

COASTS

SUMMARY 2007-08

OVERVIEW

- Northland Regional Council (NRC) monitors water quality at the most popular freshwater and coastal bathing sites in Northland through the Recreational Bathing Water Quality Programme.
- NRC also tests water quality at popular shellfish gathering sites in the region.
- NRC is responsible for the administration and monitoring of approximately 133 marine farm resource consents in Northland.
- NRC monitors six marinas in Northland to ensure compliance with their respective resource consents.
- Other NRC coastal monitoring programmes include the Estuarine Monitoring Programme; harbour water and sediment quality monitoring; beach profile monitoring and Tsunami hazard assessment modelling.
- NRC administers and provides funding for community CoastCare groups.

PERFORMANCE TARGETS

Continue to implement and improve a prioritised State of the Environment (SOE) monitoring programme and monitor compliance with, and the effects of, the exercise of resource consents and Regional Plans by:	Target Achieved:
➤ Carrying out sampling and reporting on summer coastal and freshwater bathing water quality.	✓
➤ Carry out a prioritised estuary health monitoring programme.	✓
➤ Supporting and contributing to the development and implementation of coastal hazard management strategies, by the collection and provision of coastal hazard and processes information and advice to the communities of affected areas.	✓
➤ Promote and support community based 'coast care' projects.	✓
➤ Inspecting significant coastal structures and works, marine farms and carrying out surveys of the coast where there is sand mining activity.	✓

SUMMARY OF RESULTS 2007-08

- Water quality at 44 coastal bathing sites was monitored for 12 weeks over the summer. A total of 628 samples were taken over the season; 94% met the guidelines for recreational bathing water quality.
- NRC monitored water quality at 15 popular shellfish gathering sites in Northland. Only 1 site complied with water quality guidelines.
- Abatement notices were issued to 25 marine farms that were found to be significantly non-compliant with the conditions of their resource consent.
- Levels of bacteria at all six Northland marinas were found to be within specified limits. Levels of Copper at Tutukaka marina were found to exceed specified limits.
- Three harbours were surveyed through the Estuarine Monitoring Programme. Results indicate that biological communities have been affected by human activity.
- CoastCare groups planted a total of 13,000 spinifex and 6,000 pingao.

INTRODUCTION

Northlands' coastline includes 14 major harbours, numerous smaller estuaries and extensive stretches of rocky and sandy open coast. Tourism in the region is centred on the region's beautiful coastline and internationally renowned marine environment. However, this coastal environment is under increasing pressure from human activity.

The Northland Regional Council (NRC) carries out considerable monitoring of the coastal environment in order to monitor the current state of this resource, and changes over time. In 2004, the Regional Coastal Plan for Northland (RCP) became operative and this plan outlines the rules and regulations regarding what people can and cannot do in coastal areas, with regards to activities that may impact on the coastal environment.

In 2007-08, 44 popular coastal bathing sites were monitored through the Recreational Bathing Water Quality Programme. These sites were monitored for twelve weeks over the summer months. Water samples were taken from each site on a weekly basis and analysed for illness causing bacteria. Results for each site were then compared to water quality guidelines and each site was given a weekly grading depending on the results – green for 'safe' for swimming, amber for 'caution' and red for 'unsafe' for swimming. For more information and for the results from 2007-08, refer to the [Coastal Recreational Bathing Water Quality](#) section of this report.

For 12 weeks over the summer months, NRC also undertakes water quality testing at a selection of coastal sites to assess their suitability for recreational shellfish gathering. During the summer of 2007-08, sampling was undertaken at a total of 15 sites. The water samples taken are analysed for levels of *faecal coliform* bacteria and the results are compared to guidelines issued by the Ministry for the Environment to determine if the sites are safe for shellfish gathering. For more information, go to [Water Quality for Recreational Shellfish Gathering](#).

NRC is responsible for the administration and monitoring of approximately 133 marine farm resource consents in Northland. Visual inspections of the farms are undertaken by NRC staff on a biannual basis and each farm is graded according to compliance with the conditions of its resource consent. In 2007-08, 25 abatement (stop) notices were issued to farmers whose farms were found to be significantly non-compliant. In addition, NRC staff undertook monitoring of the six marinas in Northland to check compliance with the conditions of their consent.

In 2007-08, three estuaries – Whangarei, Ruakaka and Kerikeri – were surveyed as part of the [Estuarine Monitoring](#) Programme. For each estuary, three assessments were undertaken. The catchment land-use for each harbour was mapped to ascertain potential sources of contaminants, intertidal habitats were mapped using aerial photos and a biological survey was undertaken of the intertidal sand/mud flats of each site. Preliminary results indicate that these systems have been adversely impacted by human activity.



Photo: Mangawhai

Harbour water and sediment quality is also monitored by NRC in the Whangarei Harbour and Bay of Islands. In 2007-08, the monitoring programme was revised. The programme is now targeted at monitoring levels of contaminants in the fine sediments located close to urban and industrial areas, levels of bacteria in harbour waters, nutrient levels and sediment loading. During 2007-08, 32 sites were monitored, 16 in each harbour system. For more information, refer to the [Harbour Water Quality and Sediment Monitoring](#) section of this report.

With over 3000 kilometres of coast and 30 coastal settlements, Northland's exposure to [tsunami hazard](#) is high. In 2007-08, the National Institute of Water and Atmospheric Research (NIWA), commissioned by NRC, undertook a tsunami hazard assessment of Northland's coastline. The most likely scenarios for creation of a tsunami were used to model the predicted wave height and wave inundation at selected coastal locations in the region. The results were then mapped to show those locations most at risk from tsunami hazard.

The [Beach Profile Monitoring Programme](#) continued in 2007-08 to provide information on the stability (i.e. accreting (growing), equilibrium (staying the same) or eroding) of the foreshore and foredune at selected coastal locations in Northland. The general trend is for small losses or gains at most sites however significant erosion was experienced at Pouto and Omapere during 2007-08.

The NRC [CoastCare Programme](#) was established in 2005. The aim of the programme is to enable communities to better understand coastal processes and initiate protection, restoration and enhancement of dune ecosystems through the establishment and resourcing of community-based CoastCare groups. In 2007-08, there were over 20 community CoastCare groups registered with NRC. During the winter of 2008, these groups planted a total of 13,000 spinifex and 6,000 pingao plants, contributing towards the restoration of dune and beach systems across Northland.

COASTAL RECREATIONAL BATHING WATER QUALITY

The Recreational Bathing Water Quality Programme is a joint project run by NRC, in conjunction with Kaipara, Whangarei and the Far North district councils and the Northland District Health Board (DHB). The programme involves sampling water quality at a number of the most popular freshwater and coastal swimming sites around Northland for 12 weeks over the summer months. For results from freshwater sites, please refer to the 'Rivers and Streams' section of this Annual Monitoring Report.

Most of the coastal sites monitored through the programme are located within semi-enclosed water bodies, such as estuaries and harbours. Water quality in these locations is more variable than open coastal sites as it is influenced by freshwater input, either from rivers and streams or rainfall run-off, and is therefore more vulnerable to pollution.

During the 2007-08 summer season, 44 coastal swimming sites around Northland were monitored. Samples were collected from each site on a weekly basis and analysed for *Enterococci* bacteria. These bacteria indicate faecal contamination of water from warm-blooded animals, which in turn indicates the likely presence of pathogens which can affect human health.



Map: Recreational Bathing Water Quality Programme – Coastal Sites

The results for each site are compared to water quality guidelines issued by MfE. Each week, sites are given a grading based on the levels of bacteria present – green for 'safe for recreational use', orange for 'caution' or red for 'unsafe for recreational use'. These gradings and results are posted at the end of each week on the NRC website - <http://www.nrc.govt.nz/swimming>.

The table below shows the thresholds used to grade water quality at each site. Results from weekly sampling are forwarded to each of the district councils and the DHB at the end of each week. In the event of an 'alert' or 'action' result, the relevant district council and DHB is informed within 24 hours. They then take the necessary action to minimise any potential risk to human health.

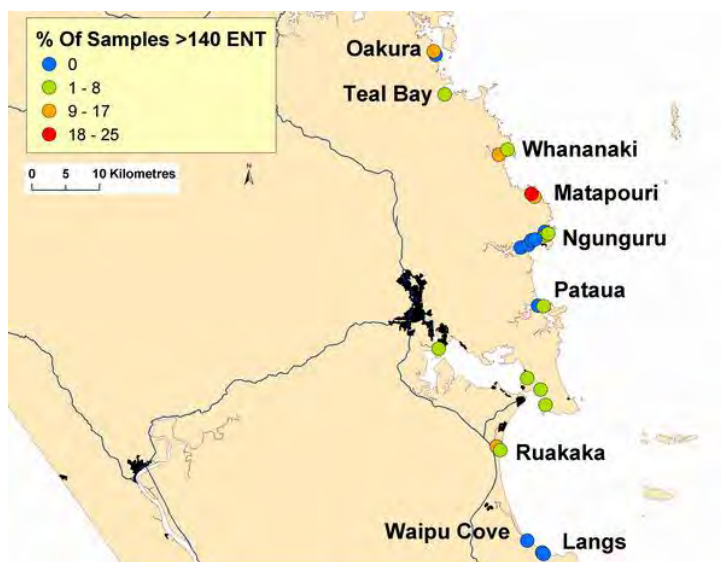
Enterococci threshold per 100 millilitres of seawater:	Action to be taken:
Less than 140 – Safe	Surveillance - continue routine sampling
140 – 280 – Caution	Alert - increase sampling and investigate source of contamination
Greater than 280 – Unsafe	Action - increase sampling, investigate source of contamination and erect public warning signs

Coastal Water Quality Results 2007-08

- A total of 628 water samples were taken for analysis during 2007-08 from the 44 sites in the programme.
- 94% of the samples taken were less than the 'alert' threshold, indicating that water quality at the sample sites was likely to be 'safe' for swimming.
- 2% of samples taken were within the 'alert' threshold, indicating some pollution at the sample sites ('caution').
- 4% of samples taken were within the 'action' threshold, indicating the water quality at the sample sites was likely to be 'unsafe' for swimming.
- Further sampling and investigation was undertaken at sample sites with 'alert' or 'action' results in order to monitor water quality and determine the source of contamination.
- Warning signs were erected at any sample sites with consistently 'unsafe' water quality.

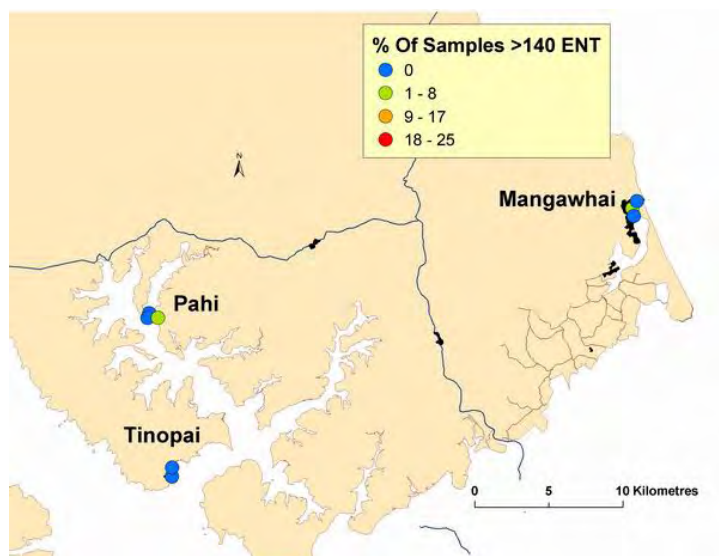
The results from 2007-08 indicate that water quality at virtually all semi-enclosed sites (e.g. estuaries) or sites adjacent to major river outflows is effected by heavy rainfall, with the majority of 'alert' or 'action' results recorded after heavy rainfall events. Levels of *Enterococci* usually return to safe levels within 1-2 days of these events.

In the Whangarei District, four sample sites had more than 10% of samples exceed the recommended 'safe' level of bacteria (<140 Ent. per 100ml). These sites were the Ruakaka River, Matapouri Estuary, Whananaki Estuary and Ohawini Bay. The remaining sites in the district had no or only one sample that exceeded the recommended guidelines during 2007-08.



Map: Percentage of samples that exceeded the recommended 'safe' guideline of less than 140 *Enterococci* per 100ml of seawater in the Whangarei District

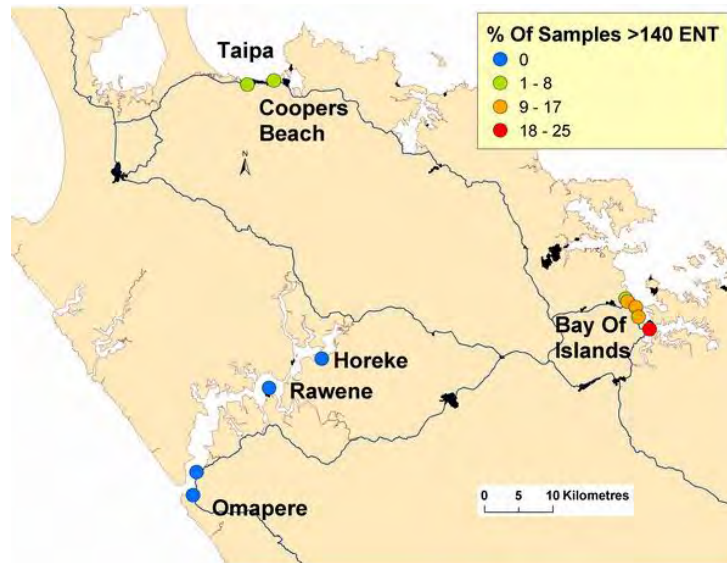
In the Kaipara District, two sample sites had between 1-8% of samples above the recommended 'safe' guideline. These sites were at Pahi and Mangawhai. Samples taken from the remaining sites complied with the recommended guidelines on all sampling occasions.



Map: Percentage of samples that exceeded the recommended 'safe' guideline of less than 140 *Enterococci* per 100ml of seawater in the Kaipara District

In the Far North District, 1-8% of samples taken from Taipa and Coopers Beach, 9-17% of samples taken from Paihia and Te Haumi and 18-25% of samples taken from Opuia exceeded the recommended 'safe' guideline.

All of the samples taken from sites in the Hokianga Harbour complied with the recommended guidelines during 2007-08.



Map: Percentage of samples that exceeded the recommended 'safe' guideline of less than 140 *Enterococci* per 100ml of seawater in the Far North District

WATER QUALITY FOR RECREATIONAL SHELLFISH GATHERING

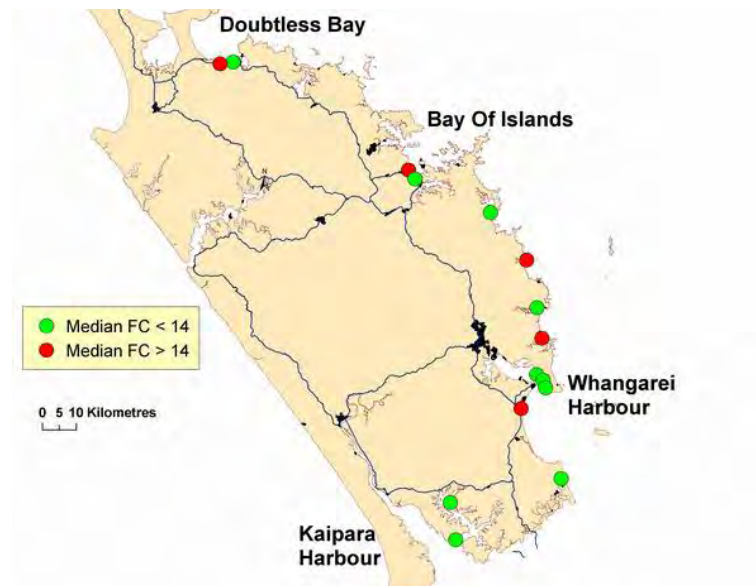
For 12 weeks over the summer months, NRC undertakes water quality testing at a selection of coastal sites in the region to assess their suitability for recreational shellfish gathering. During the 2007-08 summer season, sampling was undertaken at a total of 15 sites.

The water samples taken are analysed for levels of *faecal coliform* bacteria. *Faecal coliform* bacteria can enter water bodies through direct discharge of waste from mammals and birds, from agricultural and storm water runoff and from leaking septic tanks. As shellfish are filter feeders, they may be contaminated and unsafe for human consumption if contamination is present in the water around them.

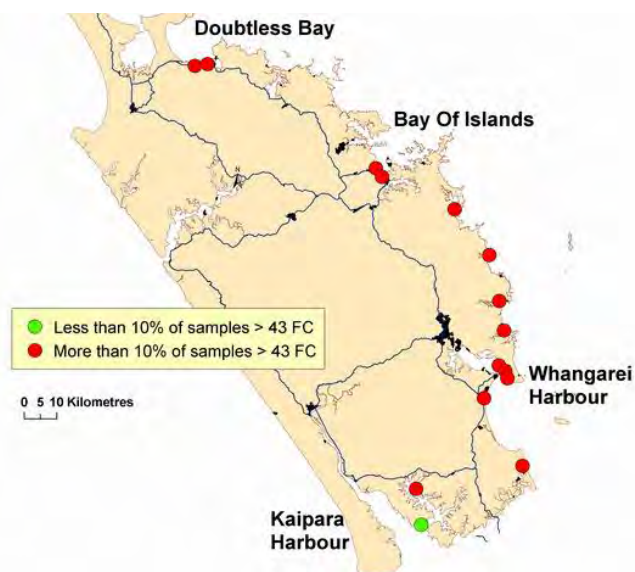
Two *faecal coliform* standards are used when assessing water quality for recreational shellfish gathering. In order for a site to be deemed suitable for shellfish gathering, the median for the season must be no more than 14 faecal coliforms per 100 millilitres of seawater AND no more than 10% of samples from the season must exceed 43 faecal coliforms per 100 millilitres of seawater.

Results 2007-08

- Of the 15 sites sampled in 2007-08, the median faecal coliform result for five sites exceeded the limit of 14 per 100 millilitres of seawater.
- Of the 15 sites sampled in 2007-08, 14 had more than 10% of samples that exceeded a *faecal coliform* count of 43 per 100 millilitres.
- Only one site, Tinopai in the Kaipara Harbour, met both water quality standards for safe recreational shellfish gathering in 2007-08.



Map: Sites monitored for recreational shellfish gathering water quality and whether they complied with the median faecal coliform standard in 2007-08



Map: Sites monitored for recreational shellfish gathering water quality and whether they complied with the standard of no more than 10% of samples exceeding 43 faecal coliforms per 100 ml in 2007-08

One of the main reasons for non-compliance is that the majority of the sites monitored are within semi-enclosed water bodies, such as estuaries and harbours. These water bodies are heavily influenced by freshwater input from rivers and streams and rainfall run-off, both of which transport contaminants into the system. In addition, it takes longer for contaminants to flush out of semi-enclosed systems and water quality may therefore be poorer at these sites for longer than at open coastal locations.

The table below shows water quality results from recreational shellfish gathering sites for the past five years.

Site	Water Quality Guideline Compliance for Recreational Shellfish Gathering in Northland				
	2003-04	2004-05	2005-06	2006-07	2007-08
Ngunguru	Pass	Fail	Fail	Fail	Fail
Oakura – north	-	Fail	Fail	Pass	Fail
McLeod Bay	-	Fail	Fail	Fail	Fail
Taurikura	-	Fail	Fail	Fail	Fail
Urquharts Bay	-	Fail	Fail	Pass	Fail
Pataua	Fail	Fail	Fail	Fail	Fail
Waitangi	Pass	Fail	Pass	-	Fail
Te Haumi River	-	Pass	Pass	-	Fail
Tinopai	-	Fail	Fail	Fail	Pass
Ruakaka	-	Fail	Pass	Pass	Fail
Mangawhai	Fail	Fail	Fail	Fail	Fail
Pahi	-	Fail	Fail	Fail	Fail
Taipa	Fail	Fail	Pass	Pass	Fail
Coopers Beach	Pass	Pass	Fail	Fail	Fail
Whananaki	-	-	-	-	Fail

AQUACULTURE MONITORING

NRC is responsible for the administration and monitoring of approximately 133 marine farm resource consents in Northland. The majority of these farms are oyster farms within the intertidal regions of Northland's estuaries and harbours. There are also 6 mussel farms at Houhora Bay and in the Kaipara harbour and 1 mussel spat-catching farm in Whangape harbour.



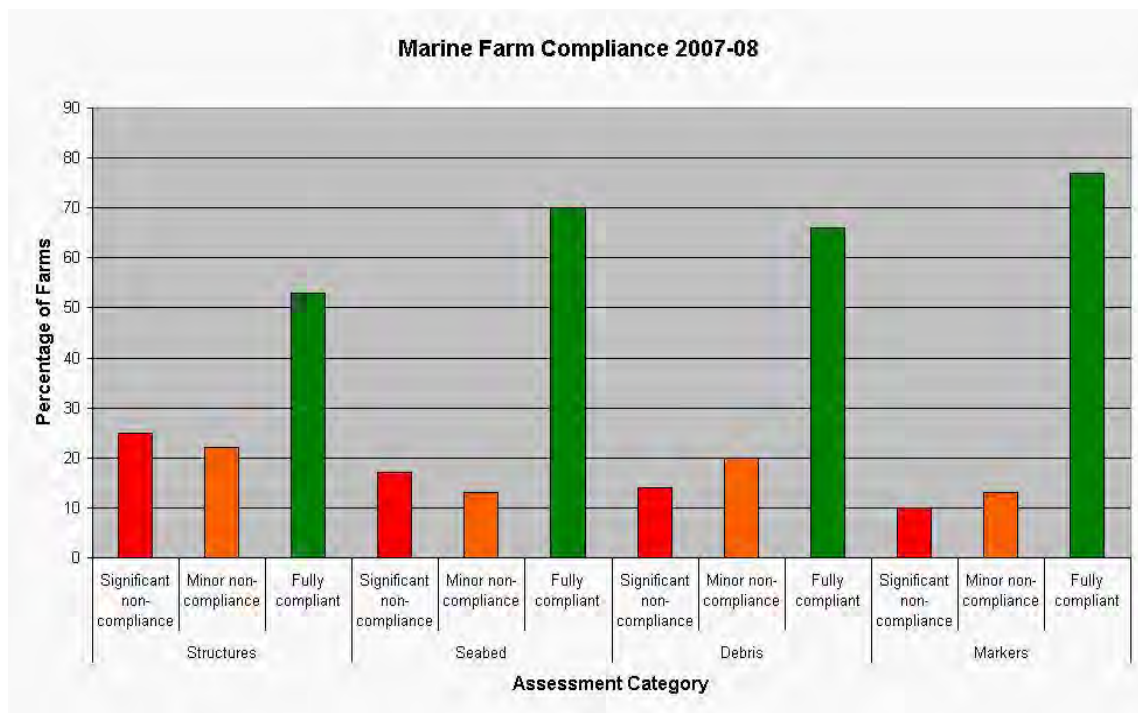
Photo: Oyster farm, Bay of Islands

Consented Monitoring

NRC undertakes visual inspections of all marine farms on a biannual basis, usually between March and May. These inspections involve assessing each farm for compliance with the conditions of resource consent. Each farm is assessed on the following criteria:

- The condition of the farm structures - including racks, bins, lines, buoys, etc;
- The condition of the seabed - the amount of shell and sediment deposition beneath the farming structures;
- Presence of debris - this includes any debris within the farm or surrounding area that originated from the farm; and
- Presence of navigational markers – including location and suitability of the markers to ensure the safety of other marine users.

Depending on the results of the assessment, each farm is given a compliance grade - fully compliant, minor non-compliance or significant non-compliance. The graph below summarises the results from the 2007-08 survey season.



Farms that were found to have minor non-compliance in any of the assessment categories were requested to undertake remedial action. Abatement notices were issued to 25 farmers with significant non-compliance, requiring them to undertake actions to ensure compliance by the next inspection in mid-2009.

Non Consented Monitoring

During the 2007-08 financial year, NRC commissioned the Cawthron Institute (using an Envirolink grant) to review literature on the ecological effects of intertidal oyster farms. The report was commissioned in order to gain a better understanding of the environmental impacts of oyster farming, which could be used to enable more effective management of the 130 oyster farms in the region.

The key finding of this report was that the largest potential ecological impact of oyster farming comes from the introduction and spread of pest organisms. The NRC biosecurity team is currently reviewing the Regional Pest Management Strategies, with a particular focus on marine pests, in order to mitigate this potential impact.

The second most significant ecological impact is on the seabed within and immediately adjacent to oyster farms. However, this impact appears to be reversible once farming ceases.

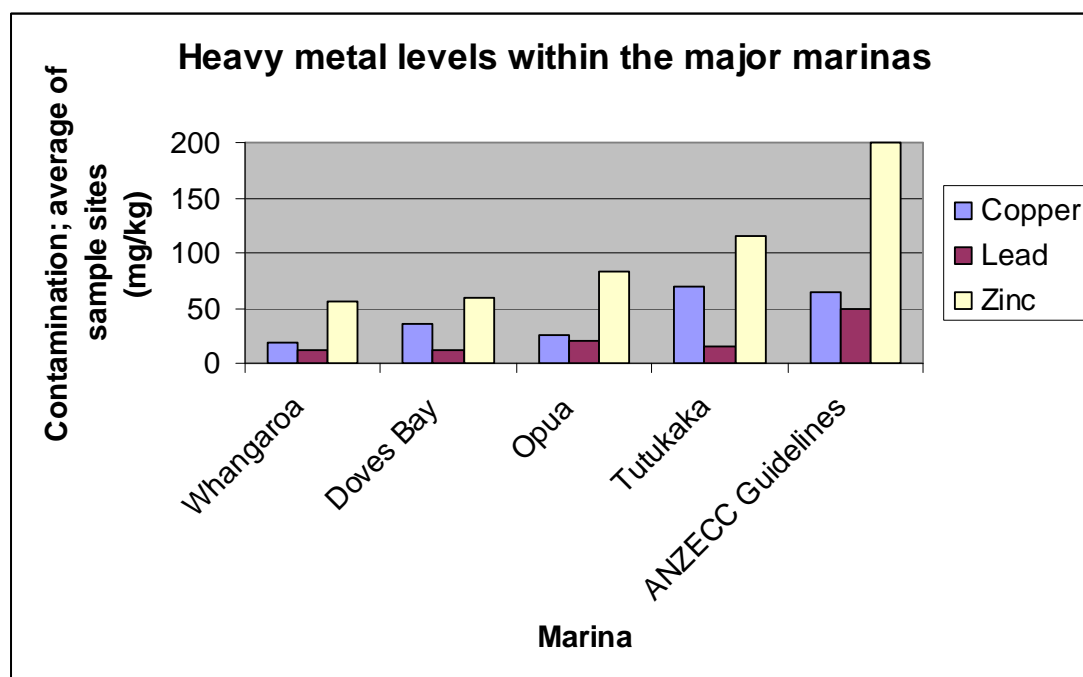
Historically, monitoring of oyster farms has focused on compliance with resource consents rather than the effects of the farm. The NRC coastal monitoring team is currently investigating an effects-based monitoring programme to assess seabed status in and around oyster farms in Northland. Proposed sites for study include the Hokianga and Houhora harbours.

MARINA MONITORING

There are currently six marinas in Northland. NRC is responsible for ensuring compliance with their respective resource consents. The resource consents require individual monitoring programmes for each marina, which can include measuring bacteria in the water and heavy metals in both sediments and water.

In 2007-08, bacteriological water quality in all marinas in Northland was found to be within the limits set by the respective resource consents. This indicates that the berths within the marinas are complying with the 'no discharge' conditions imposed by the Regional Coastal Plan for Northland, Marine Pollution Regulations and resource consent.

Results from heavy metal analysis undertaken in 2007-08 show general compliance across most marinas in Northland. However, levels of Copper within Tutukaka marina were found to be elevated above ANZECC guidelines. Further sampling is proposed for 2008-09 in this marina.



A review of the way NRC monitors marinas is currently underway. It is proposed to move away from effects and enforcement based monitoring, which is highly labour-intensive and costly, to an education and elimination based approach. This would involve marinas requiring lock-off of sewage facilities on all berthed vessels and education of berth holders. It is hoped this would allow for better management of marinas and provide better environmental outcomes in the long-term.

ESTUARINE MONITORING

Introduction

Estuaries are highly important ecological habitats. They are incredibly productive and support a large number of plant and animal species. Estuaries are also important economic, social and cultural assets. Harbour and estuarine systems in Northland, such as Whangarei Harbour and the Bay of Islands, contribute significantly to the region's economy and its natural value.

Northland's estuaries have been heavily modified and impacted by human activity over the last century. The impacts of human activity include sedimentation and nutrient enrichment of estuarine systems from land clearance activities and poor land management, and heavy metal contamination from industrial and urban development.

In order to monitor the health of Northland's estuaries, and record change over time, NRC implements an estuary monitoring programme (EMP). The monitoring programme has evolved from the Estuary Monitoring Protocol (Robertson et al 2002) developed by Cawthron for Regional Councils. The results from the programme will identify significant environmental issues and provide scientific information to enable people to make informed environmental management decisions.

The programme currently focuses on estuaries located in areas of significant economic growth and development or areas where there are specific environmental concerns. Monitoring has already begun in the Whangarei harbour, Kerikeri inlet and Ruakaka estuary. In 2008-09, sites in the Whangaroa and Kaipara harbours will be added to the programme.



Photo: Whangaroa Harbour

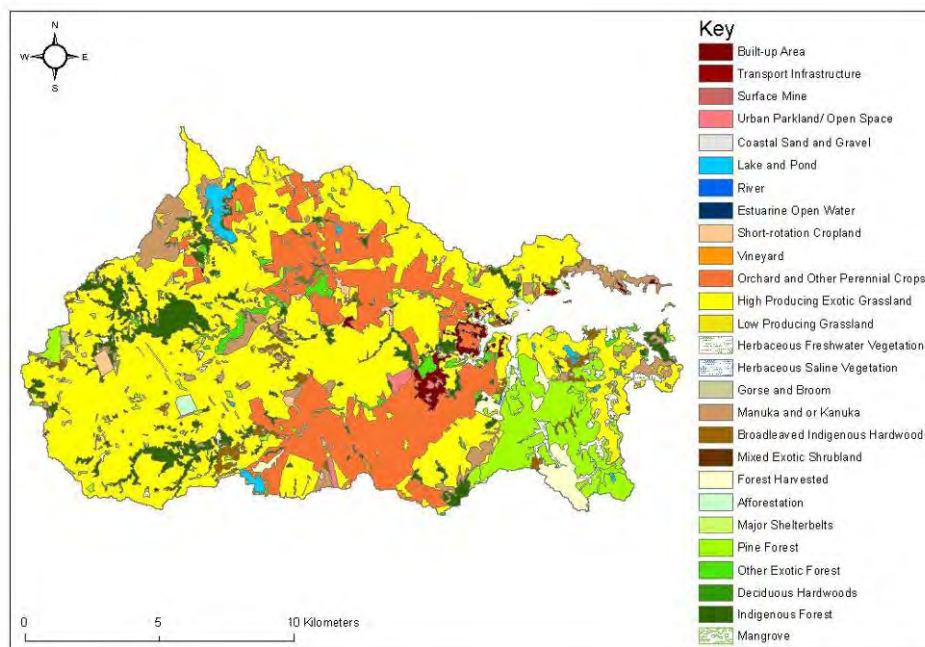
Methodology

The EMP involves three assessment strategies:

- Identifying the catchment characteristics (such as land-use) and identifying potential inputs into the estuarine system;
- Fine-scale habitat assessment of the intertidal zones; and
- Mapping of key intertidal habitats.

Catchment Assessment

Catchment assessment involves looking at the land use and physical characteristics of the catchment that feeds each estuarine system, using computerised mapping (GIS) software. From this information, activities and practices that may affect estuarine health can be identified.



Map: Land-use in the Kerikeri catchment

Habitat Assessment

Fine-scale habitat assessment involves monitoring the biological community (plants and animals) and the physical and chemical characteristics of the sediments at permanent sites located in the intertidal sand/mud flats of each estuary. Once this baseline data has been collected, it is possible to monitor change in nutrient levels, metal contamination and community characteristics over time.

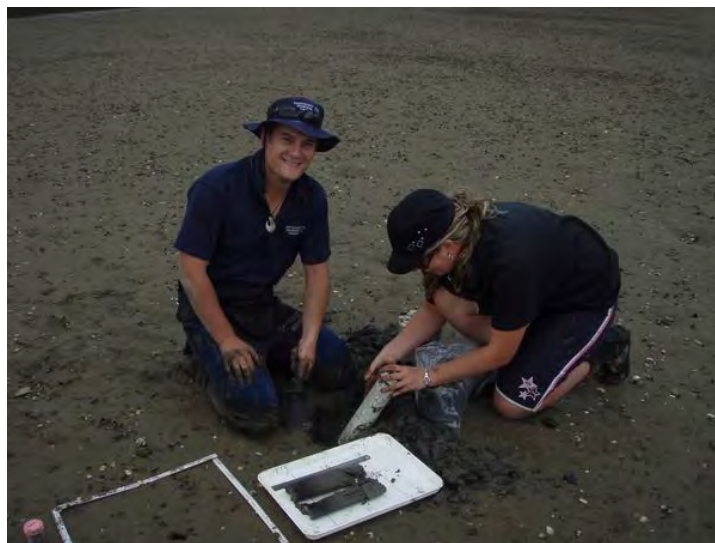


Photo: Regional Council staff undertaking sediment sampling

Monitoring undertaken at each site includes:

- Sediment core profiles – these show changes in the sediment over time;
- Analysis of sediment cores - looking at sediment grain size, nutrient levels and metal contaminants;
- Percentage cover of macroalgae on the surface of the sediment; and
- Identification and abundance of bottom-dwelling (benthic) animals.

Habitat mapping

Habitat assessment involves mapping key habitats, such as mangrove forest, sea grass beds and saltmarsh habitats, using both aerial photographs and field based surveys. This information is used to monitor changes in the distribution and extent of key habitats over time.



Photos: Digitalisation of mangrove habitat in the Mangapai River, Whangarei Harbour

Results 2007-08

Preliminary results from the three estuaries sampled during 2007-08 indicate that the biological communities (plants and animals) have been adversely affected by human inputs into these systems. At several sites, nutrient and metal contaminant levels were found to be elevated and evidence was found to suggest that sedimentation has had an impact on community health.

Further analysis of the results will be undertaken and incorporated into a technical report. In addition, future monitoring of these, and other estuaries in Northland, will further complete the picture of the current state of the region's estuarine systems.

HARBOUR WATER QUALITY AND SEDIMENT MONITORING

During 2007-08, NRC and NIWA undertook a review of the marine water and seabed sediment quality monitoring programme carried out in the Bay of Islands (BOI) and Whangarei harbours. This review was achieved utilising Envirolink funding.

Key recommendations from the review included:

- Re-designing the monitoring programme to produce more accurate results that are easier to interpret and which increase confidence in detecting changes in environmental quality over time;
- Increasing monitoring to detect temporal and spatial trends at study sites;
- Establishing historic trends in sedimentation and contamination rates; and
- Developing 'regional response' trigger values to avoid contaminant levels exceeding ANZECC guideline values.

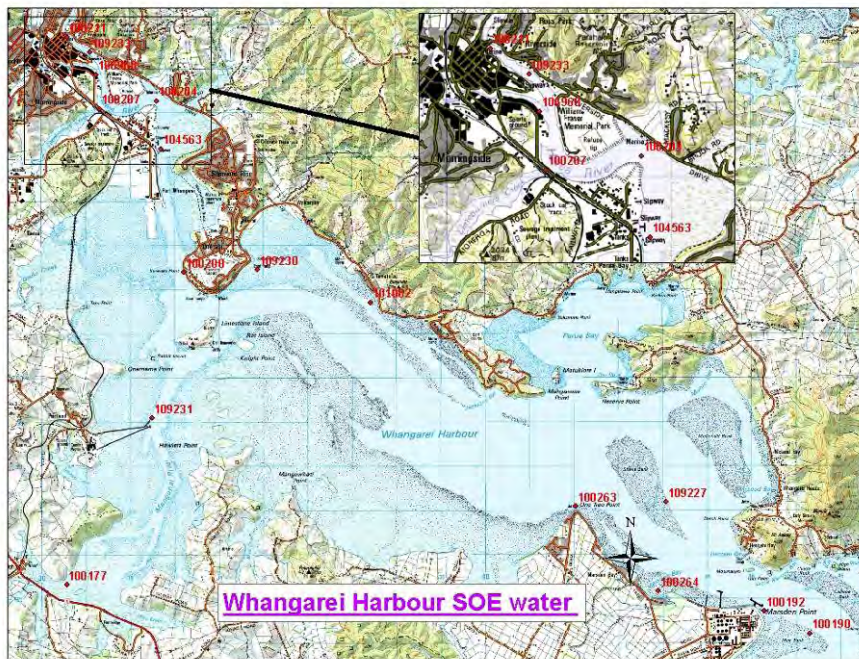
A revised state of the environment monitoring programme has now been designed. The programme has been tailored to address the following issues:

- Levels of contaminants in fine sediments near urban and industrial areas;
- Bacterial (microbial) contamination in coastal waters from human and animal effluent, predominantly in areas of low tidal flushing and high density mooring areas;
- Nutrient enrichment of coastal waters and sediments; and
- Sediment loading and its affect on seabed and physical water quality parameters.

The programme requires external laboratory analysis of water and sediment samples. The programme is being implemented in stages in accordance with the available budget. The water sampling programme for 2007-08 involved monitoring 32 sites, 16 in the Whangarei harbour and 16 in the BOI.



Map: Water and sediment quality monitoring sites in the Bay of Islands

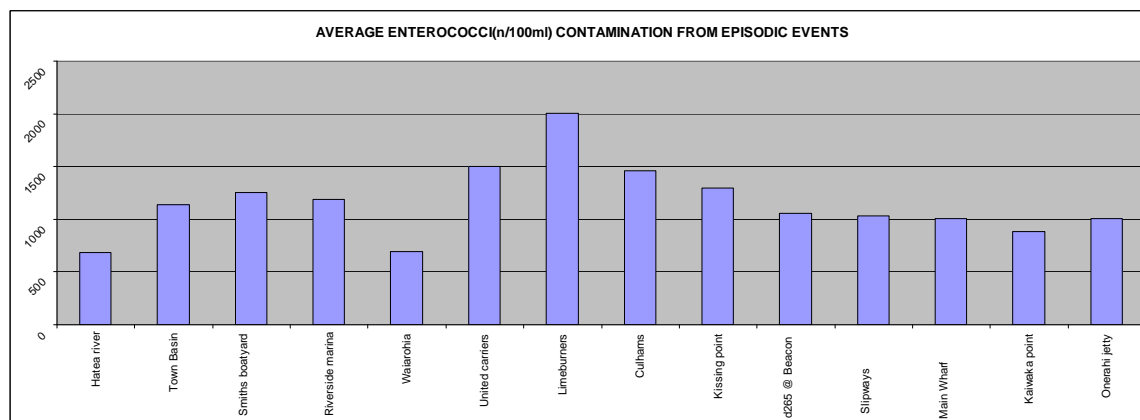


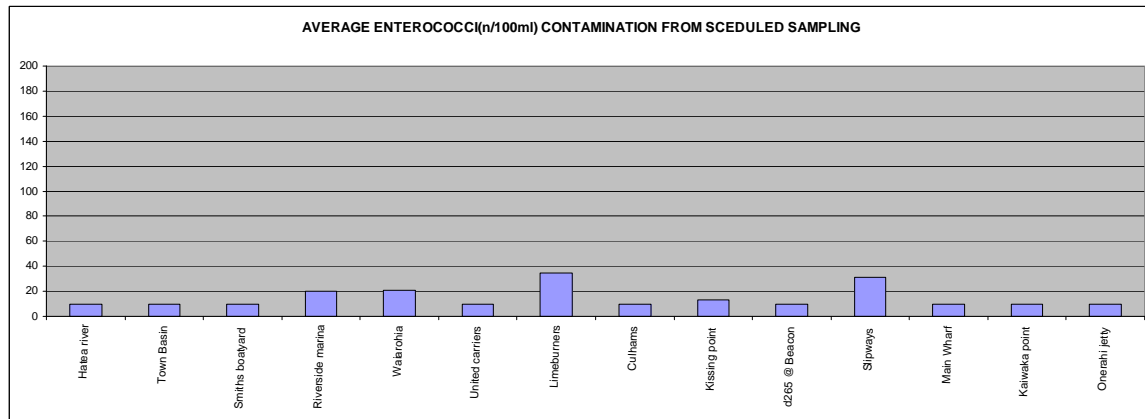
Map: Water and sediment quality monitoring sites in the Whangarei harbour

Additional parameters that are now being sampled include *Enterococci* bacteria, phosphorous, ammonia and nitrogen. Whilst the number of parameters has increased, the sampling frequency has decreased, with the addition of occasional (episodic) sampling after heavy rainfall events. Depth profiling of the physical properties of harbour waters has also commenced, which utilises remote monitoring equipment. Data from this monitoring may be used to increase our understanding of the way contaminants move (are transported) around the harbour systems.

Episodic sampling

During 2007-08, a number of episodic sampling runs were undertaken in the Whangarei harbour, following heavy rainfall events. Results from this sampling show significant microbial contamination in the upper harbour after heavy rain. The graphs below give the results from episodic and scheduled sampling for the Whangarei Harbour for 2007-08.





According to the MfE *Microbiological Water Quality Guidelines*, a median result of greater than 277 *Enterococci* per 100ml of sea water means the water is unsafe for recreational contact. In order to minimise the potential for adverse human health impacts, it may be necessary to classify these waters as 'unsafe' for contact recreation after heavy rainfall events.

NZRC

A review of the New Zealand Refining Company (NZRC) monitoring programme has been undertaken by NRC and NZRC employees. The revised programme is now being implemented. Significant changes to the coastal component of programme include extending the suite of contaminants analysed for, increasing the spatial distribution of sites and commencing stormwater basin sediment sampling.

Harbour model

In 2007-08, NRC invited the submission of proposals for the development of a hydrodynamic dispersion model for the Whangarei Harbour and modelling of specified microbial contamination scenarios.

Specific issues to be addressed in the model include:

- What are the dispersion rates and residence time of microbial contaminants in the harbour, arising from specified point source and diffuse discharges?
- What are the implications of significant freshwater inputs on the dispersion rates and residence times of contaminants?
- What are the likely impacts of these contaminant discharges on water and shellfish in terms of suitability for use?

The modelling exercise for Whangarei Harbour is proposed in two stages. The first stage generates a coarse model and is focused on microbial contaminants, with the second stage developing a finer scale model which incorporates additional contaminants.

TSUNAMI HAZARD ASSESSMENT

Tsunami hazard is considered a significant risk for Northland's coastal communities. Recent investigations of tsunami generating sources, and a review of recent and pre-historic tsunami events, have provided evidence of the natural hazards occurrence and likely consequences in the region. However, there are a number of 'unknowns' about tsunami hazard risk for Northland, for example, what is the likely extent of wave run-up and land inundation (flooding) and how does this vary depending on the source of the tsunami.

To better understand tsunami hazard, and to better prepare for the event of a tsunami in Northland, NRC contracted the National Institute of Water and Atmospheric Research (NIWA) to undertake a modelling-based assessment of tsunami hazard for the region. The modelling-based assessment is based on three studies:

- **Model Study 1:** to model maximum wave heights at the shoreline for selected districts in the Northland region;
- **Model Study 2** - Model the extent of landward inundation from tsunami hazard at priority coastal settlements; and
- **Model Study 3:** Model the extent of landward inundation from tsunami hazard at other coastal settlements.

In 2007-08, Model Study 1 was undertaken and completed. The focus of this study was to model the maximum wave heights at the shoreline for selected districts in the region for the most likely sources of tsunami, and to undertake inundation modelling for two specified communities.

Based on the results from the tsunami source study (Goff et al. 2006), the following sources were identified as likely to cause significant tsunamis in the study areas:

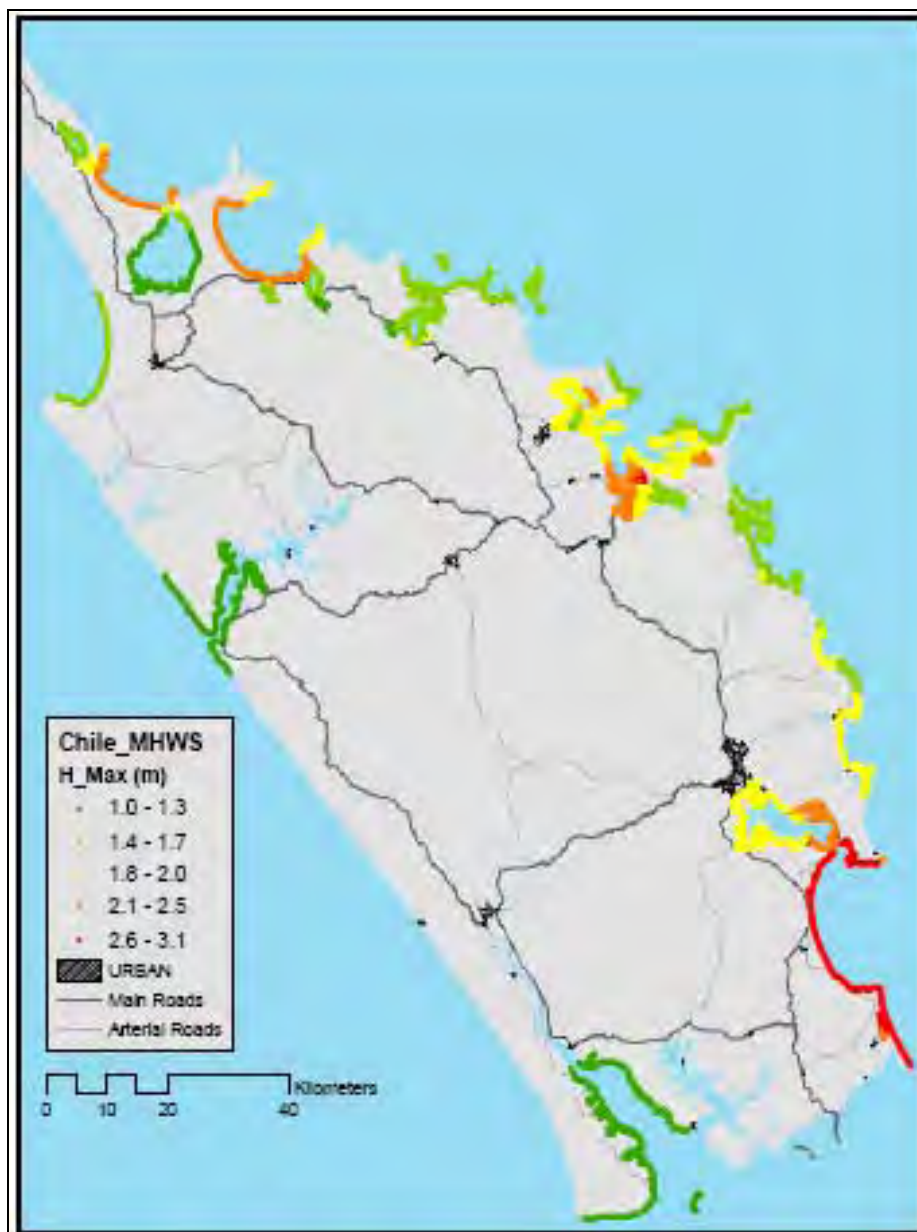
- **Distant** – Eastern: South America (Chile). A distant tsunami comparable to either the 1868 Peru (now Chile) earthquake (M_w 9.0) event or the 1960 Chile Earthquake (M_w 9.5) event. This represents the most probable tsunami in the 50-100 year timeframe.
- **Regional** – Eastern source: Tonga Kermadec trench. Two tsunamigenic earthquakes were studied: a M_w 8.5 subduction zone event located just to the north of the Rapuhia Scarp (i.e. in the central portion) and a M_w 9.0 subduction zone event in the central and southern portion. These are identified as worst - case scenarios, with a return period of 500 – 2000 years.

For each of these events, NIWA modelled wave height up to the Northland shoreline, with specific emphasis on the following districts:

- Doubtless Bay (Knuckle Point to Berghan Point);
- Ahipara (Shipwreck Bay to Headquarters Road);
- Bream Bay (One tree Point/Darch Point/Bream Head to Bream Tail);
- Whangarei (Mair Road to Home Point, to Town Basin road bridge);
- Bay of Islands (Cape Brett to Cape Wiwiki);
- Whangaruru (Home Point to Okupe Beach);
- Whangarei East Coast North (Motuara Point to Whau Point);
- Whangarei East Coast South (Whau Point to Awahoa Bay);
- Whangaroa (Point immediately west of Taupo Bay, Motuiwi Island including Stephenson and Cavalli Islands);
- Mangawhai (Sentinel Rock to Te Arai point);

- East Beach (Stanley Point to Blackney Point including Walker Island);
- Omapere (Waihopai River to Waimamaku River); and
- Dargaville.

The following maps give an indication of the likely wave heights at each of the study sites for both the distant and regional sources.

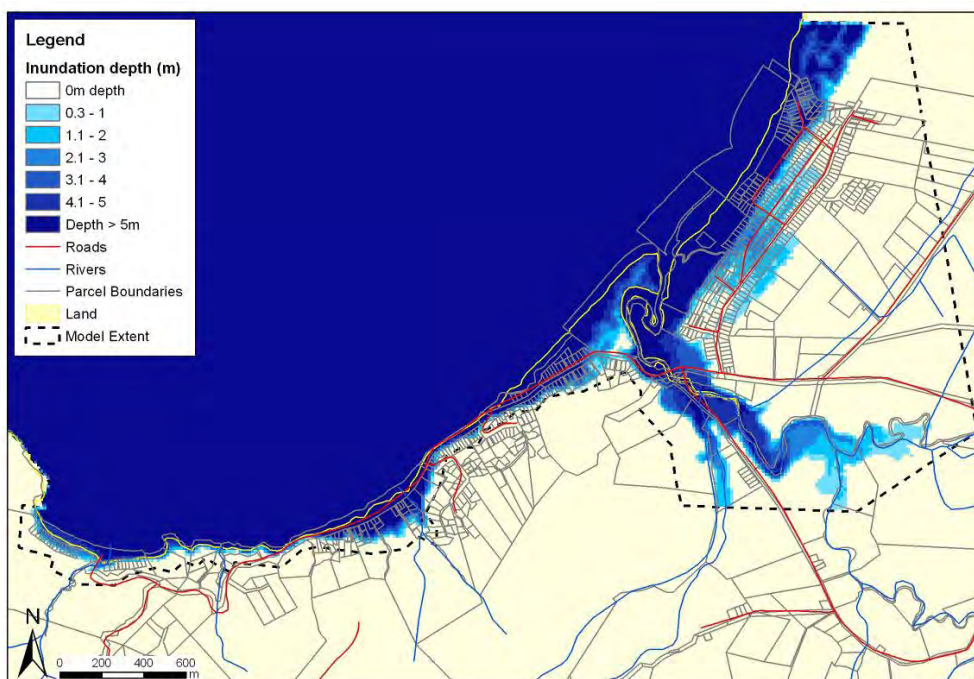
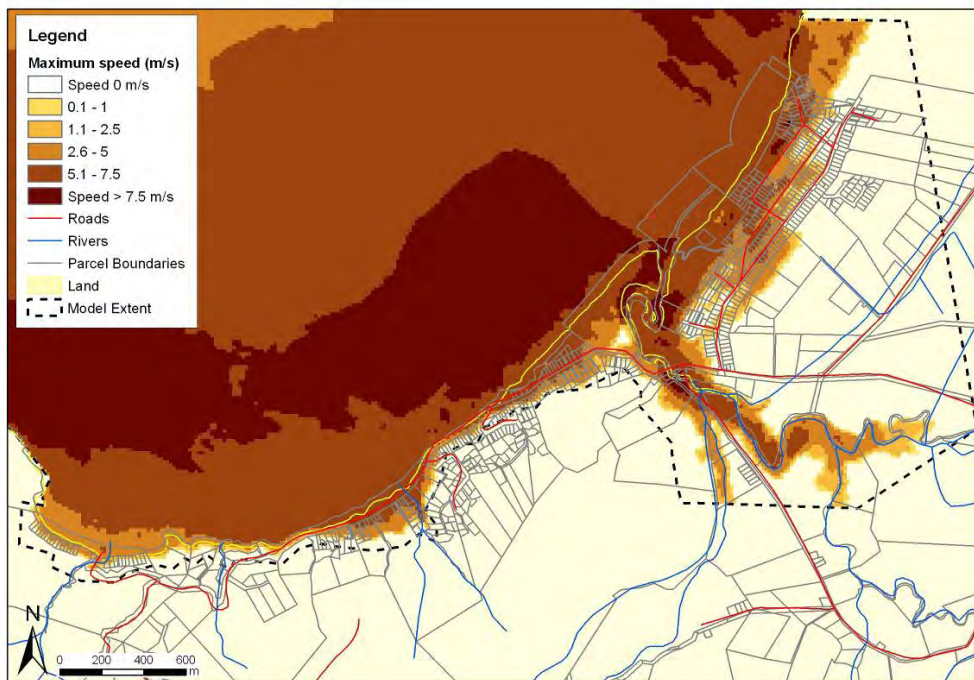


Map: Maximum wave height at shoreline for the South American scenario at Mean High Water Springs (MHWS). Areas of shoreline with no colour were not included in the model output.



Map: Maximum wave height at shoreline for the Mw9.0 Tonga-Kermadec subduction zone scenario at MHWS. Areas of shoreline with no colour were not included in the model output.

Inundation modelling was also done for Taipa (in Doubtless Bay) and Ahipara. Sea level rise scenarios of 30 and 50 cm which represent the 50 and 100 year projections defined by the Intergovernmental Panel on Climate Change (IPCC) were also modelled for each scenario. The maps below show the maximum inundation speed and depth for the Tonga-Kermadec subduction zone scenario.

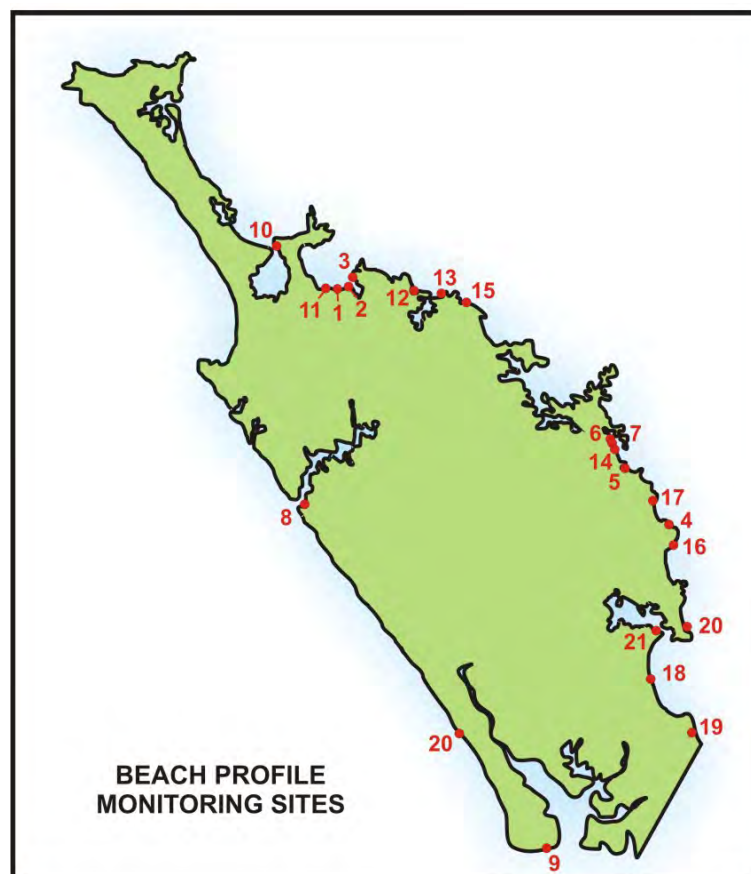


Map: Ahipara: Maximum inundation speed (upper) and depth (lower) plots for the Mw9.0 Tonga-Kermadec subduction zone scenario at MHWS (to extent of LIDAR).

BEACH PROFILE MONITORING

The NRC beach-profile monitoring programme was initiated in 2003-04 and involves mapping the position of the foreshore and foredune and/or cliff at selected coastal locations in Northland. The programme provides valuable information on changes in the position of our beaches, i.e., whether they are eroding, in equilibrium (staying the same) or accreting (growing). Data gathered from this programme enables a better understanding of coastal systems in Northland, which assists the Council and community when looking at the suitability and effect of development in and adjacent the coast. It can also be used to identify 'coastal hazard zones'.

Monitoring is undertaken at 6-monthly intervals (once in winter and once in summer) at key 'monitor' beaches in the region. A cross-section profile of the foreshore and foredune at each coastal location is taken and the exact location of the foredune 'toe' is mapped using a Global Positioning System (GPS). Other beaches in Northland are also monitored on a less regular basis following events that may cause significant change, for example, landslides or storm events.



Map: Beach profile monitoring sites

The table below shows the history and state of the beaches surveyed by NRC. In the 'trend' column, **red** indicates erosion and **green** indicates accretion.

	Beach Name	Section Name	Date Range of Surveys		No. of Years surveyed	Number of Records	Trend (metres per year)
			From	To			
1	Cable Bay		13/05/1999	4/02/2008	9	7	0
2	Coopers Beach		9/09/2003	4/02/2008	5	5	0.04
3	Hihi		13/05/1999	4/02/2008	9	6	0.11
4	Matapouri	M1	2/02/2001	7/01/2008	7	19	-0.15
		M2	2/02/1998	4/12/2007	9	21	-2.43
		M3	2/02/2001	7/01/2008	7	19	1.84
		M4	2/02/2001	7/01/2008	7	19	1.68
5	Ngawai		10/05/1999	15/03/2007	8	4	0.42
6	Oakura		3/02/1998	15/03/2007	9	4	0.21
7	Ohawini	OHW1	3/02/1998	22/03/2005	6	4	0.64
		OHW2	22/03/2005	15/03/2007	2	2	-0.03
8	Omapere	OM1	26/10/2001	17/04/2008	7	7	-0.20
		OM2	26/10/2001	17/04/2008	7	6	-0.43
		OM3	26/10/2001	17/04/2008	7	6	0.25
		OM4	26/10/2001	17/04/2008	7	6	-0.57
		OM5	26/10/2001	3/12/2007	6	4	-0.04
		OM6	26/10/2001	3/12/2007	6	6	-0.53
9	Pouto	P2	16/01/1989	20/02/2008	19	34	1.66
		P3	16/01/1989	20/02/2008	19	34	15.97
		P3A	20/02/1990	20/02/2008	18	34	0.85
		P4	16/01/1989	20/02/2008	19	35	-8.87
		P4A	21/02/2000	20/02/2008	8	16	-7.58
		P5	16/01/1989	20/02/2008	19	34	0.08
10	Rangiputa	Rangiputa A	25/05/1999	4/02/2008	9	4	0.04
		Rangiputa B	25/05/1999	16/03/2007	8	4	-0.51
		Reef Lodge	25/05/1999	16/03/2007	8	4	-0.62
11	Taipa		22/02/1990	4/02/2008	18	11	-0.35
12	Taupo		12/05/1999	4/02/2008	9	9	-5.98
13	Tauranga		4/07/2002	4/02/2008	6	9	2.35
14	Te Mimiha		10/05/1999	16/03/2007	8	4	0.76
15	Te Ngarie		10/07/2002	4/02/2008	6	8	-0.13
16	Wellingtons Bay		10/03/1998	7/01/2008	10	6	0.32
17	Whananaki		16/08/2004	13/08/2007	3	5	0.89
18	Bream Bay	RM 7	14/07/1976	23/06/1983	7	31	-0.46
		RM 8	14/07/1976	12/09/2007	31	52	-0.32
		RM 9	14/07/1976	7/07/1982	6	30	0.8
		RM 10	14/07/1976	23/16/1983	7	39	-0.25
		RM 11	8/12/1977	12/09/2007	30	29	0.05
		RM 12	21/09/1976	23/06/1983	7	34	0.99
		RM 13	13/07/1976	12/09/2007	31	43	0.56
		RM 14	13/07/1976	23/06/1983	7	40	-0.27
		RM 15	13/07/1976	12/09/2007	31	42	-0.3
		RM 16	13/07/1976	23/06/1983	7	48	1.92
		RM 17	29/11/1977	12/09/2007	30	36	-0.21
RM 18	2/11/1976	23/06/1983	7	36	-0.44		

	Beach Name	Section Name	Date Range of Surveys		No. of Years surveyed	Number of Records	Trend (metres per year)
		RM 19	21/10/1976	1/03/1998	12	36	0.71
		RM 20	24/08/1976	23/06/1983	7	32	2
		RM 21	23/08/1976	24/06/1983	7	31	1.85
		RM 22	30/06/1977	24/06/1983	6	35	0.07
19	Mangawhai	M5	27/07/2000	28/08/2007	7	15	3.19
		M6	27/07/2000	28/08/2007	7	14	0.38
20	Glinks Gulley		29/09/1994	1/08/2008	14	21	1.44
20	Ocean Beach	OB1	15/07/1976	12/09/1977	1	12	24..46
		OB1A	4/05/1977	10/07/1979	2	25	0.61
		OB2	23/08/1976	10/07/1979	3	30	-0.26
		OB3	22/11/1976	10/07/1979	3	36	0.35
		OB4	22/11/1976	10/07/1979	3	35	1.62
		OB5	23/08/1976	10/07/1979	3	31	-1.21
		OB6	23/08/1976	18/03/1981	5	44	4.05

As can be seen from the table, the general trend is for only small rates of accretion or erosion at most sites.

During 2007-08, the beach at Matapouri underwent beach nourishment and so the beach is still finding its natural state. The foreshore at Omapere was subject to significant erosion during the year and rockwork was required to stabilise a house located on the beach front. The beach at Pouto, a highly dynamic system, was cut back extensively to the east of the cliffs.



Photo: Beach nourishment at Matapouri

COASTCARE PROGRAMME

The NRC CoastCare programme was initiated in 2005. The aim of the programme is to enable communities to better understand coastal processes and initiate protection, restoration and enhancement of dune ecosystems through the establishment and resourcing of community-based CoastCare groups.

There are now over twenty CoastCare groups operating around the region (see summary of CoastCare projects below). During the winter of 2008, these groups planted approximately 13,000 spinifex, and 6,000 pingao plants to help restore dune habitats in their local environments. For more information on CoastCare groups operating in your area go to: <http://www.nrc.govt.nz/Environment/Coast/Take-action/CoastCare/>.



Photo: Planting Day at Waipu Cove

CoastCare Case Study – Tauranga Bay

Tauranga Bay is a typical example of a Northland east coast modified dune system. The beach frontage is designated as a District Council Coastal Reserve and a private campground is located on the frontage. The dunes themselves have been flattened in the past and native vegetation replaced with kikuyu.

The Tauranga Bay Community Association, with support from NRC and the Far North District Council (FNDC), designed and implemented a restoration strategy for dunes on the foreshore, adjacent to the reserve. In 2007, the group planted spinifex and pingao on the dunes, erected fences around the newly restored areas and constructed formal access ways, to direct foot traffic down to the beach, away from the new plants.

The plants thrived and sent out long runners (stolons) and although a severe storm swell in the winter of 2008 killed a number of plants, the new planting helped to bind the banks of the dunes and reduce erosion damage (see pictures below). The stolons left trailing over the steep face caused by the erosion will be able to take root and trap wind blown sand, in time restoring the dune profile.



Photo: Dunes at Tauranga Bay before restoration work (August 2002)



Photo: Dunes at Tauranga Bay after restoration (June 2008)



Photo: Erosion damage to dunes after storm (winter 2008)

Summary of CoastCare Group Activities 2007-2008				
	Site Name	Group Name	District Council	Key Activities
1	Ahipara	Ahipara CoastCare Group	FNDC	New group set up to undertake dune restoration. Also concerned with the issue of vehicles on beaches.
2	Baylys Beach	Baylys Beach Society Inc	KDC	Formed with the aim of protecting the dunes from threats such as vehicles and to undertake dune restoration, including planting of native dune-binding plants. Over the last two years, the group has planted spinifex and pingao, and erected fencing to protect the dunes and newly planted areas. In July 2008, storms destroyed some of the fencing and eroded a section of the dunes. An NRC Environment Fund grant has been approved for repair work in these areas and to continue restoration work.
3	Glinks Gully	Glinks Gully Protection Society	KDC	The Society has undertaken weed control and planting of native trees in the back dune area and gully. The rear dune system has been degraded by bovine grazing & vehicle access. Over 2,000 native shrubs and trees have been planted to date.
4	Kaimaumau	Kaimaumau Coastal Reserve Group	FNDC	This group has undertaken weed and pest control in the dunes and adjacent wetland area, and planted appropriate native species. An NRC Environment Fund grant has been approved for continuation of this work.
5	Karikari Peninsula	Karikari Peninsula Beach Care Group	FNDC	<p>The group was formed in response to a growing number of coastal issues in the area. Careless use of vehicles on the beach and dunes was creating problems, including compromising the safety of other beach users and causing environmental damage to the fragile dune system.</p> <p>Strategies and projects are also being formulated that will assist in the conservation and restoration of the beach and surrounding</p>

				<p>significant conservation areas.</p> <p>The group is making a leaflet which will include information on the bay and will be distributed to all permanent and temporary residents.</p>
6	Marsden Point	New Zealand Refining Company	WDC	The refining company planted approximately 1000 spinifex on World Environment Day. The company plan to continue this planting next winter.
7	Mangawhai Spit	Mangawhai Harbour Protection Society	KDC	<p>Work has been undertaken to stabilise the sand spit dunes, including erecting wind-break fences, planting native species, top dressing and rabbit control. It is hoped that these measures will reduce sand movement on the spit and so prevent further sedimentation of the estuary.</p> <p>The Society has also been successful in establishing a nursery, which has grown thousands of native pingao plants. These have been planted on the spit by volunteers from the community and members of the society. Spinifex plants are grown in Tauranga from seed collected on the spit.</p> <p>The planting, fencing and rabbit control regime are part of a longer-term programme which hopes to see the spit completely revegetated. Planting days are held annually. In 2008, approximately 5,000 spinifex and 10,000 pingao were planted.</p>
8	Oakura	Oakura Foreshore Residents and Ratepayers Association	WDC	WDC are currently planning planting areas along the Oakura foreshore. The intention is to commence planting of Spinifex in the winter of 2009.
9	Owahini		WDC	The main issues on this beach are vehicles driving unsafely in the presence of other beach users and parked vehicles obstructing access to the beach. Some spinifex has been planted at the end of Owahini bay and more will be planted during the 2009 winter.
10	Ocean Beach	Ocean Beach Protection Society	WDC	The Ocean Beach Protection Society aims to work with nature to restore and protect biodiversity in the area. To date, species

				planted at the back of the dunes include manuka, kanuka, cabbage tree, flax, coprosma and pohutukawa. Weed and pest control have also been undertaken. The group plans to continue planting work, including revegetation of the sand dunes with native sand-binding plants, such as pingao and spinifex.
11	Omapere Opononi	-	Hokianga Harbour Foreshore Protection Society	FNDC Hokianga residents established the incorporated society to help NRC and FNDC manage coastal erosion along the Omapere-Opononi foreshore. A number of reports and studies have been undertaken to investigate the various options for erosion control along the Omapere-Opononi foreshore. The latest report is the 'Omapere-Opononi Dune Restoration Strategy' which brings together the previous studies and reports. The strategy recommends dune restoration, by reshaping and planting with native sand-binding plants, as the most sustainable means of erosion control. A public meeting will be held in October 2008 to consult with the local community.
12	Omamari (Ripiro)		Hua Rakau Ki Omamari Trust	FNDC The Omamari beach group was established in 1997 in response to declining numbers of pingao, godwit and inanga populations in the local area. The group started by collecting, growing and planting pingao seedlings on the sand dunes. They also undertook pest control, erected signage, and constructed a manuka wind-break. The group then focused on restoring the backdune area, particularly next to the Omamari stream, by planting pohutukawa and harakeke. In addition, some pest plants, such as alligator weed, have been cleared and designated walkways created.
13	One Tree Point		Pyle family	WDC Planting of spinifex and pingao for erosion control.
14	Owhata (Herekino)		Owhata Ahu Whenua Trust	FNDC A 'shade house' has been built, with money from NRC's Environment Fund. This is being used to propagate pingao and

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				other native plants, which will be planted along the foreshore to protect the peninsula from erosion. To date, a large number of native plants and trees have already been planted on the peninsula and foreshore.
15	Ruakaka	Bream Bay Coastal Care Trust	WDC	The Trust intends to protect and enhance indigenous flora, fauna and habitats in the local area. The Trust has been working on an ongoing project to restore the dune lake at Ruakaka (with assistance from the NRC Environment Fund). They are also undertaking pest control in the area adjacent to the Ruakaka Wildlife Refuge and will be collecting spinifex seed to propagate and plant.
16	Taipa	Taipa Beach Improvement Society/Taipa Area School/Taipa CoastCare	FNDC	This is a joint project between the school and local community. To date, 800 spinifex have been planted along the foreshore, mainly in front of the school. Four wooden 'sand ladders' have also been built to provide designated access down to the beach, thereby reducing footpath erosion. Further spinifex and pingao planting will take place in the winter of 2008, using money from the NRC Environment Fund. School students are also designing signs to encourage people to keep off the dunes.
17	Tapeka	Tapeka Ratepayers Group	FNDC	This project was initiated by residents who are concerned about severe erosion damage along this stretch of coast. Permission was granted to dig a channel directly out to sea. The bank was then reshaped and planted out with 600 spinifex. Sand ladders have been put in place to facilitate pedestrian access to the beach and discourage people from walking on the dunes.
18	Taupo Bay	Taupo Bay Progressive Society	FNDC	Taupo bay is a favourite dotterel nesting area, however before the group formed, very few chicks were surviving. Intensive pest control has been undertaken by the group and this year, eight young dotterel were recorded.

				<p>Pest control in this area has also had a positive effect on the remnant kiwi population.</p> <p>Vehicles are now prohibited from the beach, which has also helped the dotterel population, and a large amount of planting has been undertaken in the bay.</p>
19	Tauranga Bay	Tauranga Bay Community Association	FNDC	<p>A sub-committee of the Tauranga Bay Community Association has been formed to work on CoastCare activities and the protection of nesting dotterels from inappropriate vehicle use on the beach.</p> <p>To date, over 3000 spinifex have been planted along the foreshore adjacent to the FNDC reserve. Temporary fencing has also been erected around the dotterel nesting area. Dotterel and oyster catcher numbers have increased as a result.</p> <p>Spinifex has established well. In April, spinifex planted the previous August had sent out 3m runners. Severe storm surges in July eroded the developing dune and caused the loss of a number of plants. However, the majority of plants survived and will help with the restoration of the dunes.</p>
20	Te Ngare Bay	Te Ngare Bay CoastCare	FNDC	<p>This group was formed by local residents to protect the beach from vehicle damage and enhance the natural beauty of the bay. Spinifex and pingao are being propagated from seed collected from the bay. These will be planted out in winter 2009. The group have also planted native coastal shrubs and plants in the reserve, with money received from FNDC.</p>
21	Waipapakauri	Waipapakauri Coastal Care Group	FNDC	<p>The group was formed to restore the damaged dune system near the Waipapakauri ramp onto Ninety Mile Beach. The main issues at this beach include erosion and degradation of the sand dunes, caused by pedestrians, vehicles and wild horses. The group have fenced off the dunes adjacent to the ramp, planted native vegetation</p>

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				<p>and built a path for pedestrian access from the car park to the beach.</p> <p>Prior to the July storms, the planted spinifex was growing well. However, the storms wiped out a large section of the dunes north of the ramp. The planted area south of the ramp survived relatively untouched. Planting will continue in 2009 to fill in the gaps in the planted area.</p>
22	Waipu Cove	Waipu Cove CoastCare	WDC	<p>This group was formed to work towards restoring the dune system at Waipu. However, winter storms eroded the bank in front of the surf club and caused the loss of the majority of the planted. More plants are due to be planted in August 2008 to replace those lost.</p>
23	Whangaruru	Whangaruru Coastal Community Group	WDC	<p>This recently formed group aims to tackle a range of issues in the Whangaruru harbour and catchment. The group plans to undertake dune planting in the winter of 2009.</p>

VEHICLES ON BEACHES

Over the summer of 2007-08, a 'Vehicles on Beaches' education campaign was run in Northland with the aim of raising awareness about the dangers and potential environmental impacts of driving on our beaches. The campaign included inter-agency information days at popular beaches in the region, radio and newspaper adverts and the distribution of a revised '*Driving Safely on the Beach*' information leaflet.

As part of the campaign, a survey was conducted to ascertain whether or not people felt there was an issue with vehicles on beaches and if yes, what people felt local councils should do about the issue. The majority of those surveyed felt that speed was a key issue and most respondents felt that speed limits should be introduced and enforced. Very few of those surveyed felt that vehicles should be banned completely, although some people felt that they should be restricted to certain areas.

Following on from this campaign, NRC and the District Councils have been working together to develop a strategy for managing vehicles on beaches. Significant progress has been made in the Whangarei and Kaipara Districts. A different management approach has been developed for each district but both strategies achieve an improved management regime, which provides for increased safety for beach users.

Whangarei District Council (WDC) will introduce a bylaw to restrict the speed of vehicles driving on the beach at Bream Bay. The aim is to have this bylaw in place by Christmas (December) 2008. In the Kaipara District, the Department of Conservation (DOC) has agreed to take on the implementation of a bylaw restricting speed on a selection of beaches in the district. Consultation on this will take place over the summer of 2008-09. The Far North District Council has not yet developed a management regime for vehicles on beaches in their district.

Funding has been approved by Land Transport New Zealand (LTNZ) to continue the education campaign over the summer of 2008-09 and for advertising and signage for the newly introduced speed restrictions.



Photo: 'Vehicles on Beaches' display at Ahipara, February 2008