THE ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN

"What mana allows, indeed requires, is sharing"

(Sir Hugh Kawharu, 2004)

NGATI WHATUA O ORAKEI

Visionary statement: ***Waters fit to swim in at all times, with thriving marine eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in and on the bay as users and kaitiaki***

Document prepared for Ngati Whatua Orakei 2012

Compiled by: Richelle Kahui-McConnell

THE ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN

PHASE I – PLANNING PROCESS

The Ōkahu Bay Ecological Restoration Plan (ŌCERP) has been developed in order to implement the Whenua Rangatira Reserves Management Plan and the Ngāti Whātua Ōrākei Heritage and Resource Management Kaupapa, Strategy and Policy 2010-2011. It looks to promote, develop and enhance Ōkahu Bay as the public face or gateway to the Whenua Rangatira while respecting its existing cultural and spiritual value to the Tangata Whenua and enhancing its relationship with the Waitematā.

The ŌCERP sits firmly within the Ngāti Whātua Iwi Management Plan and alongside the work conducted by the Heritage and Resource Management Unit of Ngāti Whātua Corporate. It is anticipated that the tasks required to implement the ŌCERP will work in conjunction with the Heritage and Resource Management Unit and will rely on complete integration of work streams to ensure a successful outcome.

Visionary statement: ***Waters fit to swim in at all times, with thriving marine eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in and on the bay as users and kaitiaki***

Section one defines a set of Ōkahu Bay Restoration Management Objectives identified to implement restoration outcomes as identified by Ngāti Whātua Ōrākei ecological health indicators

Section two outlines the historical perspective of the Ngāti Whātua Ōrākei and Ōkahu Bay legacy over the past 100 years

Section three identifies the current status of the Ōrākei Catchment drawing on trends and findings of the literature review, monitoring results and mātauranga of Ngāti Whātua Ōrākei

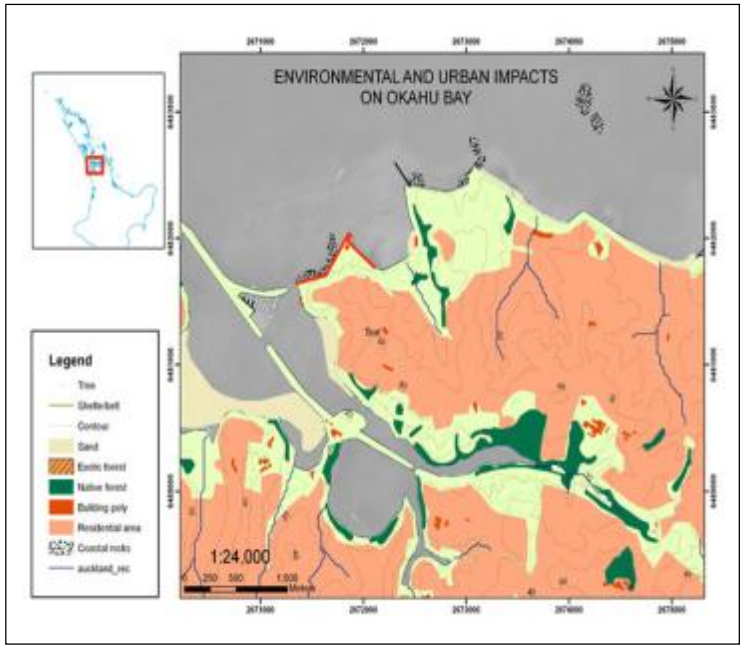
Section four offers a framework to implement restoration mechanisms

ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN

PHASE II - IMPLEMENTATION

The Ōrākei Act, 1991, directed that The Whenua Rangatira Reserve Management Plan be prepared under the provisions of the Reserves Act. Part of the agreement determined that the land known as the Whenua Rangatira is set aside as a Māori Reservation for the common use and benefit of the Ōrākei Hapū and the citizens of the City of Auckland. This land is under joint administration of the Ngāti Whātua Ōrākei Māori Trust Board and the Auckland Council.

The Whenua Rangatira ('chiefly or noble land') of the Ōkahu Bay Catchment is a remnant of the Ōrākei Block which NWO campaigned vigorously over more than a century to retain in hapū ownership. The kāinga was located on the flat backing Ōkahu Bay until it was destroyed by deliberate government action in the early 1950s. The Whenua Rangatira is broken down into 6 activity areas which are determined by cultural, environmental and activity-related character: Takaparawhau, Tai Hara Paki, Kohimaramara, Papakāinga , Te Ngāhere and Ōkahu Bay. Takaparawhau is dominated by flat, open, grass ridged spaces, ringed by steep cliffs which are open to natural erosion processes with risk of slippage.



The spiritual significance of the land was recognised by Ngāti Whātua Ōrākei ancestors who sought to safeguard the Whenua Rangatira as a place which links water, land, forest and sky (Tangaroa, Papatūānuku, Tānemahuta and Ranginui) maintaining a strong link with surrounding cultural landmarks within the isthmus and beyond. The Ōkahu Bay Catchment lies within the Tāmaki Ecological District Boundary 09.03. It is bounded by the ridgeline roads of Kepa Road, Ngāpipi Road and Kupe Road but does not limit the inclusion of communities and land adjacent to these roads.

Ōkahu Bay is the primary receiving environment for stormwater runoff from this catchment. "Associated sediment and contaminants contribute over 70% of the pollutant load to Ōkahu Bay and the Ōrākei Basin and some 7% from the entire Auckland isthmus' stormwater runoff to the harbour" (Scoop, 2003). Myriad communities utilise Ōkahu bay, both land and water, and it is a major tourist location within the Auckland District.

Business	0%	Special Purpose	24%
Residential	40%	Roads	22%
Open Space	14%	Indicative catchment imperviousness	35%

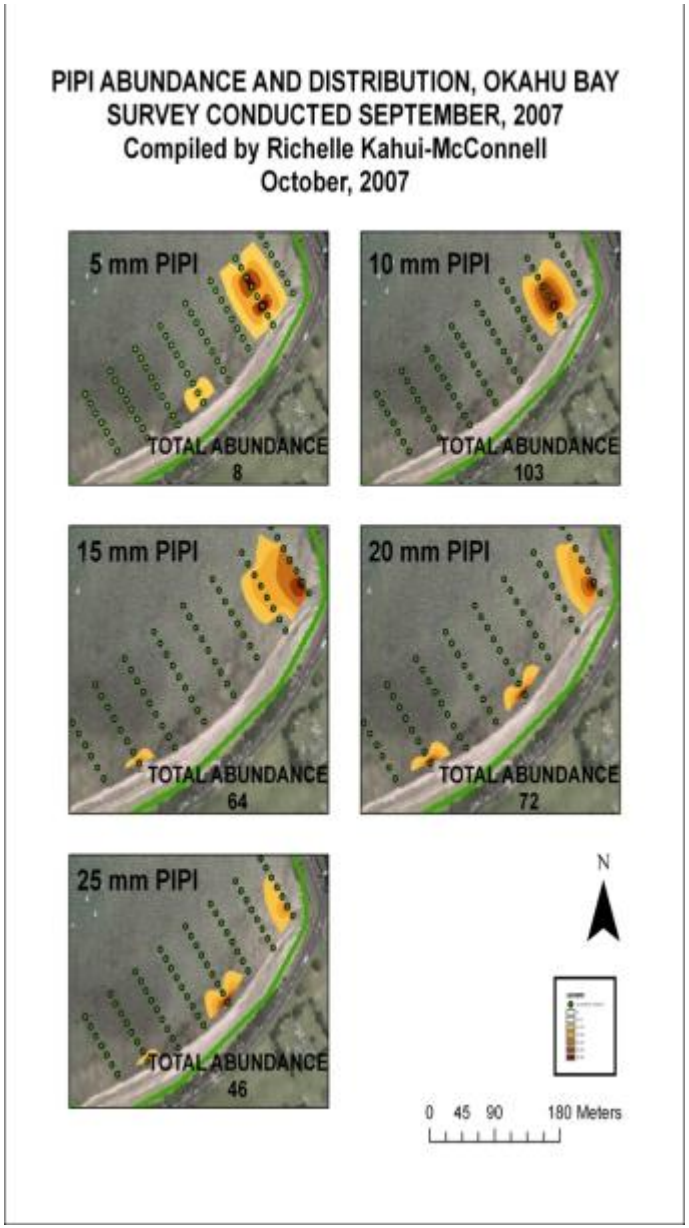
Existing vegetation remnants of Takaparawhau and Ōkahu Bay show severely degraded ecological value (through human colonisation and past grazing practices). Current vegetation consists of a highly modified urban ecology, related to lengthy human occupation - both Māori and Pākehā.

Tāmaki Drive halts the natural coastal processes interacting between land and sea, and provides large amounts of pollution and contamination from the 21,000 cars which commute along the thoroughfare twice a day. Major disturbance to Ōkahu Bay hydrology has also occurred following the construction of Tāmaki Drive, creating frequent flooding episodes and concerns for Ngāti Whātua in regards to tidal influences on ground water - particular with regard to the Ōkahu Bay Urupā and the impact of groundwater levels on burials.

Prior to urban development and intensification from the 1950's, the substrate was predominantly sand with sand bars present throughout the bay. 10,000cm³ of sediment enters Ōkahu Bay per annum. This has created a varying substrate, from sandy sediments at the eastern end of Ōkahu Bay to very muddy deposits at the western end and within the body of the bay.

Substrate and contours of Ōkahu Bay foreshore, December 2011

Sandbars and contours in foreshore 1938



Abundance of Pipi and Cockle 2007-2011

Although the shellfish which are present in the bay are reaching sexual maturity, are well-nourished and generally in good condition, they do show elevated tissue content of heavy metals (chromium, mercury, copper and lead) and generally fail to reach full maturity.

Overall abundance is low and natural migration patterns are impaired. As shellfish mature they migrate further away from the High Tide Mark, travelling into the body of the bay to achieve maturity.

Shellfish are highly susceptible to the fine mud particles which are present in the body of the bay which clog their filter feeding systems, causing mortality. Maps provided indicate general trends of low abundance and maturity rates which dramatically decline with migration into the body of the bay.

Water quality 2011

Following upgrades of stormwater systems to Ōkahu Bay there are still exceedences of Enterococci. From April-July 2011 3 "Red" alert exceedences of enterococci occurred following heavy rainfall, along with 5 "Amber" alert levels.

Marina Surficial sediment for copper

As reported in the Assessment of Environmental Affects prior to the development of the marina, sediment levels within the marina had a mean total copper concentration of 5.6mg/kg

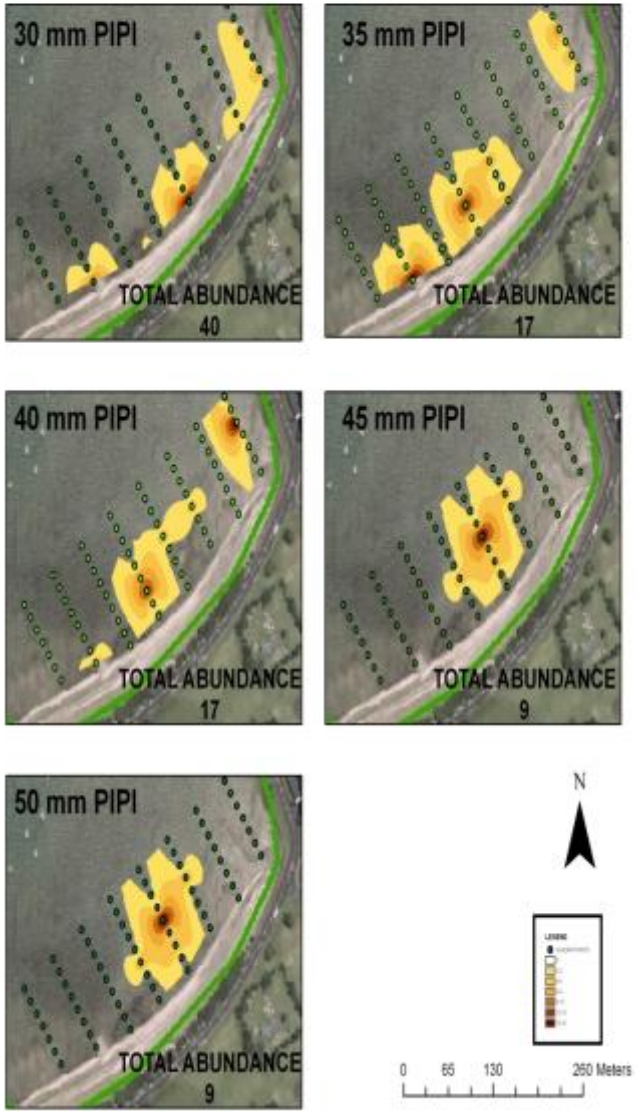
- In February 2009 tests indicated a total copper concentration of 35.5mg/kg
- In 2011 the total copper concentration mean was 24.7 mg/kg

Results of sampling at location at point source drain from The Ōkahu Bay Landing

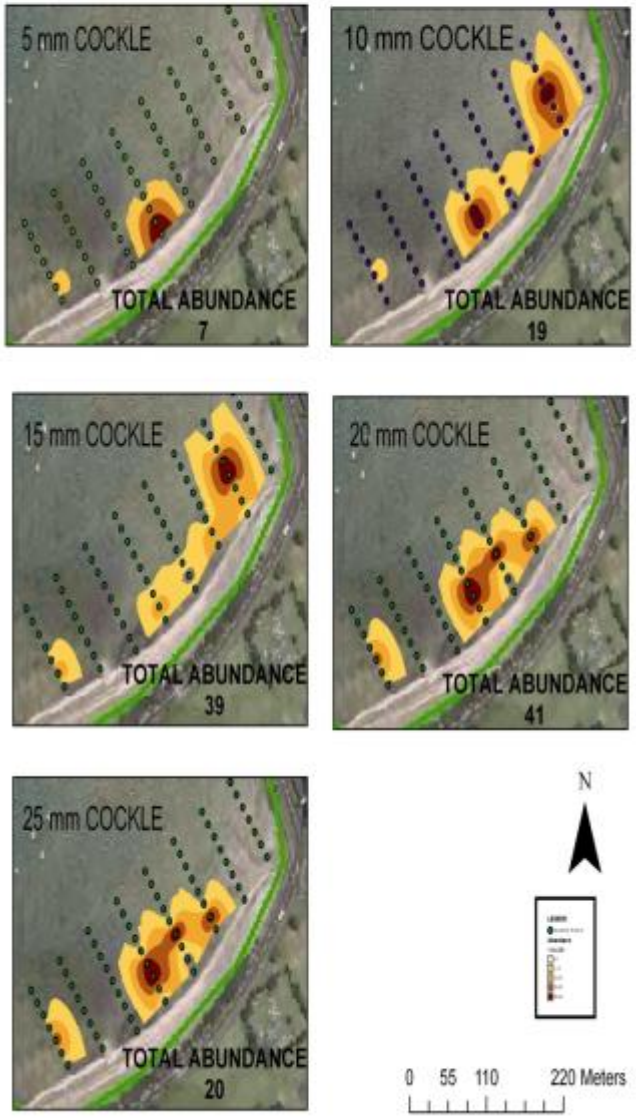
- Significant level of copper contamination 44.4 µg/g
- The red zone trigger level given by TP168 (2004) is >34µg/g/
- The reading outside the hardstand therefore is a red zone reading

Ecosystems with this level of contamination present are expected to be negatively impacted.

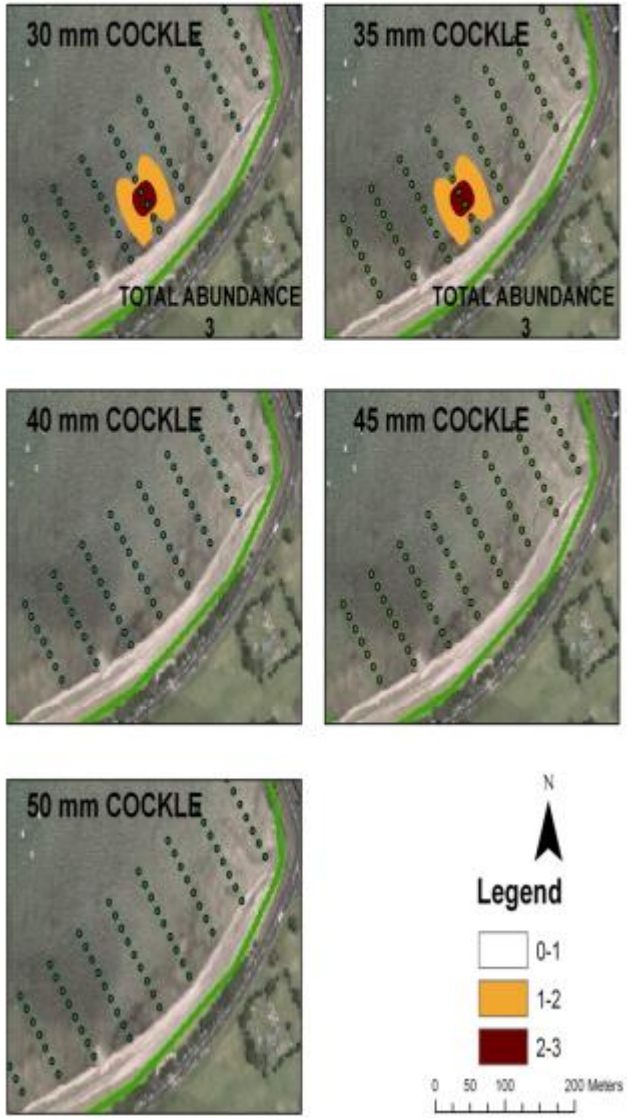
PIPI ABUNDANCE, OKAHU BAY
SURVEY CONDUCTED SEPTEMBER, 2007
Compiled by Richelle Kahui-McConnell
October, 2007



COCKLE ABUNDANCE AND DISTRIBUTION, OKAHU BAY
SURVEY FROM SEPTEMBER 2007
Compiled by Richelle Kahui-McConnell
October, 2007



COCKLE ABUNDANCE AND DISTRIBUTION, OKAHU BAY
SURVEY CONDUCTED SEPTEMBER, 2007
Compiled by Richelle Kahui-McConnell
October, 2007



THE ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN

RESEARCH INFORMING PROCESS

In April 2012 further work was commissioned to identify management objectives and mechanisms to implement restoration strategies. Research into the anthropogenic impacts onto Ōkahu Bay and brokering community and stakeholder engagement has defined management options.

COMMUNICATION STRATEGY

In order for implementation and maintenance of kaitiakitanga within management objectives, Ngāti Whātua Ōrākei identified their own ecological health indicators in Phase I of the Restoration Plan. (See Appendix A: Environmental Performance Indicators of Ōkahu Bay Community).

This process enabled strategies to support active participation of whānau within the restoration, monitoring and mitigation process. A series of hui were conducted to further inform key stakeholders of research outcomes and the restoration process. Frequent communication between all strata listed is required to ensure 'ownership' and engagement with the Ōkahu Catchment Ecological Restoration Plan.

The Visionary Statement for the Restoration Plan defined the kaupapa:

"Waters fit to swim in at all times, with thriving eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in, on and around the bay as users and kaitiaki"

Communication strata:

- Toki Taiao (NWO heritage and resource management unit)
- Ōrākei Marae hui
- Ngāti Whātua Ōrākei website and E Wawa Ra / Te Puru newsletters

Kuia and Kaumātua
The Ngāti Whātua Reserves Board

External communication strata:

- Auckland University
- Auckland Museum
- Auckland Council
- Ōrākei Primary School
- Ōkahu Marina 'The Landing'

Māori Television Project Mātauranga and Science Series
Ōrākei Local Board
Hauraki Gulf Forum
Waterfront Auckland
World Wildlife Fund

Department of Conservation

STAKEHOLDER ENGAGEMENT

Ōkahu Rākau Bush Care and Nursery implement the *ko te Pūkākī* broadleaf and Pōhutukawa coastal forest restoration project on Takaparawhau, which is committed to non-chemical mechanisms of weed control, alongside providing ecosourced "plants that Whakapapa to the land" within the 'Whenua Rangatira Ecological District'. Its work takes the wider matrix of green spaces, patches and corridors of Tāmaki Mākaurau into consideration when discussing regional ecological restoration. Over 11 years Ōkahu Rākau have planted more than 160,000 plants and within the six month period of January to June, 2012, they worked with 328 volunteers from the Auckland City Mission, the community, week day groups and Corrections, having conducted 3,349 volunteer hours.

An engagement plan with Ōkahu Rākau has outlined key mechanisms for ecological restoration within the Ōrākei Catchment:

- Defining a relationship for Ōkahu Rākau to be the ecological restoration entity which external stakeholders engage with
- Defining a Whenua Rangatira Ecological District plan using an adaptive management process to deliver ecological restoration across the catchment with particular regard for marine restoration of Ōkahu Bay – research informing objectives which are evaluated and adapted according to further research findings
- Working in conjunction with the delivery of Mai Ora Mai Whānau to deliver the kaitiaki components of waste minimisation, edible gardens, fruit trees, native plants replacing weeds in a holistic manner.

A mapping process and engagement plan for the wider Ōrākei community and formal and informal agencies, identified mechanisms to integrate and collaborate with partners, stakeholders, interest groups and ecological enhancement and restoration programmes, alongside formal agencies. Formal agency engagement will further inform mitigation and restoration techniques, and assist with the implementation strategy of the restoration plan - which includes defining priorities and outlining an action plan.

With limited resourcing and expertise available to Ngāti Whātua Ōrākei, it is essential to collaborate with existing programmes that provide the ability to dovetail multiple deliverables. The engagement strategy facilitates a localised community engagement process between the Auckland Council and regional networks, which enable the sharing of information and ideas and provides opportunity for efficient working programmes that deliver objectives that enhance the environment.

Toki Taiao have engaged with the Auckland Council Sustainable Catchment Programme, which works with a targeted communities of the Whangateau, Hōteo and Kaipara Harbours to encourage and motivate environmental action in relation to areas of high cultural, commercial and tourism significance. The programme builds the capacities of communities who are already engaged in kaitiakitanga, to work as a collective towards enhancing environmental outcomes. Its principles are to provide an integrated planning and implementation framework for catchments to address the long term health of priority habitats.

This mechanism will co-ordinate engagement processes between key Auckland Council officers within Biosecurity, Natural, Cultural and Built Heritage, Stormwater, Community Development, Environmental Education and other departments / CCOs such as the Coastal Team and Waterfront Auckland. It is designed to meet the needs of people and science by scaling issues, priorities and urgencies determined by knowledge gaps and providing a structure for potential priority actions, further research and an implementation programme that measures success.

- Whole catchment planning
- The use of science, planning and community processes
- Framework to draw together stakeholders
- Integrating objectives and interventions
- Tailoring the response to the catchment
- Identifying priority actions to inform the Long Term Planning Process
- Engaging multiple roles in council

Toki Taiao also propose the development and dovetailing of two programmes to deliver social, cultural, environmental and economic outcomes:

- Ngāti Whātua Ōrākei already delivers the Mai Ora Mai Whānau sponsored programme of Whānau Ora. This programme works alongside 150 households within the Ōrākei Catchment providing health, education and vocational guidance and advocacy services. *ko te Pūkākī* propose to deliver additional kaitiaki components which include support setting up waste minimisation systems, edible gardens, fruit trees, chickens and native regeneration and weeding on private properties.
- The Sustainable Neighbourhoods Programme which works with community to achieve environmental outcomes through landscape restoration activities; both individually in people's own time or collectively – and on both private and public land. The approach engages communities on a neighbourhood scale using a community development model within a Council-neighbourhood partnership. The programme was piloted in January 2008 in two neighbourhoods within the Waitākere Ranges Heritage Area - Piha and Henderson Valley. By May 2011, there were 55 participating neighbourhoods, approximately 340 households and community stewardship over 300 hectares of land.

Neighbourhood projects typically start with an environmental restoration focus, for example;

- Eradicating weeds
- Planting native plants
- Improving stream health
- Encouraging birds and wildlife
- Developing eco-friendly landscaping

ANTHROPOGENIC IMPACT

Like the larger Auckland Harbours, Ōkahu Bay is a sink for the disposal of urban stormwater and associated contaminants. Kaimoana species show low total abundance and population changes in community structure which are characteristic of a disturbed environment. Pipi and tūangi seeding and recruitment appear to be occurring but with very few reaching full maturity. Mātauranga informs our science that kaimoana abundance dropped off around the 1980s, which was around the same time that sandbars started to disappear and mud started to appear, alongside a surge in seagrass abundance.

SEDIMENT

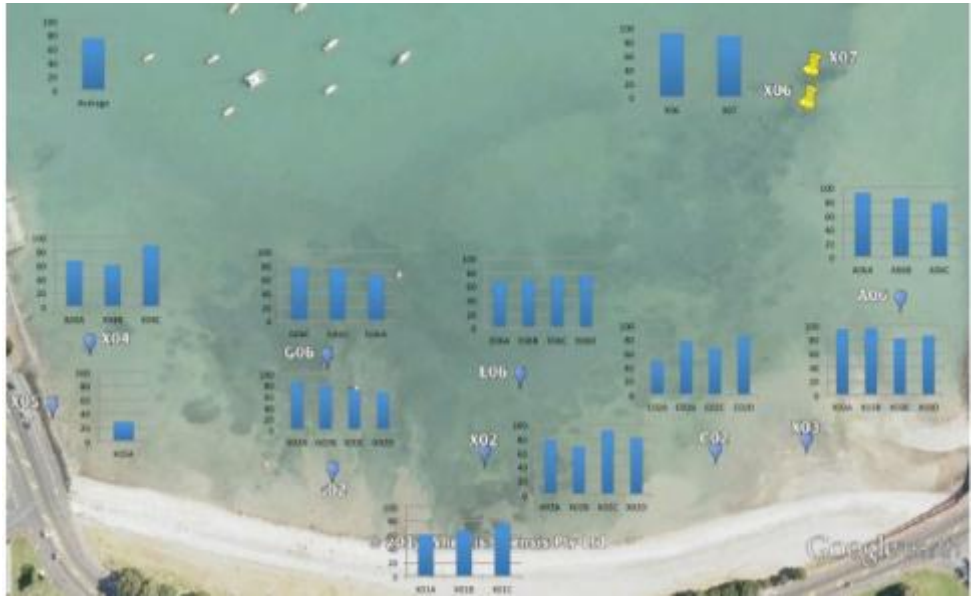


Figure 1: Sediment Composition against Depth in Ōkahu bay

As of 2003 no detailed surveys of sediment movement in the Waitematā Harbour and Hauraki Gulf or Ōkahu Bay had been carried out. 2012 summer sediment research indicates that sediment deposits in Ōkahu Bay vary widely from sandy sediments at the eastern end of Ōkahu Bay to very muddy deposits at the western end and the variability in sediments appears to be increasing, as deeper sediments were less variable. This concurs with mātauranga which confirms the earlier presence of a sandy bay, having recently filled in with mud. The trend is very likely to be linked to changes in flow patterns in Ōkahu Bay, and changes in catchment characteristics.

A baseline level of 20µg/g for zinc appears to be present in Ōkahu Bay which is reflective of urban environment. Zinc results indicate that there is a link between metal content of sediments and the particle size distribution. Smaller mud particles have a larger surface area; they have more area to hold onto Zinc than larger particles like sand. Because there is a higher mud content within the body and around the Western end of the Bay, this could explain why we have high metal content in those areas in comparison to sandier areas. Core samples showed a general trend of increasing zinc although the same trend was not present with copper within the Bay.

Results of sampling at location at a point source drain from the marina hardstand indicate significant levels of copper contamination at 44.4 µg/g. The Red zone trigger level given by TP168 (2004) is >34µg/g/. The reading outside the hardstand therefore is a red zone reading. Ecosystems with this level of contamination present are expected to be negatively impacted (Hurst, E. 2012, Ngā Pae o te Māramatanga summer studentship project).

Further testing of this 'plume' of high zinc loads is being conducted to understand extent and perhaps map its source. It is further suggested that continued monitoring of sediment loads, heavy metal loads and particle distribution should be conducted to re-enforce the knowledge gained to date.

COASTAL ENGINEERING

The Ōkahu Bay Landing comply with ANZECC anti-foul and in-water cleaning guidelines, having recently re-designed their maintenance area drainage collection pit for residues, solid coatings, liquid and other form of waste. This ensures diversion of stormwater drainage away from the marina to avoid potential sediment contamination from passive antifoulant leaching.

The Landing management are committed to not only implementing International 'Blue Flag' standards but to also conduct management practices that exceed 'best practise'. In response to elevated copper levels the Landing management have gone further to replace the sand filter system to a sphagnum moss and peat system to ensure more effective diversion of antifoulant leaching. Toki Taiao are working with The Landing management to discuss further improvements in order to decrease the anthropogenic impacts of the hardstand maintenance area, the moorings and the marina on the ecological health of Ōkahu Bay.

The Ngāti Whātua Ōrākei submission on the MAF Discussion Paper Draft Anti-fouling and In-water Cleaning Guidelines 2012 formally stated:

The balance sought after by the ANZECC Code's Guidelines to offset managing environmental risks with operational realities is not achieved. Ōkahu Bay Marina provides an example of a set of practices that sit outside of the jurisdiction of the Guidelines; the Marina contains only recreational vessels and allows for non-professional maintenance of vessels.

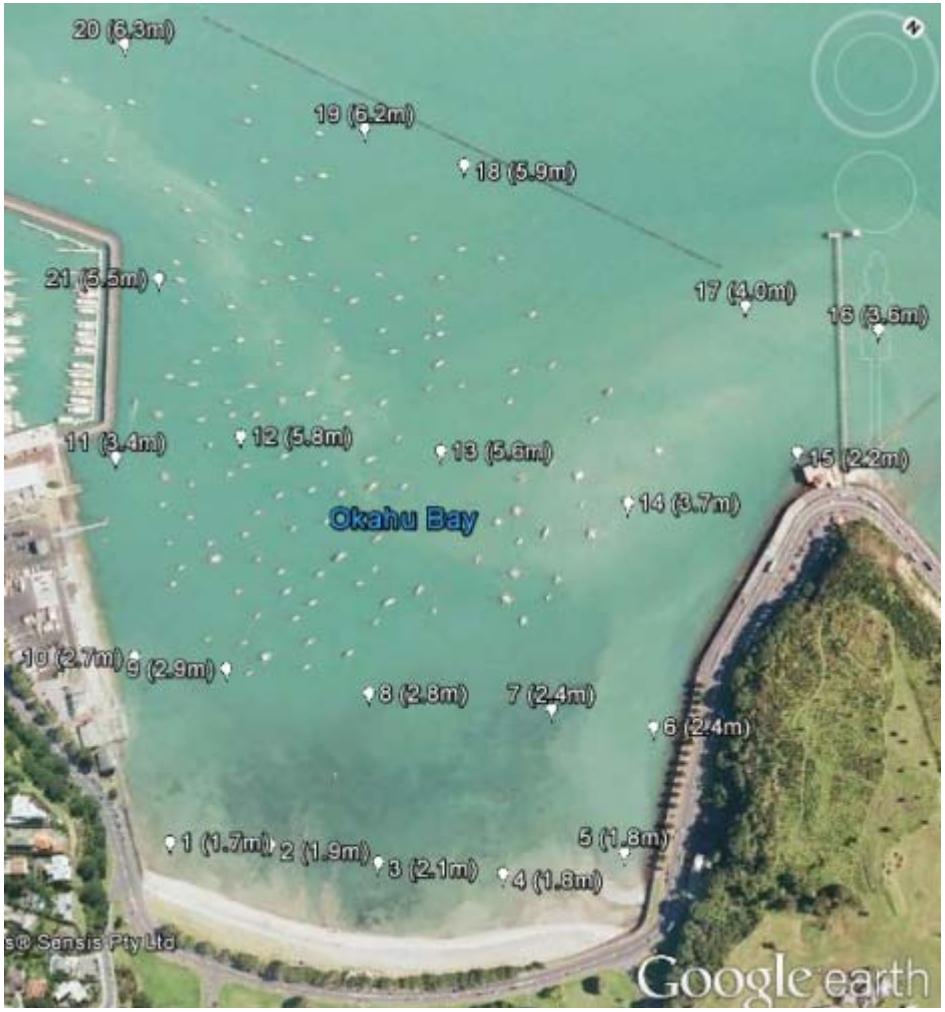
Empirical proof of negative extrinsic environmental effects highlights changes that have occurred in relation to the vessel maintenance practices of the Marina.

The ANZECC Code is not strong enough to ensure shore-based maintenance or provide guidance for facilities to contain waste produced and minimise the release of contaminants.

Furthermore we submit that the ANZECC guidelines are required to:

- Provide guidance on biosecurity and contamination risks posed by in-water cleaning and maintenance that must apply to recreational and commercial vessels, including all vessel types and other movable structures, in all aquatic (marine, estuarine and freshwater) environments
- Application, maintenance, removal and disposal only be carried out at maintenance facilities that adopt measures to ensure that all bio-fouling, coatings and other physical contaminants removed from vessels and structures are retained and treated in a manner that is compliant with relevant local regulations
- Outline what alternative management is required to avoid potential sediment contamination from passive antifoulant leaching which is a necessary consequence of marina activity where all residues, solid coatings, liquid or any other form of waste, including removed biological material and used product containers should be collected and stored for disposal in-line
- Inform compliance concentrations required to be met in relation to stormwater outflows; the source and quality of which is therefore required to be part of marina facility accountability measures
- Limit application, maintenance and removal of antifouling coatings to approved, licensed facilities and include non-professional with professional guidelines
- Inform procedures to outline uniform licensing of such facilities
- Require restrictions on use of Tributyltin-based antifoulant on craft >25m in length, where these operate in confined waters
- Ensure through accountability guidelines to marina facilities and Regional/District/Coastal Plans that new facilities include design and management provisions to capture and retain all waste and to enable eventual disposal to sewer of treated waste waters
- Ensure through accountability guidelines to the marina facilities and Regional/District/Coastal Plans, that existing facilities plan for upgrading to eventual sewer disposal of waste waters

BATHYMETRY



The only Bathymetry available for Ōkahu Bay was over 20 years old with no specific readings for Ōkahu Bay. The 2012 bathymetry results illustrated a gradient in depth with an increase seaward, with shallower areas at the high tidal zone (beach) and outer areas of the bay. This study illustrated the general bathymetry of Ōkahu Bay that could be used to model the hydrology in order to further analyse the associated activities in the environment, such as the sedimentation, the friction, the tidal flushing and contaminant load. Mātauranga indicates that 'the bay is filling in' and so it is further suggested that continued monitoring bathymetry readings should be conducted to re-enforce the knowledge gained to date.

In addition to the level of contaminants that come with the stormwater outflow into the sea, another important factor is the amount of freshwater input. The measurement of salinity levels could assess whether the bay maintains a natural level of salinity that is tolerated by marine species. Especially if there is little tidal flushing, there could be a lower level of salinity, higher concentration of bacteria, or other factors that may contribute to ecosystem health (Kaināmū, A., 2012, Ngā Pae o te Māramatanga summer studentship project).

Further research into salinity levels, freshwater input and independent bacteria load testing from the Auckland Council Beach Bathing Survey, prompting beach closures from alert levels of E.coli, should occur to inform management objectives.

Depth in metres (in brackets) across Ōkahu Bay

HYDRODYNAMIC MODELLING

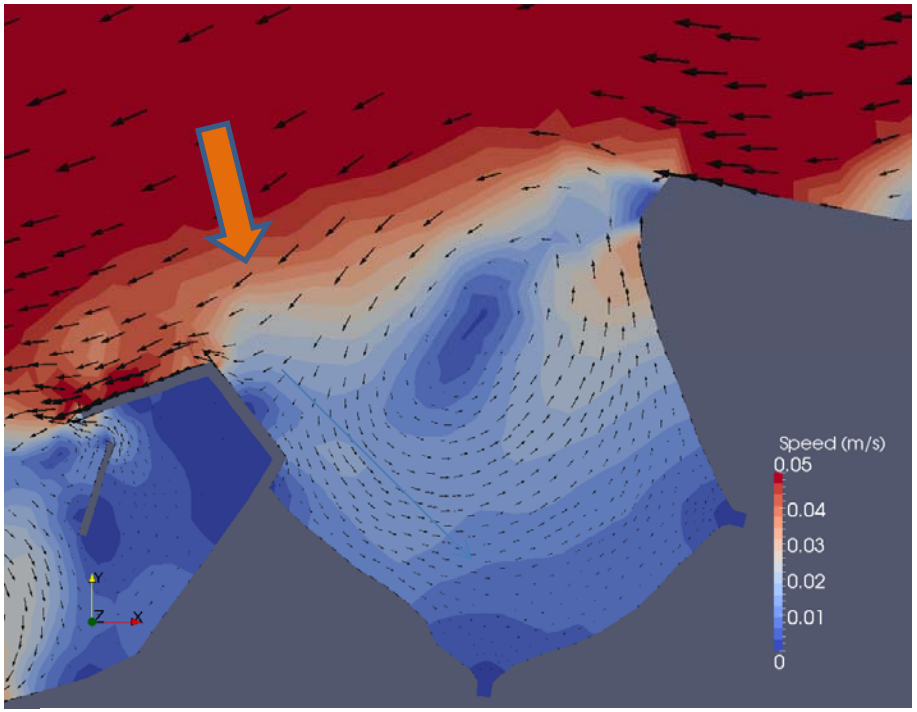
The Auckland University Department of Engineering Science conducted a modified version of the Hauraki Gulf numerical hydrodynamic model in conjunction with a particle tracking model for simulating the dispersal of contaminants. This model estimates long-term build-up of sediment and heavy metals from stormwater and wastewater overflows around the Auckland City coastline.

The hydrodynamic model indicates that the presence of the marina will have had some impact on the currents in Ōkahu Bay, particularly at the western end. Without the marina, the long-term sedimentation rates in the Ōkahu Bay zone were 0.135mm/year, with the marina they are 0.156 mm/year - increasing the probability of contaminants from the east entering the bay and the sedimentation rate overall.
This has likely caused sedimentation and heavy metal deposition rates in the bay to increase, because the hydraulics of the bay provide conditions in which particles settle in the middle of the bay. The mātauranga of Ngāti Whātua Ōrākei tells us that the historical migration routes and harvesting of tūangi occurred into the same area of high deposition, which could give a reason for the decline of kaimoana in Ōkahu Bay.

The hydrodynamic model also shows an increase of zinc loading by 6% based on the deposition rates. Based on the fact that our background zinc levels are 20mg/kg as of 2012 (which is indicative of an urban setting), this means that even without the marina Ōkahu Bay would have reached alert levels of 240mg/kg by 2070. With the marina it will reach this level by 2050.

Modelling was based on stormwater inputs from 2005 but do not include updated stormwater inputs from the Landing following the construction of their filtration system.

In order for this model to clearly indicate anthropogenic impacts of stormwater into Ōkahu Bay, further modelling is required to outline if sediment particles are being trapped with current stormwater inputs and also the impacts of any proposed further coastal development.



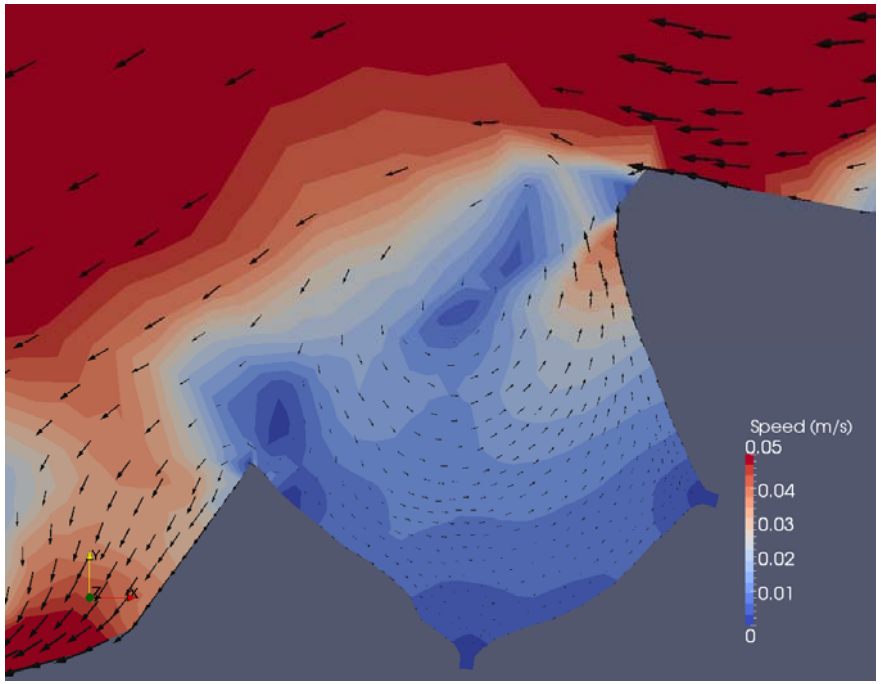
Model of residual currents with marina

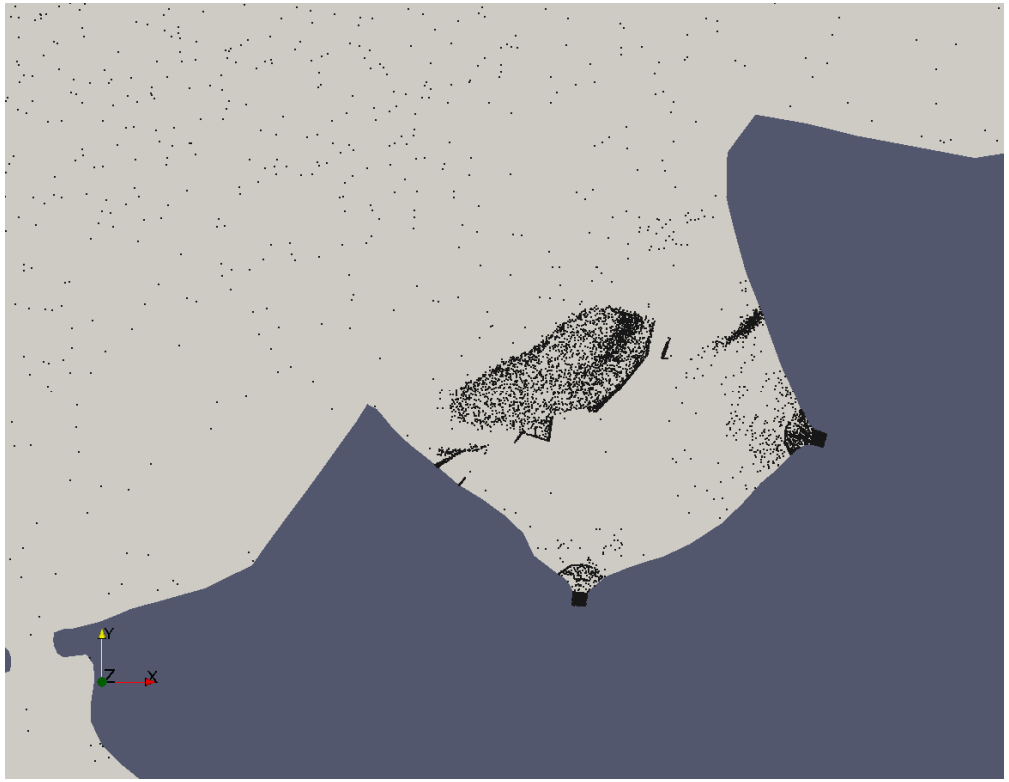
Just outside of Ōkahu Bay the flood-tide currents are slightly stronger than the ebb-tide currents, so the residual currents point west, up the Waitematā Harbour.

The currents inside and around the marina itself have been obviously altered by the marina's presence. The presence of the marina extends the western end of the headland out to sea, catching flood-tide currents. Within Ōkahu Bay, the overall current pattern is not very much changed. An anticlockwise circulation of about the same size and similar shape can be seen in both cases.

The main differences, as would be expected, are towards the western side of the bay, where the residual currents pointing south (into the bay) are of slightly greater magnitude - ***indicating an increased probability of contaminants from sources to the east being diverted by the marina into the bay and becoming trapped there.***

Model of residual currents without marina





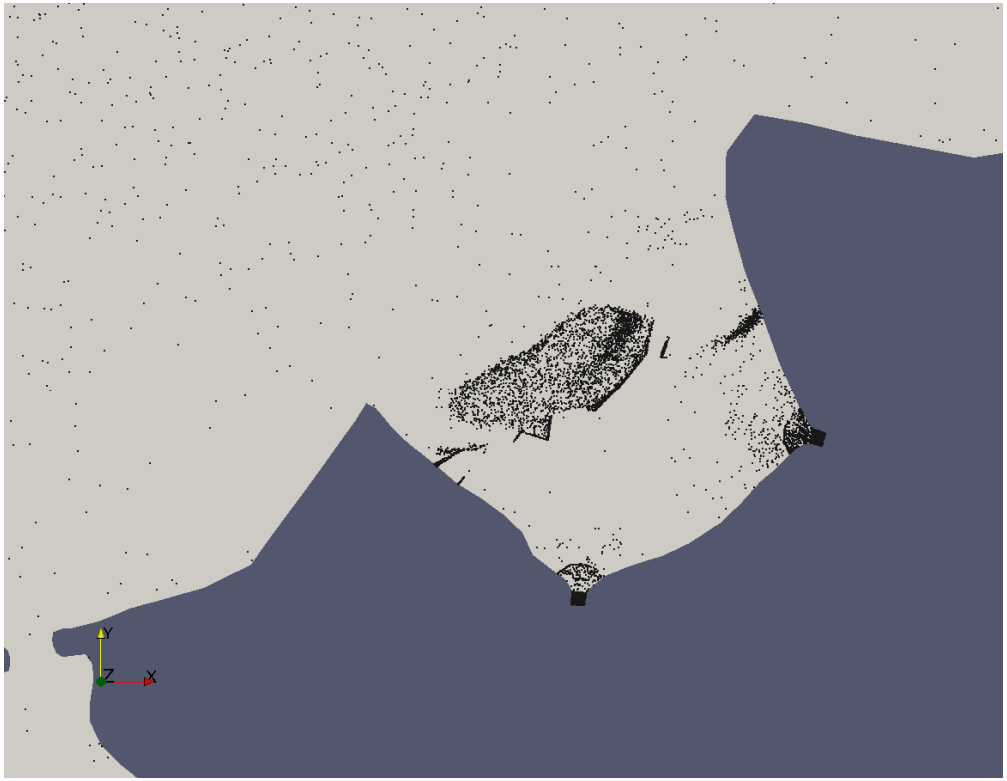
Final particle positions from medium storm, no marina

Figures show example final sediment particle positions from one of the storm events (of medium intensity), without and with the marina respectively. In both cases there are high concentrations of particles around the outfalls in the bay (these are the larger, heavier particles which drop out into the mud before travelling far).

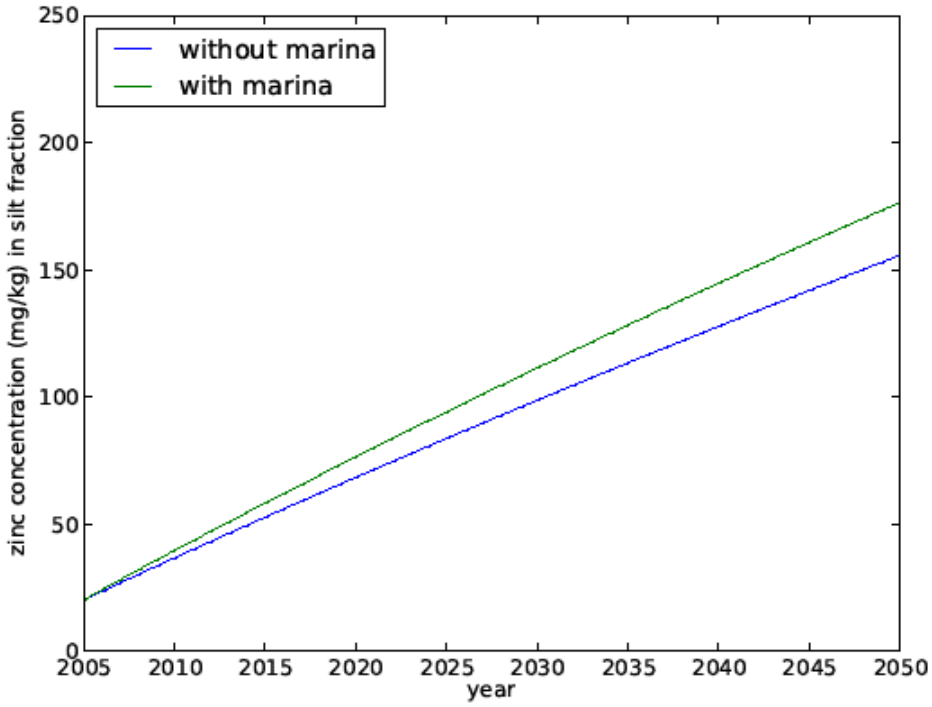
With the marina in place, a higher concentration of particles inside the marina can be seen, indicating that the marina will probably silt up over time unless repeated dredging is carried out.

Within Ōkahu Bay itself the main central area over which particles accumulate is slightly larger with the marina present, although it is not quite as densely covered.

This data substantiates claims from Ngāti Whātua Ōrākei kuia and kaumātua who inform that the bay 'is filling up' and goes to explain why there are no mature kaimoana within Ōkahu Bay - because this is where they would migrate to mature.



Final particle positions from medium storm, with marina



This figure shows modelled benthic zinc concentrations in Ōkahu Bay from 2005 to 2050, both without and with the marina.

These are average concentrations over the Ōkahu Bay deposition zone, and assume an arbitrary starting value of 20 mg/kg in 2005. They can be used to evaluate the effect of the marina on overall trends.

It can be seen that the presence of the marina is predicted to increase deposition of zinc.

By 2050 the increase in zinc concentration over the assumed starting value of 20 mg/kg is around 6% greater with the marina present than it would be without the marina.

MAURI MODEL

The Ecological Health indicators which set the management objectives of the restoration plan were detailed by Ngāti Whātua Ōrākei whānau in three consecutive hui. These indicators set the vision "Waters fit to swim in at all times, with thriving eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in, on and around the bay as users and kaitiaki".

When deciding what the priorities and strategies were for the Restoration Plan, it was imperative that the pure intention of Ngāti Whātua was not lost in interpretation, did not lose the wairua of the hapū and did not get swayed unduly by cost benefit analysis and the perceived economic benefits of the status quo.

Through the relationship that has been brokered with Auckland University, Dr Kepa Morgan was invited to apply his Mauri Model to the Restoration Plan. The Mauri Model is a decision making framework that integrates the social, economic, environmental, and cultural well-being dimensions of sustainability assessment. The Mauri Model Decision Making Framework adopts mauri ('integrity' or the binding force between the physical and the spiritual elements or capacity to support life) as the measure of environmental, economic, social, and cultural well-being, in place of the monetary basis used conventionally for cost-benefit assessment.

Mauri is the bonding force between the spiritual and the physical. When this bond is extinguished the result is death in a living organism or alternatively the loss of capacity to support life in a material such as air, water or soil. The decision making framework incorporates this concept into a series of steps to determine whether the mauri of each dimension is being fully restored, enhanced, maintained, diminished, or totally destroyed.

The Mauriometer assessment allows determination of the long term environmental, economic, social, and cultural sustainability of different courses of action. The use of mauri rather than money as the measure of sustainability avoids the disadvantage of making decisions based solely on economic or psuedo-economic considerations, which is more in line with Māori thinking – therefore well suited for this application.

Stakeholders engaged were Ngāti Whātua Ōrākei, Ōrākei residents, Auckland City Council representatives and marina users. These groups were asked to indicate the changes to mauri and the overall environmental, economic, cultural and social well-being of the bay when they considered the following four options:

- No marina built - allowing us to see the effects on the Bay, had the marina not been put into place.
- Marina present
- Implementing Low Impact Development into stormwater run-off management, decreasing the amount of heavy metals / hydrocarbons being deposited into Ōkahu Bay during rain fall events from impervious concrete or asphalt surfaces by utilising bio-retention areas to detain stormwater
- Marina extension

The model uses the four dimensions of wellbeing, adapted from Daly's triangle of sustainability. Wellbeing and sustainability are expressed in terms of the mauri of the four dimensions:

- Mauri of the environment (ecosystem wellbeing)
- Mauri of the hapū (cultural wellbeing)
- Mauri of the community (social wellbeing)
- Mauri of the whānau (economic wellbeing)

Stakeholder/Mauri dimensions	Environmental	Hapū	Community	Whānau
Ngāti Whātua Ōrākei	32	35	18	15
Ōrākei residents	35	18	29	18
Marina users	26	6	43	26
Local council	27	15	24	33

- Ngāti Whātua holds the mauri of the hapū as being most important, followed closely by the mauri of the environment.
- The Ōrākei residents rank the mauri of the environment as being most important.
- The marina users value the mauri of the community most highly.
- The local council rank the mauri of the whānau (economic wellbeing) as being most important.

CONSIDERING THE STAKEHOLDER VIEWPOINTS CUMULATIVELY, THE MOST IMPORTANT WELLBEING DIMENSION IS THE MAURI OF THE ENVIRONMENT.

Applying the 'mauriometer', where anything less than zero has a negative impact and values above will be most beneficial for the mauri of Ōkahu Bay:

Stakeholder	Marina built	Marina not built	Low impact development	Marina extension
Ngāti Whātua Ōrākei	-0.89	0.67	0.47	-0.84
Ōrākei residents	-0.71	0.57	0.46	-0.61
Marina users	-0.50	0.46	0.38	-0.10
Local council	-0.72	0.54	0.24	-0.64
Total	-2.82	2.24	1.55	-2.19
Average	-0.71	0.56	0.39	-0.55

- The option that would be most beneficial for the mauri of Ōkahu Bay would have been to not have built the marina (+ 0.56).
- Implementing low impact development to reduce the wastewater runoff into the Bay is also mauri positive (+ 0.39), indicating that is beneficial to the wellbeing of Ōkahu Bay
- Having the marina (- 0.71) and an extension of the current marina (-0.55) are detrimental on the mauri of Ōkahu Bay.

Thus, the results indicate that in accordance with the four stakeholder groups, the best option would be to advocate for Low Impact Development to reduce wastewater runoff and that a marina extension would be detrimental to the mauri of Ōkahu Bay.

THE ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN

Kaupapa	Management Objectives	Strategies	Priorities	Action Plan	Timing
Tino Rangatiratanga	Ngāti Whātua maintenance and implementation of kaitiakitanga within management objectives through the Iwi Management Plan, Coastal Strategy, Auckland Spatial Plan and the Long Term Council Community Plan Iwi Management Plan to direct Council responses e.g. regional cultural and heritage authorities and memorandum of understanding with Watercare Joint consenting authority with Auckland Council and Ngāti Whātua commissioners used at hearings Develop a 'formal and informal agency' engagement plan Hapū defined and active participation in definition of restoration/monitoring/mitigation outcomes	Define an ŌCERP Communication strategy for Ngāti Whātua Ōrākei and wider community/stakeholder in regards to • Restoration plan • Mitigation techniques • Social enterprise and training Define a community, formal and informal agency stakeholder mapping and engagement process that highlights inclusion in decision making, thus enabling a 'sense of ownership' and further definition of a Restoration Plan Define a response system for Toki Taiao to inform agency relationships e.g. Auckland Council, Ōrākei Local Board,	Continue with Communication Strategy with stakeholders that is committed to; • Restoration Vision • Ngāti Whātua Ōrākei and Ōkahu Rākau are the key agents which will broker strategic relationship with agencies that will inform and implement the restoration plan • Whānau identified ecological health indicators that have informed management objectives • Adaptive management – research informing management and evaluating success • Current findings that are informed by research that has been brokered by Ngāti Whātua • Information sharing that empowers and encourages commitment to the kaupapa	Formalise commitment and funding from Ngāti Whātua Ōrākei and external parties to continue co-ordinator position Broker planning hui with Sustainable Catchment Programme team of Auckland Council Communicate programme information through Wawa Ra and Te Puru newsletters, the *ko te Pūkākī* Facebook site and the Ngāti Whātua Ōrākei website Define calendar of strategic meetings to present findings to; whānau, marae hui, Reserves Board, Marina Board, Hauraki Gulf Forum, Local	September 2012 September 2012 September 2012 September 2012

			from Ngāti Whātua Ōrākei • Identify and actively broker opportunities to inform Tāmaki Mākaurau of work conducted within restoration plan • Promote Ngāti Whātua Ōrākei mana moana in the inner Waitematā , the northern shores of the North Shore and Manukau • Promote the Mauri Model outcomes that identify stakeholder priorities of coastal development and restoration planning in relation to retention and promotion of mauri	Board, Auckland Council Institute communication strategy with wider Ōrākei community; community centre, schools, clubs, local newspaper Facilitate further research on marine and terrestrial ecology of Ōrākei Catchment with Auckland University	October 2012 September 2012 – on-going
Kaupapa	**Management Objectives**	**Strategies**	**Priorities**	**Action Plan**	**Timing**
Tino Rangatiratanga	Developed opportunities for community economic development and training	Define an entrepreneurial and business engagement plan for Ōkahu Rākau Bush Care and Nursery to implement a community economic development strategy that provides opportunities for training and business engagement	Ōkahu Rākau Bush Care and Nursery and NWO are the key agents that will broker strategic relationship with agencies that will inform and implement the restoration plan Extend Ōkahu Rākau's work throughout the catchment so that Ngāti Whātua are the major	Implement communication strategy and relationship plan that centres NOW and Ōkahu Rākau as the agents responsible for all restoration work in the catchment Implement a booking and management system that supports	September 2012 November 2012 November

			landscaping/weeding/planting contractor Develop a funding plan that will resource the extra positions required to deliver the restoration plan	the increase in work that Ōkahu Rākau will incur Implement a volunteer co-ordinator position to manage the increase in work response that Ōkahu Rākau will incur Broker relationship with Ōrākei Primary that enables ownership and commitment to the restoration plan and sets the school up as a 'restoration hub' Foster an active link to Ngāti Whātua tamariki that attend schools within the area to offer vocational pathways that offer the ability to become kaitiaki (with the added support of the Ngāti Whātua Ōrākei scholarship	2012 – on-going August 2012 – on-going August 2012 – on-going

				programme) Link catchment primary schools into the programme Development of a training plan for Ngāti Whātua Ōrākei ; restoration co-ordinators, permaculture principles, ethnobotany, marine sciences Engagement with masters/doctorate internships from tertiary institutions and the New Zealand Social Innovation and Entrepreneurship Research Centre to identify community economic development, social innovation and entrepreneurship opportunities	 November 2012 – on-going November 2012 – On-going November 2012 – On-going
Kaupapa	**Management Objectives**	**Strategies**	**Priorities**	**Action Plan**	
Ecological functioning of	To enhance the ability to exercise mana whenua and implement	Utilise research available on anthropogenic impacts	Broker relationships with key tertiary institutions to conduct	Formalise commitment and	August 2012

ngā awa, te takutai, ngā moana and Te Whenua Rangatira	manaakitanga and kaitiakitanga as a hapū Increase in the volume of customary take of kaimoana (measured by records of marae and kaumātua) Increase in the presence, abundance and success rate of maturation of customary/traditional target species (and associated species) observed by whānau members, hapū, iwi and marae Increase in water quality (clarity and contamination) with positive effects on the mauri of the marine environment and community health Increase the ecological and cultural sustainability of land Restore the native bio-diversity across Tāmaki (including that of a broadleaf/Pōhutukawa coastal forest across the "Whenua Rangatira Ecological District" which takes in the Ōkahu	on Ōkahu Bay to set baseline of inputs/identify mitigation/restoration techniques for loss of ecological functioning and health Promote effective riparian planting and actively protect the ecological and cultural sustainability of waterways where it is good and enhance it where it is not Promote installation of 'Heritage planting' e.g. Te Uru Karaka – Te Uru Houhi and pā harakeke and other stands of vegetation for cultural use at appropriate locations across the catchment and wider Tāmaki Promote innovative stormwater management including treatment and detention, water re-use and waste minimisation Protect wāhi tapu and wāhi hira	research strategy that identifies catchment influences on Ōkahu Bay Define clear and measurable goals for the restoration project to determine appropriate monitoring and evaluation processes Define and have input into catchment based stormwater maintenance system e.g. inflow and infiltration survey Increase in the quality of outfall from the stormwater (reducing contamination and debris) Extension of *ko te Pūkākī* throughout the catchment – mapping; connecting corridors and reserves and day lighting of streams using heritage, "eco-sourced" planting Define strategies to implement mitigation / restoration techniques Development and implementation of a process of	funding from Ngāti Whātua Ōrākei and external parties to employ a volunteer co-ordinator and to continue co-ordinator position Following brokerage of strategic relationships with agencies, define framework of priorities, mitigation techniques and implement projects that support a successful outcome of the Restoration Plan Broker student intern programme with tertiary institutions to identify • Total annual sediment input • Core samples indicating changes of sediment over time • Stormwater and wastewater flow	November 2012 August 2012

	catchment) Increase in the number of Tangata tiaki/kaitiaki appointed under the customary fishing regulations to approve customary take	Increase the mauri of Ōkahu Bay by advocating for Low Impact Development principles to be used within the catchment	communication between the Ministry of Health and Ministry of Fisheries and Ngāti Whātua Ōrākei via a Police operational protocol, enabling timely notification to iwi organisations following drowning deaths in order to facilitate the possible placement of rāhui Develop a process of communication between the Ministry of Fisheries to enable Tangata tiaki/kaitiaki coastal officers	volumes • Salinity and bacterial content of water • Further define hydraulic modelling with new marina dimensions and new information about inputs from The Landing Conduct studies and broker relationships to define and implement • Stormwater treatment e.g. wetland treatment systems • Mapping and implementation of Sustainable Catchment Programme and Low Impact Urban Design Principles with particular regard to community	November 2012

				engagement, provision of fish passage and day lighting streams • Pest management Strategy developed and delivered by Ōkahu Rākau • Map fruit trees and increase potential for a local food network within the catchment with a view to increase community based food production • Investigation into catchment modelling (stormwater, impervious surfaces, green space matrix and corridor mapping) to identify issues impacting the ecological functioning of the Bay including riparian margins	

				and coastal erosion impacts within the catchment • Monitoring and evaluation programme aligned with ecological indicators of Ngāti Whātua Ōrakei.	
				Implement kaitiaki component to be delivered by Ōkahu Rākau into the Mai Ora Mai Whānau, Whānau Ora programme	February 2013
				Implement the Sustainable Living Programme to be delivered Ōkahu Rākau within the Ōrākei area	February 2013
				Work with key government agencies that regulate discharges to water	February 2013
				Define and implement	February

				an information relay process and stakeholder relationship outcomes Define and implement a funding plan and social enterprise plan for restoration project Host hui for local, regional and national expert information transfer	2013 March 2013 February 2013

APPENDIX A

ENVIRONMENTAL PERFORMANCE INDICATORS OF ŌKAHU BAY COMMUNITY			
TOPIC	NGĀTI WHĀTUA HEALTH INDICATORS	ŌRĀKEI COMMUNITY HEALTH INDICATORS	SCIENTIFIC INDICATORS
3.2.1 KAIMOANA	• Return of fishing and diving • Harvesting and eating kaimoana from the beach • The return of bbq's on the beach	• Seeing people collect shellfish and more people fishing	• Shellfish contaminant monitoring sampling complying with international standards; DDT, chlordane, lindane, dieldrin, PCB's, Copper, Zinc and Lead • Presence/absence and overall abundance counts of indicator species within MfE guidelines • Changes in abundance, distribution, maturation rates of kaimoana customary take by measurements record of marae, whānau and hapū
3.2.2 WATER QUALITY	• No hesitation to go into the water, feeling comfortable to swim after any weather • Let the dogs swim with no hesitation • No more warning signs against swimming in contaminated waters • Clear water, not brown, that you can see your feet through	• No foam like a thick bubble bath • Swimming freely whilst recognising the closeness of the metropolitan area	• Identify water physio-chemistry values and targets for the receiving environment • Water quality levels consistent with the environmental response criteria of Auckland Council; dissolved and particle metals; dissolved oxygen, dissolved copper , particulate zinc, dissolved zinc, lead, fluoride, nitrate-nitrogen, total dissolved nitrogen, dissolved reactive phosphorous, total dissolved phosphorous, ammonia and total suspended solids (See table for trigger values of dissolved oxygen, copper, zinc) • Water testing complying with Auckland Council microbial guidelines: enterococci (>32-40 enterococci/100ml as a threshold where there is an increased risk of gastrointestinal illness) • Positive community perception survey of water quality

TOPIC	NGĀTI WHĀTUA HEALTH INDICATORS	ŌRĀKEI COMMUNITY HEALTH INDICATORS	SCIENTIFIC INDICATORS
3.2.3 STORMWATER	• A slower force of water onto the beach • No rubbish after storms, broken bottles on the beach • Decrease in pipes	• No contamination or debris in the bay through the pipes • A reduction in the contamination of mud lines that fill the bay after a heavy downpour • An increase in the quality of the outfall from the stormwater that the shape of Ōkahu can handle	• Whole effluent toxicity testing indicating no effluent discharge to water • Stormwater and wastewater flow volume to inform response level from local agencies • Presence/absence and overall abundance counts of indicator species within MfE guidelines • Number of toxic contaminants in shellfish • Decreased stormwater debris within the receiving environment
TOPIC	NGĀTI WHĀTUA HEALTH INDICATORS	ŌRĀKEI COMMUNITY HEALTH INDICATORS	SCIENTIFIC INDICATORS
3.2.4 SUBSTRATE QUALITY	• Return of original seabed with sandbar • Decrease in rocks from seawalls which cut feet • No muck instead of sand • Decrease in beach sterilisation; no taking of sand or seaweed from the beach • Rock pools or reefs on the seawalls instead of just their structure	• Nice smooth sand with no broken shells so that beach shoes don't have to be worn • A building up of the beach, getting wider • Ripple forming sand that is not squidgy • Ability to access the whole beach, especially the western end, without having to walk on rocks because the beach has been denuded of sand • No rocks breaking down from the rock wall	• % of beach, dune land • Sediment physio-chemistry: texture, dynamics, concentrations of contaminants or other physical characteristics that may affect the ecological community • Sampling of mud-sand transition zones in order to predict probability of occurrence of diversity relative to sediment mud content • Identify substrate values and targets for the receiving environment

TOPIC	NGĀTI WHĀTUA HEALTH INDICATORS	ŌRĀKEI COMMUNITY HEALTH INDICATORS	SCIENTIFIC INDICATORS
3.2.5 LAND	• Streams which meander and provide natural input into the beach instead of stormwater pipes • Bush from the ridgeline, which provides shade and a visual barrier of the road from the beach • The bay being more than a little bit of grass and a beach • Not to have to look hard to find anything in the beach, more pipi, seaweed, crabs scuttling around, less oysters		• Length of mean high water springs adjoined by 'natural' vegetation more than 10m wide in estuaries and 20m wide on the open coast • % area of different habitat types/ecological classes • Changes in extent of indigenous vegetation compared to historic and baselines • The condition of selected ecosystem types compared to historic and current baselines • Change in the distribution of selected alien predators and herbivores • Change in the distribution of selected invasive weed species • Spatial distribution and relative abundance of key habitat forming species within the terrestrial and marine environment compared to historic and current baselines • Spatial extent of selected terrestrial and marine habitats. The evolutionary diversity remaining in selected taxonomic groups compared to historic and current baselines

ENVIRONMENTAL RESPONSE CRITERIA FOR SEDIMENT CONTAMINANTS

PRIMARY CONTAMINANTS (MG/KG)			
Parameter	Red	Amber	Green
Zinc	>150	124-150	<124
Copper	>34	19-34	<19
Lead	>50	30-50	<30
HMW-PAH	>1.7	0.66-1.7	<0.66
SECONDARY CONTAMINANTS (µG/KG)			
Parameter	Red	Amber	Green
Chlordane			
DDT total			
Dieldrin			
Lindane			
Total PCB			

* Green concentrations present a low risk to the biology so the site is unlikely to be impacted
* Amber concentrations indicate contaminant levels that are elevated and the biology of the site is possibly impacted
* Red concentrations indicate that contaminant levels are high and the biology of the site is probably impacted

(ARC Blueprint for monitoring urban receiving environments, TP 168 (2004:11)

TRIGGER VALUES FOR DISSOLVED OXYGEN, COPPER AND ZINC VALUES

	Red	Upper Threshold	Amber	Upper Threshold	Green	Upper Threshold
Dissolved Oxygen	<65%		65-80%	>110%	>80%	<110%
Copper (µg/l)	>3.0		1.3-3.0		<1.3	
Zinc	>23		15-23		<15	
Enterococci	Two consecutive single samples >277/100ml		Single sample >136 enterococci/100ml		No single sample >137 enterococci/100ml	

(ARC, Blueprint for monitoring urban receiving environments, TP 168: 2004:11-39)

JOB DESCRIPTION – ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN - CO-ORDINATOR ROLE

Toki Taiao are a small team that have built considerable momentum and support for the Restoration Plan. Continued momentum and facilitation of the Action Plan requires on-going co-ordination which Toki Taiao cannot commit sufficient time to.

Formalise the co-ordination role of the restoration plan and use initiative to respond to opportunities for its successful implementation.

STAKEHOLDER ENGAGEMENT

- Broker planning hui with Sustainable Catchment Programme team of Auckland Council
- Define calendar of strategic meetings to present findings to; whānau, marae hui, Reserves Board, Marina Board, Hauraki Gulf Forum, Local Board, Auckland Council
- Work with key government agencies that regulate discharges to water
- Define and implement an information relay process and stakeholder relationship outcomes
- Broker a working relationship with local and central agencies that are associated with the Ōkahu Bay Marina in order to have input into management practices and to decrease environmental impact of the marina/hardstand on the ecology of the bay
- Host hui for Local, regional and national expert information transfer
- Define and implement a funding and social enterprise plan for restoration project

RESEARCH

- Following brokerage of strategic relationships with agencies, define mitigation techniques and implement projects that support a successful outcome of the Restoration Plan
- Broker student intern programme with tertiary institutions
- Conduct studies and broker relationships to define and implement
    - Stormwater treatment e.g. wetland treatment systems
    - Mapping and implementation of Sustainable Catchment Programme and Low Impact Urban Design Principles with particular regard to community engagement, provision of fish passage and day lighting streams
    - Map fruit trees and increase potential for a local food network within the catchment with a view to increase community based food production

- Investigate catchment modelling (stormwater, impervious surfaces, green space matrix and corridor mapping) to identify issues impacting the ecological functioning of the Bay, including riparian margins and coastal erosion impacts within the catchment
- Facilitate further research on marine and terrestrial ecology of the Ōkahu catchment with Auckland University

COMMUNICATION

- Institute communication strategy with wider Ōrākei community; community centre, schools, clubs, local newspaper
- Communicate programme information through E Wawa Ra and Te Puru newsletters, the *ko te Pūkākī* Facebook site and the NWO website
- Implement communication strategy and relationship plan that centres *ko te Pūkākī* and Ōkahu Rākau as the agent responsible for all restoration work in the catchment

SOCIAL CAPITAL BROKER

- Development of Ōkahu Rākau to deliver a programme for local pest control
- Broker relationship with Ōrākei Primary that enables ownership and commitment to the restoration plan and sets the school up as a 'restoration hub'
- Broker relationships with other schools within the Ōrākei area as a restoration syndicate
- Link catchment primary schools into the Ngāti Whātua Ōrākei scholarship programme
- Development of a training plan for Ngāti Whātua Ōrākei ; restoration co-ordinators, permaculture principles, ethnobotany, marine sciences
- Engagement with masters/doctorate internships from tertiary institutions and the New Zealand Social Innovation and Entrepreneurship Research Centre to identify Community Economic Development, social innovation and entrepreneurship opportunities
- Implement the Sustainable Living Programme to be delivered by *ko te Pūkākī* within the Ōrākei area

JOB DESCRIPTION – ŌKAHU CATCHMENT ECOLOGICAL RESTORATION PLAN - VOLUNTEER CO-ORDINATOR

Formalise a volunteer co-ordination role to respond to the increase in volunteers, to respond efficiently and effectively to the higher demand for contracts to deliver restoration projects throughout the catchment and to use initiative to respond to opportunities for success of the Ōkahu Catchment Ecological Restoration Plan.

STAKEHOLDER ENGAGEMENT

- Implement a volunteer co-ordinator position to manage the increase in work response that Ōkahu Rākau will incur
- Development of Ōkahu Rākau to deliver a programme for local pest control
- Broker relationship with Ōrākei Primary that enables ownership and commitment to the restoration plan and sets the school up as a 'restoration hub'
- Broker relationship with other schools within the Ōrākei area as a restoration syndicate
- Implement the Sustainable Living Programme to be delivered by *ko te Pūkākī* within the Catchment
- Implement kaitiaki component to be delivered by *ko te Pūkākī* into the Mai Ora Mai Whānau, Whānau Ora programme

COMMUNICATION

- Communicate programme information through E Wawa Ra and Te Puru newsletters, the *ko te Pūkākī* Facebook site and the NWO website
- Implement a booking and management system that supports the increase in work that Ōkahu Rākau will incur
- Institute communication strategy with wider Ōrākei community; community centre, schools, clubs, local newspaper
- Define and implement a funding plan and social enterprise plan for restoration project
- Implement communication strategy and relationship plan that centres *ko te* Pūkākī and Ōkahu Rākau as the agent responsible for all restoration work in the catchment