. These dunes are populated with marram grass and remnant stands of sand stabilisers like pīngao [*Desmoschoenus spiralis*] and spinifex [*Coprosma acerose*], tauhinu [*Cassinia letophylla*] and shore bindweed [*Calystegia soldanella*]. Ground covers like shore pimpernel [*Samolus repens*] and tidal ureure or glassworts [*Sarcocornia quinqueflora*] are a few of the local, indigenous estuarine plants present.

The lower reaches of the Ōhau River (including the ‘Loop’) are hydrologically linked to the tidal estuary, to Te Hākari dune wetland and the larger, contiguous system stretching towards the Waikawa River. The coastal estuarine region remains predominately in Māori title either as shareholdings in large, dairy farming Incorporations or as part of Ahu Whenua, Whānau or other Trusts’ arrangements. Since its inception, Te Hākari Dune Wetland restoration project remains grounded in a kaupapa and tikanga Māori epistemology of knowledge development. The hands-on project first mooted in 2000, suggests that restoration of fragmented ecological systems is interdependently related to the healing of a community, especially to Iwi and Hapū relationships with the natural and cultural landscape, thus implying it is essential to think about the related goal of ecological restoration in this broader cultural and system-wide context.

It is helpful at this point to define the terms natural and cultural landscape. In relation to the wider natural landscapes, the teams recognize them as places where living organisms and plants co-exist in a co-evolutionary relationship with each other and interact with soils, the atmosphere, and hydrological features and processes. Cultural landscapes are places where humans have transformed natural areas or where natural settings have shaped people’s way of life. Humans have greatly influenced nature, so that it could be said that all landscapes are cultural landscapes. Cultural landscape also refers to the activities of ancestors and ensuing generations, whose influences and adaptations have shaped lands and waterways over time. The understanding of cultural landscape in Kuku grew from lands and waterways that existed in Hapū and whānau ownership, which continues today for coastal areas retained in Māori title. Over generations, a range of close relationships and associations have accumulated among these natural and cultural entities; specifically, among people, land holdings, and freshwater, marine, and forest resources.⁸

2.1 Aspects of ownership

Aspects of ownership and kaitiakitanga responsibility by Hapū of Ngāti Tukorehe and other close affiliates (despite many land tenure changes over time), extend to areas between the Waiwiri Stream (flowing from Lake Waiwiri/Papaitonga) and the Waikawa River. In the general vicinity, Te Hākari dune wetland was once hydrologically and ecologically linked to the dune lakes and wetland systems of Ōhine Lagoon, Lake Waitaha and Ōrotokare wetland

⁸ This overview of wetland restoration draws heavily on a previously published and unpublished research papers, including H. Smith (2008, 2012) *Hei Whenua Ora ki Te Hākari Reinstating the Mauri of valued ecosystems—history, lessons and experiences* from the Hei Whenua Ora ki Te Hākari/Te Hākari Dune Wetland Restoration project and the affidavit of evidence for National Freshwater and Geothermal Resources Claim, 2012.

at Muhunua in the north. Tahamata Incorporation (the farming incorporation for shareholders from Hapū of Ngāti Tūkorehe) purchased Te Rauawa property on the northern side of the Ōhau River at Muhunua and continue to farm this area. Since first ancestral occupation, the coastal lands and waterways have been retained by Hapū on the southern side of the Ōhau River. There are shared responsibilities for the Waiwiri region (north of the Ōhau River) for affiliated tribes like Ngāti Kikopiri and Ngāti Hikitunga, and for neighbouring Muāupoko, who have responsibilities for areas bordering the Waiwiri region too.

Kaitiakitanga and ownership responsibilities therefore extend from Waiwiri Stream to the Waikawa River, where Hapū relationships are shared with Ngāti Wehiwehi.⁹ Te Hākari dune wetland is also hydro-logically and ecologically related to dune wetlands and lakes that exist within the wetland and former shared mouth/harbour of the Ōhau and Waikawa Rivers for Pekapeka Taratoa Ahuwhenua Trust; the wetlands of Ransfield Corporation and series of Māori Trusts to Waikawa; the former Manga Pirau wetland (now effectively drained) near the beach settlement of Waikawa, and further south to other coastal dune lakes including Huritini, Kahuwera wetland and Lake Waiorongomai, near the Waitohu Stream, Ōtaki.

Hapū of Tūkorehe came to occupy the Kuku/Ōhau coastal region from around 1823, where certain papa kainga, areas of resource use, different events, and periods of occupation were commemorated by specific names. Tahamata was one of these areas and the current farming enterprise operates under this bestowed inheritance. The tribe's farm was established in 1974 and was celebrated as the first Māori farming Incorporation in Horowhenua that brought shareholders or tribal descendants, and the Tūkorehe marae together.¹⁰ Tahamata is a productive dairy farming operation founded upon ancestors' entrepreneurial trading and horticultural activities. Today, a chairperson and board of directors strategically manage overarching goals and objectives, while the farm manager, farm workers and farm consultant/advisor fulfil the requirements of day-to-day dairying operations. The aim of Tahamata is to achieve a successful, diversified, indigenous business by growing its future responsibly, and managing and enhancing the coastal farm in an environmentally, sustainable manner.

Hapū relationships to the significant water body of Te Hākari and contiguous wetlands towards Waikawa continue today. Important contemporary Māori expressions of belonging or tūrangawaewae are composed to emphasise ancestral connections and intergenerational responsibilities for the highlighted region's lands, rivers, streams, wetlands, healing springs and fresh water springs within Kuku. This is present in the encompassing pepeha that identify natural markers as tribal boundaries:

Taku turanga ake ki runga ki ngā maunga titohea o te takiwā nei, ko Tararua, Ōtararere, ko Poroporo, ko Pukeātua, ki ngā wai ora, ki ngā wai puna, ki ngā wai tuku kiri o te Iwi, ko Ōhau, ko Waikokopu, ko Kuku, ko Tikorangi, ko Mangananao, ko Te

⁹ Derived from John Rodford Wehipeihana, 1964, *Sequent Economies in Kuku: A Study of a Rural Landscape in New Zealand*, Master of Arts in Geography, Victoria University: Wellington.

^{1b.} Aspects about boundaries also derived from Draft Ngāti Tūkorehe claim to Waitangi Tribunal, 2007.

¹⁰ Personal communication and notes taken in 1995, with Mr Ian Joll, who was the first farming consultant for Tahamata Incorporation.

Mateawa, ko Te Rangitāwhia, ko Ngāti Manu, ko Patumākuku, ko Ngāti Kapumanawawhiti o te rohe ki te lwi nei o Ngāti Tūkorehe.¹¹



Figure 2.1.1: Te Hākari Dune Wetland in larger cultural landscape (above pine forest) adjacent to dunes and Ōhau Estuary, 2009. (Photograph by Lawrie Cairns, Palmerston North)

2.2 Dependence on wetlands and coastal estuaries as food and sources of material

Our ancestors depended on wetlands and coastal estuaries as food and sources of material. They generated an intimate closeness with the environment and shaped the landscape, wetlands and waterways through their human actions and influences over time. They lived, procreated, died and sustained themselves by their seafaring, fishing, gardening and housing skills using natural resources from the biodiversity rich, wetlands, coastal and estuarine regions. They entreated spiritual entities and their associated environmental properties.

¹¹ Composed by Sean Bennett-Ogden in 2005. Te Iwi of Ngāti Tūkorehe Trust embraces another expression of belonging, of kaitiakitanga and governance over tribal grounds or turangawaewae. 'Mai i te take o te maunga ki te hukahuka o te tai, ki te rohe e mōhiotia ana nō Tūkorehe, mō āna uri, me āna moetanga katoa.' Loosely translated as 'from the mountains to the froth of the tides, for the area known, named and claimed from Tūkorehe, for his descendants and all their associated dependants'.

They supported themselves with knowledge systems based on generations of understanding brought about from talking about place, observing place and developing place in a detailed way.¹² These ways of knowing were prerequisites for maintaining a healthy environment and its customary knowledge rights.¹³

Ancestors' interactions with resources were through shellfish gathering, freshwater fishing for eels and fish in streams, rivers and wetlands, fishing activities at sea, and for horticulture. These essential activities made sense of their local world. They used the maramataka or Māori moon calendar 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 also from the foothills and mountain forest regions. These combined 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.¹⁴



Figure 2.2.1: Important ahu otaota (middens) within coastal landscape on northern side of Ōhau River, on land that is currently not owned by Iwi or Hapū (Photograph by Huhana Smith, 2005).

It has been well noted in scholarly text that Māori tribal identity and the wellbeing of Iwi, hapū and whanau remains inextricably intertwined with the natural environment, through cultural places and landforms, natural resources and taonga species.¹⁵ 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 like Te Hākari dune wetland or coastal foreshore ecosystems that possessed such qualities, or a river ecosystem, or a forest, could be considered, with the people it sustained,

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

13 This text is drawn from previous report from 2008 and 2012 called *Hei Whenua Ora: Reinstating Mauri of valued ecosystems- history, lessons and experiences from the Hei Whenua Ora ki te Hākari/Te Hākari Dune Wetland Restoration project*.

14 *ibid.* 4

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

to be a living being and be termed a taonga.¹⁶ Hapū also inherited their mana for lands and waterways through their close associations with the intrinsic power that these natural areas produced. Such associations sustained their lives and contributed to their well being and security.



Figure 2.2.2: Wetland in 2002 (left) and after raising water levels from 2003-2005 (right).
(Aerial photography 2002 and 2005, Lawrie Cairns, Palmerston North)

The following sections of the overview draws upon the lead author's unpublished PhD thesis of 2007.

16 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.

2.3 Historic control

The Kuku/Ōhau coastline is a powerful associative, cultural landscape where relations with the natural elements required ancestral (and now contemporary) kaitiaki to actively protect environmental values and principles therein. Today's responsibilities to this place stem from:

- Early nineteenth century inter-lwi contest
- Established inter-tribal alliances and allegiances
- Rights afforded by long term occupation, settlement and cultivation of the region
- Interred ancestors in designated burial places
- Shared collective enterprises and events that cemented ties with other whakapapa-related tribes. and
- Many experiences that have accumulated between peoples and spiritual entities in natural areas.

As highlighted in a previous MTM research report, *Assessing the Holistic Health of Coastal Environments: Phase 1* (Hardy *et.al* 2012), historic control by key hapū of this coastal, palustrine and flood plain region has witnessed a complex, Māori history of warfare and conquest, due to consequences over land, waterways and resources that arose from the migrations from Kāwhia Harbour by Ngāti Toarangatira that began in 1819.¹⁷ A later series of induced migrations south for Ngāti Raukawa affiliates trans located lwi and hapū from their original homelands around Maungatautari, Waikato.¹⁸ When lands and waterways in the Ōhau River, Horowhenua region were allocated at the behest of other related and significant leaders,¹⁹ hapū of Ngāti Tūkorehe, first established their customary mana whenua obligations over the coastal land and its resources. They enjoyed many decades of relatively natural, pristine fullness within the coastal plain to the sea.²⁰



Figure 2.3.1: Pekapeka Taratoa Ahu Whenua Trust lands, where Ōhau and Waikawa Rivers shared a harbour or mouth, (Photograph by Huhana Smith, March 2012.)

17 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 Tahutahunui', and after Taranaki 'Te Heke Tātaramoa', a name coined after the bramble bush that commemorated the difficulty of the journey experienced.

18 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.

19 Waitohi (Ngāti Raukawa and Ngāti Toarangatira) was the sister of Te Rauparaha and Nohorua. She was a leader in her own right and 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. Sourced from Oliver, W. H. & Teremoana Sparks. Waitohi b.?-d.1839. Dictionary of New Zealand Biography, updated 7 April 2006. URL: <http://www.dnzb.govt.nz/>

20 Derrylea Hardy, Murray Patterson, Huhana Smith & Aroha Spinks, *Assessing the Holistic Health of Coastal Environments: Phase 1, Research Design and Findings from Cross Cultural Research Phase 1*. Sourced from www.mtm.ac.nz

As outlined in previous reports²¹, despite complex pressures of district and other regional land losses in the past,²² the coastal land still remains predominately in Māori ownership or under guardianship through Incorporations or Trust arrangements with the Māori Land Court today. There are also concerted, strategic objectives for Iwi and Hapū entities to buy back former ancestral lands for the sake of future generations.

2.4 Loss of natural integrity

At the time of ancestral occupation in the early 1820s, significant natural forest cover existed. The later forest clearance in the coastal and inland district was swift and relentless²³ shrinking from around 73.8% forest cover to just 1% within 90 years. The forested land was rapidly cleared and converted to pasture. The development of wetlands like Te Hākari, was more constrained or protected by communal Māori ownership, but it too would fall victim to agricultural pressures by the 1930s.

	1840	1883	1890	1914	1920	1930	1963
Forest	73.8%	66.5%	38.5%	10.0%	1.0%	1.0%	1.0%
Swamp	9.7%	9.3%	9.3%	9.3%	7.0%	2.5%	2.5%
Streams, dunes, sand-flats, fern, native grasses	16.0%	14.2%	12.0%	10.9%	5.9%	4.8%	4.6%
Cleared land	0.5%	10.0%	40.2%	69.8%	86.1%	91.7%	91.9%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Railway era

Refrigeration era

Dairying era

Table 2.4.1. This table indicates the alterations to natural cover with subsequent forest-cover removal and swamp drainage in Kuku from 1840-1963.²⁴

According to John Rodford Wehipeihana's research,

In 1914, the area in Kuku under bush was only one quarter what it had been in 1890. Trees were felled and burnt and the ashes sown with English varieties of grass e.g. cocksfoot, clover. Swamp drainage, an extensive and expensive undertaking, was not carried out in Kuku in the first part of this period. The fact that the swamp zones at the

21 The next pending Mātauranga Māori report chronicles more details on intimate ancestral relationships to whenua and awa in the case study region.

22 A series of associated pressures on land in the Horowhenua/Manawatu region included the Awahou Deed of Purchase, 1858, the Manawatu/Horowhenua deed of Purchase 1864, the Muhunua Deed of Purchase 1864–1874, the Native lands Act 1865, the actions of the Native land court in Ōtaki, and the bisecting of the community with lands acquired by the Main railway line 1877–1878.

Information sourced from draft Treaty Claim by Te Iwi o Ngāti Tūkorehe Trust, which was derived from Professor Alan Ward, 1997, *National Overview Volume III*, Waitangi Tribunal Rangahaua Whānui series, GP Publications: Wellington, 229–231.

23 After Paula Loader (2003), Unpublished Masters Thesis, Victoria University, Wellington.

24 The table is taken from unpublished Master of Arts in Geography thesis by John Rodford Wehipeihana, 1964, *Sequent Economies in Kuku: A Study of a Rural Landscape in New Zealand*, Victoria University: Wellington, 27.

coast were owned by a group of impecunious, easy-going Maoris helps to explain this lack of economic development.²⁵

Within the decades of intensive clearing of natural forest cover between 1890s and early 1930s, Te Hākari wetland may have been regarded as ‘underdeveloped’ because its extensive resources were still in use by hapū for housing, weaving, medicinal resources and for sustenance, health and general well-being. ‘Impecunious’ relates only to a ‘cash poor’ status. The authority of our earlier generations and their reality as essentially retainers and users of their land and waterways defined their mana as important forms of significant cultural wealth, and therefore cultural standing in the Māori world.

When first subjected to intensive drainage, Te Hākari dune wetland (like many other dune lakes in the wider district) became a captured, groundwater fed and rainfall enriched system, with a 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.’²⁶ As land tenure in the region continued to change for many, complex reasons, later drainage and waterways modification schemes like the Kuku Drainage District scheme (1927-1963) for non-Māori lessees, concentrated on controlling inland streams and springs. The drainage board converted to the Manawatu Catchment Board in 1963, and continued to control, modify and channel natural waterways. Despite the damage to once significant spring systems in the region, including ones within the tribe’s farming operation and others that feed the Kuku Stream at various points along its length, there is still a significant spring named Te Awa a Tamati at the end of Soldiers Road, Kuku.

Today, the Manawatu Catchment Board functions under the Ōhau Manakau River Scheme, overseen by Horizons Regional Council who upgrade stop banks at certain points along rivers and streams in its ambit of authority, and extract gravel and modify smaller waterways for flood control. However a wider more environmentally or pro-biodiversity protection focus has become a greater part of the council’s activities, with designs for fish friendly passes, major lake restorations underway, major river leader accords and new technologies utilised to monitor flood risk.

In 2001, it was reported that most wetlands in Aotearoa New Zealand had been drained,²⁷ 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 similarly confirmed that there has been an 85 percent decline in Aotearoa New Zealand’s wetlands since European settlement. The decline is one of the most dramatic known anywhere in the world, even far higher than the countries in which modern agriculture began large-scale draining of swamps and marshes.²⁸ Coastal wetlands and dune lakes systems between

²⁵ Ibid. 33

²⁶ The Booklet Committee, 1964, *The Centenary of the Rowland Family in New Zealand 1864-1964*, 19.

²⁷ 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.

²⁸ 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, 151.

Waiwiri and Waitohu Streams 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 Manawatū/Wairarapa region is estimated to have lost 97.4% of its wetlands (since 1900), with just 1% of swamp areas still intact.²⁹

From 2000-2002 a series of discussions with kaumatua, kaitiaki and farm board with associated activities, enabled a kawenata or covenant of twenty five years to be placed over Te Hākari dune wetland under Section 29 of the Conservation Act 1987.

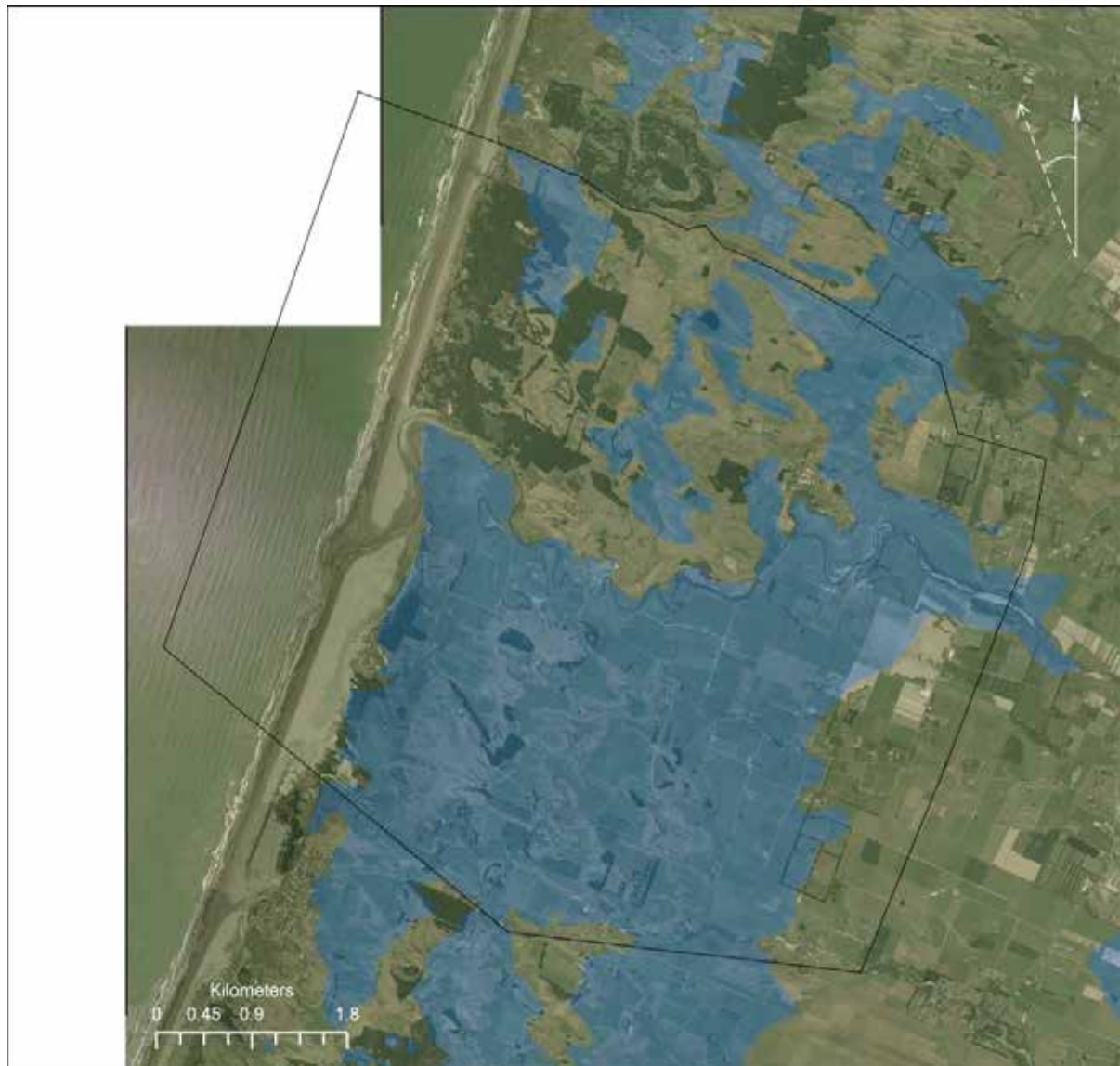


Figure 2.4.1: Pre 1840s Wetlands in region

Map sourced from *Ahi Kaa Roa: Mapping Cultural Landscape Report* for Te Iwi o Ngāti Tukorehe Trust, 2009.

(Map created by Dr Anthony Cole, 2008-2009)

²⁹ D. J. Hardy et al., 2012, *Assessing the Holistic Health of Coastal Environments: Research Design and Findings from Cross- Cultural Research*, Manaaki Taha Moana Phase 1, MAUX0907, Taiao Raukawa, Kuku/Massey University, Palmerston North, 38.

After officials, kaitiaki and Tahamata board members discussed appropriate approaches for securing a covenant for Te Hākari wetland, it was settled that Ngā Whenua Rahui³⁰ was the most favourable agency to fund and implement the strategies of action research. To secure the kawenata, the former Minister of Conservation, the Hon. Sandra Lee entered into an arrangement with Tahamata Incorporation in July 2002.

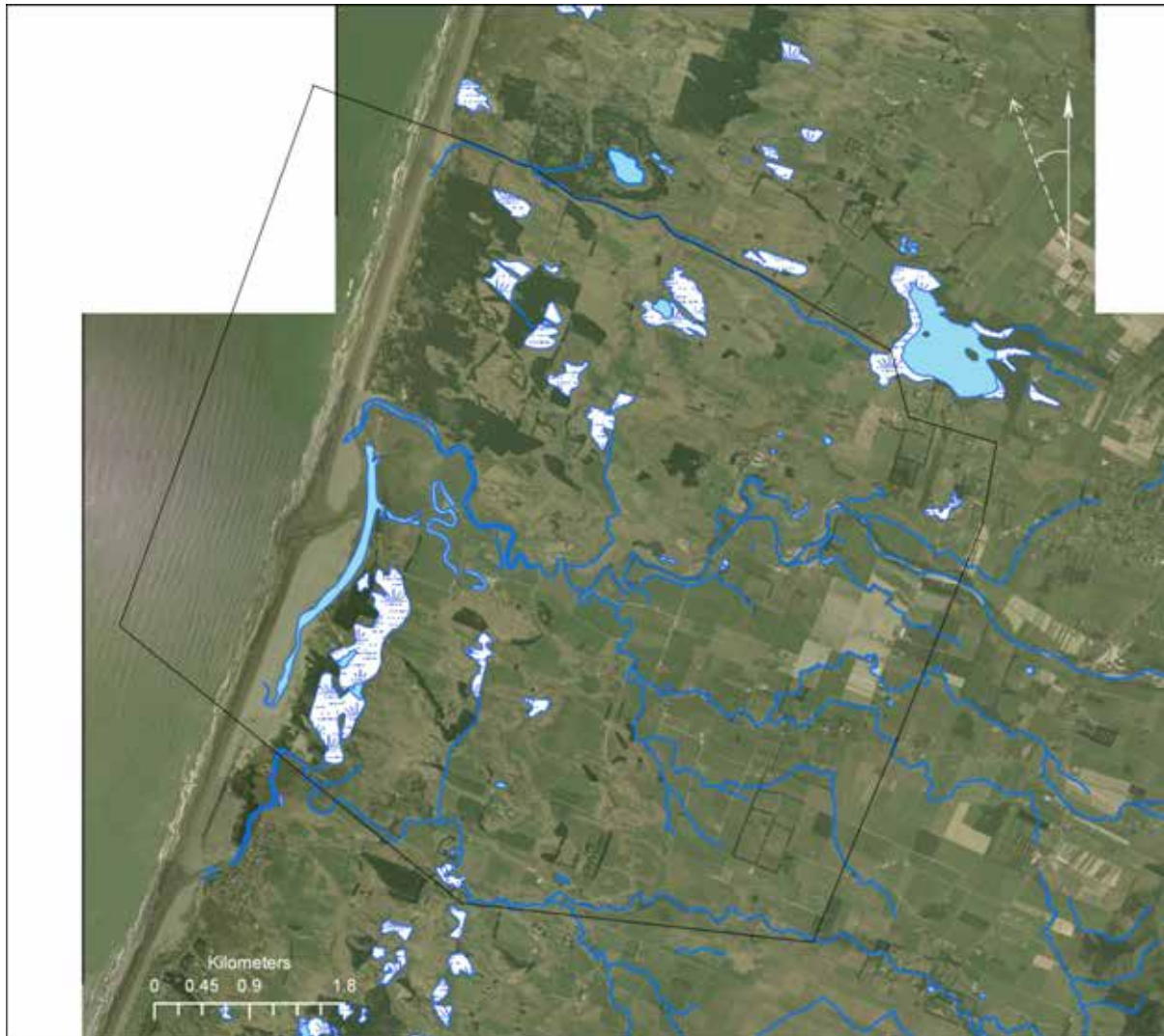


Figure 2.4.2: Waterways in Muhunoo, Kuku to Waikawa region, including dune lakes, wetlands and stream confluences
Sourced from *Ahi Kaa Roa: Mapping Cultural Landscape Report* for Te Iwi o Ngāti Tukorehe Trust, 2009.
(Map created by Dr Anthony Cole, 2008-2009)

The Minister's signature sealed the conservation of the natural and historic resource, Te Hākari dune wetland, encompassing an area of 13.7 hectares (33.85 acres), the southwest paddock with ephemeral wetland adjacent to the farm's pine forest, the larger wetland system itself and Te Hākari Stream. The area was set apart as a Māori reservation pursuant

³⁰ An entity serviced by the Department of Conservation through an annual allocation of finances from Government. Both Ngā Whenua Rahui and Mātauranga Kura Taiao are support agencies for Māori-based initiatives, especially designed to protect indigenous ecosystems on Māori owned land. Of interest are the remaining indigenous ecosystems that represent a full range of natural diversity originally present in the landscape. These agencies provide the incentive for hapū and Iwi participants to take up voluntary conservation. Since 2010, Ngā Whenua Rahui have been training selected young Māori from around the country as part of their cadetship amongst Te Whanau a Apanui at Te Kaha. Ngāti Tūkorehe's trainee is Mr Rangikauhoe Markus Heke (25 years old) and he will be fully qualified by end of 2013.

to Section 338 of Te Ture Whenua Māori Act 1993. After further discussion with Tahamata Incorporation, the Minister was satisfied that the dune wetland would manage, preserve and protect the natural and historic resources, and bolster the spiritual and cultural values of the interrelated region. While drainage to Te Hākari dune wetland was reversed in 2003 with temporary sand bagged weirs, drainage and modification of wetlands continues unmonitored (and illegally as in 2004) in interrelated wetlands where valuable ecosystem services continue to be lost.



Figures 2.4.3: Processes of transformation from paddock to wetland forest from December 2002 to August 2011. (Photos by Huhana Smith)

The kawenata acknowledges the mana whenua status of Tahamata Incorporation and its Iwi and hapū shareholders because the wetland lies within Māori land.³¹ A covenant protects and enhances the natural character of the land with particular regard taken for remaining indigenous flora and fauna, their diverse communities and interactions with the environment that support them. The kawenata protects and enhances the cultural and spiritual values by recognising the historic, archaeological and educational values associated with the land and its related water bodies. The kawenata maintains landscape amenity values of the land. It provides for the public's recreational use and enjoyment of the land consistent with the objectives and consent of Tahamata Incorporation as a leading economic entity of Ngāti Tūkorehe.

Tahamata Incorporation is compelled to use all reasonable endeavours to restrict domestic stock coming through or grazing the land within the covenanted area. Certain provisions have been made available to authorise removal of native plants, shrubs, trees and plant material from the land by local healers for customary Māori healing purposes. This is an important objective of all the environmental projects underway, as access to residual customary knowledge for re-edified learning is vital for improving the tribe's future

³¹ Derived from the Kawenata document created between the Minister for Conservation and Tahamata Incorporation.

generations' contact with rōngoa Māori or Māori medicinal properties derived from the forest.

Access is provided and Tahamata can carry on work without restriction, engaging in the business of dairying and forestry on any adjoining or neighbouring land or other land owned by, or leased by the farm. As part of permitted public access to the kawenata, management plans envisage future access ways, boardwalks, interpretation signs or whare raupo (shelters built of bullrushes and reeds) as bird hides - all carefully placed within the area of the covenant to enable peoples' enjoyment and enhancement of their relationships with the natural within this revered cultural landscape. These provisions have been arranged within the kawenata but they restrict the taking of any native plants, shrubs and trees from the land by others not of the tribal region. Tahamata Incorporation retains the right to decline access and entry onto the land for the purposes of reasonable management, to protect the extensive revegetating wetland forest, its incorporated lake systems and spring fed waterways, and to protect against fire.

In September 2014, a neighbouring kawenata for Incorporation of Ransfield's adjoining coastal wetland to Te Hākari dune wetland that was signed off by the Hon. Dr. Nick Smith, Minister of Conservation. All the teams who persevered to make this finally happen are delighted. The whole dune wetland that spans two tribal farms for shareholders has been reconnected again.

2.5 Cultural, Spiritual Identity and Tikanga (Protocols)

Tribal members were once fully engaged with the lessons of Kuku and its natural resources. Their distinct and close relationships with place allowed an understanding of all aspects of the environment, ranging from the rational to the transcendental and immanent. Many accounts of such relationships recognised a spiritual, philosophical, and metaphysical attitude that often went beyond the material world. For example, the notion of kaitiaki or guardian birds for whanau, may appear esoteric to the uninitiated, however in a local, rural community with a long-term Māori presence, relationships among human, natural, and spiritual entities were experienced and expected.

In Kuku, particular knowledge about entities within a spirit world remained in the cultural memory of kaumatua and others, whose experiences supported the assertion that Māori continued to believe that certain trees, sites and places, spots or other objects were dwelling places of guardian spirits. According to Māori scholars, this did not mean the spirit was the spirit of the tree; rather, a spirit could use a tree, a place, a river, or even a person as a 'home'. Particular kaitiaki may be described as tribal taniwha, spiritual entities or beings, ancestral guardians, or other local spiritual keepers.³²

Local kaitiaki, taniwha, or guardian entities took various forms at the coast and further inland in other waterways traversing Kuku. Taniwha ranged from an inverted log with exposed roots that could move upstream and indicated an abundance of kaimoana, to a

32 Merata Kawharu, 1998, *Dimensions of Kaitiakitanga: An investigation of a customary Māori principle of Resource Management*, Unpublished PhD. Thesis in Social Anthropology, Oxford University, England, 12.

taniwha in an area known as ‘The Deep’ in a bend in the Ōhau River; others were a flounder with specific facial features, fresh water crayfish in particular waterways, or a large eel that cried out from its wetland home when the weather over the sea was disturbed. Some informants knew of the dangers of the last three and spoke of the wailing eel as a sure sign of danger—a portent that the adjacent beach environs would soon be unsafe for humans because of the probable risk to humans from storm-surge or tidal waves. As in Kuku, probably every Māori iwi, hapū and whanau in the country had their kaitiaki, each with their own special stories and signs by which they were recognised.

Kaumātua of Tūkorehe have also long confirmed that there had been both cultural and common sense protection measures for sensitive sacred burial sites and natural areas, for the related biodiversity, resources within the coastal waterways and at the beach. Occupation narratives and settlement patterns have recounted how inter-tribal contest secured customary land tenure from the beach, the adjacent flood plain, along the Ōhau River, the streams that flowed into it, adjacent wetlands, peat lands and dune systems to the Tararua Ranges. As people who knew the coastal environs well when seeking sustenance or at seasonal shellfish or customary fishing harvest, kaumātua accounts also recalled long observed and consistent protocols.

“You only go out there...[to the beach] if you’re going out there to get pipis or toheroas, the old people used to say... now you only go out there and get what you need.”

Any catches, gathered shellfish or ‘hauling’ for fish at sea or the estuary were taken well into the dry sands or better still, taken home to prepare and cook. By not cleaning catches or cooking gathered food on the beach, this was a cultural precaution, a sign of respect to those subjugated by earlier battles to maintain the region. In other ways too, it made good sense not to foul areas of resource collection. Resource use precaution at Kuku Beach 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.³³ Other 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.

A kuia of Kuku related how she ran into trouble with her father when as a young girl she and her sisters cooked their whitebait catch 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 encounters were regarded as an external knowing or being present in the moment of experience,³⁴ which informed their understandings and respect for the beach and environs forever.

33 Charles Te Ahukaramū Royal, 2004, *Mātauranga Māori and Museum Practice*, Discussion paper prepared for National Services Te Paerangi, at the Museum of New Zealand Te Papa Tongarewa, 21.

34 Manulani Aluli Meyer, 2003, *Ho’oulu Our Time of Becoming: Hawaiian Epistemology and Early Writings*, ‘Ai Pōhaku Press Native Books: Hawai’i, 63

Applying tikanga to, and getting it right for Te Hākari dune wetland has included karakia, protocol *and* extensive rehabilitation work. Since first planting took place in September 2002, Hapū members, shareholders, indigenous visitors and other many other interested parties have planted 1000s of pioneer tree species into former cow grazed paddocks. From 2003-2006 important hydrology research has assessed subsurface water quality and size of waterbodies beneath the wetland. Raising wetland water levels to near natural contour since 2003, has transformed surrounding marginal pasture that was once cow pugged and nitrified. In particular, the common Māori name wīwī is used for a number of species of *Juncus*, which grow profusely in wetlands, along stream banks and other damp places. Wīwī [*Juncus gregiflorus*] is tolerant of a wide range of conditions and produces large quantities of microscopic seed that remain viable in the soil for years. In the Te Hākari stream area wīwī literally helped the dune wetland recover its memory with obvious flushes of other rushes and sedges growing on the banks and into the former pasture area. The higher water levels led to increased sedge [*Isolepis prolifer*], local sea rush [*Juncus kraussii s.s australiensis*] and sedge [*Schoenoplectus pungens*].



Figure 2.5.1: Wīwī in wet delta region surrounding Te Hākari Stream, 4 June 2014. (Photo by Huhana Smith)

In this renewed, thick and luscious state, a combination of reeds, sedges and rushes form bright and variegated green clumps of narrow, wiry stems are buffeted and shaped by north-westerly winds. Reeds and rushes were once important resources when bundles were tied together for finishing off the inner linings of whare raupo.³⁵ A healthy, re-vegetating fringe

³⁵ According to oral accounts, other forms of temporary housing recalled in the region were made of driftwood or car case wood, roofed with bracken fern, harakeke or raupo. Some had dried, crushed shells on dirt floors or wool hessian sacks sewn together as a floor covering. Some whānau members recalled these forms of housing as still in use, up until the 1930's.

habitat helps remove stock nutrients from water. When frog numbers increase in biologically important shallow fringe habitat like these, they attract greater numbers of wading birds to feed. Since allowing water to return to the wetland, the wet delta has become a significant, reinvigorated ecosystem interlinked to Te Hākari Stream, the wetland itself, the dune systems, the Ōhau River flowing to sea and the subsurface water that flows under pressure into the ground depression, wetland itself.

Of bird biodiversity importance is New Zealand's most threatened wetland species, matuku or Australian brown bittern [*Botaurus stellaris poiciliptilus*]. A resident pair of matuku has been recorded feeding in the delta many times. The wet delta also attracted self introduced white-faced heron [*Ardea novaehollandiae*], endemic kotuku or white Heron [*Egretta alba modesta*], little egret [*Egretta garzetta immaculate*], and kotuku ngutu-papa or royal Spoonbill [*Platalea leucorodia regia*]. Te Hākari wetland is also likely a suitable area for endangered native fish species such as banded kōkopu [*Galaxias fasciatus*] and giant kōkopu [*Galaxias argenteus*]. These species are still valued as varieties in need of protection and care. In the decade since restorative processes began with simultaneous pest control, efforts are bearing fruit where rare birds like the matuku are breeding and the reinstated wet delta region and Te Hākari Stream to the Ōhau River, is teeming with whitebait again.



Figure 2.5.2: Rare and endangered Matuku feeding on whitebait in reeds at Te Hākari Dune Wetland. (Photograph by Huhana Smith, 9 October 2009)

Ensuring healthy water as waiora requires sound hydrological research of the subsurface waterways. Research undertaken at Te Hākari notes that water can be lost through

Other temporary structures at the estuary beach were made of tarpaulins, painted with bitumen. There were also a series of small, more robust summer-houses or fishing batches made of wood. They were one to two room dwellings permitted to be erected by the Māori landholders.

evaporation from open water; transpiration from plants; flows out of drains and streams, and through groundwater outflow. The water balance of a wetland describes the balance between the sources and discharges of water. Therefore, Te Hākari dune wetland is a dynamic, hydrological system 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 any moment in time, one or more component 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. Groundwater level monitoring provides information on how the wetland interrelates with the underlying water table, and how this relationship may change through the year. Monitoring data calculates the direction of groundwater flow around the wetland during the summer and winter seasons.³⁶ For Te Hākari dune wetland 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 2m (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 pressurises (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. There remains a strong inter-relationship 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.

2.6 The capacity for correction

There are multiple pressures and stressors facing water health for all waterways in the Kuku region from the foothills to sea. Even though kaitiaki undertake expanded ecological projects between Waiwiri to Waitohu stream as part of *Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū* (MTM) 2009-2015 research project, they have probably never faced problems of such complexity that threaten the health and wellbeing of hapū and Iwi, upon lands held in Māori tenure and for waterways subjected to the ill effects of unsustainable agricultural practices. Hands-on, action research for wetlands and waterways

36 Mark Gyopari, 2006, *Te Hākari Wetland Hydrological Study*, Phraetos Ltd, Wellington, 3.

attempts to understand aspects of customary and remaining local knowledge, and reapply it in a different context to what ancestors may have faced in the past. Restoration projects build upon well-established oral narratives, whakapapa, dialogue and synthesis of research and other relevant information. The process of combining these different ideas, influences, or objects into a new whole are based on the experience of hapū and Iwi participants undertaking solutions-focussed and pro-active revitalisation of fragmented ecosystems within cultural landscape.

Central to the ongoing MTM project is an exploration of kaupapa Māori approaches to defining and valuing coastal ecosystem services of importance to Iwi and hapū, and for facilitating the appropriate uptake and communication of such knowledge so that it is 'heard' in decision making processes. This requires MTM to identify those coastal ecosystem services that are important to Iwi and hapū and to explore ways of 'measuring' them alongside the traditional 'western science' indicators of ecological health; and to conduct research in such a way that tangata whenua can reunite with their natural and coastal environments. Through this research, it is hoped that hapū and individuals, as well as non-Māori stakeholders/end-users, will positively engage in the search for answers as to why coastal degradation is occurring, and thus in working with common purpose on practical restoration initiatives to stem the degradation.³⁷

There have been impacts of cultural disintegration on historically established indigenous, cultural landscapes, as much as there have been complex restoration challenges in a culturally diverse landscape where influences range from multiple agencies, including individuals, government and privately-owned institutions. Certain intricate problems and questions have arisen over contemporary Iwi and hapū interrelationships with the natural environment, their waterways and wetlands. Kaitiaki working on Te Hākari dune wetland restoration project often wondered how well they were actually doing when dealing with such fragmented ecosystems and the impact this was having on their human condition. As key informants in generations pass away, knowledge, observations and experience of place decline, resulting in generations being increasingly separated from intricate relationships to ancestral place. The worst effect of this loss is manifested in contested genealogies, fighting over shares, variances or contradictions in peoples' narratives and understandings of their relationships to lands. There remain very real, ongoing tensions witnessed between closely related peoples. In the last decade or so, long-standing land ownership and share conflicts over coastal parcels of land have led whānau within hapū to pit themselves against each other and to legally challenge each other in the Māori Land Court.

The capacity for correcting this complex situation is underway. Since 2002, in the Horowhenua case study region, Te Hākari Dune Wetland has been well supported by Nga Whenua Rahui and Mātauranga Kura Taiao agencies and staff through the Department of Conservation. Their objectives align with the concept of active kaitiakitanga, where hands-on projects are grounded in kaupapa and tikanga, whole-of-system, multiple-goal and action-orientated methodologies. Local Māori knowledge has been harnessed to re-emphasise once intimate, physical, cultural, inter-generational and spiritual interfaces with lands, water

³⁷ D.J. Hardy et al., 2012, *Assessing the Holistic Health of Coastal Environments: Research Design and Findings from Cross-Cultural Research*, Manaaki Taiaho Phase 1, MAUX0907, Taiaho Raukawa, Kuku/Massey University, Palmerston North, 34.

and resources to directly bolster the knowledge of local biodiversity, rongoa Māori plant resources and special areas within wetlands and aquifers - all for the sake of enhancing the tribe's ongoing identity with their coastal lands, their regionally significant wetlands, their waterways and the resources therein.

2.7 Specific research objectives of MTM for Horowhenua case study

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

This initial objective of MTM research focused on determining the extent of critical coastal ecosystems and their services in the case study regions of Tauranga Moana and Horowhenua coast. The relevant research questions were:

- What are the critical ecosystems?
- 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?

In the Horowhenua case study, the ecosystems listed and their services are freshwater systems into the marine between Hōkio to Waitohu Streams. The case study encompasses back dune systems with associated dune lakes; river meanders, wetlands with streams into riverine estuaries, and streams into the sea, albeit functioning within landscapes significantly modified by agricultural, horticultural and forestry expansion. Associated knowledge about them exists, however, tenuously within their surrounding environment. The species within ecosystems are still valued as biodiversity varieties in need of protection, care and rehabilitation.

From a historic, biophysical and cultural perspective, early occupants and related ancestors would have witnessed quite different ecological systems between the coastal plain and river systems to sea. We acknowledge that earthquakes are the key drivers for environmental change on this coast too, where there have been immediate, historic impacts from this activity, and delayed outcomes in unique, sand dune formation and river aggradations in the region.³⁸ There are also substantial subsurface waterways beneath dune lakes and related spring systems.

In more recent years the coastal area within the case study has been mapped for high-risk susceptibility to liquefaction, due to past earthquake events³⁹. In summer 2015, the case study will undergo an historic tsunami assessment and groundwater intrusion.

The coastal area supported unique estuarine bird life, fresh water-based and marine resources including a range of shellfish species. Te Hākari dune wetland adjacent to Kuku Ōhau estuary is part of a contiguous wetland that stretches towards Waikawa River. The wetlands were likely the former course of the Ōhau River with a shared mouth of the Waikawa River, forming a harbour to sea. The wetland regions remain home to several

³⁸ Bruce McFadgen, 2012, *Horowhenua?* Sourced from presentation to Landscape Architecture students as part of their wānanga, 12 March 2012, Tūkorehe Marae, Kuku.

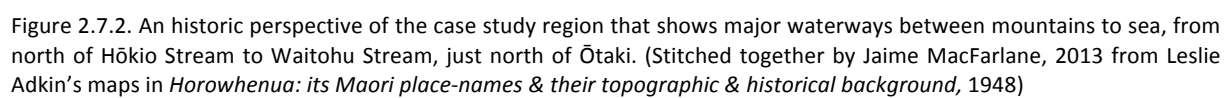
³⁹ Sourced from the affidavit of evidence for National Freshwater and Geothermal Resources Claim, 2012, page 2.

endangered, indigenous bird species including matuku and puweto, with the later now not likely due to predation by mustelids. The wetlands were once a superb breeding grounds and habitat for inanga in both adult and juvenile (whitebait) forms and for tuna or eel. It was a likely suitable area for endangered native fish species such as banded kōkopu and giant kōkopu⁴⁰. With help these rare species are expected to thrive again when the wetland areas and adjacent re-vegetating forest are returned to better health. Ongoing pest management and monitoring regimes need to control introduced predators.



Figure 2.7.1 Dynamic Kuku Ōhau estuary coastline (Photograph by Huhana Smith, 24 August 2014)

⁴⁰ Matuku, Australasian bittern [*Botaurus stellaris poiciloptilus*]; puweto, spotless crane [*Porzana tabuensis plumbea*]; inanga [*Galaxias maculatus*] in both adult and juvenile (whitebait) forms [*Galaxias fasciatus*]; tuna, eel [*Anguilla dieffenbachii*]; banded kōkopu [*Galaxias fasciatus*], and giant kōkopu [*Galaxias argenteus*].



2.8 Concerns for local environmental health

From the 1990's, local kaitiaki lamented how vestiges of natural food resources had deteriorated so rapidly from ongoing inappropriate or unsustainable actions. Many are virtually non-existent today. For example, kaumatua and resource gatherers worried about white baiting in unsuitable or non-compliant areas, and before season, which impacts on breeding stocks of inanga or whitebait for others. There are real concerns for shellfish species like toheroa and tohemanga⁴¹ declining, and for their endangered status overall in a coast once famous for their abundance. There have also been long standing concerns for those who avoided fees at public refuse transfer stations, and used the beach environs to sea as their private dumping ground for inorganic or domestic refuse. Such activities suggest a total disregard for natural integrity and a shift away from the kawa or sustainable resource use protocols once strictly observed by Iwi and Hapū. The emphasis of these projects has been to re-encourage that sensibility again, and raise capacity and capability in active kaitiakitanga. To this end rubbish left in coastal spaces has been arrested somewhat with the initial phases of the Kuku Ōhau estuary frontage project completed in March 2014, whereby a car park, bollards, seven wire fence (with plantings between) and a gate has halted much of the destructive access to the estuarine coast. The ambit of kaitiakitanga has also been bolstered by local residents being active participants in the restoration of this area, as they too value the integrity of this coast and all it has to offer for their human wellbeing.

However, certain complexities continue to challenge Iwi and Hapū kaitiaki when dealing with culturally significant landscapes that have been significantly altered by intensified agricultural or coastal forestry activities. From the 1970s, local and regional council engineering activities in tandem with ecological decline issues, have all contributed to the tenuous balances created between the cultural and spiritual needs of Hapū and Iwi to their resources. Despite shifts and changes towards more synergistic environmental/engineering activities, detrimental modifications of natural waterways are still made across the region. For shareholders of Māori lands and waterways to sea, within economic operations of two tribally based, large-scale, dairying operations with coastal pine forestry blocks between the Ōhau and Waikawa Rivers, there has been a quantum shift in attitude about farming sustainably, particularly since positive changes have been made to the Ōhau River "Loop" system paid for by Horizons Regional Council or for wetlands systems to Waikawa, whereby protective covenants have been extended by the Minister of Conservation. However, where land tenure has changed and access to waterways for collecting watercress or resources from streams as former mahinga kai has been restricted, there has been an accumulative loss with detrimental effects on Hapū kaitiaki, through inability to harvest and express manaakitanga as hosts at their local marae.

Since 2010, more kaitiaki within the case study region are now much more aware of the range of environmental threats, stressors for fresh waterways to sea and impacts on related biota. Through the hīkoi method (where teams walked within and around ecosystems over 25 times), the groups witnessed first hand, the direct effects of reactive nitrogen on ecosystems, where water ways are no longer touchable. Teams of walkers have seen the

⁴¹ Toheroa [*Amphidesma ventricosum*], tohemanga [*Oxyperas elongata*]

detriments of acidification and de-oxygenation effects on soils and fresh water systems; eutrophication in lakes and coastal ecosystems to sea with invasions of nitrogen loving weeds; nitrogen saturated soils from stock urine; spread of oxygen-depleting aquatic plants in wetland lakes; and the associated biodiversity losses and changes in abundance of beneficial soil organisms.

All effects have contributed to ecological decline and the destruction of mauri in the coastal to marine environments within the case study. For example, whilst many positive changes have been enacted at the coast, it is in the wider Kuku region to the foothills, where non-point source pollution from other farming systems still remains the most significant risk to the coastal environment and to the future of farming in the region itself. Catchments like the Kuku Stream, from mountains to sea indicate clearly that where the stream reaches the Ōhau River, a community wide endeavor of kotahitanga (coming together with common purpose) is required to sort poor water quality issues out. In the *Ōhau “Loop” Phase 1: Existing Status and Recommendations for Improvement* report (Allen *et. al.* 2011) it was reported that the Kuku Stream has high nitrate and *E. coli* concentrations relative to both the Ōhau River and the “Loop”. It is another waterway requiring close care and rehabilitation.

2.9 Local, Regional Councils and Water health

With other waterways in the case study region, Horizons Regional Council and Horowhenua District Council target the Waiwiri Stream and Waikawa River catchments for improvement. For example, in the operative Horowhenua District Plan,

Lake Papaitonga (61.8 ha), also known as Waiwiri, is a dune lake surrounded by indigenous forest, which together makes up the 122ha Papaitonga Scenic Reserve administered by the Department of Conservation. The Lake contains two islands, Motuklwi and Motungarara; these were previously named Papaitonga and Papawhaerangi. Motungarara is an artificial island created by Muaupoko in 1820. The Waiwiri Stream is the outlet to the lake and crosses the 4.8 km of sand plains and farmland to the coast. Lake Papaitonga and Waiwiri Stream are highly interdependent in terms of their hydrological balance and ecological health. For Iwi, the lake and stream are inextricably linked as components of one system, connecting the lake and sea, and providing for the seasonal migration of fish. Consequently, both landscape features are considered to form a single Outstanding Natural Feature and Landscape (ONFL).⁴²

The Horizons Regional Council also offers a snapshot of water quality that is of interest to our case study. It highlights Lake Horowhenua and Waikawa Stream as follows:

Lake Horowhenua = Very poor. Lake Horowhenua is a coastal dune freshwater lake with significant biodiversity values. Historically the lake was affected by Levin's sewage discharge, which was halted in the 1980s. There are ongoing issues with the phosphorus, which remains in the lake from this contamination. Although faecal contaminants are low, the lake's extremely high nutrient concentrations mean that recreational use is often inhibited due to frequent toxic algal blooms.'

⁴² Sourced from URL 7 July 2014

<http://www.horowhenua.govt.nz/Documents/District%20Plan/Plan%20Changes/Natural%20Landscapes%20and%20Features%20Review%20August%20202011>

Waikawa Stream = Good, significantly degrading to poor. Waikawa Stream has exceptionally good water quality in the headwaters in the Tararua Forest Park. It is home to very high quality native fish communities. The stream degrades significantly as soon as it hits the lowland pastoral area and contains high levels of nutrients and faecal contaminants. Suitability for swimming is often affected by faecal contaminants and blue-green algal blooms.⁴³



Figure 2.9.1: Supportive Horowhenua District Council officials from the Planning team, Conservation Corp volunteers (organized through Landcare New Zealand) and kaitiaki planting along Ōhau River “Loop” on Tahamata farm. (Photograph: Moira Poutama, 25 July 2013).

The MTM team recognizes the efforts of other neighbouring tribal authorities such as Muaūpoko Tribal Authority’s work with Lake Waipunahau (Horowhenua), and other whanau groups who are working with Ngāti Pareraukawa over the lake and Hōkio Stream. A report was released on 14 October 2014 that explains the extent of those relationships and partnership activities over their natural taonga tuku iho.⁴⁴ The team acknowledges the Lake Horowhenua Accord as another process underway. The MTM team (through Taiao Raukawa) leaves these entities to deal well with the rehabilitation of the lake.

2.10 Subdivisions and Access ways on coastlines

In recent years, pressures from proposed and actualised coastal peri-urban developments have lessened somewhat within the operative district plan. For example, in POLICY CL.7, the District plan highlights the need to protect the landscape, natural, ecological, historic heritage and cultural values of the Coastal Lakes landscape, particularly Waipunahau (Lake

⁴³ <http://www.horizons.govt.nz/about-us/who-what-where/news/water-quality-top-priority/a-snapshot-of-water-quality-in-the-horizons-region/> Sourced 31 July 2014.

⁴⁴ Daphne Luke, et. al, 2014, *Te Aho: The Woven Strands*, Te Arahanga o Ngā Iwi Limited, Ōtaki.

Horowhenua) and Waiwiri (Lake Papaitonga) and their surrounding areas, from inappropriate subdivision and land development.⁴⁵

This HDC assessment also concluded that the Outstanding Natural Features and Landscapes (ONFLs) of the District are as follows:

- The Tararua Ranges and including the Skyline of the Tararua Ranges
- Lake Horowhenua, Moutere Hill and the Hōkio Stream
- Lake Waiwiri (Papaitonga) and the Waiwiri Stream
- The Manawatū River Estuary
- The Coast including the fore dune and adjacent dune lands.⁴⁶

There is a consented subdivision known as Muhunua Forest Park⁴⁷ or Ōhau Sands at Muhunua, on the coast from Ōhau township, and another proposed walkway to sea (*e.g.* the Muhunua Beach Accessway or Woods Way, Ōhau) in between neighbouring coastal areas no longer in Māori land tenure. The subdivision coastal block is owned by the Woods family from Wellington. The adjoining river side property was owned by the Acland family from Wellington and Ashburton (Te Wai Pounamu/South Island).⁴⁸ The coastline at Muhunua and Waiwiri has always been inaccessible to the public, however with a consented subdivision with two proposed accessways for the proposed 15 lots, an esplanade strip and another public coastal access walkway development underway, these ventures will increase human access to sensitive coastal dune systems. Each will have an affect on associated coastal dune vegetation, the dune wetland areas and their special qualities. There are also potential affects on hidden archaeological information or spiritual significance within cultural landscape at the coast.

At the time of the commissioners hearing for the Woods family subdivision in December 2010 (and for the later decisions made by HDC Committee) Ngāti Kikopiri were not happy with the potential impact upon the Ōhine wetland or lagoon, the former Kainga Pipi mahinga mataitai (a significant cultural occupation and harvest area) and other archaeological information within the dune systems. Kikopiri representatives were present at all informal pre-hearing meetings as active kaitiaki or guardians of the region, despite land tenure changes. It remains lamentable that Iwi and Hapū have become disassociated from cultural significance within this landscape for a variety of reasons – the legacy of colonial regimes, alienation of lands, migrations, reinterpreted histories, or more recently, the disturbances that occur when ancestral landscapes are appropriated for development. The means for protecting historic places in Aotearoa New Zealand remains weak, compared with many other countries. In particular Māori cultural and spiritual values in landscape are often over-ridden, with incentives for better protection almost entirely lacking.⁴⁹

45 Sourced from URL 7 July 2014 <http://www.horowhenua.govt.nz/Download/?file=/Documents/Resource%20Consents/District%20Plan%20Review/Proposed%20District%20Plan%20-%20Decisions%20Version/Part%20B%20Combined%20Clean.pdf>

46 *ibid*

47 Taiao Raukawa opposed this subdivision based on archaeological and cultural landscape concerns.

48 The block containing Tirotirowhetu pā site of significance was sold by the Acland family to a local business person in early December 2014. Tahamata farm made a valiant attempt to purchase this significant block however timing of the sale for the farm's better business was not conducive.

49 S. M. Smith, 2007, *Hei Whenua Ora: Hapū and Iwi approaches for reinstating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North, 143.

Any current and future planning needs to consider all sensitivities for the Ōhau River coastal blocks. Particularly Tirotirowhetu pā site on the northern bank where the Ōhau River turns south is an area of cultural significance for ahu otaota (middens). There is also general specialness for the related Kainga Pipi area further north of Tirotirowhetu site. These places are known to associated Iwi and Hapū and must be protected according to heritage protection mechanisms within heritage and resource management laws.

2.11 Associative landscapes

The MTM team understands landscapes as embracing layers of association, which intensify the relationships between people and their areas. This means that cultural landscapes warrant unique protection and management, with mitigating measures⁵⁰ firmly in place. It was on this basis concerns Taiao Rauakwa trustees worked closely with Horowhenua District Council in 2012 towards alleviating such concerns. Therefore, according to Horowhenua District Council's revised Objectives/Policies: Coastal Environment Chapter in Horowhenua District Plan (Proposed - Decision Version) 2013, paragraphs were added to recognize cultural attributes:

'The coastal landscape contains a significant number of archaeological sites and sites of particular cultural value to Iwi resulting from the historical pattern of settlement of the area. The local coastal areas are of great significance to Māori both spiritually and as a source of food, weaving and carving materials. Over time land use and development activities have reduced the coast's natural values and its ability to provide food and other resources. Coastal resources continue to provide sustenance and identity to coastal Māori. Māori regard the coastal environment as 'baskets of food' providing kaimoana. As a food source, the coast needs to be treated with respect. Sand dunes contain many important cultural sites including middens and urupa (burial grounds) reflecting historical activities. These sites are very significant spiritually to Māori. Inappropriate subdivision, use and development within the Coastal Environment have the potential to adversely affect the values, which make the Coastal Environment of such great significance to Māori.

Protected customary rights provide recognition and protection of Māori customary activities, uses and practices that are exercised in the common marine and coastal area. A customary rights order is an order made by either the Māori Land Court or the High Court over an area of the public foreshore and seabed. A customary rights order will recognise a particular activity, use or practice that has been carried out on an area of the public foreshore and seabed since 1840. Each customary rights order will clearly define the type of activity, use or practice, and its scale, extent and frequency. Activities carried out in accordance with customary rights orders are known as recognised customary activities under the RMA. Section 6 of the RMA includes "the protection of recognised customary activities" as a matter of national importance that shall be recognised and provided for when exercising functions and powers under the RMA. Resource consent is not required for recognised customary activities. Of particular importance to Council is ensuring that appropriate access to the common marine and coastal area is available to those with customary rights so that these customary activities can be continued. It is noted that there are parts of the Horowhenua Coastline that are privately owned some of which is Māori customary land or Maori freehold land. The presence of

50 Miranda Sims & Michelle Thompson-Fawcett, 2002, 'Planning for the Cultural Landscape' in Kawharu, M., 2002 (ed.) *Whenua: Managing our Resources*, Reed: Auckland, 257-258.

recognised customary activities in coastal areas will directly influence how the Coastal Environment is managed and used'.⁵¹

Currently, recreational 4 x 4 vehicles or trail bikes access the coastal region from Hōkio, Waikawa and Ōtaki beaches. These vehicles continue to put oystercatcher and black-backed gulls' nests in the foreshore sand dune systems at risk. Increased vehicular access compresses the wet inter-tidal sands, which puts at risk:

- Toheroa [*Amphidesma ventricosum*],
- Tohemanga [*Oxyperas elongata*],
- Tuatua or kahitua [*Amphidesma subtriangulatum*] beds in the foreshore region and kokata [*Amphidesma australe* or *Paphies novaezealandiae*] under pressure.
- Native covers like Māori or native musk [*Mimulus repens*]
- Ureure or glasswort [*Salicornia quinqueflora*]
- Carpets of sea primrose or shore pimpernel [*Samolus repens*]
- Dune stabilisers like piingao [*Desmoschoenus spiralis*] Spinifex [*Spinifex sericeus*], tauhinu [*Cassinia letophylla*] and shore bindweed [*Calystegia soldanella*]
- Other endangered plants that survive amongst the marram grass.

The interplay of activities listed in this segment of the report have all contributed to the decline of remnant ecological integrity across the coastal region. Indigenous resources or local delicacies have disappeared from coastal waterways, streams, lagoons and dune wetlands once considered vital to Hapū wellbeing. Therefore all MTM efforts focus on key solutions required within this complex of accumulated impacts.

2.12 Methods of Hīkoi - Wānanga

All MTM teams from each participating entity work directly with Te Manaaki Awanui, other agencies and local communities to harness and build on the knowledge of Objective 1. Each team supports each other 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?'

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

The six detailed case studies in the Horowhenua region are based on topics of importance to local Iwi and Hapū, where the Horowhenua MTM team has developed methods that enhance and restore specified coastal ecosystems and their services. We refined the methodologies of addressing obvious coastal ecosystems' decline and their services by prioritizing ecosystems by undertaking many hīkoi (walking talking hui) from November 2010 through to March 2014, particularly as part of the Landscape Architecture students and their community/student learning engagement with MTM that led to co-funded wānanga at

51 The author of this report along with representatives from Taiao Raukawa and other Iwi Trusts/Authorities worked with Horowhenua District Council in 2012, to prepare chapters for the District Plan review, which included a strengthened Māori focus across the plan. (Horowhenua District Plan (Proposed - Decision Version) 5-1- Version: 16 October 2013).

marae, held at Kikopiri at Muhunua, Tukorehe at Kuku, Te Pou o Tainui and Raukawa at Ōtaki, which has developed into Kei Uta: Compelling Alternatives opportunities.

The MTM team has worked closely with other environmental groups such as Forest and Bird and Waitohu Stream Care Group for bird count monitoring, and local and regional councils. To this end, HDC's wastewater specialists have been undertaking complementary-focused research, with their flow gauging/water quality report for the Levin Waste Water Treatment plant, known locally as 'The Pot'.

This co-aligned research forms part of the updating of results required for renewed resource consent to Horizons Regional Council. The HDC research has been developed out of our research collaboration with them over the microbial source tracking and poor state of the Waiwiri Stream from lake to sea (Allen *et.al* 2012). At present, HDC are working with Olivier Ausseil and Cawthron Institute on this project. As recommended by the author of this report, Tene Tangatatai (Rarotongan Māori, Te Ngare a Huia of Ngāti Kikopiri, Ngāti Tamatera and Ngāi Tūhoe) has agreed to work with HDC to help out from a Hapū perspective. Tene is also very knowledgeable on the cost benefit analysis of riparian planting for this catchment.

Objective 3: Implementation and Benefit Transfer to other Iwi and

Both Tauranga Moana and Ngāti Raukawa ki te Tonga (with neighbouring Muaūpoko) have catalogued the poor state of many coastal ecosystems and resources in their rohe. The teams also include their documentary work on recollections of tribal elders and resource gatherers who talked of abundant kaimoana found 20-40 years ago, but not today. A condition of our research programme and commitment is that our research must activate real changes in the state of coastal ecosystems in respective rohe.

To this end, the Iwi and Hapū groups in both case study regions, through this MTM research programme have implemented a series of activities to address the range of declining trends. They have put in place many Action Plans and other mechanisms to improve the quality of the coastal environment. The remaining Horowhenua action research projects are described in more detail for the rest of this report.

3. ACTIONS FOR EACH MTM PROJECT WITHIN THE HOROWHENUA CASE STUDY

3.1 Waiwiri Stream, from Lake Waiwiri (Papaitonga) to sea

For the first hīkoi (walking/talking hui) of the case study, the newly convened MTM teams walked from Waitohu Stream, Ōtaki to Ōhau River over a 2.5-day period, from 11-13 November 2010. The group camped at Lake Waiorongomai on the Friday evening, then walked around the lake and along its stream to coast, into the Strathnaver Drive to Waikawa settlement, through the Waikawa coastal dune fields and onto the former shared river mouth or harbour at lands governed by Pekapeka Taratoa Ahuwhenua Trust. The former harbour lies between Incorporation of Ransfield's and Tahamata Incorporation- two Māori shareholder farms at the coast between Ōhau and Waikawa Rivers. From this vantage, the group walked along the dune ridgeline towards the back dune wetlands that run from Kuku towards Waikawa. After an overnight rest in the comfort of 658 State Highway One whare at Kuku, the teams were up early on Sunday 13 November 2010 to continue along the estuary

and up the Ōhau River to the Tahamata Incorporation bridge, overlooking the Ōhau River. After the second hīkoi in February 2011, in close collaboration with local tāngata whenua (including Hapū of Ngāti Kikopiri, Ngāti Hikitanga and neighboring Muaūpoko) the research team ascertained that poor water quality in Waiwiri Stream was a priority for investigation.

Revered in recent memory by kaumātua as an abundant food resource, the Waiwiri coastal foreshore adjacent to the mouth of the Waiwiri Stream once provided local Hapū and kaitiaki with a plentiful supply of shellfish, including toheroa. The area remains a highly significant cultural region to tangata whenua despite land tenure changes, for the range of Māori cultural and heritage landscape reasons. At the coast, the Waiwiri Stream opens onto the coastal foreshore, where kaumatua and kaitiaki told of once abundant eel harvests, shellfish fisheries and seasonal summer harvests for preparing and drying shellfish resources in the sheltered lee of the fore-dunes.

In the months following the investigative hīkoi along the coast, the main coastal issue for tangata whenua was the demise of collective, coastal mahinga mataitai practices like customary fishing or hauling at sea, the loss of mahinga kai, the barriers and pollution affects on tuna heke (tuna/eel migrations) and the inability to harvest shellfish that also took place at mahinga mataitai. Anecdotal evidence also suggests that the Waiwiri stream has suffered severe ecological degradation in the past 35 years, with acceleration noted since 2002, reflecting the cumulative effects of loss of riparian vegetation, sedimentation, increased nutrient and faecal loading in Lake Waiwiri (Papaitonga) catchment to sea.

The MTM collaborative agreed that the Waiwiri Stream (next to the shorter Waiorongomai Stream) was the most visually, degraded stream outlet between Hōkio and Waitohu Streams. In February 2011, the hīkoi team were appalled by the thick brown-black sludge that had settled around areas of the stream mouth that summer, which had not been seen to that extent elsewhere within the wider case study area. Such waterway pollution by effluent exacerbates negative affects that often manifests in Hapū and whānau dysfunction.

Similarly, by depleting various coastal species there is an associated loss of mana for local Hapū and whānau not being able to provide delicacies for sustenance and health at marae. Kaitiaki recall that since 2002, it has not been safe to collect any kai resources (tuna or shellfish) from the Waiwiri Stream. After discussions with local elders and kaitiaki from Muhunua and Kuku, it was clear that the Waiwiri catchment would be prioritized for microbial source tracking, water testing and the beginning of shellfish health monitoring.



Figure 3.1.1 Waiwiri Stream mouth choked with nutrient enriched celery weed, with former mahinga mataitai (customary food gathering area) on right near pole and area under macrocarpa. (Photograph: Huhana Smith, 12 March 2013)

3.2 Microbial Source Tracking (MST)

With assistance from Cawthron Institute, the MTM research project for Lake Waiwiri and Waiwiri Stream to sea catchment became the pilot study for comprehensive Microbial Source Tracking (MST). The aim of MST was to identify sources of poor water quality that are detrimental to the health of harvested coastal species of high cultural value, specifically shellfish such as toheroa, tohemanga, and tuatua/pipi. The Waiwiri is a relatively small catchment so identifying potential point source and non-point source contamination was easily achieved.

When the final Waiwiri report was released in October 2012, it highlighted in many ways the typical lowland streams in the case study area, flowing out of a shallow dune lake through land that has been highly modified for pastoral agriculture and, in some cases, for forestry and residential development. Pastoral land use is known to lead to such effects in lowland rivers around New Zealand, and has been ascertained as the leading cause for contamination of water in the Waiwiri Stream.

The insights into the source of contaminants such as *Escherichia coli* (*E. coli*), faecal coliforms and specific viral markers were very useful, so far as their approximate location within the catchment and whether they were of human, ruminant or avian origin. Mandated kaitiaki had long expressed concern about the possible contribution of human faecal matter from the Horowhenua District Council effluent pond or the Levin Wastewater Treatment Plant (commonly known as 'the Pot'), which is an artificial pond built on an area of elevated sand dunes approximately 300m from the stream. The unlined pond receives secondary treated effluent via a pipe from the. From The Pot, effluent either seeps into groundwater or is spray-irrigated onto surrounding pine forest at a rate of up to 20,000 m³ per day. Effluent also disperses via evaporation. (Allen et. al. 2012)

Our action research team responsible for water sampling and getting the chilled samples to Nelson, assessed the influence of two land use practices on water quality in the Waiwiri catchment: pastoral land use and human effluent input from 'The Pot'. We looked for evidence of a longitudinal decline in water quality by first interpreting historical data (Allen

2011), before narrowing the focus to look for the presence and likely source of faecal contaminants. Historical water quality data from the catchment were assessed with reference to national and regionally specific water quality guidelines, which assessed the risk posed to either aquatic ecosystems or human health (e.g. ANZECC 2000).

Our historical data gathered indicated that the Waiwiri Stream was in a poor state of health, with total phosphorus, ammoniacal nitrogen, total nitrogen, dissolved reactive phosphorus, carbonaceous biological oxygen demand and faecal coliforms as all above guideline values. Between Lake Waiwiri and the coastal mouth of Waiwiri Stream there is a longitudinal decline in some water quality parameters, that is total coliforms, nitrate and total dissolved solids. Since these parameters are not source specific, the decline may be due to pastoral land use, human effluent input from The Pot, or avian sources (Allen *et al.* 2012). While cattle effluent was the most prevalent marker, any human effluent residue in water is still considered abhorrent to local kaitiaki and the Māori land owners at 'The Pot'.



Figure 3.2:1: Microbial Source tracking from 2011-2012. Sampling locations for microbial tracking effluent in the Waiwiri Stream. Red markers indicate shellfish samples; cyan and blue markers indicate surface water samples from the Waiwiri Stream or a direct tributary, and white markers indicate surface water samples taken from Lake Waiwiri (Papaitonga).

The microbial source tracking project was extremely timely because there were specific locations within the Waiwiri catchment from which the contaminants stemmed. Firstly as mentioned, human markers may enter the stream via runoff or shallow groundwater from the nearby 'Pot' as seen in Figure 3.2:1. Secondly, there are a number of dairy farms within the catchment, where only two farms have their stock fenced away from the stream. Third, there are significant resident populations of swan and Canadian Geese in Lake Waiwiri (Papaitonga), which feeds the Waiwiri Stream. Finally, the influence of larger water bodies such as the contaminant plume from the Manawatū River was also considered.

From the first hīkoi experiences in 2010, to the later series of wānanga with community and student Landscape Architects held between 2011-2014, the visual information collated from these walks and the projects completed by students, have combined to garner effective support for ongoing activities for Ngāti Kikopiri and Ngāti Hikitunga to add benefit to their

rohe. The effort has also strengthened more positive working relationships with HDC and their research. This is a positive move away from previous, less than ideal situations of engagement with HDC executive over 'The Pot', which the MTM team and Taiao Raukawa had witnessed in 2010.

Microbial Source Tracking on shellfish analysis focused on determining faecal bacteria levels and where such pollutants were coming from. Microbial source tracking (MST) was used to link faecal contamination with host organisms to identify the dominant source of faecal contamination and determine if human faecal matter enters the stream. From a cultural perspective, any faecal matter and especially human faecal matter anywhere in the stream is offensive regardless of whether there is 'longitudinal decline'. The inability to manaaki (care for) guests with healthy, local delicacies at marae is a grave loss of mana or standing.

What the MTM team concluded was that human markers were present in two of the 42 water tests and not present in the six shellfish tests. Human markers were found in water from a tributary that enters the stream from land surrounding 'The Pot', indicating that water containing traces of human faecal matter, enters the Waiwiri Stream at this point. The evidence suggests that, relative to other sources, human sources are a minor contributor to faecal contamination in the stream overall. Non-host specific MST results indicate substantial faecal contamination in the stream as well as in shellfish collected at the mouth. High concentrations of ruminant faecal marker and the persistent presence of bovine faecal markers indicate that the dominant source of faecal contamination in the Waiwiri Stream is manure from cows. Ruminant marker concentrations were high at almost all stream sampling sites, but the highest densities were found in the stream, close to the point where it leaves the lake.

3.3 Press release for Waiwiri report, October 2012.

Massey University has joined with the Cawthron Institute and Iwi to produce recommendations to improve coastal waterway quality in the Horowhenua district. Professor Murray Patterson from Massey's School of People, Environment and Planning says water quality in Lake Waiwiri (known locally as Papaitonga) and Waiwiri Stream is poor and has declined over the past 20-30 years.

A recent study investigated sources of faecal contamination and found that, while both birds and livestock appear to be impacting the lake, cattle were the source of nearly all of the faecal contamination in Waiwiri Stream.

"The highest concentrations were found close to the point where the stream leaves the lake. Faecal bacteria from cows were also found in shellfish at the mouth of the stream."

Traces of human faeces were found in a Waiwiri tributary that drains the land surrounding The Pot, an artificial unlined pond that receives effluent piped from the Levin Wastewater Treatment Plant. From The Pot, wastewater is spray-irrigated onto surrounding pine forest and either seeps into groundwater or evaporates.

Cawthron Institute senior scientist Jim Sinner says the study used a technique called microbial source tracking, which uses DNA-markers to distinguish between faecal matter from humans, cattle, birds and other animal sources.

The research was part of the Manaaki Taha Moana (MTM) programme, a research consortium led by Massey University with Taiao Raukawa, (a Ngāti Raukawa ki te Tonga based Māori environmental research organisation) and the Cawthron Institute from Nelson.

The Waiwiri report, by Cawthron Institute scientists (with support from local kaitiaki of Ngāti Kikopiri, Ngāti Hikitanga, Ngāti Tukorehe, Muaūpoko Tribal Authority and Massey), recommends:

- *More fencing and planting of waterways*
- *Improvements to non-compliant agricultural practices*
- *Continued management of Canadian geese on the lake,*
- *Improved management of effluent disposal at The Pot, and*
- *Resumption of groundwater monitoring around The Pot by Horowhenua District Council.*

Dr Huhana Smith of Taiao Raukawa says there are grave concerns about the poor water quality in Waiwiri Stream and along the coastline, and discussions are now underway with the councils and local landowners to address the issue.

In September and October, Taiao Raukawa and other MTM researchers met with local kaitiaki, available landholders, Horowhenua District Council (HDC), New Zealand Landcare Trust, Department of Conservation and Horizons Regional Council to discuss the findings of the report and what could be done.

Some of the Waiwiri catchment is already fenced, to varying degrees of effectiveness, and landholders have been offered financial support to extend fencing, planting and alternative stock water systems.

Dr Smith says the Horowhenua District Council has indicated it will be resuming its monitoring of groundwater in the vicinity of The Pot, as well as investigating the potential to increase the land area over which effluent is sprayed, although this raises sensitivities for tangata whenua.

While the study focused on the Waiwiri catchment, she believes the level of contamination found is likely to be indicative of other streams along this coastline.

"The coastal case study area was once made up of large dune lakes or wetland systems that have been cleared and drained for farming. The coastal areas remain very wet in winter, therefore waterways need more protective buffers."

Local kaitiaki Rob Kuiti of Ngāti Kikopiri says the beaches near Waiwiri Stream were revered in recent memory as an abundant food resource that provided local Hapū with a plentiful supply of shellfish, including toheroa, but this is no longer the case today.

"The inability to offer tuna (eels) and local shellfish from what was once an abundant resource is a grave loss, which we feel deeply every time we have visitors at our marae at Muhunua."

Tipene Perawiti, also of Ngāti Kikopiri, Ngāti Hikitanga and Ngāti Tukorehe, says it is alarming many locals continue to harvest shellfish from these beaches unaware of how contaminated the local waterways are.

"Our whanau know that we have not been able to safely harvest at the mouth of the Waiwiri since around 2002, as the water quality had declined too much. When I was a kid to young adult I used to go there every long summer with my relations. It worries me that I cannot take my moko (grandchildren) there now."

The MTM research programme is also investigating restoration of other waterways along the Horowhenua coast, including: a remnant "Loop" of the Ōhau River (cut off for flood control

purposes in 1972-1974) with Horizons and a local Ngāti dairy farming operation; more protective mechanisms for contiguous wetlands and Māori coastal blocks to Waikawa River with Nga Whenua Rahui of the Department of Conservation; and returning health to Lake Waiorongomai just north of Ōtaki, a dune lake with Kahuwera wetland that has been de-vegetated, drained and farmed for many generations, in co-operation with the local Hapū and landowners.

A study will begin next year to test contamination of shellfish and other effects on abundance and health of shellfish along the 17km beach from Waitohu Stream, Ōtaki to Hōkio Stream, Hōkio.

The MTM team is halfway through a six-year research contract from the Ministry of Business Innovation and Employment, which assists Iwi and Hapū and the wider community to enhance and maintain coastal ecosystems of cultural and natural significance, for the mutual benefit of all. The project also includes a case study in Tauranga harbour with Tauranga Iwi and Hapū, and WakaDigital, an IT company.⁵²

3.4 Taking action for listed recommendations

As highlighted in the press release and the 2012 Waiwiri Stream health report, the key recommendations for restoration include:

- Riparian fencing and planting
- Improving management of effluent irrigation to land surrounding 'The Pot'
- Improvements to non-compliant agricultural practices in the catchment
- Continued management of populations of Canadian geese around the lake
- Resumption and continuation of groundwater quality monitoring around 'The Pot' (which started again with HDC from 2013).

From all of the above recommendations, the team also encouraged as much capability development through local Iwi and Hapū participation in the Waiwiri Stream and Lake data collection, the water testing collection and sending of samples, and shell fish monitoring. MTM team encouraged local customary fisheries kaitiaki to be involved. This author also had meetings with a key trustee from the Māori owners group of 'The Pot'. Despite Peter Ashford living in Perth, he remains a strong advocate for active Hapū participation in improving the Levin Wastewater System at Waiwiri, from a Muaūpoko and Raukawa ki te Tonga, perspective.

In direct relation to the local council resuming their groundwater quality monitoring around 'The Pot' too, Tene Tangatatai became a summer intern on MTM for 2012-2013. She too is engaged with a series of hui and possible future research to determine better outcomes for 'The Pot'. With a BBS majoring in Accountancy and Finance, a Graduate Certificate in Science and Technology and a Postgraduate Certificate in Planning, Tene submitted her Masters in Environmental Science, in July 2014.

⁵² Sourced on Monday 30 June 2014 at

http://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=7BD22AF3-9C85-D485-666F-E7E3C0E388B0

Tene focused on the issues facing the Waiwiri and Waimarama Stream catchments in Muhunua, Ōhau. Tene worked with others from Massey on the MTM-related project to examine the economic, ecological and socio-cultural costs and benefits of riparian planting on coastal waterways. She uses her skills and qualifications to contribute to increasing health of the environment and advancing sustainable development, especially for her papa kainga or main home base, Muhunua, near Ōhau.

Tene's Masters research focused and her abstract reads as follows:

'Freshwater ecosystem health is an important policy priority in New Zealand, recently highlighted by the government's launch of the 'Freshwater Reform 2013'. One practical way of improving freshwater ecosystem health is riparian planting. In this context, the aim was to develop and apply a cost benefit analysis (CBA) methodology to evaluate riparian planting options for restoring five freshwater coastal streams of importance to Iwi/hapu in the Horowhenua, drawing on two distinct disciplines – freshwater ecology and economics.

Essential to this CBA methodology was an explicit evaluation of a desired policy outcome. Accordingly, attention was given to assessing what constitutes the desired policy outcome that is 'freshwater ecosystem health of coastal streams'. This assessment was based on developing a detailed understanding of the attributes that must be managed to achieve 'freshwater ecosystem health' including: in-stream temperature, periphyton, sediment, water flows, ecological connectivity, nitrate and ammonia, key fish species and stream invertebrates. The CBA methodology then focused on developing a new systems framework (interrelated ecosystem 'biophysical structures', 'processes' and 'functions') for assessing the ecological role of riparian vegetation in improving freshwater ecosystem health.

Non-market economic values required for CBA calculations were then derived using a benefit transfer method. Data from three study sites (Karapiro South Waikato, Hurunui Canterbury, and Canterbury) based on 'choice experiment' values were evaluated for their suitability for use in the policy site (Horowhenua). The suitability of data from study sites for use in the policy site applied the Welch T test and Wilcoxon rank sum, using 'personal income' as the assessment criterion. Over 100 hundred planting scenarios were then tested by CBA, with almost all having positive net present values for both 5m and 10m width planting options.

The study concludes with a discussion of the practical and policy implications of these findings, and highlights the limitations of this study and how these can be overcome in future research ' (Tangatatai: 2014).

While Tene was an MTM team member whilst completing her Masters, in August 2014 she accepted a position as Ranger in Department of Conservation's Partnerships team at the Palmerston North office. With support from this author as a referee, DOC was particularly delighted with her skill base in cost benefit analysis and how this might benefit Iwi and Hapū and other groups in active kaitiakitanga. DOC is also keen on how cost benefit analysis might also help drive change for local and regional authorities, landholders and multi-entities, working more effectively together.

3.5 Waiwiri stream mouth

An additional plan to alleviate impacts for the Waiwiri catchment has been funded by He Tini Awa Trust through Horizons Regional Council. Māori landowners on the northern side of the Waiwiri stream mouth will undertake the primary work in April 2015. The plan is to fence the

coastal back dune wetland area off to prevent any non-owner accessing the land for no recompense to the whanau trust owners; prepare the site with pest weed control; create a comprehensive pest control regime, and to prepare large amounts of harakeke from the wetland site for replanting along the Waiwiri stream's riparian margins.

In the wet foot region of the block, sedge and jointed rush are likely to be dominant, in association with marsh bedstraw, bachelor's button [*Cotula coronopifolia*], water forget-me-not, [*Myriophyllum propinquum*], clustered dock, and [*Persicaria decipiens*]. There is likely local Swamp buttercup [*Ranunculus macropus*] and water celery [*Apium nodiflorum*], [*Juncus effusus*], and [*Carex ovalis*] present. Spike sedge [*Eleocharis acuta*], tussock sedge [*Carex maorica*], creeping buttercup, water celery, raupo [*Typha orientalis*], the native annual herb [*Persicaria decipiens*], rautahi or cutty grass [*Carex geminata*] are locally common. Sedge and sweet grass are common, in association with creeping bent and scattered leafless rush [*Juncus effusus*]. Other species present include: creeping buttercup; tall fescue; paspalum; yorkshire fog; dock, and marsh bedstraw. Raupo is dominant in the reed land with scattered harakeke over Pōhue or bindweed [*Calystegia sepium*], lotus, and yorkshire fog, with local creeping buttercup, and a few toetoe, [*Cortaderia toetoe*], yarrow [*Achillea millefolium*], and toetoe upoko-tangata [*Cyperus ustulatus*]. Harakeke and toetoe are common over bracken, baumea [*Baumea rubiginosa*], lotus, and swamp kiokio [*Blechnum novae-zelandiae* s.s.] in association with the rhizomatous herb [*Cyperus*], yorkshire fog, creeping Pōhuehue [*Muehlenbeckia complexa*], Mingimingi [*Coprosma propinqua*], Hukihuki [*Coprosma tenuicaulis*], spike sedge [*Carex secta*], tussock sedge [*Carex maorica*], with some tī kouka [*Cordyline australis*]. Harakeke stands 2-3 metres tall and is common around the wetland margins over kuawa [*Schoenoplectus tabernaemontani*], over Pōhue or bindweed [*Calystegia sepium*], lotus, bracken, and cutty grass [*Carex geminata*] and a few Mingimingi [*Coprosma propinqua*], and karamū [*Coprosma robusta*]. Raupo and kuawa [*Schoenoplectus tabernaemontani*] are dominant over [*Carex secta*], yorkshire fog, lotus, and swamp kiokio [*Blechnum novaezelandiae*]. As water ponds in depressions following heavy rainfall, sedge is dominant there with scattered soft rush and occasional gorse. Other species include Jointed rush [*Juncus articulatus*], yorkshire fog, catsear, browntop, kopakopa [*Plantago australis*], creeping buttercup, and lotus.

In talking with the nearest Waiwiri Stream neighbour to the Māori owners in February 2013, (name withheld), he generally approves of the amelioration project at the Waiwiri mouth region within the Māori block, but does not agree for any such work to take place on his southern, neighbouring property. He is keen to see Horizons engineering teams continue to access the Waiwiri Stream for "drain clearing", as he calls it. While his area is fenced off from stock to a certain degree of effectiveness, he is not keen on riparian buffers on his property and wants to see a five-metre zone kept clear for the digger to access. The next neighbour (name withheld) also wants to maintain the digging/clearing regime and is not open to any riparian native buffers at all. Ongoing high-level dialogue needs to be had with landholders and Horizons Regional Council over this kind of engineering "requirement" that runs counter to waterway rehabilitation and the recommendations in the Waiwiri Stream report that listed actions for improved waterway health.

In writing about challenges, Craig Mitchell, Group Manager Environment Management for Horizons Regional Council and Trustee for He Tini Awa Trust remains very supportive of the MTM projects in the region. He and the HTA Trust can clearly see that the Waiwiri Stream

mouth project aims to help ameliorate the ill effects of human and cattle effluent contamination in water and in shellfish at the coast. He and his team support a protective native buffer to poor water quality within the Waiwiri Stream itself.

In September 2012, Craig Mitchell was also a key player in the MTM team's series of collaborative discussions over the poor water results for Waiwiri. More recently he commented positively in a letter of support for possible Community Environment Funding (CEF) from the Ministry for Environment in 2013,

"I can personally endorse Taiao Raukawa's track record in research, their professional, collaborative approach to research and the respect paid to all participants, their attention to project detail and financial transparency and careful use of funds. I was present at the Waiwiri series of hui in late September 2012, over the Waiwiri report that highlighted water and shellfish contamination by cattle then human effluent. The team tackled the difficulties in alerting different landowners with aplomb, whereby it was not a 'shame and blame' exercise but a 'how to bring them on board with respect' to their farming needs."

What Craig also highlights is the time taken by the MTM team to bolster Māori values in relation to environmental problems, by exercising manaaki (showing care and respect) for all landholders and kaitiaki of interest, in matters that affect them. For the team, it was crucial to wānanga (engage in intensive learning exercises) and bring all participants together, for face to face dialogue or via email or phone (as was the case for two landholders) over Waiwiri catchment. Each participant was welcome to go through the documents created, to debate and question aspects, seek clarification, improve key messages, but also be part of the solutions-focussed outcomes.

A whole-of-catchment rehabilitation for the Waiwiri stream and immediate lands surrounding Lake Waiwiri (Papaitonga) is required to enhance overall surface and subsurface waterway quality. Farmers and market gardeners need to work together to alleviate the impacts their economies are having on water quality. Considerable integrated work is required by all groups to rehabilitate habitat for freshwater species such as tuna (eel). For coastal areas too, once considered of high cultural value for seasonal harvest of kai moana (specifically toheroa, tohemanga, tuatua/pipi and kahitua), it is vital that all landholders and users along the Waiwiri catchment build consensus and work together to implement solutions based on the recommendations in the Waiwiri research report findings.⁵³

As mentioned, the HTA-funded Waiwiri mouth project with kaitiaki of Ngāti Kikopiri, Ngāti Hikitunga is rescheduled for 2015. Taiao Raukawa and its MTM team will continue to work closely with: Tene Tangatatai and her role at Department of Conservation; Horizons Regional Council; Horowhenua District Council; local landholders (if willing), and other responsible entities. Taiao Raukawa administers any contracts related to this HTA project, and tracks and records project progress.

53 As mentioned, Taiao Raukawa have good working relationships with Horowhenua District Council and Horizons Regional Council. HDC Technical experts for the Levin Waste Water Treatment Plant, Taiao Raukawa, Cawthron Institute, local Trustees for the Māori owners and local Kikopiri kaitiaki have been discussing research opportunities on groundwater. HDC have a flow-gauging project underway with Hamish Lowe of Lowe Environmental based in Palmerston North. Oliver Ausseil is working with Cawthron Institute on additional water quality work. It has been signaled that a local Hapū researcher(s) be added to the research group.

3.6 Collaborating with Department of Conservation for Buffering Lake Waiwiri and stream.

Since MTM started, a series of visually rich IBooks have been created around Lake Waiwiri and along the Waiwiri stream since the first walks took place with DOC, key staff and other communities of interest.⁵⁴

The current work undertaken by Department of Conservation in the Lake Waiwiri/Papaitonga region builds on the purchase of the land that took place around 3 years ago, to the west of the existing reserve. Since that time, DOC has undertaken weed control in the purchased area especially around the natural forested areas, as old man's beard and woolly nightshade are a particular problem. DOC staff have fenced along the northern side of the land acquisition including a new fence along the previously unfenced boundary and an upgrade of the current fence to make it stock proof.

On the 11 June 2014 a new weir was installed, following a lengthy consenting process. This is functioning well and has increased the surface water area, which will hopefully lead to less fluctuation in the lake's level. DOC has eco-sourced plants from the reserve and have around 1800 available for planting in the acquired area, in the coming months. Along with these listed tasks, DOC keeps the public track infrastructure maintained, with any rubbish removed whenever the site is visited for operations. DOC continues with possum and rodent control in the forested area of the reserve, filling bait stations on a 3-month rotational basis. This has been ongoing since 1996. Weed control is undertaken every summer with three to four weeks of dedicated staff time allocated to this work, an important task that has been ongoing since 1999. Mustelid traps were set up around the entire reserve in 2013 and have proven effective in eradicating these damaging animals to the Lake Waiwiri/ Papaitonga bird populations.⁵⁵

3.7 Collaborating with School of Architecture and Design, Victoria University, Wellington

MTM regards indigenous approaches to active katiakitanga in our highly fragmented modern natural/cultural landscape, as highly significant, not only for research on ecological restoration but for multi-disciplinary orientations that encompass species, community *and* ecosystem restoration.

Historically, Māori culture has survived by being intimately coupled in a co-evolutionary sense with the wellbeing and survival of natural ecosystems. One goal cannot be achieved without the other. Therefore, from our Māori worldview, ecological restoration efforts involve human intervention in a highly complex, socio-cultural-ecological system. Efforts will ultimately founder if we fail to acknowledge human relationships with the natural and cultural landscape, with place, and with the sacred realm. The implication of this for tāngata

⁵⁴ Titles of these visual documents include: MTM Hikoi Tuarua: From Ōhau River to Hōkio Stream 19-20 February 2011; First Waiwiri Walk with Craig Allen (Cawthron Institute), Tipene Perawiti and Huhana Smith (Manaaki Taha Moana), 22 June 2011; Lake Waiwiri Walk, 25th October 2011, and Hapaitia te Mauri o Waiwiri/Waiwiri water testing and shellfish sampling, 2011 and 2012.

⁵⁵ Personal communication with Clint Purchase, Department of Conservation, with Email correspondence dated 7 August 2014.

whenua is unmistakable.⁵⁶ Previous papers chronicle the experience of MTM linking with the School of Architecture and Design, Victoria University, Wellington,

‘Given that Aotearoa New Zealand is recognized as a bicultural country with indigenous knowledge bases and that a country’s landscape is a reflection of its culture, one would expect to see more evidence of Māori influence in its cultural and public landscapes. However, apart from the shift to a greater environmental awareness reflected in the ‘greening’ of most urban centres, and increased focus on place and sustainability precipitated by the Resource Management Act 1991 (RMA), there is very little in designed landscapes and public spaces that better reflects the status as a bicultural nation.’⁵⁷

3.8 Our Methodologies

The wānanga method encourages kaitiaki to work collaboratively with the students from the four research areas of Waitohu/Waiorongomai, Waikawa, Kuku/Ōhau and Waiwiri regions, to determine the best visual design and plans that might actualise environmental/cultural landscape enhancement projects. The wānanga also engages with kaumatua and kaitiaki/resource gatherers’ knowledge of place, the marae, tikanga and associated Māori relationships to the environment despite considerable loss of natural integrity for lands and waterways.



Figure 3.8.1: On a rainy day, Clint Purchase, (DOC) Vina Quartermain, Winston Dewhirst, and Larry Parr (his back), part of Landscape Architecture group overlooking Lake Waiwiri (Papaitonga) and area to be re-vegetated as part of DOC’s plans for the region. (Photograph by Huhana Smith, 5 March 2014).

External experts’ provide seminars and visual presentations, which are held on the first, four mornings of the week-long wānanga, followed by series of hīkoi or walking/talking hui of the region. The evenings and final days are dedicated to students getting their initial ideas down and articulating them to the class with local kaitiaki taking part. Key features of the *Rae ki te Rae* research wānanga are to integrate economic, environmental, cultural and social factors; interweave mātauranga, indigenous and local knowledge of place; encourage interdisciplinary activities; work cross-culturally; use applied/problem solving techniques and be technologically innovative.

⁵⁶ H. Smith, (2008, 2012) *Hei Whenua Ora ki Te Hākari: Reinstating the Mauri of valued ecosystems—history, lessons and experiences from the Hei Whenua Ora ki Te Hākari/Te Hākari Dune Wetland Restoration project*, Ngā Māramatanga-ā-Papa (Iwi Ecosystem Services), Research Monograph Series, (FRST MAUX 0502).

⁵⁷ Allen, P. & Smith, H., (2013) ‘Research at the Interface: Bicultural studio in New Zealand, a case study’, *MAI: A New Zealand Journal of Indigenous Scholarship*, Vol 2: 2, Victoria University, Wellington.

Over the years of engagement, Associate Professor Penny Allen, tutor Jaime Macfarlane, Research Leader Māori Dr Huhana Smith and researchers Moira Poutama and Aroha Spinks have improved on the wānanga model that began in 2011. Most recently in 2014, the team made further modifications whereby the students focussed on two areas - Waiwiri and Waiorongomai. The two student groups for each area attended a four day wānanga. They then caucused each region collectively back in the design lab in Wellington, before branching off to bring their own ideas to fruition. During the development period the MTM team visited the lab for student crits and attended the final presentations. In June 2014, other experts were invited including local kaitiaki Heni Collins (Ngāti Kikopiri) and harakeke expert and conservator of Māori textiles or Whatu Rananga, Rangi Te Kanawa (Ngāti Maniapoto).



Figure 3.8.2: Students at 2014 Wānanga, walking around Lake Waorongomai. (Photograph by Huhana Smith, 6 March 2014)

The wānanga method brings local kaitiaki together with students and senior staff, and external experts in coastal processes and hazards; ecosystem services and environmental economics; biodiversity, local/regional government and archaeology/seismology. Ecosystem revitalization, when drawn from local knowledge relies upon a sense of promise of well being to come. When kaumātua and resource gatherers offer what they know of place, their stories of encounters with local taniwha, spiritual guardians, or protocols observed around special places in coastal estuarine, dune lakes and wetland regions highlight a value system that stresses respectful interaction with the natural and cultural environment.⁵⁸ Because these values remain fundamental for forming principles and guiding philosophies for culturally based sustainable development, practical environmental projects cement closer relationships with lands and waterways. Current generations renew and enhance their understanding about the true significance of the cultural landscape, waterways and ecosystems that they are dealing with. Together with these experts they help determine best solutions for environmental rehabilitation activities for this distinct, cultural and coastal landscape.

Whilst writing this report our engagement with School of Architecture and Design resulted in a runner up merit award for the team at the International Exhibition of Landscape Design Works from Schools of Architecture And Landscape, based in Barcelona, Catalonia, Spain. The team received a special merit award (or a likely second) for the Wellington based school

⁵⁸ S. M. Smith, 2007, *Hei Whenua Ora: Hapū and Iwi approaches for reinstating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North.²³

and the students' contribution to cultural heritage and bicultural engagement in landscape architecture, based on their engagement with MTM research activities.



Figure 3.8.3: Bruce Mcfadgen and students at 2013 Wānanga. (Photograph by Huhana Smith, 12 March 2013)

4. The Rationale for the Shellfish Survey from Hōkio to Waitohu Streams

The shellfish survey (April to May 2014) highlighted the impacts poor water quality in the region is having within the case study region, which has rendered shellfish unfit for human consumption at areas along the coast, particularly after certain rainfall conditions. Considerable work needs to be completed to ensure local Māori communities and all landholders/users living in the case study region, along with local and regional councils affect positive land use changes or the sake of freshwater health into the marine.

Keremihana Heke, customary kaitiaki for Ngāti Tukorehe and Deputy Principal for Whakatipuranga Raumano Kura Kuapapa in Ōtaki was a key participant (along with his whanau) in the shellfish survey in April 2014. As a customary fisheries officer for Ngāti Tukorehe he has for many years (like others in the wider coastal region) been concerned about the decline of toheroa (*Paphies ventricosa*), tohemanga (*Oxyperas elongata*), other surf clam species (tuatua/pipi) and estuarine species (kokata/ pipi and cockles) along the Horowhenua coastline. Kaumātua, kaitiaki and other customary fisheries representatives have expressed concern about the safety of eating shellfish harvested along the Horowhenua coastline, more so since poor water quality and faecal contamination were evident in the water quality report in the Waiwiri Stream from Lake Waiwiri to sea.⁵⁹

⁵⁹ C. Allen et al. 2012 *Waiwiri stream: Sources of poor water quality and impacts on the coastal environment*,

Other kaitiaki in the region including Hapai Whenua Ltd, a Ngāti Raukawa Māori environmental consultancy, have also commented on the severe decline in shellfish populations, particularly “the total absence of Tohemanga⁶⁰ (in areas) ... once revered as a place of abundance for the large delicacy. It is now devoid of Tohemanga, which is an alarming finding”.⁶¹

In complimentary research reports (including a recent study by National Institute of Water and Atmospheric Research,⁶² NIWA ‘identified a number of factors that could help to explain the decline of toheroa and tohemanga, including land use change and associated changes to the freshwater flows coming onto the beaches, food availability, climate and weather, sand smothering/sediment instability, damage caused by vehicle traffic, predation, exploitative harvesting, toxic algal blooms and disease. At the same time, a literature review by Cawthron Institute⁶³ identified many of these same potential factors, plus the possibility that ghost shrimp (*Biffarius filholi*) are predating or otherwise displacing toheroa and other shellfish, or may be correlated with other changes that are causing shellfish decline.’⁶⁴

In the comprehensive proposal for the shellfish survey (which was used and modified for three funding attempts between late 2012 and early 2014), the Cawthron and MTM team also identified the following influences on toheroa populations: ghost shrimp modifications to the habitat; changes to freshwater seepage and beds of freshwater streams; seepage from brackish lagoons behind adjacent sand dunes or where the water table lies close to the surface⁶⁵; groundwater flow supplies of nutrients to benthic diatoms, an important food source for toheroa; increases to the area able to be inhabited without desiccation; lowering of the water table, which affects erosion of beach sediments; altered temperature and salinity regimes that might be important cues for spawning, that may directly affect the ability of toheroa and other shellfish to survive;⁶⁶ effects of land use change on toheroa populations; increases in forestation and greater decrease in the number of watercourses annotated on topographical maps over time.⁶⁷

4.1 The Sampling Methodology

When the shellfish samples collected after moderate to heavy rainfall near the Waiwiri Stream mouth were found to have *E. coli* concentrations of more than three times (and up to ten times) over the limit recommended for human consumption (230 MPN/100g NZMOH

60 The terms tohemanga and toheroa, or tuatua and pipi are often used interchangeably by tangata whenua on the Horowhenua coast. Moore and Royal may also have been referring to toheroa (*Paphies ventricosa*). For others, Tohemanga is regarded as a specific Ngāti Raukawa dialectical name for toheroa. This report acknowledges the interchangeability of names where certain kaumātua have referred to them as one and the same, while others have referred to them as separate species. After viewing shellfish in Te Papa’s collection the author of this report regards them as two different species due to distinct differences in their shell markings. This is also not to say that anyone is right or wrong in their terms of reference or to oral narratives collated from a wide range of local people.

61 Pātaka Moore & Caleb Royal C 2012. *Between the Ōhau River and Hōkio Stream*. Ngāti Raukawa Sites of Significance Natural Resource Monitoring series. Hapai Whenua Consultants Ltd. 18

62 J. Williams, et al. 2013a. *Review of factors affecting the abundance of toheroa (Paphies ventricosa)*, New Zealand Aquatic Environment and Biodiversity Report No. 114. Ministry for Primary Industries, Wellington.

63 K. Heasman, et al. 2012. *Factors affecting populations of toheroa (Paphies ventricosa): A literature review*. Manaaki Taha Moana Research Report No. 10, Cawthron Report No. 1997.

64 Dana Clark et al. (2013). Proposal for Horowhenua surf zone shellfish Study.

65 J. Williams, et al. 2013a. *Review of factors affecting the abundance of toheroa (Paphies ventricosa)*, New Zealand Aquatic Environment and Biodiversity Report No. 114. Ministry for Primary Industries, Wellington

66 K. Heasman, et al. 2012. *Factors affecting populations of toheroa (Paphies ventricosa): A literature review*. Manaaki Taha Moana Research Report No. 10, Cawthron Report No. 1997.

67 See also the latest comprehensive and related reports by Cawthron and MTM team members in the *Faecal Contamination of shellfish on the Horowhenua coast and Kaimoana On Beaches From Hōkio To Ōtaki*, Horowhenua reports, August 2014.

1995) (Allen *et al.* 2012), the team were left uncertain about contamination levels under conditions of lower rainfall. Therefore, by pooling knowledge and experiences, the MTM and Cawthron teams with local kaitiaki helped design a revised methodology for a more intensive survey of the Horowhenua surf zone habitat between Hōkio and Ōtaki.



Figure 4.1.1: Local kaitiaki [left to right], Iritana Bennett-Ogden, Brieahn Heke and Janette Gregory participating in shellfish survey. (Photograph by Jim Sinner, 5 April 2014.)

Using Tangata whenua and long-term residents local knowledge of place about historical and current populations of surf zone shellfish on the Horowhenua beaches, the group originally identified 16 sampling sites along the coastline, which was later reduced to 13 due to accessibility. The team re-planned the methodology for placement of transects, the hands-on sampling work in the tidal zone, and the freestyle searches into the water.

This comprehensive survey took place on 3-6 April 2014, after the group postponed the weekend of 14-16 March 2014 due to possible impacts of Cyclone Lusi, which at that time was wrecking havoc in other areas of Te Ika ā Maui/North Island. As part of this larger study of shellfish populations, the teams investigated factors affecting the population and health of shellfish tuatua/pipi. For example, they were sampled for FIB (faecal indicating bacteria) on three occasions following a dry period (3-6 April), moderate rainfall (6-7 May), and light rainfall (22 May) 2014. The teams also investigated the factors of changes in land use and freshwater flows to tidal zone. As secondary objectives in the shellfish survey, habitat changes were explored particularly those associated with increase in ghost shrimp and prevalence of faecal contamination in shellfish.

4.2 Success of Shellfish Survey, April to May 2014

The overall shellfish survey was a success on many fronts. It drew many kaitiaki together with freshwater to surf zone specialists and scientists to learn first hand of the problems facing local resource gatherers over a shellfish resource that many commented on, was being taken for granted. The MTM team were grateful for consolidated financial support from Cawthron Institute, Massey University and Raukawa ki te Tonga, the mandated Iwi authority for the tribe's fisheries and shellfish assets. Despite applying to three different funding agencies for funding and missing out, the MTM collaborative then reshuffled its financial priorities. With added Iwi support for kaitiaki engagement, the shell fish survey could then take place.

The following press release "Iwi and Hapū conduct survey of Horowhenua shellfish" was issued to media on 11 April 2014.

In the last days of daylight savings, from 3 to 6 April 2014 approximately forty members of Ngāti Raukawa ki te Tonga and affiliates, conducted a survey of shellfish on the Horowhenua coastline to Ōtaki, alongside three marine ecologists from Cawthron Institute. The aim was to learn more about the health of shellfish and why populations have declined.

The beach teams were organised by Taiao Raukawa Environmental Resource Unit researcher, Moira Poutama. Moira, Aroha Spinks (Taiao Raukawa researcher) and Dr Huhana Smith (independent contractor to Massey University) worked closely with Cawthron scientists to ensure the survey included mātauranga Māori (Māori knowledge) and associated resource gathering methods, alongside science methods. The work involved counting shellfish at 13 different sites along the coast and collecting a range of samples of sediment, water and shellfish. Shellfish will be tested for faecal contamination, while land use behind the beach will be considered as a possible factor affecting shellfish populations.

"We found that tuatua, which we locally refer to as pipis, were quite common in some places and less so in others" said Dr Smith, "but the toheroa that were once abundant on this coast have virtually disappeared. We only found one toheroa in our sampling over four days."

"Kaimoana is of immense significance to tangata whenua and to other members of the community too. We are hoping that this work with Cawthron will help us identify conditions that support healthy shellfish populations and what might be contributing to their decline, so we can work with the relevant councils and environmental agencies to restore the populations."

The survey is part of the wider, collaborative research programme called Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū (MTM), led by Massey University. The group is funded by the Ministry of Business, Innovation and Employment (MBIE). The survey also received funding from Raukawa ki te Tonga Trust to engage local kaitiaki from the region in active kaitiakitanga (environmental guardianship).

Local kaitiaki Moko Morris of Ōtaki was "thrilled to have my children involved in this local Hapū initiative, whose vision is to secure better outcomes for all who enjoy the moana (sea). We learnt and laughed alongside all those contributing to the future health of Tangaroa (entity of the sea). It was an honour to be engaged in active kaitiakitanga and to strengthen whanaungatanga (interrelationships) amongst us."

Results from the shellfish survey are expected by the middle of the year. These findings will be added to the expanding body of knowledge and data collated since adverse findings for shellfish health were revealed in 2012. In that study, kaitiaki from Muhunua, Ōhau and

Cawthron investigated the source of faecal contamination in the Waiwiri Stream that flows out of Lake Waiwiri (Papaitonga), which made shellfish gathered near the mouth of Waiwiri Stream unfit to eat. The wider survey aims to find out how healthy shellfish populations are in the larger coastal area.

Cawthron Institute scientists Jim Sinner, Emma Newcombe and Dana Clark were also working on the project.

“We’re hoping this shellfish survey will identify factors along the beach that are affecting the health of shellfish populations,” Cawthron Institute senior scientist Jim Sinner says. “We’ll get the shellfish and samples tested, then use statistical analysis to look for relationships between environmental variables and shellfish counts. Ultimately, if we can find out what’s causing the decline, we’re a step closer to restoring the shellfish populations.”

As solutions-focussed researchers, the MTM team, kaitiaki and specialists are also trialling methods to restore whitebait and other species in the Ōhau River “Loop” area. Protection and enhancement of the Waiwiri Stream mouth, of the Kuku Ōhau River estuary and neighbouring dune wetlands are underway, while Lake Waorongomai near Ōtaki is undergoing major rehabilitation. All collaborative efforts in developing methods to restore coastal ecosystems of cultural significance, will not only benefit Iwi and Hapū, but also the wider community.



Figure 4.2.1: Local kaitiaki counting shellfish at Waitohu Beach. (Photograph: Huhana Smith, 4 April 2014.)

4.3 Results of Shellfish Survey

With final reports completed (Newcombe *et al.* 2014) in August, the results noted that shellfish in most areas sampled are unfit for human consumption when collected after light and moderate rain. This is not good news.

Bivalve shellfish such as toheroa, tuatua, and pipi feed by filtering particles of organic material from the water. When water contains faecal material this is also taken up by filter feeders, where associated bacteria are concentrated in the digestive system and tissues of the shellfish. Bacterial contamination is not harmful to the shellfish themselves, in fact the bacteria may serve as a food source for the animals. Many bacteria are, however, potentially harmful to humans who consume contaminated shellfish. Moreover, presence of some bacteria indicates the presence of faecal material in the mahinga kai areas or customary food gathering areas.

Depletion and degradation of kaimoana resources is of immense concern to Iwi and Hapū and all communities of interest within the case study region. Degradation in the quality of the shellfish resource can be caused by contamination by toxins, or by biological contamination, both of which can make kaimoana unfit for human consumption. Faecal contamination is of particular concern to Iwi and Hapū both as a health issue – when levels are high enough to cause illness when kaimoana is consumed – and because faecal material with food sources is offensive. Sources of faecal contamination in the coastal marine environment include human sewerage systems, farmed animals, and wild animals such as possums and birds. Contamination of coastal waters is higher after rainfall as material, which has been deposited on the land during dry periods is washed into rivers and streams, into the tidal zone and out to sea.

4.4 Proposed Solutions with New Research

At the dissemination of research findings hui on 2 August at Raukawa Marae, Ōtaki, the attendees were well informed of the outcomes. It was edifying that a wider range of people and kaitiaki came together to hear and ask questions about faecal contamination, land use changes and other associated stressors on freshwater into the tidal zone. The reports were clear that shellfish populations had been reduced to the point where it is no longer possible to effectively study them in the local environment.⁶⁸

The teams are now addressing new funding options to major agencies, to take this research to next levels for restoring toheroa populations on Horowhenua Beaches. This this extent, a proposal was put forward to Pacific Ocean Initiative entitled *Restoring Toheroa On Horowhenua Beaches* in August 2014. In particular, the team will be working with more Iwi and Hapū groups from Ngāti Huia with key kaitiaki of those region keen to be on board. Our collaborative proposal read as follows:

Toheroa (Paphies ventricosa) are taonga (treasured) shellfish that have declined to critically low numbers on beaches on the lower west coast of the North Island of New Zealand. Concerned about this near extinction, local Māori aspire to re-establish toheroa on a coastline once famous for the abundance of this kaimoana (seafood).

The failure of toheroa populations to recover from historical overharvesting is common throughout New Zealand. There are many knowledge gaps regarding environmental and biological factors influencing survival. Moreover, shellfish that are currently harvested from Horowhenua beaches (largely the northern tuatua Paphies subtriangulata) are contaminated

⁶⁸ Emma Newcombe et.al, 2014, *Kaimoana on Beaches from Hōkio To Ōtaki*, Horowhenua, 35. Compelling details within the two shellfish survey reports can be found on line at mtm.ac.nz.

with faecal material to the point that they are regularly unfit for human consumption. Faecal contamination in itself is especially offensive to Māori.

The challenges faced in re-establishing abundant and healthy Horowhenua toheroa are common to many shellfish populations. Combined social, cultural, and scientific approaches are appropriate to robustly address the issue. Ngāti Raukawa ki te Tonga and Cawthron scientists have generated successful collaborative processes, including engaging enthusiastic teams of kaitiaki (environmental guardians). We have identified other researchers and other Iwi/hapū members with specialist knowledge, skills and enthusiasm for the project, whom we would like to involve in future work.

PROPOSED SOLUTIONS:

Further engage the local Māori community to:

- *Maximise the role of local knowledge in the re-establishment work*
- *Enhance community involvement in active protection of the resource, including development of a management strategy and relevant up skilling*
- *Improve scientists' understanding of customary approaches to harvest of kaimoana*

Produce spat (juvenile toheroa) for reseeded by:

- *Adapting techniques for other species to produce toheroa spat*
- *Determining most appropriate spat sources with genetic analyses*
- *Identifying a technique to mark cultured individuals*

Identify the best reseeded sites and strategies by:

- *Predicting larval movement (modelling fine-scale coastal water movements would contribute to this, and also help identify primary sources of land-based faecal contamination)*
- *Integrating population connectivity (genetic) and hydrodynamic information with assessment of site quality (including existing and new research on local and optimal environmental conditions for toheroa survival)*
- *Identifying the best approach with respect to landscape restoration, incorporation of spat placement with adult translocation, scale of reestablishment activity, etc.*

Monitor spat survival and environmental factors (e.g. food supply) to:

- *Address information gaps regarding the survival of toheroa in the early life stages (which will further inform restoration activities)*
- *Assess the success of reseeded.*



Figure 4.4.1: Toheroa, [M.280325/13]. Aroha Spinks holding a toheroa shell collected 20 March 1986 between Hōkio, Kuku and Ōtaki beaches, held at Museum of New Zealand Te Papa Tongarewa. (Photograph by Huhana Smith, 15 May 2014.)

5. ŌHAU RIVER 'LOOP', FOR INANGA (WHITEBAIT) IN THE RELATED COASTAL ENVIRONMENT

Whitebait numbers are declining countrywide, mainly due to loss of spawning habitat. A prominent example is the Ōhau River 'Loop', which has suffered the detriments of channel alteration and intensive dairying over the last 40 years, with the once-abundant fisheries habitat in the 'Loop' cut off from the main channel and turned into a stagnant and polluted remnant. Despite attempts to activate a comprehensive restoration plan for the 'Loop' in 1998, there was no shared sense of the need for collaborative action to address the declining health of waterways. At that time the Regional Council, Tahamata farm managers and shareholders resisted proposed changes to flood protection mechanisms and farming practices.

The context for protecting waterways on farms has thankfully changed since then, but there still is along way to go for waterways in the whole Manawatū Horowhenua region to be treated as taonga or valued systems. To this end, all waterways and drains on Tahamata farm have been fenced off with some riparian planting undertaken for the 'Loop'. There are comprehensive restoration plans in place for Te Hākari dune wetland (since 2002) and also a report with recommendations for Ōhau 'Loop' (2011) through the MTM research project. The opportunity to enhance whitebait habitat, in collaboration with kaitiaki, Taiao Raukawa, MTM Horowhenua team, Horizons Regional Council and Cawthron, was one of the recommendations. This coming together with common purpose is vital for improving the health of the 'Loop' and its taonga value to local Hapū.

The Ōhau 'Loop' restoration project in Phase 1 assessed the Ōhau 'Loop' and identified possible restoration measures for the benefit of Tahamata Incorporation farm and for whitebait habitat. The Ōhau 'Loop' 2011 report led to a fish-friendly flood gate being installed at the bottom of the 'Loop' (or closest to estuary end of 'Loop') by Horizons Regional Council, which was well supported by Tahamata and Māori shareholders. In ways, the regional council recognised their historic role in contributing to the decline of the whitebait resource, as their predecessor the Manawatū Catchment Board was responsible for the engineering and execution of the cutting off of the meander.

"From 1965, the Manawatu Catchment Board targeted the coastal flood plain area for waterway control. From 1971, the Ngāti Tūkorehe Tribal Committee, the later convened Tahamata Incorporation Board, some Māori landholders and some local non-Māori farmers supported the diversion scheme, as did others who leased Māori land at the coast. The latter Ōhau River Scheme and its staged plans were detailed in engineering diagrams, maps, letters and reports, in the oral accounts of those who carried out the works and from those who experienced the dramatic changes first hand. With sanction from the Ngāti Tūkorehe tribal committee, the Manawatu Catchment Board did not have to purchase the land around the river nor carry out the water engineering works under the Public Works Act. While there were vocal hapū and whānau objections during and after the scheme's excavations and stop banking work, the Ngāti Tūkorehe Tribal Committee as lead authority of the day endorsed the flood mitigation project as beneficial for the tribe's burgeoning dairy farm operation. Like early ancestral entrepreneurs involved in trading and cultivating activities before them, tribal leaders of the time approved the 'cutting' of the river. This marked another major transition in land and resource use by Māori landowners. Tahamata developed into a lucrative dairy farm and successful economic base for the hapū and iwi shareholders and the marae of Ngāti Tūkorehe."⁶⁹

The MTM research programme relies on local Māori inter-generational knowledge of place and science coming together respectfully and meaningfully, to determine solutions for declining species. In liaison with kaitiaki and whitebaiters, Cawthron and the MTM project team guided the community environmental monitoring and enhancement of inanga (whitebait) egg-laying (spawning) habitat within the lower reaches of the Ōhau 'Loop'. Phase 2 activated a series of changes to enhance freshwater fisheries by installing temporary artificial inanga (whitebait) habitat and assessing its effectiveness via community monitoring with kaitiaki during March, April and May 2014.

The team identified inanga egg-laying habitat and quantified existing inanga egg abundance; assessed potential measures to improve existing spawning habitat, and installed artificial inanga egg-laying habitat along the lower reaches of the Ōhau 'Loop'. Improving spawning habitat along the lower reaches of the 'Loop' is expected to make a significant contribution to restoring the whitebait freshwater fishery in the 'Loop'.

69 S. M. Smith, 2007, *Hei Whenua Ora: Hapū and iwi approaches for reinstating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North.

5.1 Programme of activities for Inanga/Whitebait:

In 2014, the Ōhau 'Loop' whitebait project was funded by Te Wai Ora fund through Te Wai Māori Trust of Te Ohu Kaimoana. The fund paid for Cawthron Institute water science, hydrology, biodiversity, water health expertise and for kaitiaki engagement. Horizons Regional Council provided inkind support with freshwater ecology expertise and assistance for assessing health of freshwater within coastal ecosystems. The Research Leader provided inkind support for administration and project management. The programme of activities included:

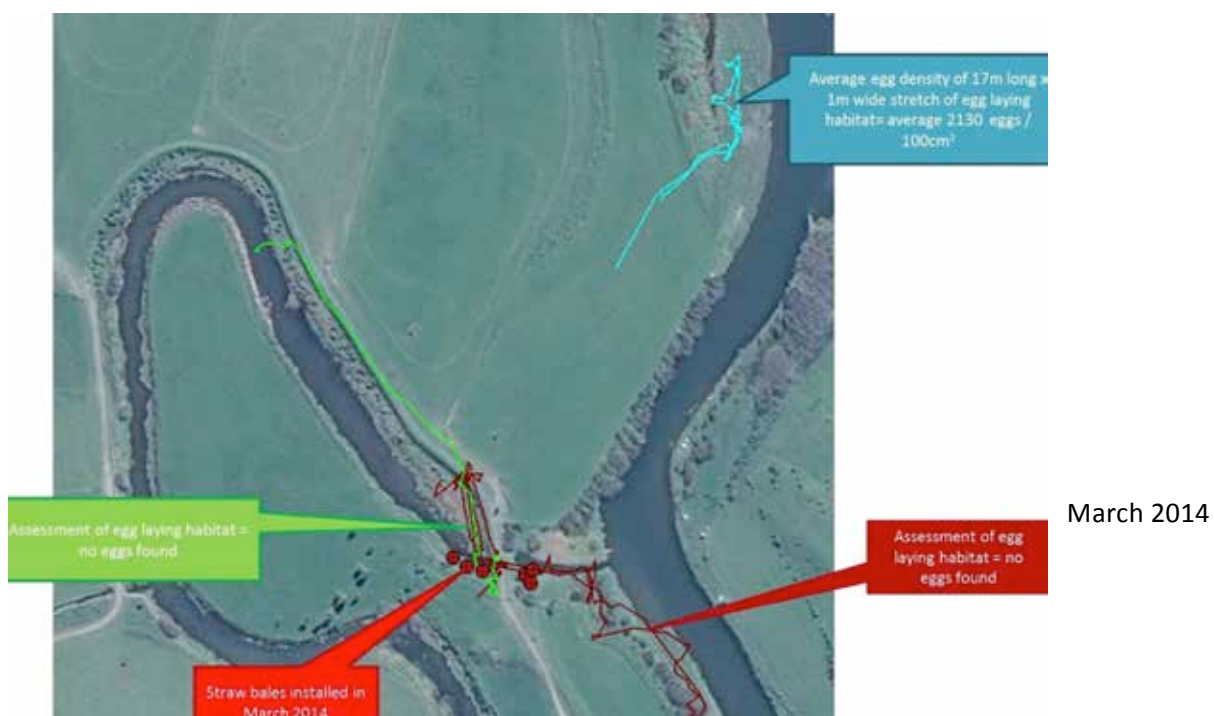
March 2014 - Cawthron scientists (Kati Doehring and David Taylor) and Horizons Regional Council staff (Anna Deverall and Alesha Cooper) travelled to the Ōhau 'Loop' for **two days**. With the help of local Kaitiaki including Yvonne Wehipeihana-Wilson, Pat Seymour, Janette Gregory, Rangimarkus Heke, Richard Anderson and Huhana Smith, the team identified the likely location of inanga egg-laying habitat. Inanga eggs were present therefore pre-intervention abundance was quantified. GPS locations and photos of all sites were taken.

April 2014 - Cawthron scientists travelled to the Ōhau 'Loop' **for one day** and liaised with local Kaitiaki. The teams surveyed and quantified existing inanga egg abundance; assessed potential measures to improve existing spawning habitat, and installed artificial inanga egg-laying habitat along the lower reaches of the Ōhau 'Loop'.

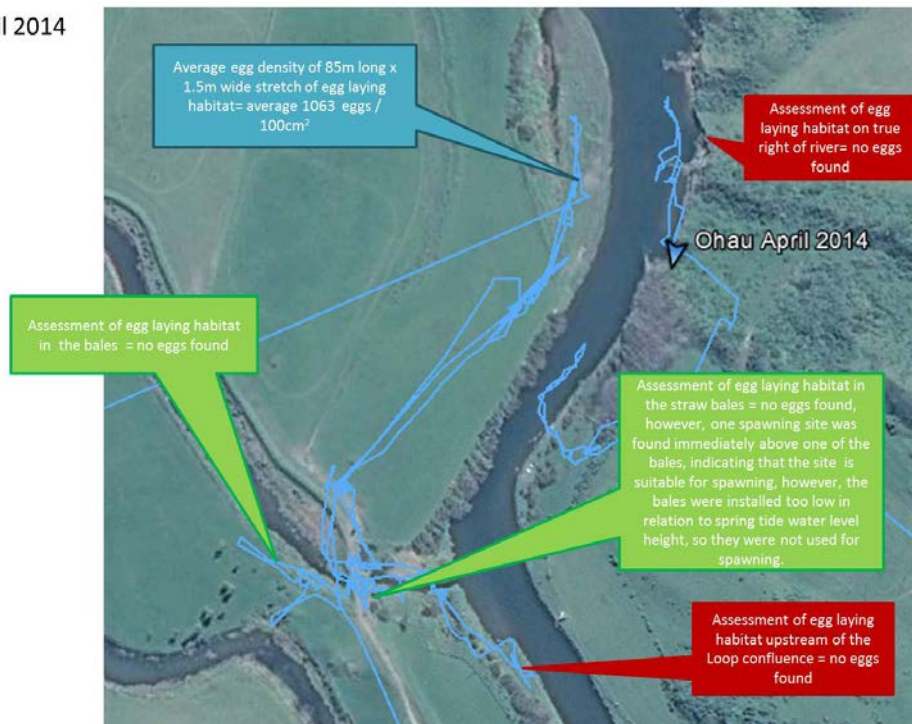
May 2014 - Cawthron scientists and Horizons Regional Council staff travelled to the Ōhau 'Loop' **for one day** and liaised with local Kaitiaki to monitor egg abundance within the artificial egg-laying habitat. They tracked and quantified post-restoration inanga egg-laying within the Ōhau 'Loop'.

March 2015 - Cawthron scientists will travel to the Ōhau 'Loop' **for one day** to help local Kaitiaki monitor and quantify inanga egg-laying habitat post spawning habitat restoration. The results will allow direct comparison of egg abundance with the survey conducted in the previous year and provide an indication of the restoration success.

In April 2015, Cawthron and Taiao Raukawa Trust will provide the final report.



April 2014



Figures 5.1.1: [Previous Page and Above] Results of habitat and egg quantification in March and April 2014.

This whitebait project aims to actively increase Iwi and hapū capacity and capability in restoring inanga habitat and to improve ability to control and monitor this freshwater delicacy or taonga species. Local whitebaiters were keen to be part of enhancing inanga habitat in their rohe. In knowing more on the location and care of inanga egg-laying habitat, whitebaiters and kaitiaki will also continue to monitor the resource.

May 2014

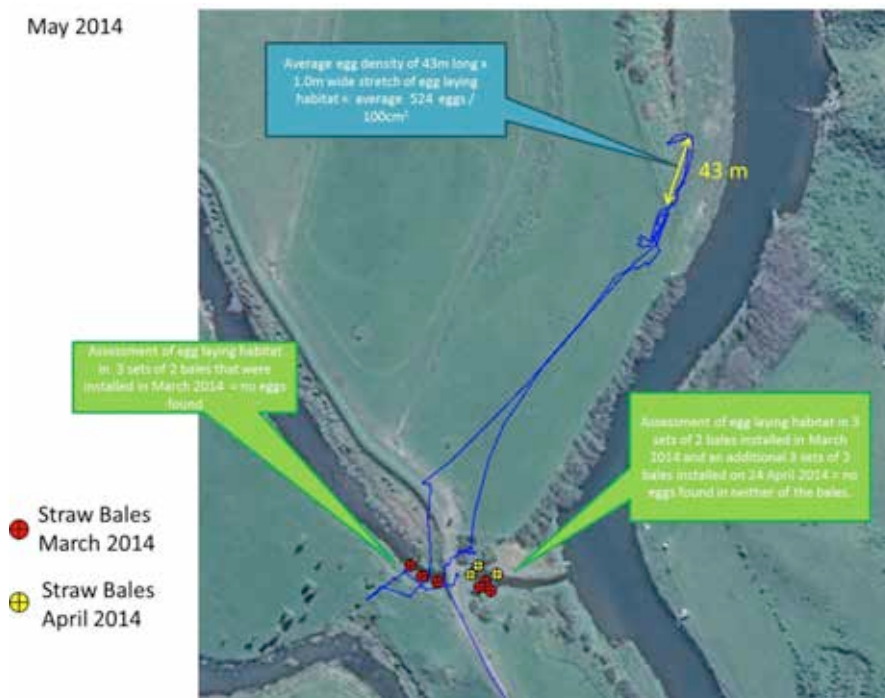


Figure 5.1.2: Results of habitat and egg quantification in May 2014 and location of straw bales for artificial habitat.

The 2013 and 2014 whitebaiting seasons were poor so kaitiaki are keen to know how they can help restore habitat. Local whitebaiters are also far more open to the changes that need to be made for freshwater health. The level of resistance to our work has dropped considerably since 2011. This indicates recognition of the benefits from our activated recommendations, particularly where resistance to change to flood protection mechanisms came initially from Horizons Regional Council engineers and Tahamata farm Management and its Board. However, when all interest groups came together to discuss the recommendations from our MTM Ōhau 'Loop' report on the impacts of freshwater and tidal flow restrictions in the 'Loop' area for whitebait habitat, the Horizons Regional Council's biodiversity and engineering teams then agreed to install the fish friendly floodgate in February 2013. This has been of huge benefit as whitebait were observed making their way into the 'Loop' during the August/September 2013 whitebait season. Similarly there have been benefits for the farm, whereby paddocks have dried out more readily due to lower water levels in the meander or river remnant.

With whitebaiters participating in the research, the MTM team aims to foster indigenous fisheries expertise, knowledge and understanding of the resource from a Mātauranga Māori, place-based and science perspective. Our MTM research collaborative has been actively increasing the quality and range of information to Iwi and hapū on freshwater fisheries and the complexities of proprietary rights to water too.



Figure 5.1.3: Setting up artificial whitebait spawning areas on Ōhau River loop region near the fish friendly flood gate at low tide. (Photograph by Huhana Smith, 12 March 2014).

In 2012, Taiao Raukawa was involved in the National Geothermal and Water claim and MTM research team also attended workshops on national water policy and implementing national freshwater standards. Taiao Raukawa has been working across its tribal region to ensure

that our indigenous fisheries can be enhanced, as has been proven with the range of action research projects underway with related Hapū groups, including the following: Ōroua River Catchment care through the Manawatū River Leaders' Accord/Ngāti Kauwhata; Tokomaru River/Ngāti Whakatere; Manawatū River/for all Ngāti Raukawa Hapū; Kairarawa Stream, Waitarere/ Ngāti Huia; dune wetlands from Koputaroa to Waikawa for related Iwi and Hapū; dune lakes at Pekapeka Taratoa, and at Lake Waiorongomai with related Hapū, too.

In 2015, the inanga spawning restoration results will be communicated at hui on marae along the coast and at seminars at Te Takere, Levin and Ōtaki Library; with Horizons Regional Council, Horowhenua District Council (as their planners have been part of our Ōhau River 'Loop' riparian planting teams), with Te Wānanga o Raukawa and associated Kura Kaupapa; via the MTM website; via published reports in print and online, and at relevant hui attended by customary fishers and kaitiaki.

5.2 Maintaining, enhancing the dialogue and raising capacity

As we find out more about our projects, the information is shared by direct dialogue (kanohi kitea) and invitations to participants to contribute their thoughts or queries on research findings. This allows all participants to contribute actively to final reports before they are published. Our MTM team also tries to mitigate any possible risk as quickly as possible by engaging everyone together about the projects from the onset. The MTM research projects have dedicated considerable time to capacity raising, to upskilling our people and to growing future opportunities where kaitiaki and all entities with an environmental interest, can work better and more closely together. Evaluation of this work is by growth in numbers of active participants knowledgeable of decline issues towards their more active, practical care for our waterways and our resources.

To recap on the progress made on Ōhau 'Loop' since first meetings on site with Horizons Regional Council, Tahamata operations, local hydrologist and Board members in 2011, the final tidal measurements for 'Loop' were completed in January 2012. A fish friendly floodgate was installed on 4 February 2013, paid for by the Ōhau Manakau River Scheme through Horizons Regional Council. This opened the 'Loop' to the Ōhau River again (at the cut area) to allow tides to flow back into the remnant lagoon. Horizons Regional Council provided harakeke to plant out the realigned area in winter of 2013, which was then completed in early September 2013.

All teams were delighted that Tahamata management was much happier when paddocks around the 'Loop' dried out more readily, due to a tidal flow being reinstated. The 'Loop' also emptied on low tide which has a positive effect on groundwater levels. Such benefits to the farm enabled the next phases to proceed, based on sound costings and involvement of farm operations in the activities of rehabilitating the Ōhau River meander.

Te Ohu Kai Moana and the Ministry for Primary Industries are kept informed on whitebait project progress and how combined, positive efforts for all the coastal dune wetland restoration work with related, associated activities for the Ōhau River pan out. An application for more funding to Sustainable Farming fund will be completed in 2015/2016 financial year

to complete the final Ōhau River phases as outlined in Tahamata farm management strategies by 2019.

Tahamata Incorporation, Cawthron Institute and kaitiaki now see the possible benefits of dredging the accumulated sediment from the 'Loop' and the opening up of races with culverts for complete passage of water around the 'Loop'. A new action plan in 2015/2016 with complete costings will be finalised.

Additionally, a locally devised, kaitiaki-led, longer term vision aims to implement an approach for all our freshwater resources in all our waterways, from our mountains to sea for the whole Kuku rohe.

6. THE RENEWED HARAKEKE INDUSTRY

The MTM research project has built on a successful range of research methods that emphasise how important it is to co-create solutions, based on whanau or related peoples' interdependencies to each other and by generating constructive working relationships between other participants.

On the weekend of the 19–20 March 2005, with a kaumatua day held on 18 March, *Te Pā Harakeke: Our Future with Harakeke* Wānanga was convened for the purposes of 'kei te wānanga te hui i te take',⁷⁰ discussing, debating, analysing and focussing on matters that expanded peoples' understanding of the taonga species - harakeke. That wānanga was held with local and external Māori interest groups and contributed to knowledge dissemination within the objectives of Te Hākari Dune wetland restoration project. Local weaving specialists, Māori kaitiaki, environmentalists and other sustainable farming advocates presented viewpoints, knowledge and research, over potential new futures with harakeke. At that time, two key players were not able to attend, namely Te Aue Davis (who has since passed away, 28 November 2010) and Rangi Te Kanawa, the latter with whom we are now working far more closely with, on making the harakeke industry happen.

The MTM and Muka project teams are keen to use harakeke as an all-round healer for whenua and awa and as a general, sustainable resource for increasing environmental health in the coastal case study for some years now. There are a range of new uses for harakeke that have been forged from projects that deal with fragmented ecosystems and subsequent impacts on the human condition. Projects range from using harakeke as rehabilitator for polluted waters in streams and rivers by planting harvestable riparians, or as sustainable resource solutions for drainage systems and nutrient uptake that integrates harakeke back into farm and rural land management processes. Working with harakeke is not new, as local researchers/teachers from Te Wānanga o Raukawa based their early harakeke research on their own whakapapa relationships to the Mangapouri stream area in Ōtaki. They assessed the role that harakeke played in the uptake of pollutants from the stream and planted the depleted waterway at the southern end of the Pukekaraka block in Ōtaki.

Their research also investigated once intricate relationships between biota like the giant kōkopu and harakeke and other diverse riparian plants. As misuse of the stream and

70 "By earnest and prolonged discussion we can sort the issues" sourced from 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, 41.

domestic pollution has impacted on the integrity of the Mangapouri, local mana or authority over the stream and its resources has simultaneously reduced.⁷¹

In respecting the range of customary understandings and uses of harakeke, the wānanga in 2005 aimed to set more sustainable farming targets. Harakeke had been a significant industry for ancestral Iwi and Hapū, so the proposal to extensively regrow harakeke as riparian or plantation planting projects, aims to actively revitalise previous relationships with harakeke and protect biodiversity. Harakeke is able to absorb and slow floodwaters as it lies down when water rises and flows over it. Harakeke stabilises stream and riverbanks and prevents bank erosion.



Figures 6.1: Rangī Te Kanawa, Harakeke agent at MTM Landscape Architecture student Wānanga, Kikopiri Marae (Photograph by Huhana Smith, 6 March 2014.)

The aims of research around new industries for the whole plant use of harakeke and its by-products are directly linked to sustainable, economic, environmental and social health dimensions. Harakeke creates possibilities for new enterprises, with renewed industries and employment opportunities. There is considerable value in planting harakeke for shelter or as a nutritious stock feed. For example, green-waste from the process of haro or stripping harakeke leaves for muka fibre had been researched to be a nutritional by-product for stock. The green waste aids digestion and relieves worm problems in ruminating animals like cattle.⁷² Other opportunities include the planting of extensive plantations with the view to producing fine quality fibre for high-end fine fabric markets, both nationally and internationally. In developing new textiles or fabrics from harakeke, Rangī Te Kanawa's company Muka Limited, based out of Te Kuiti, Waikato actively promotes the re-establishment of pā harakeke with a view to creating an economic base. The project takes into account the customary practices of harvesting harakeke and stripping leaves for muka, of caring for and clearing around the plants in order to keep insects at bay and allow light to enter around the pā harakeke.⁷³

71 S. M. Smith, 2007, *Hei Whenua Ora: Hapū and Iwi approaches for reinstating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North.

72 The last two projects received substantial research support from the Sustainable Farming Fund.

73 Rangī Te Kanawa, 2005, *New Research for the Harakeke Industry*, Workshop at Industrial Research Limited, Gracefield, Lower Hutt, 12 March 2005.

In considering how current fragmented ecosystems could be rehabilitated or how a range of potential new uses of harakeke may ensure sustainable farming practices - not all views for customary or contemporary use, coalesced that weekend back in 2005. Some weavers objected to the use of harakeke green waste after haro or stripping, being used as a by-product for cows for their healthy digestion, and not the weaving remainder returned to nurture the harakeke plant after use. In the minds of many present at the wānanga harakeke also comes within the realm of Hine-te-iwaiwa, the tutelary deity of weaving. When one of the weavers (supported by some others) fervently opposed the sustainable farming presenters' views on harakeke use (whose key aim was to improve animal health farming practice and ease the environmental and human health burdens of nitrified water) the weaver vehemently considered such ways of using harakeke as degrading.

In this way, the wānanga about harakeke and Te Hākari dune wetland explored some causes of conflict in the research gathering process. The confrontation highlighted how concurrent aspirations for harakeke reflect a range of different experiences or ways of seeing the world of harakeke. With beneficial uses of harakeke including economically sustaining marae with a raw muka product for possible new industries in harakeke fabric; to sustaining lands, waterways and improving farm animal health for eventual human use or consumption- the harakeke plant could be viewed as a whole plant healer or a whole-of-system healer. When the customary weaving view contested another's aspirations for harakeke as environmental rehabilitator, the two ethics or ideologies clashed. Making sense of both of them proved demanding for some participants, organisers and presenters.

In also considering stronger relationships between customary and contemporary views about harakeke, the wānanga opened up dialogue around harakeke that did not necessitate confining its wider healing properties. In revitalising harakeke use with customary knowledge bases there is the need to allow opportunities for participants to think outside their own resource-use views and envisage harakeke has having a place in the context of Māori lives lived today. New knowledge around old industries should be internally meaningful to culture and hold relevance to issues for a contemporary Māori world.⁷⁴ Whilst considering all the important spiritual and physical values of harakeke, there are added value uses for the resource that can ultimately benefit ecosystems, human and animal well being.

Back in March 2005, this wānanga looked at taonga species such as harakeke the new sustainable directions investigated for the versatile natural resource of harakeke, with its potential to be a renewed, sustainable and beneficial industry. As stated by key Māori scholars on Māori knowledge systems, Dr Charles Royal offers that:

'The task is not merely to reconstruct a worldview so as to return to it...but rather to develop an understanding of aspects of that worldview, and to explore how they might inform a new paradigm... [Māori] have to shape a worldview that weaves these elements convincingly and into a lived whole. One way to do this is to draw connections between key themes and ideas in our traditional knowledge bases, and critical issues facing human society everywhere. For why revitalise and revive mātauranga Māori if not to make a contribution to our world?'⁷⁵

⁷⁴ After Charles Te Ahukāramu Royal, 2004, *Mātauranga Māori and Museum Practice*, A Discussion paper prepared for the Museum of New Zealand Te Papa Tongarewa, 3.

⁷⁵ Ibid, 26.

6.1 Soil analysis from Horizons Regional Council

In 2013, the MTM team secured funds from Horizons Regional Council to have Malcolm Todd (Soil specialist) map Tahamata Incorporation's coastal farm for its diversity of soils. The overall aim was to assist Tahamata in pasture and nutrient management according to best sustainable farming practices. This information formed part of a package of support that Horizons Regional Council has given to MTM over the research term. The information provided is also being used to help prioritise sites within the farm for planting around streams and/or harvesting harakeke in wetlands.

Harakeke grows in a range of different environments in the wider rohe of Raukawa ki te Tonga. The key areas referred in the maps provided are potential pilot projects that will maximise the potential of harakeke plantation to remove nitrogen from the shallow groundwater before it enters a wetland or a nearby waterway. The MTM team (and Malcolm Todd) understands from the work undertaken with Te Hākari Dune wetland that harakeke can remove nitrogen from shallow groundwater in several ways.

'Firstly, denitrification can remove up a third of the nitrogen. Denitrification works by anaerobic bugs in the soil harvesting oxygen from nitrate in order to allow them to feed on available carbon. Therefore the effectiveness of any plantings in removing nitrogen by denitrification will depend on the: size of the wetland in relation to the upstream catchment (a bigger wetland removes more nitrogen); time that the water remains in the saturated seepage zone; wetter ground and slowed flow removes more nitrogen. In a flood, surface flow will go right over the wetland without any nutrients being removed. In dry situations it is worthwhile to impede the drainage with artificial weirs so that the surface remains saturated. Otherwise the soil may aerate, causing denitrification to cease or even to reverse, so that existing nitrogen is released to the soil water by nitrification, and finally, carbon content of the topsoil (carbon supplementation can increase nitrogen removal e.g. with wood chips, sawdust or charcoal).'⁷⁶

In direct relation to the potential of harakeke as a productive crop for the making of fine fibre, another process of nitrogen removal is by absorption into growing plants. For example, when wetland plantings are first established there is much greater nitrogen removal than in subsequent years when leaf growth is balanced by die off. Therefore, a continual harvest of flax leaves would be expected to increase the effectiveness of the plantings in harvesting nitrogen before it reaches the wetland. Another process of nitrogen removal is by settling particulate matter. Once stock are removed settling (rather than erosion) tends to happen.

If harvesting harakeke, care would need to be taken not to trample wet ground too much where resulting mud reverses the beneficial effects. Therefore it is worthwhile to focus on peaty soils with a 'very poor' drainage class, to maintain water levels to ensure subsoil saturation and to harvest vegetation carefully without causing erosion and mud.⁷⁷

⁷⁶ Email communication with Malcom Todd, July 2014

⁷⁷ References provided by Malcom Todd, Horizons Regional Council, July 2014.

They include: Chris Tanner, M L Nguyen and J P S Sukias (2005) Export of nitrogen in subsurface drainage from irrigated and rain-fed dairy pastures and its attenuation in constructed wetlands. In *Developments in Fertiliser Application Technologies and Nutrient Management*. (Des L D Currie and J A Hanly). Occasional Report No. 18 Fertiliser and Lime Research Centre,



Figure 6.1.1: Avoiding pugging in wet areas (Photograph by Huhana Smith, 13 August 2014)



Figure 6.1.2: Potential to retro-fit a former cow shed and milking shed into a Harakeke Hub by the Kuku Stream (Photograph by Huhana Smith, 13 August 2014)



Figure 6.1.3: The Harakeke Hub in situ to be potentially developed around Kuku Stream towards the Ōhau River, as a pilot on Tahmata farm. (Photograph by Huhana Smith, 13 August 2014.)

Massey University, Palmerston North, New Zealand. Pp 105-113 and Wilcock et al (2011) *Benefits of wetlands in farming landscapes* sourced from http://www.massey.ac.nz/~flrc/workshops/11/Manuscripts/Wilcock_2011.pdf

Continued...

Sukias et al (2014) *Controlled drainage – Assessing the Relevance to NZ Pastoral Situations*. http://www.massey.ac.nz/~flrc/workshops/14/Manuscripts/Paper_Sukias_2014.pdf

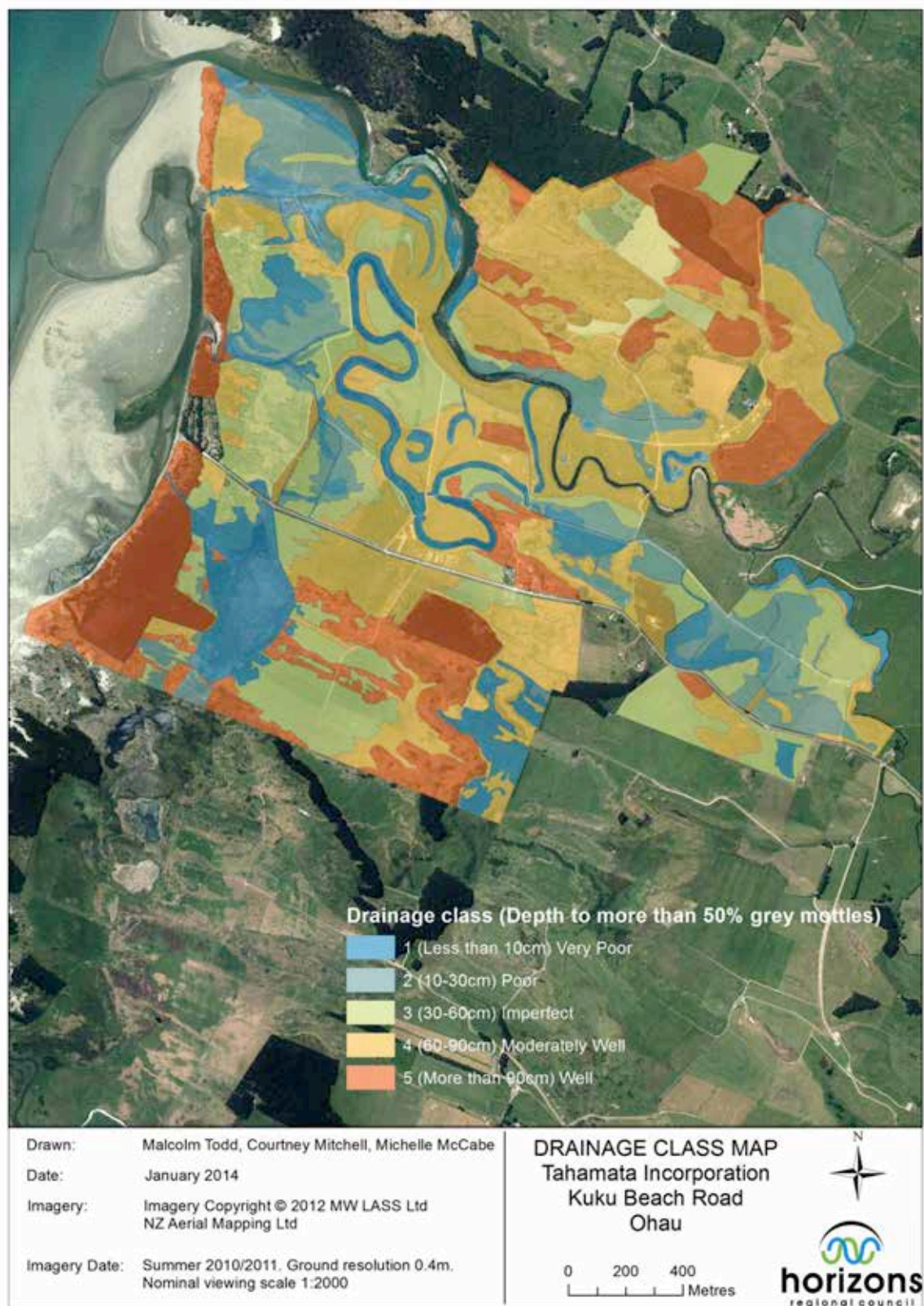
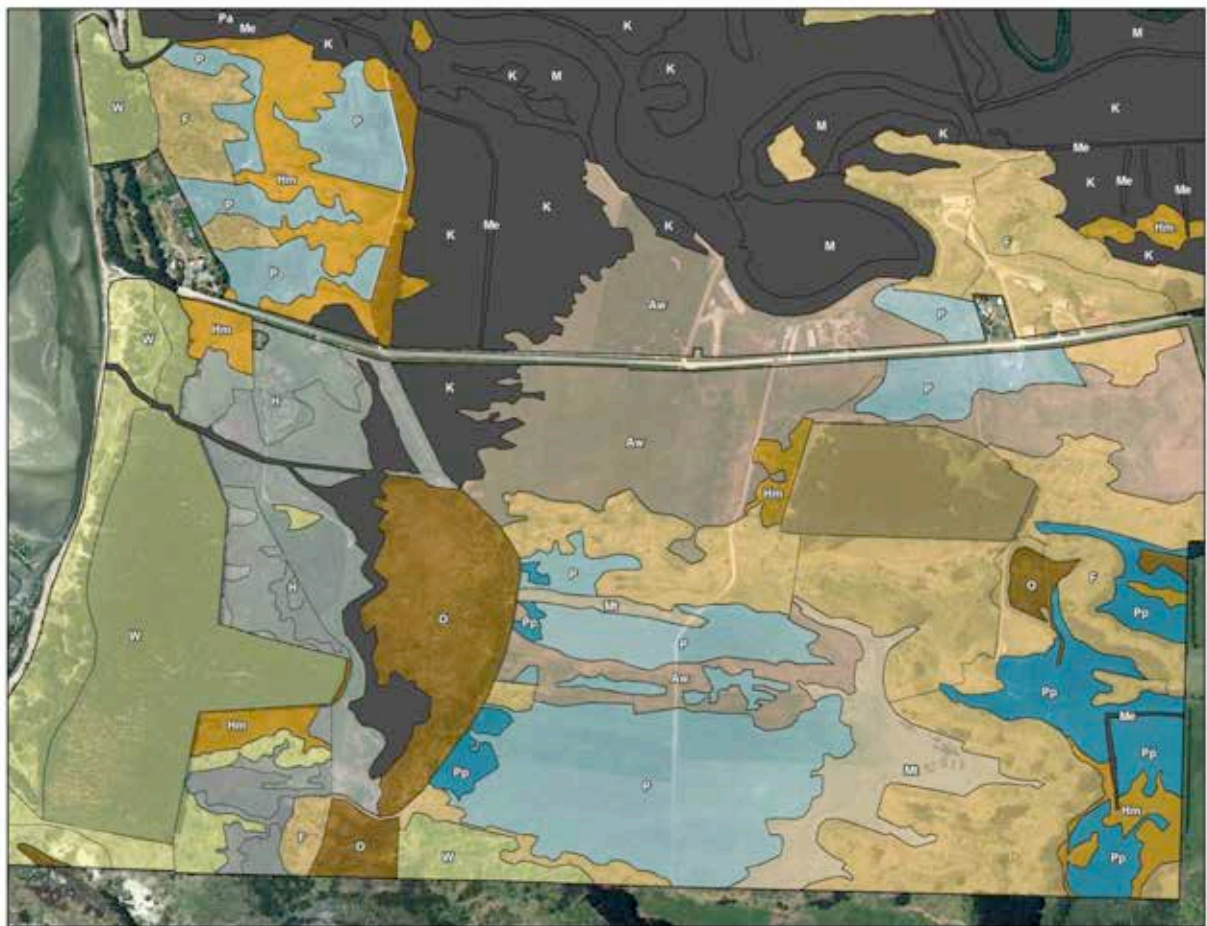


Figure 6.1.4: Drainage class of soils on Tahamata Farm. The most suitable sites for planting harakeke to remove nitrogen on Tahamata Incorporation farm, are therefore the easily spotted – they are the wettest and are most prone to pugging. (Source: Malcom Todd, Horizons Regional Council, March 2014)



Soil series

- W Waitarere
- H Hokio
- Mt Motuiti
- Hm Himatangi
- Pp Pukepuke peaty
- P Pukepuke
- Aw Awahou
- F Foxton
- O Omanuka
- Op Opiki

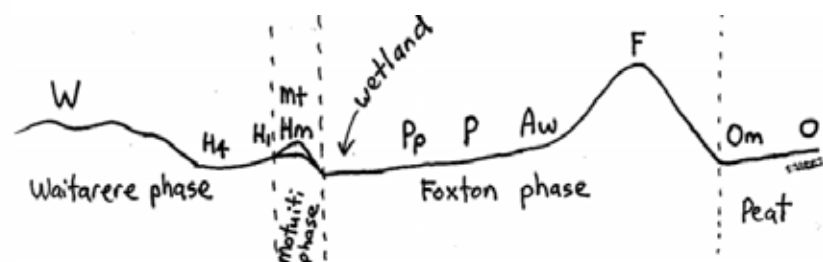


Figure 6.1.5: Soil Series within the sand country on Tahamata farm with potential to denitrify wetlands, particularly for Hōkio **peaty** sandy loam (H4), Omanuka peat (Om) and Pukepuke **peaty** loam (Pp).

(Source: Malcom Todd, Horizons Regional Council, March 2014)

In highlighting the **peaty** and **silt clay**, this is to distinguish these soil types from other types in the same series (e.g. Hokio sandy loam, Parewanui silt loam; etc), which are less wet and therefore would not have high denitification rates. In the vulnerability to pugging map

above, such areas are identified as vulnerability class 5 (very vulnerable) in the river silts and 4 (vulnerable) in the sand country.

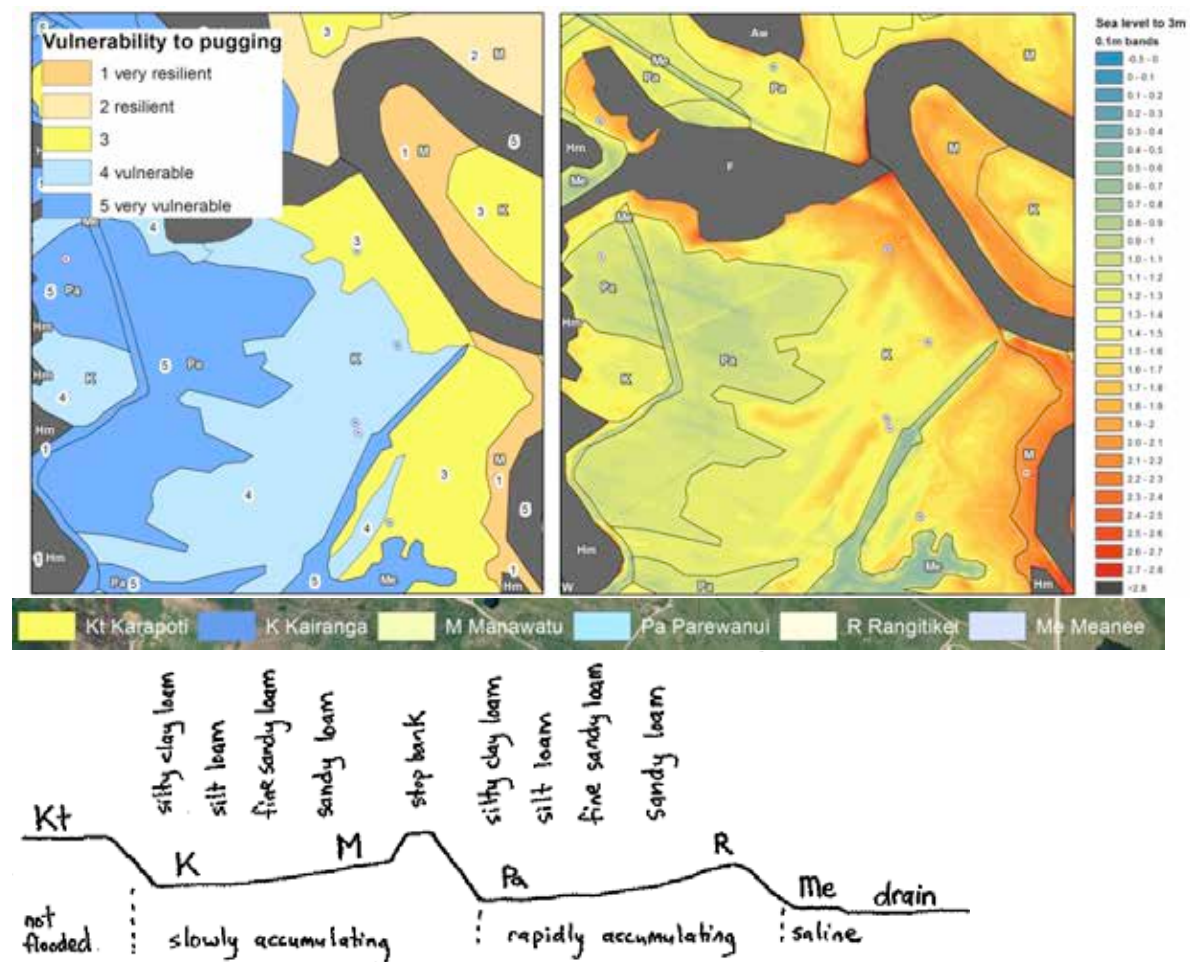


Figure 6.1.6: Within the river silts: (potential to denitrify the Ōhau 'Loop') on Parewanui **silty clay** loam or Kairanga **silty clay** loam. (Source: Malcom Todd, Horizons Regional Council, March 2014)

We know from our team's *Ōhau River Phase 1: Existing Status and Recommendation for Improvement* report, that the Kuku Stream (from its confluence with Mangananao Stream to the Ōhau River) is in poor condition. Section 5.4.4 of that 2011 report⁷⁸ clearly indicates that the Kuku Stream had the highest nitrate-N, total nitrogen and *E coli* concentrations of all the water samples taken. High nitrate-N concentrations in the Kuku Stream are likely to be due to high agricultural run-off into these waterways from adjacent farmland.

Therefore, the following maps and pilot project images help provide insight as to where harakeke as a de-nitrifier could be used on Tahamata farm, and in particular for supporting

78 Allen C, Doeiring K, Young R, Sinner J. (2011). *Ōhau 'Loop' Phase 1: Existing Status and Recommendations for Improvement*. Manaaki Taha Moana Research Report No. 5. Cawthron Report No. 2041, p 37.

this section of the Kuku Stream to the Ōhau River.



Figure 6.1.7: Areas that are most suitable for harakeke planting with added areas in pale green for extended plantings too, (approximately 40 hectares). [Source: Map developed by Deborah Scott⁷⁹, September 2014 on aerial photo with farm paddocks created by Malcom Todd, March 2014.]

⁷⁹ With many thanks to Victoria University's Masters in Landscape Architecture student, Deborah Scott who kindly permitted her maps and overview of harakeke hub, to be included in this report as part of her "making harakeke industry real for dairy farming". Masters submitted in late 2014.)

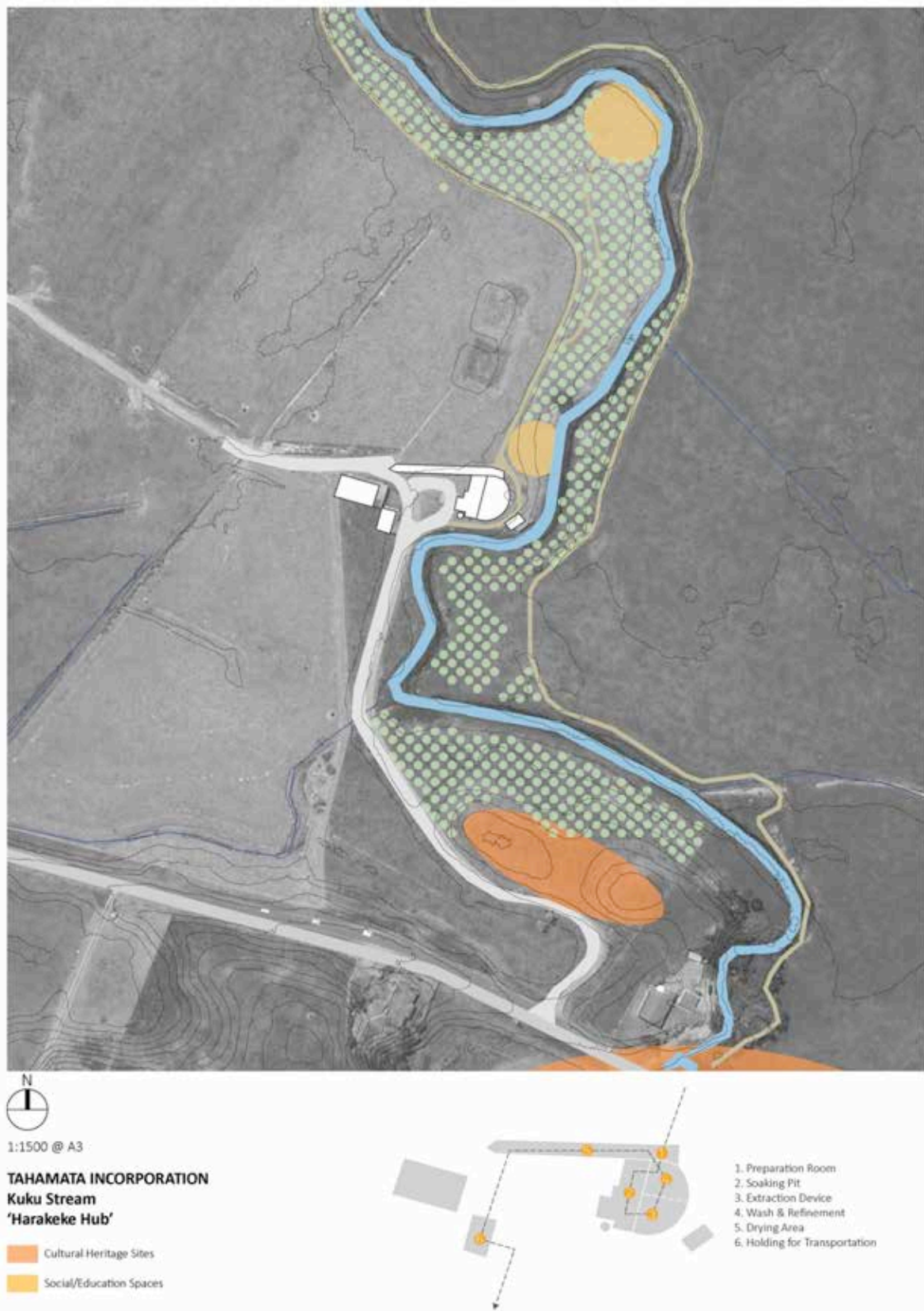


Figure 6.1.8: Developing a Harakeke hub around Kuku Stream towards Ōhau River, off Kuku Beach Road. Small green circles are harakeke plants. (Source: Deborah Scott, Masters student in Landscape Architecture, Victoria University, 2014)

7. HAPAITIA TE NGUTU AWA O KUKU ŌHAU/ REVITALISING THE KUKU ŌHAU ESTUARY FRONTAGE.

As highlighted throughout this report, the Kuku Ōhau estuary is part of a significant natural coastline, with ancestral, cultural and spiritual values between Waiwiri Stream and Waikawa River for Hapū of Ngāti Tukorehe. It is revered for its estuarine and coastal fisheries, despite some land use changes overtime. The Hapū and wider community values the expansive, open coastal spaces beyond the Ōhau River estuary into the marine. The estuary is noted for its rare estuarine bird and plant biodiversity and as a feeding ground for Siberian godwit on their annual migrations. The dynamic region was famous for its plentiful shellfish and fisheries resources. The entrance enhancement project aims to enhance and protect all indigenous biodiversity therein. As the wider coastal area is still enjoyed for its natural wildness and relative isolation, an attractive entrance area aims to encourage greater respect for these qualities and values.

In recent years, the Kuku Ōhau estuary and beach dune environment became the favoured haunt of trail biking groups and 4 x 4 enthusiasts. Each weekend and during the week in summer into autumn, riders and drivers made it difficult for Hapū and the local/regional/international community to enjoy the region's natural integrity. Destructive recreational access "ripped up" sensitive dune systems and shorebird nesting grounds. The frontage area off Kuku Beach road became a dumping ground for organic and inorganic rubbish and for lighting fires in the driftwood, even in high-risk fire seasons.

In 2013/2014, He Tini Awa Trust (administered by Horizons Regional Council) funded the MTM project to split harakeke around ephemeral wetland and replant it; complete initial spray regime; create a quality car parking area; hire machinery to remove macrocarpa trees; erect a bollard fence; plant ground covers and other dune plants in car park surround; build a security fence and gate; level and metal the access way to estuary; and design and erect new quality signs to welcome people to the area. The signs also cover a list of customary and commonsense protocols on how to care for the coastline. Since completing the car park in March 2014 (also supported by Horowhenua District Council, Tahamata Incorporation, Te Iwi of Ngāti Tukorehe Trust, and local businesses such as Taylor Tarseal and Carl Gibson Ltd), the coastal estuary has been reclaimed by Hapū, local Kuku residents, environmental groups such as Royal Forest and Bird Society members, other ornithological enthusiasts, regional, national and international visitors. The protection afforded is supported as a Hapū led initiative by local and regional entities. Since this project was completed, we have also been awarded core business Department of Conservation Funds to help set up a training programme in pest weed management and restoration planting techniques for local rangatahi from Hapū of Ngāti Tukorehe, Wehiwehi and Kikopiri.

7.1 Rationale for Kuku Ōhau Estuary frontage area

The rationale for the Kuku Ōhau Estuary project is to create a naturally, attractive frontage area of some 2.4 hectares or 5.9 acres, which welcomes communities of interest to the wider estuary and coastal region. While the site is Māori freehold land and part of Tahamata farm, the re-vegetation project encourages all New Zealanders to contribute to sustaining the full range of indigenous biodiversity in the area, and to share in its benefits. With natural re-vegetation of the site, local kaitiaki and communities of interest are encouraged to

respect the area, whilst benefiting from walking or driving (with limited vehicle access for fishing only) through an enhanced frontage, to the estuary and into the wider coastal region.



Figure 7.1.1: The completed car park, gate, bollards and protective fence for Kuku Ōhau Estuary frontage. The 2.2 hectare area on the estuary is planted from April 2015. (Photograph by Huhana Smith, 26 March 2014.)

The project objectives are to actively enhance the 2.4-hectare entrance site adjacent to Kuku Ōhau Estuary, with native plantings for fore dunes, the ephemeral stream wetland and back dune areas with appropriate species as part of Phase One (until 2017) of a wider coastal buffering strategy to be completed by 2020. The project aims to increase interrelated biodiversity values for the area, which benefits the wider Kuku Ōhau Estuary and increases human wellbeing through their respectful engagement. There are many synergies and alignments with the vision, goals and principles established as part of New Zealand’s commitment to conserving and sustainably managing biodiversity, especially through the overarching Biodiversity Strategy goals as follows:

Goal One: Community and individual action, responsibility and benefits Enhance community and individual understanding about biodiversity, and inform, motivate and support widespread and coordinated community action to conserve and sustainably use biodiversity.

This staged revegetation project over three years, as part of the suite of activities continues to draw together the community and kaitiaki to work collaboratively on solutions to problems on this sensitive, coastal dynamic. With Te Iwi o Ngāti Tukorehe Trust endorsing the Kuku Ōhau Estuary project, the Trust encourages also “communities to share responsibility for, and benefits from, conserving and sustainably using” the resources of the estuarine and coastal region. The estuary has had other rare birds arrive, including the Eastern Curlew sighted by Royal Forest and Bird Society, Horowhenua in March/April 2013. This group have been bird monitoring and collating data for the MTM research project at the estuary and the wetland for kaitiaki of the region, since 2010. Other groups such as Waitohu Stream Care, Ōtaki; Waikawa Ratepayers Association, Waikawa and Hōkio Progressive Association, Hōkio support our initiatives. Our experiences in active conservation, methodologies and research findings are readily shared with them.

Kuku Ōhau estuary and related beach environs has nesting grounds for more unique and diverse range of sea and estuarine birds, particularly poaka or pied stilts [*Himantopus himantopus*], torea or pied oystercatchers [*Haematopus ostralegus*], karoro or black-backed gulls [*Larus dominicanus*] and red-billed gulls [*Larus novaehollandiae scopulinus*]. Kuku

Beach and Ōhau river estuary are important resting grounds for taranui or caspian tern [*Sterna caspia*] and kuaka, Siberian godwit [*Limosa lapponica*] after their major flight migrations where they arrive in late winter to mid spring. The estuarine beach area is a place where kōtuku or white heron [*Egretta alba*] feed, as do kōtuku ngutu papa or royal spoonbill [*Platalea regia*] during the summer months. Kōtuku ngutu papa remain at the estuary and the neighbouring Te Hākari Dune wetland into early winter and then return to the Wairau region of Te Wai Pounamu or the South island to breed. They return to the estuary again in summer. Those present in late winter, or those who feed over spring into summer are the younger, non-breeders.

Goal Two: Treaty of Waitangi

Actively protect Iwi and Hapū interests in indigenous biodiversity, and build and strengthen partnerships between government agencies and Iwi and Hapū in conserving and sustainably using indigenous biodiversity.

Goal Three: Halt the decline in New Zealand's indigenous biodiversity.

Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production environments.

The combined projects for MTM (including Kuku Ōhau Estuary frontage project) all coalesce to achieve whole of system understanding. By bringing environmental specialists, Hapū and the wider community together, they work towards maintaining and restoring, viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity, within this important estuarine and coastal region.

Tahamata Incorporation, the tribes coastal farm also has a Strategic Plan 2011-2031 (updated in 2014), where the Board of Directors agree to action the following:

SO6: Manage and enhance our coastal farm in an environmentally, sustainable manner.

SG6: To maintain best, sustainable farming practice for environmental health of soils, water bodies and coastline.

ACTION PLAN:

- To complete the fencing of all waterways and drains
- To continue to support Te Hākari Dune wetland, Kuku Ōhau Estuary frontage and Ōhau River 'Loop' projects
- To collaborate with regional and national entities in appropriate environmental research
- To maintain the environmental compliance standards of regional authorities
- To annually revise and fine-tune the nutrient and effluent management plans
- To manage fertilizer application as per industry's code of conduct

For this MTM project there is considerable support from Hapū, shareholders, Te Iwi o Ngāti Tukorehe Trust, Taiao Raukawa Environmental Resource Unit, kaitiaki Māori, and customary

fisheries officers working alongside local and regional authorities. Neighbouring Iwi members and groups from Muaūpoko support our initiatives. We also share our research findings with them.



Figure 7.1.2: Te Hākari Stream flowing into Ōhau River Estuary makes up part of the 2.2 hectares to be planted out in coastal estuarine and back dune plants. (Photograph by Huhana Smith, 13 August 2014).

8. LAKE WAIORONGOMAI REHABILITATION

Ngā Hapū of Ōtaki will report on the extent of this project when Aroha Spink's completes her PhD thesis.



Figure 8.1: Lake Waiorongomai in drizzle. (Photograph by Huhana Smith, March 2011)

9. KEI UTA : COMPELLING ALTERNATIVES FOR FRESHWATER WITHIN HINTERLANDS: A MAJOR EXHIBITION?

Kei Uta⁸⁰: Compelling Alternatives for Freshwater within Hinterlands is the driving concept underpinning the potential of an activist exhibition⁸¹, which is a multidisciplinary, design,

⁸⁰ Uta is the Māori term for the land (from a sea or water perspective) that is inland (from a coastal perspective) or interior (of a country or island). Kei with uta is a location word or locative therefore Kei Uta is the closest Māori term for hinterland.

⁸¹ http://www.moma.org/explore/inside_out/category/rising-currents and Thomas de Monchaux, "Blue in Green: Notes on 'Rising Currents,'" *Log 19* (Spring/Summer 2010)

contemporary art and science exhibition of solutions to freshwater problems within a wider hinterlands project. From MTM's collaborative efforts the multidisciplinary teams have been able to coalesce complexity into an idea for a major exhibition.

The concept document reads as follows:

Development pressures continue to transform metropolitan hinterlands around the world at an unprecedented rate. A city's connection to its hinterland is fundamental to the resilience of both. The exhibition asks: how can we use design and resilience thinking in an already damaged and vulnerable regional environment to arrive at networks of mutual benefits? What are the compelling alternatives?⁸²

This multidisciplinary, national and international activist exhibition builds on nationally recognised urban resilience research, contemporary art and the anthropocene⁸³, and a large iwi-led (tribally-led), cross-cultural collaboration (2009–15), which has assessed key ecological decline issues for freshwater into the marine and related biodiversity between Hōkio to Ōtaki, Horowhenua. This area demarcates a stretch of the southwest coastline of Te Ika ā Maui (North Island), Aotearoa New Zealand. For the purposes of this exhibition the area will encompass the neighbouring Kāpiti region and Wellington.⁸⁴

With an international reach that brings in Australia and Spain too, the proposed exhibition brings together leading contemporary visual artists (indigenous and non-indigenous) with landscape architects, designers and scientists from each country to provide a range of compelling solutions and alternatives, relevant to respective countries. The reason these countries are considered is that there are a range of exciting collaborative projects underway, either led by indigenous communities with range of experts, or within regions like Catalonia, Spain.⁸⁵

The aim of the exhibition is to design scenarios that intend on future-proofing New Zealand and selected international hinterlands, their waterways and the cities they might support. Based on design, specialist expertise and cross cultural projects that address conflicting demands for services on land and ecosystems in hinterlands, the exhibition aims to communicate coherent visions for the future, with far-reaching implications for the relationships between the built environment, land use, freshwater health, community and culture.

Iwi and hapū have been agents or active kaitiaki involved in six kaupapa Māori hands-on projects within Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū (MTM) research programme, funded by Ministry for Business, Innovation and Employment since 2009 until 2015.⁸⁶ The MTM research team bring evidence-based research on ecosystem values within ancestral landscapes, including rivers and streams to sea, coastal wetlands and dune lakes. Such project findings will inform solutions required to return whenua and taonga species to health, for the benefit of all communities.

82 The Kei Uta team have begun to address these questions with undergraduate Bicultural Design Studio and 15 architecture and landscape architecture students as part of their post-graduate Kei Uta: Compelling Alternatives research lab at the School of Architecture, Wellington.

83 A new geologic era marked by the impact of human activity on the earth.

84 Already the team is making links to similar projects taking place in Barcelona, Spain, Melbourne and country Victoria around the Murray River, and with other related projects underway in Western Australia.

85 <http://online.wsj.com/articles/catalan-leader-signs-decree-for-independence-referendum-1411809286>

On 27th September 2014, Catalonia's regional leader signed a decree convoking a nonbinding referendum on independence for Nov. 9, pitting the wealthy industrial region in a high-stakes showdown with Spain's central government.

86 See <http://www.mtm.ac.nz>

Exhibition Description

Humans need to adapt to new conditions; and to do so we need to change minds; and to change minds, art, images and design will lead the way, more so than politics or science. (Cyril Stanley Smith, Museum of Modern Art)

Architects and urban designers around the world are increasingly focused on cities and urban density to the detriment of a city's hinterlands. Cities are expanding at the expense of their regional landscapes when, in fact, their survival depends on them.

In Aotearoa New Zealand, kei uta or hinterlands are valued for their beauty, productivity, amenity and recreation potential. They support areas of cultural significance and are stores of biodiversity, food and fresh water. These values draw in conflicting forces when: developers look to expand the city limits; tangata whenua want to defend cultural integrity and determine their own futures; farmers demand increased productivity; tourists seek environmental gratification; and life stylers look for their own piece of 'paradise'. Our New Zealand exhibition study site, Wellington and the Kāpiti/Horowhenua region, has further complications: a high hazard environment with shifting fore dunes, earthquake activity with potential liquefaction, occasional serious flooding and long-term effects of sea-level rise.

The exhibition aims to synthesise complex data from the iwi and hapū-led MTM research project along with those of artists, designers, economists, planners, hydrologists, ecologists, climate change scientists, geo-morphologists, archaeoseismologists/archaeologists and engineers. The exhibition attempts to disseminate findings in innovative and compelling ways. For the New Zealand section, the exhibition also acts as a catalyst for negotiating conflicts between, iwi and hapū, communities, councils, farmers and environmentalists. The holistic approach of the art/design/science scenarios with related teams allows for focus on reconciling contradictory and conflicting forces at a number of scales: the large interdependent scale of city and hinterland; the regional scale of Kāpiti and Horowhenua; and more local scales, to be addressed through a number of onsite proposals for particular sites.

To support this premise, the Kei Uta team is making links to similar projects taking place in Barcelona, Spain, in Victoria and in Western Australia. For example, the river plains of the Llobregat near Barcelona have up until 50 years ago, been predominantly cropped. The Llobregat River is the main river in the Barcelona Region that has its source 200km away in the Pyrenees and discharges into the Mediterranean 10 km south of Barcelona's centre. For 31 km its lower reaches run through the Barcelona Metropolitan Area (AMB), a district managed by over 30 different municipal authorities. In the last 50 years the cropped area has reduced from 75% to 20%, while urbanization has increased from 10% to 65%. In the process of urbanization the natural river plain has been significantly narrowed with associated decline issues.⁸⁷ In the last 10 years there is increasing public interest in the use of the natural environment, and a demand for water quality improvements leading to the development of strategies that address these issues.

The team is building relationships with indigenous artists, scientists and designers, particularly around water and cultural/environmental health. To this extent, they have been looking to Mulan, the indigenous owners and their wider team for a significant ancestral desert lake in their Indigenous Protected Area of Paruku, Kimberley in Western Australia. Representatives of Mulan, artists and

⁸⁷ As a result water quality has been reduced – an issue for Barcelona that relies heavily on this potable water source. The aquifer has become drier and more polluted. Water flow rates have increased due to the narrowing of the river, affecting the outpour of sediment into the Mediterranean. Communities have been isolated from the river because of its large flood prevention barriers.

scholars presented the Paruku project at the Art and Environment conference 9-11th October 2014, at Nevada Museum of Art, Reno, Nevada, USA.⁸⁸

The exhibition's reach to these countries aspires to stimulate a shift in thinking (whilst highlighting indigenous knowledge systems with science and design) about the possibilities for resilient and sustainable futures for freshwater ecosystems within kei uta or hinterlands and the cities they support, both nationally and internationally.⁸⁹

Indicative Artists list (Not final at all TBC)	Alex Monteith - Fiordland series
Areata Wilkinson and Mark Adams - New work in response to research	Natalie Robertson - Ahi Kaa Roa series
Local Time - Danny Butt, Jon Bywater, Alex Monteith and Natalie Robertson – New work in response to research	Emma Pratt - Subterranean waterways, Sevilla, Spain Kura Puke – Existing work or new work in response to research
Robert Jahnke - New work in response to research	Israel Birch - New work in response to research
Shane Cotton - New work in response to research	Saffron Ratana, Hemi Macgregor, Ngatai Taepa - New collaborative work in response to research
Neil Pardington - New work in response to research using museum shellfish collection	Rachael Rakena - New work in response to research
Bridget Rewiti or Te Aho Collective- New work in response to research	Anne Shelton - New work in response to research/recent Spain experience
Anne Noble - New work in response to research	Jonathan Jones (Australia) - New work in response to similar research
Judy Watson (Australia) - New work in response to similar research	Fiona Hall (Australia) - New work in response to research
Lily Randall (Australia) - New work in response to research	Martin Beaver (Australia) - New work in response to research
John Wolseley (Australia) - New work in response to similar research	Sue Anderson (Australia) - New work in response to similar research
Paruku artists (Australia) - New works	Artists (Spain) TBC, and other participants TBC ⁹⁰

⁸⁸ Huhana participated in the Art + Environment conference at the Centre for Art and Environment, Nevada Art Museum in October 2014. While she was not officially on speaker list, Bill Fox the Director was keen to hear more on the MTM project. Key aspects of MTM research and Kei Uta exhibition idea with lead curators and key officials of the institution took place.

For more details on participants like John Carty and others in Kei Uta idea, see http://www.nma.gov.au/exhibitions/yiwarra_kuju/home and

www.nevadaart.org/exhibitions/detail?eid=282

⁸⁹ Current team members are linked to many institutions, for instance Royal Melbourne Institute of Technology (RMIT) in Melbourne; Victoria University, Wellington; Massey University, Palmerston North and Wellington campuses, while others in the team have strong connections to indigenous art projects surrounding water health in Victoria and New South Wales, Australia. In this latter regard, the team is hopeful to work with artist Jonathan Jones, a Sydney-based Wiradjuri/Kamilaroi artist and his projects around the Murray Darling River basin.

Judy Watson, a Waanyi woman produces works that relate to indigenous socio-political oppression, also to land, spirit and water interrelationships and will be invited to produce a new work.

Professor Penny Allan is a Landscape Architect and academic at Victoria University, Wellington. Since 2010, Penny has been an important collaborator in MTM. Penny and Huhana developed the Bicultural Design Studio and Protocols for senior students based on Māori research methods. In 2013, Martin and Penny won the Challenger Supreme Award New Zealand international Landscape Architecture Award for Excellence in Landscape Planning Research for their Earthquake Cities on the Pacific Rim. See www.victoria.ac.nz/architecture/about/staff/penny-allan and www.pennyallan.com

Mr Martin Bryant is Senior Lecturer in Landscape Architecture at Victoria University. Martin is a co-director of Wraight + Associates, a Landscape Architecture and Urban Design firm in Wellington. His research interests include water sensitive urban design, heritage of landscape materials and sustainable subdivision. In September 2014, International Biennial of Landscape Architecture Jordi Ros, September 2014, Barcelona, recognized the MTM collaborative work within a university. Martin is currently liaising with experts from RMIT, Melbourne and the Llobregat River Park project, Barcelona to engage them in the potential of this international exhibition opportunity. www.waal.co.nz

Dr Huhana Smith is Research Leader Māori for Manaaki Taha Moana: Enhancing Coastal Ecosystems for Māori (MTM) funded by MBIE from September 2009-15. Since 2010, Huhana has been contracted to School of People, Environment and Planning, Massey University, Palmerston North. She is a practicing artist, academic and museum professional. She is a Research Associate to Museum of New Zealand Te Papa Tongarewa. She has strong links to Toioho ki Āpiti, the Māori art/visual culture courses at Te Pūtahi ā Toi, School of Māori Art, Knowledge and Education; School of People, Environment and Planning at Massey University, Palmerston North; the College of Creative Arts, Massey University, Wellington; School of Architecture and Design, and Museum and Heritage Studies at Victoria University, Wellington.⁸⁹ In 2013, the Manaaki Taha Moana team was awarded the inaugural DOC Regional Kaitiakitanga Award for outstanding services to conservation by iwi and hapū. In 2014, Huhana received two Certificates of Achievement in the New Zealander of the Year Awards for her individual and community contributions to conservation/kaitiakitanga.

⁹⁰ At present no approaches for major funding have been sought for this exhibition idea or for the teams to produce works to research brief. This will be addressed in 2015.

Collections to investigate:

Shellfish, archaeology and midden material and G. Leslie Adkin collections at Museum of New Zealand Te Papa Tongarewa.

10. FINAL COMMENTS

For all the efforts, acts of kotahitanga or coming together with common purpose for Waiwiri Stream from Lake Waiwiri/Papaitonga; the extending of wetland protection towards Waikawa; the Shellfish Survey; the Ōhau 'Loop' projects; the renewed Harakeke Industry potential; the Kuku Ōhau Estuary frontage project; the revitalization of Lake Waorongomai and the Kei Uta: Compelling Alternatives exhibition opportunity based on the MTM research - there is still a long way to go to completely change attitudes towards freshwater and its importance for associated human health for the case study region, but also for Aotearoa New Zealand. All communities' collective wellbeing is highly dependant on healthy freshwater.

There should be no offsetting or privileging of economic imperatives that might compromise environmental integrity. Disregard for precious water resources continue in Aotearoa New Zealand. When finalising this document, two international visitors, Geir Sogn-Grundvag⁹¹ and Oddvar Vermedal⁹² lamented in a Dominion Post article on 24th September 2014 on the current governmental attitude to declining water quality. They wrote:

"The scientific evidence in support of deteriorating water quality seems unequivocal. Yet prominent representatives of the authorities as well as farmers' associations deny the facts and apply simple suppression techniques. In 2011, when interviewed by the BBC, Prime Minister John Key was asked about New Zealand's clean, green image and how that sat alongside comments by a leading environmental scientist at Massey University, Dr Mike Joy, who said "we are delusional about how green and clean we are". Key responded: "That might be Mike Joy's view, but I don't share that view." The interviewer then said Joy was a scientist and would have based his comments on research, to which Key replied: "Well, he's one academic, and like lawyers I can give you another one that will give a counterview". In that one statement, he reduced the value of science to mere opinion that is easily challenged. Significantly, Key has not been able to find a single scientist to provide this counterview, but there are many, including the Government's own Commissioner for the Environment, Dr Jan Wright, whose own findings largely support Joy's. To us who live in a western European country where environmental issues are now taken seriously, the low water quality in New Zealand is appalling."

To counter this disregard, Iwi and Hapū and our MTM team of collaborators and specialists are harnessing their energies (as addressed in this report) to implement hands-on action for key waterbodies in the case study area. Despite all our collaborative MTM efforts, it is not an easy ride in Horowhenua. Challenges continue.

⁹¹ A senior researcher at the Norwegian Institute of Food, Fisheries and Aquaculture Research who has been visiting New Zealand since 2001.

⁹² A board member of the Norwegian Hunting and Fishing Association and a visitor to New Zealand since 1998.

While the gate is open at Kuku Ōhau estuary for whitebait season from August to November, and despite all the well-designed, attractive area and visual signs explaining the reason for a carpark and gate, inappropriate access *up* the tidal (and at times dry but muddy) Te Hākari stream by 4x4 vehicles, has taken place. The carpark signs clearly call for respect, however vehicles drove over harakeke that was split and replanted in July 2013 and again, more recently in 2014. They also accessed an area of beach from the tribe's farm for so called recreational purposes, to rip up sensitive, estuarine dune plants and ground covers. In the meantime, a stream protection barrier has been erected to clearly indicate that driving up a tidal stream is not wanted or warranted. The gate is closed again after baiting season to avoid more damaging access. In 2015, the revegetation of the estuary frontage takes place.

Similarly, whilst working with LA students and the Muka team in August-September 2014 on getting our harakeke plans, vision and business plans readied, identifying the Kuku Stream⁹³ that flows into the Ōhau River as a possible pilot for the harakeke hub, it was in late September that the new owner of the neighbouring farm removed decades old riparian vegetation along the banks of the Kuku Stream from around one of the farm houses. This was alarming on three fronts. Firstly, Tahamata Incorporation had tried to buy this neighbouring farm but missed out, even though the Incorporation was the top tender. The vendor chose to sell the farm to the next tender at a considerable sum less, which left the Māori operation reeling as to the former owner's entrenched attitude towards local Māori. In reducing the riparian bush and macrocarpa to bare dirt, the new owners opened the Kuku Stream to sunlight that increases water temperatures in summer and impacts on any remaining freshwater biodiversity. After heavy rains fell the following week, the stream was open to sedimentation that then flows into the Ōhau River. Secondly, the tribal farm missed out on the opportunity to protect and enhance considerable cultural integrity that exists within the neighbouring lands, including former pā sites, burial areas, and sacred groves of tii kouka; and thirdly, Tahamata lost the opportunity to expand our Iwi economic development in a holistic, economically and environmentally sustainable way. The clearing of the riparian took place upstream to where MTM and the Muka/Harakeke teams have been envisaging opportunities to achieve better freshwater health on farms, as part of a Hakareke Hub trial that aims to denitrify poor quality water in the Kuku Stream.⁹⁴

With Mātauranga Māori and scientific endeavour being respected as differing systems of understanding, our collaborative approaches to projects are proving to be successful as our MTM team works towards creating a far more resilient and sustainable future for freshwater ecosystems into the coastal, tidal zone between Hōkio and Ōtaki. Despite challenges of varying degrees across the case study projects, the Manaaki Taha Moana Horowhenua team concentrates its positive efforts on the kaupapa Māori and action research tasks at hand. The team draws on as much kaitiaki support as possible to ameliorate environmental problems for freshwater into the marine for the coastal communities. By knowing the decline issues for freshwater into the marine well, our collaborative and associated teams are solutions focussed, whilst simultaneously shifting the thinking and attitude around freshwater needs for all related entities within the region, and for national and international communities of interest.

⁹³ Our MTM 2011 Ōhau River Phase 1 report determined that the Kuku Stream was in very poor health.

⁹⁴ Despite such setbacks and since this time, the MTM team and Ngāti Tukorehe are very keen to work with the new owners. In December 2014 opportunities to do just this have opened up successfully between Tahamata Board and Management, the new owners and key tribal members.



Figures 10.1: Despite appealing for respect for the coastal frontage and tidal Te Hākari stream to estuary during low summer flows, a barrier has now been erected to stop destructive access (top image). (Photograph by Huhana Smith, 20 October 2014)



Figure 10.2: The kaitiaki teams planted out a former track but drivers persisted by going up the stream (near gorse at left top of image) and turned into this area planted in 2013 and 2014. (Photograph by Huhana Smith, 20 October 2014)

REFERENCES:

- Allan, P & Smith, H.,** (2013) "Research at the interface: Bi-cultural studio in New Zealand, a case study", *MAI Journal: A New Zealand Journal of Indigenous Scholarship*, Wellington.
- Allen C, Doebling K, Young R, Sinner J.,** (2011). *Ōhau 'Loop' Phase 1: Existing Status and Recommendations for Improvement*. Manaaki Taha Moana Research Report No. 5. Cawthron Report No. 2041, 37.
- Allen, P. & Smith, H.,** (2013) 'Research at the Interface: Bicultural studio in New Zealand, a case study', *MAI: A New Zealand Journal of Indigenous Scholarship*, Vol 2: 2, Victoria University, Wellington.
- Cooper, R. & Brooking, R.,** (2002) "Ways Through Complexities" in Kawharu, M. (ed.) *Whenua Managing Our Resources*, Reed Publishing Ltd books: Auckland, 195.
- de Monchaux, T.,** "Blue in Green: Notes on 'Rising Currents,' " *Log 19* (Spring/Summer 2010).
- Gyopari, M.,** (2006) *Te Hakari Wetland Hydrological Study*, Phreatos Ltd, Wellington, 3.
- Hardy D. J., et al.,** (2012) *Assessing the Holistic Health of Coastal Environments: Research Design and Findings from Cross-Cultural Research*, Manaaki Taha Moana Phase 1, MAUX0907, Taiao Raukawa, Kuku/Massey University, Palmerston North, 34, 38.
- Hardy, D., Patterson, M., Smith H., & Spinks, A.,** (2011) *Assessing the Holistic Health of Coastal Environments: Phase 1, Research Design and Findings from Cross Cultural Research Phase 1*, Manaaki Taha Moana Research Report No. 6. Massey University, Palmerston North, (MAUX 0907).
- Kawharu, M.,** (1998) *Dimensions of Kaitiakitanga: An investigation of a customary Māori principle of Resource Management*, Unpublished PhD. Thesis in Social Anthropology, Oxford University, England, 12.
- Loader, P.,** (2003) *Te Hākari wetland restoration: a case study*, Unpublished Masters Thesis, Victoria University, Wellington.
- Lucas Associates,** (1997–1998) *Kuku–Ōhau Situation and Opportunities for the Lower Reaches of the Ōhau River*, Visual report for Te Raukawakawa o te Ora and Ngāti Tukorehe Marae Committee.
- Luke, D, et. al,** 2014, *Te Aho: The Woven Strands*, Te Arahanga o Ngā Iwi Limited, Ōtaki.
- McFadgen, B., (1997) *Archaeology of the Wellington Conservancy: Kapiti-Horowhenua A prehistoric and palaeoenvironmental study*, Department of Conservation: Wellington, 16.
- McFadgen, B.,** (2012) *Horowhenua?* Sourced from presentation to Landscape Architecture students as part of their wānanga, 12 March 2012, Tūkorehe Marae, Kuku.
- Meyer, M.,** (2003) *Ho'oulu Our Time of Becoming: Hawaiian Epistemology and Early Writings*, 'Ai Pōhaku Press Native Books: Hawai', 63.

Moore P., Royal, C., (2012) Between the Ōhau River and Hokio Stream, in the Ngāti Raukawa Sites of Significance Natural Resource Monitoring series, Hapai Whenua Consultants Ltd.

Newcombe, E., Poutama M., Allen C., Smith H., Clark D., Atalah J., Spinks A., Ellis J. & Sinner J., (2014) *Kaimoana on beaches from Hōkio to Ōtaki, Horowhenua*. Manaaki Taha Moana Research Report No. 22, Cawthron Report No. 2564, Cawthron Institute: Nelson.

Newcombe E., Smith H., Poutama M., Clark D., Spinks A., Ellis J., Sinner J., (2014) *Faecal contamination of shellfish on the Horowhenua coast*. Prepared for Taiao Raukawa and Manaaki Taha Moana. Manaaki Taha Moana Research Report No. 23, Cawthron Report No. 2573, Cawthron Institute: Nelson.

Park, G. (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.

Park, G. (2003) 'Swamps which might doubtless easily be drained': Swamp Drainage and its impacts on the Indigenous', in Pawson, E & Brooking, T (eds.), *Environmental Histories of New Zealand*, Oxford University Press: Melbourne, 151.

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.

Royal, C. (1994) *Kāti Au i Konei: A Collection of Songs from Ngāti Toarangatira and Ngāti Raukawa*, Huia Publishers: Wellington, 17-20.

Royal, C., (2004) *Mātauranga Māori and Museum Practice*, Discussion paper prepared for National Services Te Paerangi, at the Museum of New Zealand Te Papa Tongarewa, 21.

Sims, M & Thompson-Fawcett, M. (2002) 'Planning for the Cultural Landscape' in Kawharu, M., 2002 (ed.) *Whenua: Managing our Resources*, Reed: Auckland, 257-258.

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

Smith, H. (2008, 2012) *Hei Whenua Ora ki Te Hākari: Reinstating the Mauri of valued ecosystems—history, lessons and experiences from the Hei Whenua Ora ki Te Hākari/Te Hākari Dune Wetland Restoration project*, Ngā Māramatanga-ā-Papa (Iwi Ecosystem Services), Research Monograph Series, (FRST MAUX 0502), 33.

Smith, H. (2012) *Hei Whenua Ora ki Te Hākari Reinstating the Mauri of valued ecosystems* -Affidavit of evidence for National Freshwater and Geothermal Resources Claim, 2012.

Smith, S. M. (2007) *Hei Whenua Ora: Hapū and Iwi approaches for reinstating valued ecosystems within cultural landscape*, Unpublished PhD thesis, Massey University, Palmerston North, 143.

Taiapa, C., Bedford-Rolleston, A., and Rameka, W. (2014) *Ko te Hekenga i te tai a Kupe: A Cultural Health Review of the Health of Te Awanui*, Tauranga Moana. Manaaki Taha Moana Research Report No. 3. Massey University, Palmerston North, (MAUX 0907).

Tanner, C. Nguyen M. L, and Sukias J. P. S., (2005) Export of nitrogen in subsurface drainage from irrigated and rain-fed dairy pastures and its attenuation in constructed wetlands”, In *Developments in Fertiliser Application Technologies and Nutrient management*. Occasional Report No. 18 Fertiliser and Lime Research Centre, Massey University, Palmerston North, New Zealand, 105-113.

Te Kanawa, R., (2005) *New Research for the Harakeke Industry*, Workshop at Industrial Research Limited, Gracefield, Lower Hutt, 12 March 2005.

The Booklet Committee, (1964) *The Centenary of the Rowland Family in New Zealand 1864-1964*, 19.

Ward, A. (1997) *National Overview Volume III*, Waitangi Tribunal Rangahaua Whānui series, GP Publications: Wellington, 229–231.

Wehipeihana, J.R. (1964) *Sequent Economies in Kuku: A Study of a Rural Landscape in New Zealand*, Master of Arts in Geography, Victoria University: Wellington.

Williams, J., Ferguson, H., Tuck, I. (in press(a)) *Surveys of toheroa and tuatua at Ninety Mile Beach 2010 and Dargaville Beach 2011*. Presentation of FRR to Shellfish Working Group for project TOH2010-01: Distribution and abundance of toheroa and tuatua on Dargaville Beach. CONFIDENTIAL – soon to be released.

Williams, J., Sim-Smith, C., Paterson, C., Smith, S. (in press(b)). *Toheroa abundance*. Presentation of draft to Shellfish Working Group for project TOH2007-03: Toheroa abundance. NIWA. CONFIDENTIAL – soon to be released.

Websites:

<http://www.te-ripo-o-hinemata-wetland.org/background.php>

<http://www.dnzb.govt.nz>

http://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=7BD22AF3-9C85-D485-666F-E7E3C0E388B0

http://www.moma.org/explore/inside_out/category/rising-currents

http://www.massey.ac.nz/~flrc/workshops/11/Manuscripts/Wilcock_2011.pdf
Wilcock et al (2011) *Benefits of wetlands in farming landscapes*.

http://www.massey.ac.nz/~flrc/workshops/14/Manuscripts/Paper_Sukias_2014.pdf
Sukias et al (2014) *Controlled drainage – Assessing the relevance to NZ pastoral situations*.

<http://online.wsj.com/articles/catalan-leader-signs-decree-for-independence-referendum-1411809286>

http://www.nma.gov.au/exhibitions/yiwarra_kuju/home

<http://www.nevadaart.org/exhibitions/detail?eid=282>