

Priorities and Related Actions for the Sustainable Management of the Firth of Thames Ramsar site

Muddy Feet Phase II: Keep the Birds Coming

Prepared by:
B. Brownell, J. Dahm and M. Graeme

For:
Environment Waikato
PO Box 4010
HAMILTON EAST

March 2008

Document #: 1294613

Peer reviewed by:
Catherine Beard

Date March 2008

Approved for release by:
Peter Singleton

Date March 2008

Disclaimer

This technical report has been prepared for the use of Waikato Regional Council as a reference document and as such does not constitute Council's policy.

Council requests that if excerpts or inferences are drawn from this document for further use by individuals or organisations, due care should be taken to ensure that the appropriate context has been preserved, and is accurately reflected and referenced in any subsequent spoken or written communication.

While Waikato Regional Council has exercised all reasonable skill and care in controlling the contents of this report, Council accepts no liability in contract, tort or otherwise, for any loss, damage, injury or expense (whether direct, indirect or consequential) arising out of the provision of this information or its use by you or any other party.

Table of contents

Executive summary	iii
1 Introduction	1
1.1 Background	1
1.2 Purpose of the project	2
2 Structure of report	4
3 Habitat loss and degradation	6
3.1 Mangrove expansion	6
3.2 Invasive species	7
3.3 Predation and browsing	9
3.4 Human recreation and disturbance	10
3.5 Climate change	11
3.6 Drainage, infilling and associated land uses	12
3.7 Fishing/aquaculture	14
4 Sedimentation	17
5 Contaminants	19
5.1 Nutrients	19
5.2 Other contaminants	21
Recommendations	24
References	30
Appendix A: Linkages to other projects in the southern firth and catchments	31

List of figures

Figure 1: Firth of Thames showing the Ramsar site with its intertidal mudflats and mangroves. Catchment of 3600 km ² shown in light green (mainly drained by Waihou and Piako river systems).	3
Figure 2: Issues (stressors) as grouped in this summary report compared to the breakdown in the risk analysis. Relative risk posed to the Ramsar site associated with each of the key stressors as grouped in this report - including worst case scenario for the next 50 years. The worst case scenario includes climate change effects. (Adapted from Elmetri and Felsing, 2007).	5

List of tables

Table 1: Agencies and groups involved with the Muddy Feet Phase II project.	2
Table 2: Issues (stressors) as grouped in this summary report compared to the breakdown in the risk analysis.	4
Table 3: Recommendations for implementation of high priority actions/gaps.	25
Table 4: High priority gaps to be addressed through the Restoration Action Project. Numbering correlates with the relevant section of the main text.	25
Table 5: High priority gaps to be addressed by external agencies (Biosecurity NZ, MFish and CRIs).	27
Table 6: Medium priority gaps to be addressed (> 5 years).	29

Executive summary

The Muddy Feet project provides a framework for coordinated action to identify and address risks to the southern and south-western coast and intertidal zone of the Firth of Thames, an area recognised as an internationally important wetland under the Ramsar Convention. It is ranked as one of New Zealand's three most important areas for shorebirds and annually hosts more than 49 different migratory bird species, numbering some 20,000 individuals. The Ramsar site is potentially vulnerable to activities occurring in surrounding marine and land environments including drainage from approximately 175,000 ha of catchment.

'Muddy Feet' is a joint effort by Environment Waikato; Auckland Regional Council; Thames-Coromandel, Hauraki and Franklin district councils; the Department of Conservation; the Ministry of Fisheries; local iwi and the Miranda Naturalists' Trust. The project also has support from the Hauraki Gulf Forum, the Hauraki Maori Trust Board and Matamata-Piako District Council. The project was initiated in 1998 by Ecoquest Education Foundation and was funded by grants from the Environmental Initiatives Fund (Environment Waikato), Hauraki District Council and Thames-Coromandel District Council, along with other forms of support from the Department of Conservation (Auckland and Waikato conservancies), Auckland Regional Council and Waikato District Council.

The Muddy Feet project has highlighted issues of habitat loss and degradation that potentially pose a serious threat to the values of the internationally important Ramsar wetland and immediate environs in the southern Firth of Thames. Phase I of the project focused on current knowledge of the Ramsar site and the surrounding marine environment. Phase II has focused on clarifying risks to the site and identifying management gaps that need to be addressed.

This report presents a summary of the management gaps identified from Phase II of the project. In particular it outlines and prioritises critical actions that are required to reduce key risks to the Ramsar site, and also identifies critical gaps that need to be addressed through on-the-ground action now (that is, action in and around the Ramsar site). Those actions that require a longer term focus (for example, new research, policy changes and broader catchment actions) are also addressed.

It is clear from preceding work and the gap analysis that:

- the values of the Ramsar site have been modified through an ongoing trend of habitat loss and degradation
- inaction will result in ongoing degradation of this internationally important wetland.

The gap analysis has also highlighted a paucity of information with regard to the various habitats in the southern Firth of Thames and a need for a more holistic ecosystem approach to management of this area, including baseline investigations to identify the current values and community characteristics, ongoing monitoring to detect any significant change and attention to cumulative effects. There is an overarching need to develop a general ecosystem understanding, including an ability to identify and address cumulative effects.

Identified gaps have been divided into two groups based on priorities and practicalities.

- **High priority** to be undertaken within 1-5 years (ideally within the term of the current 2006-16 LTCCP). These are the practically achievable actions required in the immediate future to reverse habitat loss and degradation. They largely involve on the ground action in and around the Ramsar site.

- **Medium priority** required in the longer term (beyond five years) to prevent significant habitat loss and degradation, and include addressing indirect effects from the wider catchment.

Priorities were assessed based on the practicality and achievability of the recommended actions, the timelines likely to be required and the effectiveness of the action in addressing key threats and reversing existing trends for degradation. Prioritisation of the actions was based on both expert judgment and discussions with representatives of the various management agencies and community groups.

High priority actions have been further divided into three groups.

- A **Restoration Action Project** to implement practical on the ground actions to enhance environmental values, inform and involve local communities and arrest degradation trends. This primarily addresses the habitat loss and degradation issues highlighted in this report that require immediate action by regional and district councils over the next 1-5 years.
- **Marine biosecurity** actions required to prevent incursions of serious invasive species, to be coordinated by central government (for example, Ministry of Fisheries and Biosecurity New Zealand).
- **Fundamental research** required to develop a general ecosystem understanding to identify important values and threats, and to address cumulative effects – to be undertaken by Crown research agencies and universities using central government funding. It is expected that Hauraki Gulf Forum agencies will actively advocate and encourage this research.

1 Introduction

1.1 Background

The southern and south-western coast and intertidal zone of the Firth of Thames is recognised as an internationally important wetland under the Ramsar Convention and is ranked as one of New Zealand's three most important areas for shorebirds (Figure 1). The Ramsar site annually hosts more than 49 different migratory bird species, numbering some 20,000 individuals.

The site is also important for many local species, such as the pied oystercatcher which returns after summer breeding in the South Island. In addition, some species breed at the Ramsar site, including three species endemic to New Zealand (the New Zealand dotterel, the variable oystercatcher and the black-backed gull).

The area is potentially vulnerable to activities occurring in surrounding marine and land environments including drainage from approximately 175,000 ha of catchment.

The Muddy Feet project provides a framework for coordinated action to identify and address risks to the Ramsar site. The project was initiated in 1998 by Ecoquest Education Foundation, funded by grants from the Environmental Initiatives Fund (Environment Waikato), Hauraki District Council and Thames-Coromandel District Council, plus other forms of support from Department of Conservation (Auckland and Waikato conservancies), Auckland Regional Council and Waikato District Council.

A report produced at the end of the first phase of the project (Muddy Feet Phase I - Brownell, 2004) summarised current knowledge of the Ramsar site and the surrounding marine environment, including information from over 250 reports and studies, independent field studies conducted by the project team, and the knowledge of local stakeholders.

Phase II of the Muddy Feet study involved risk and gap analysis.

A risk analysis (Elmetri & Felsing, 2007) identified conservation values and assessed the relative threat to these values posed by risk sources (stressors). Risks were prioritised in terms of relative threats. The report identified significant threats to the values of the Ramsar site from various sources, particularly land based activities – including the generation and delivery of sediments, contaminants, habitat loss, invasive species and nutrients.

A gap analysis reviewed the risks in light of existing management actions and identified gaps. The identified gaps were prioritised to identify the critical actions required to address key risks and reverse the trend of habitat loss and degradation. The gap analysis included extensive stakeholder consultation (outlined below), production of an extensive working paper canvassing the various issues and gaps (Brownell, 2007), and production of this summary report.

The agencies and groups involved in Muddy Feet Phase II are listed in Table 1, with the project funded by Environment Waikato, Auckland Regional Council, the Department of Conservation, and the Hauraki, Franklin and Thames-Coromandel district councils. The project was overseen by a steering group comprised of Environment Waikato, and Hauraki, Thames-Coromandel and Franklin district council staff.

The gap analysis process involved a series of meetings and interviews with collaborators and the wider community (see Table 1), including the following.

- **Interagency collaboration** involving three working party sessions, numerous steering group meetings, interviews with staff and politicians, a field trip, and presentations/discussions at council meetings. Specific consultation was also held with individuals and small groups of technical experts and resource managers in areas relating to the issues raised by the risk analysis.
- A **community workshop** involving 35 community members and six representatives of agencies responsible for different aspects of management of the Firth of Thames.
- A **hui** held to discuss the ecological considerations raised by the project and to solicit feedback from tangata whenua.

Table 1: Agencies and groups involved with the Muddy Feet Phase II project.

Local government	Environment Waikato (EW)
	Auckland Regional Council (ARC)
	Thames-Coromandel District Council (TCDC)
	Franklin District Council (FDC)
	Hauraki District Council (HDC)
	Matamata-Piako District Council (MPDC) – no coastal connection, but significant catchment influences
Other Agencies	Department of Conservation – Waikato conservancy, Auckland Conservation Board and Auckland area office
	Ministry of Fisheries
Tangata Whenua and other community groups	Kaitiaki representation (led by Ngati Paoa Trust Board)
	Miranda Naturalists' Trust
	Various community groups represented at two meetings promulgated by Environment Waikato prior to initiation of the project, and a community workshop on 6/11/05
	Hui with Hauraki Kaitiaki Taiao on 22/6/06
	Informal consultations with commercial and recreational fishers from Kaiaua to Thames

1.2 Purpose of the project

The Muddy Feet project has highlighted issues of habitat loss and degradation that potentially pose a serious threat to the values of the internationally important Ramsar wetland and immediate environs in the southern Firth of Thames (Brownell ed., 2004, Elmetri and Felsing 2007).

Phase II of the Muddy Feet project has focused on clarifying these risks and identifying management gaps that need to be addressed.

This report outlines the management gaps highlighted in Phase II and in particular:

- identifies critical actions required to reduce key risks
- prioritises these actions
- identifies the critical gaps that need to be addressed through on the ground action now (that is, action in and around the Ramsar site) and those that require a longer term focus (for example, new research, policy changes and broader catchment actions).

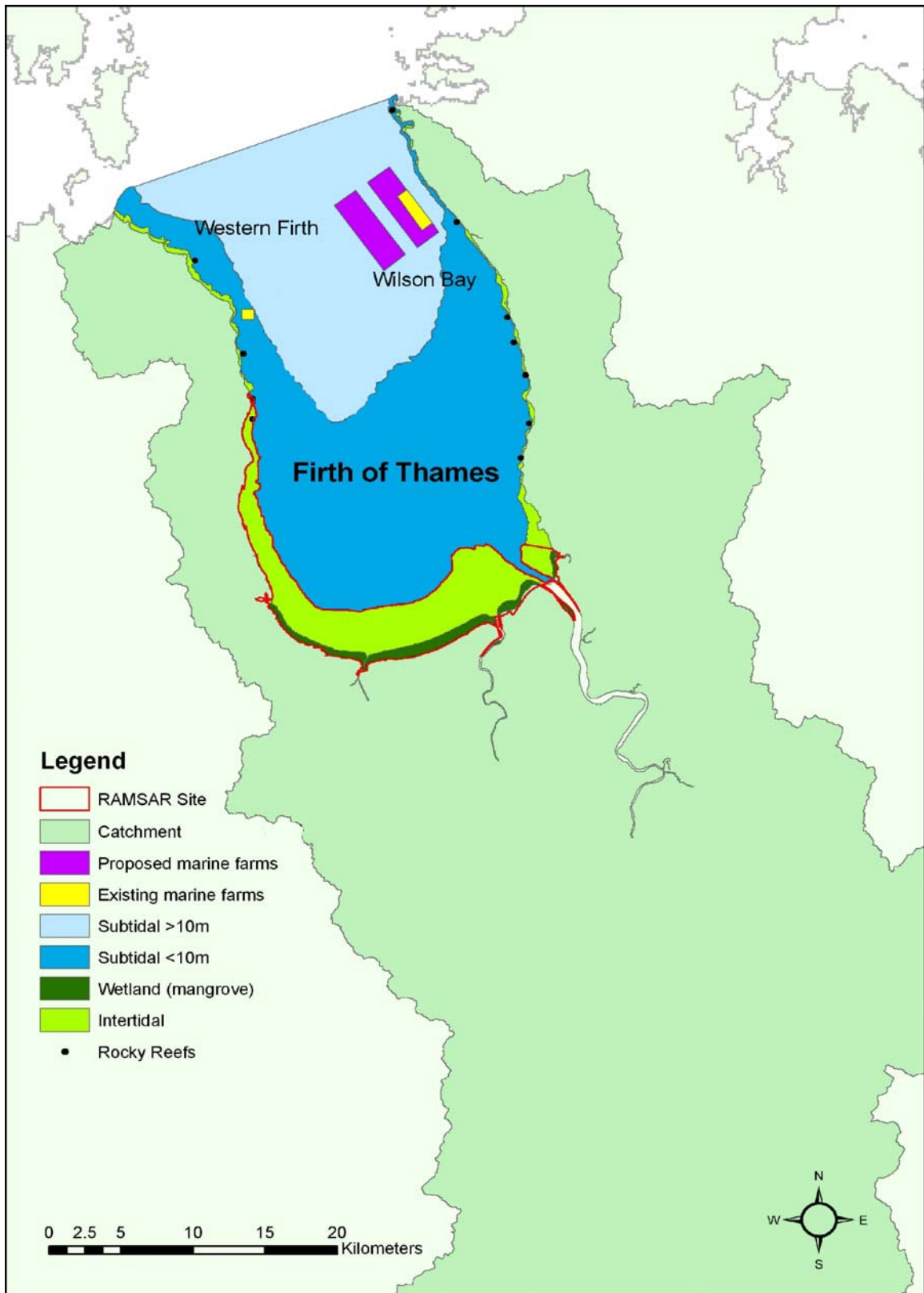


Figure 1: Firth of Thames showing the Ramsar site with its intertidal mudflats and mangroves. Catchment of 3600 km² shown in light green (mainly drained by Waihou and Piako river systems).

2 Structure of report

This report summarises the findings of the gap analysis, highlighting critical management action gaps required to address key issues identified in the risk analysis.

The risk analysis (Elmetri & Felsing 2007) found that the site was experiencing significant trends for habitat loss and degradation and that failure to address these trends would result in serious ongoing degradation. The report identified seven key issues (stressors), being sediments, habitat loss, disturbance, invasive species, harvesting and exploitation, contaminants and nutrients. In this summary report, these stressors have been grouped into three overarching issues of habitat loss and degradation, sedimentation, and contaminants (Table 2). All the issues highlighted by the risk analysis are related to habitat loss and degradation, but sedimentation and contaminants are regarded as sufficiently significant components to be addressed in a separate chapter.

Each overarching issue is covered as a separate chapter in this report. Each chapter briefly summarises the issues as identified in the risk analysis. The findings of the gap analysis are then summarised under the following key management activities:

- information and monitoring
- policy
- consents and compliance monitoring
- education
- work projects and programmes.

Chapter 6 prioritises the identified gaps in management actions and provides recommendations for action in both the short to medium term (1-5 years) and longer term (greater than five years) to address existing trends for habitat loss and degradation. Emphasis is given to the use of existing work programmes to address the identified gaps, with new initiatives identified where this is not possible. Existing work programmes relevant to the Muddy Feet project are briefly summarised in Appendix A.

Figure 2 compares the relative risk assessed for each issue by the risk analysis, grouped under the three overarching issues used in this report. The risk analysis assessed sedimentation as the single greatest threat to the Ramsar site. When grouped as in this report, the relative risks associated with each of the three overarching issues (stressors) are similar and significant (Figure 2). In the worst case scenario, the various stressors grouped under habitat loss and degradation pose the most serious risk.

Table 2: Issues (stressors) as grouped in this summary report compared to the breakdown in the risk analysis.

Summary report	Risk analysis
Sedimentation	Sediments
Habitat loss and degradation	Habitat loss
	Disturbance
	Invasive species
	Harvesting and exploitation
Contaminants	Contaminants
	Nutrients

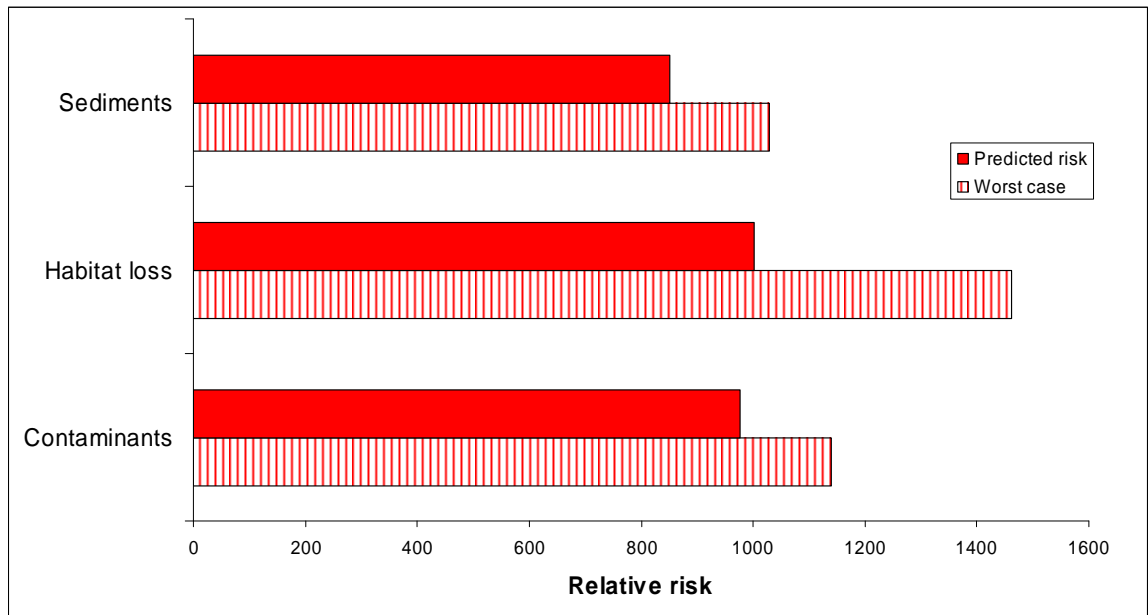


Figure 2: Issues (stressors) as grouped in this summary report compared to the breakdown in the risk analysis. Relative risk posed to the Ramsar site associated with each of the key stressors as grouped in this report – including worst case scenario for the next 50 years. The worst case scenario includes climate change effects. (Adapted from Elmetri and Felsing, 2007).

3 Habitat loss and degradation

The risk analysis identified habitat loss and degradation in the southern Firth of Thames associated with:

- mangrove expansion
- invasive exotic species (including displacement of native communities and threatened species)
- predation
- human recreation and disturbance
- climate change
- drainage, infilling and associated land uses (classed as agricultural and urban and industrial land use in the risk analysis)
- fishing/aquaculture.

The following sections summarise the findings of the gap analysis in relation to these key stressors.

3.1 Mangrove expansion

The progressive expansion of mangroves is thought to be reducing the area of intertidal mudflats available for shorebird feeding and also impacting on important habitats such as chenier roost sites and back swamp feeding grounds such as the stilt ponds. Conversely, the expansion of this community is creating increased habitat for some invertebrates (for example, mud crabs and mud snails), some birds (for example, herons and banded rail) and some fish (flounder and eel). Sedimentation is one of the drivers of mangrove expansion. Nutrient availability and climate change may also have an influence.

Current information and monitoring activities	Gaps
<ul style="list-style-type: none"> • A report currently being finalised by NIWA (Andrew Swales) for Environment Waikato on mangrove habitat expansion and sedimentation in the southern Firth of Thames. There has also been some research on factors driving mangrove expansion (Morrisey et al 2007). • Ornithological records indicate that many chenier ridges formerly used as bird roosts have been abandoned as mangroves spread around these sites. • Spray trials conducted in local canals indicate that spraying may not be an effective control method for mangroves. • NIWA has investigated the significance of mangroves as fish habitat in various northern New Zealand harbours, though not yet in the southern Firth of Thames. • Mangroves provide significant sheltering from wave effects, enhancing protection of the Hauraki Plains from coastal inundation. • Environment Waikato is monitoring mangrove expansion through estuarine vegetation surveys every five years. • Battley and Brownell (2007) report on changes in wader foraging and roosting habitat particularly related to mangrove expansion. 	<ul style="list-style-type: none"> i. Research into the potential for sediment deposits in the upper firth to drive further significant mangrove expansion and habitat change in the southern firth. ii. Investigate direct and indirect impacts of mangrove expansion on the availability of feeding habitat for shorebirds. iii. Research into the significance of mangrove ecosystems as habitat in the southern Firth of Thames. iv. Mapping and monitoring of wader roosting sites and use by key species to identify actions required to avoid any further loss or degradation of roosting habitat (for example, mangrove expansion, invasive species, predation and human disturbance). v. Assess the costs/benefits of small-scale mangrove removal around important roosting and feeding habitat. vi. Investigate criteria and methods for mangrove control where appropriate.

<p>Policy</p> <p>There are a range of general policies relevant to this issue, with existing policy protecting mangroves and requiring resource consents for any control activities.</p>	<p>Gaps</p> <p>No significant policy gaps identified.</p>
<p>Implementation – consents and compliance monitoring</p> <p>There are presently no significant mangrove control activities in the southern Firth of Thames apart from limited clearance associated with drainage activities.</p>	<p>Gaps</p> <p>No gaps identified.</p>
<p>Implementation – education</p> <p>Environment Waikato and Auckland Regional Council have produced fact sheets and booklets addressing the issue of mangrove expansion, and Morrissey et al (2007) have compiled a comprehensive review of existing knowledge and issues. However, the importance of the underlying drivers of mangrove expansion is not yet widely appreciated within the community.</p>	<p>Gaps</p> <p>i. The cause(s) of mangrove expansion and appropriate management action should be emphasised in any education programme developed for the area.</p>
<p>Implementation – work projects and programmes</p> <p>The underlying drivers of mangrove expansion are presently being addressed by a variety of catchment management activities focused on reduction of sediment and nutrient run-off (for example, Environment Waikato's Clean Streams programme and environmental farm plans).</p>	<p>Gaps</p> <p>i. Address the anthropomorphic causes of mangrove expansion where practical</p> <p>See discussion of gaps in chapters on sediments and contaminants/nutrients.</p>

3.2 Invasive species

Invasive exotic species are resulting in a loss of feeding and roosting habitat through direct exclusion and increased risk from predators, as well as impacting on biodiversity. Exotic plants pose the main threat in foreshore and intertidal areas, including spartina and saltwater paspalum (*Paspalum vaginatum*), a variety of weed species that affect roosting areas, and the dominance of *Carex divisa* and tall fescue in supra-tidal riparian margins surrounding estuarine wetlands. Native species that are particularly threatened by invasive species include Maori musk (*Mimulus repens*) and the mistletoe *Ileostylis micranthus*. Existing threats from exotic fauna include the Asian date mussel and invasives such as the sea squirts *Styela* and *Didemnum* which can affect both intertidal and subtidal habitats. There is also potential for various other serious invasive pests to be introduced to intertidal and subtidal environments via ballast water and attachment to boat hulls or aquaculture/fishing equipment. The risk analysis suggests the threat of invasive exotic species could be exacerbated by climate change. See also Section 3.3 for predation and grazing influences.

<p>Current information and monitoring activities</p> <ul style="list-style-type: none"> • Mapping of the distribution of spartina, saltwater paspalum and <i>Carex divisa</i> and discussion of the threats posed by these species. • Intertidal benthic communities (including <i>Musculista</i>, the Asian date mussel) in the southern Firth of Thames are monitored by Environment Waikato's Regional Estuary Monitoring Programme. • DOC monitors spartina, but has limited 	<p>Gaps</p> <ol style="list-style-type: none"> i. Identify appropriate control methods for weeds affecting roosting sites. ii. Investigation of factors inhibiting re-establishment of native plant communities in areas dominated by exotic invasive species such as tall fescue. iii. Assessment of the extent and effect of Asian date mussels on the benthic ecology of the Ramsar site to assess whether or not control is required.
--	---

resources for widespread monitoring of other species. Central government agencies monitor biotoxin producing dinoflagellates due to their cyclic and potentially harmful effects, and also undertakes further monitoring of particular species as needs arise.

- Various other invasive species are also being monitored (by Biosecurity NZ, NZ Marine Farming Association and DOC) and/or studied (by university and polytech students), including parasitic mussel mudworm (*Polydora*) and the seaweed *Undaria*. Some relatively common species like the hydroid *Amphisbetia* are also being treated as invasive species due to their opportunistic proliferation on marine farming structures.

Policy

There are a range of general policies relevant to this issue, with the following identified as key policies.

- *Spartina* and saltwater paspalum have been identified as key threats and are both included in the Waikato Regional Pest Management Strategy (RPMS). *Carex divisa* is currently not listed.
- There is currently no regional policy on marine biosecurity. Environment Waikato believes this is an issue that requires national focus and should be addressed by Biosecurity NZ.
- The Waikato Regional Coastal Plan provides for the removal of exotic plant species as a controlled activity where these are spreading or threatening habitat, and prohibits the introduction of exotic species to the Ramsar site.

Implementation – consents and compliance monitoring

DOC has a resource consent to control spartina in the Firth of Thames, including requirements for appropriate monitoring. This consent is currently being renewed to include newly identified spartina infestations. A recent survey found only small pioneer populations of saltwater paspalum in the firth. Saltwater paspalum can be controlled with the same herbicide as spartina (Gallant) and could be included within the spartina consent.

Marine farming is a likely vector for *Undaria* and *Styela*, and may also facilitate the proliferation of tubeworms, mudworms, hydroids, nesting mussels, sea squirts and other undesirable marine invertebrates

Implementation – education

- The RPMS provides information about spartina and saltwater paspalum and contracted Environment Waikato pest control officers

- iv. Risk assessment for known and potential invasive species to assess threat and allow for early intervention where required.
- v. Identify factors affecting threatened plant species, set management/conservation targets relevant to plant species currently under threat and investigate possible control methods for weeds inhibiting re-establishment of native plant communities.

See also 3.1(iv).

Gaps

- i. Consider adding *Carex divisa* to the RPMS if supported by further research.
- ii. Clarification of agency responsibilities for the management of marine biosecurity.

Gaps

- i. Consider inclusion of saltwater paspalum within the Firth of Thames spartina control consent.

See also 3.2(iv).

- i. Implement monitoring of the transfer of marine farming gear between distinctive water bodies, and the transfer of spat and “weed” from distant locations for re-seeding of mussel culture lines.
- ii. Inclusion of consent conditions to address the issue of biosecurity for marine farming consents in the firth.

Gaps

- i. Educate local land owners, communities and visitors in respect of locally significant invasive species.

<p>provide an information service for the public.</p> <ul style="list-style-type: none"> MinFish has distributed fact sheets to marine farmers on <i>Styela</i>, mudworm and <i>Undaria</i> (including a general sheet on the dangers of transferring boats and fishing gear from one water body to another). 	
<p>Implementation – work projects and programmes</p> <ul style="list-style-type: none"> DOC plan to undertake an eradication programme for spartina in the Firth of Thames in 2008. Grazing is presently being utilised to control <i>Carex divisa</i>. Dredging is periodically carried out in the main drainage channels to keep them free of mangroves, oyster beds and debris. There is a NZ Marine Farming Association led eradication and management programme for the sea squirt <i>Didemnum</i>. The adequacy of this and other programmes addressing invasive species needs to be assessed during the proposed invasive species risk assessment (see 3.2(iv) above). 	<p>Gaps</p> <ul style="list-style-type: none"> Restore back-swamp habitats (with special focus on threatened species) including control of <i>Carex divisa</i> and tall fescue, and reintroduce native species where the seed bank has been diminished. Control weeds affecting significant roosting sites.

3.3 Predation and browsing

Predation and disturbance from a variety of animal species is impacting on roosting and potential nesting habitat. Critical predators include cats, mustelids, rats, and hedgehogs. Unfenced cattle can also disturb birds and nesting areas (for example, black-billed gull nests between Hot Springs Drain and Karito Canal). Minimal disturbance and low predation rates are critical for successful breeding. In some areas (for example, Waihou River mouth), the movement of sand bars/shellbanks closer to shore, together with mangrove expansion, enhances predator access to roosting and breeding sites. Browsing by animal pests (for example, rabbits, rats) and unfenced stock can impact plant communities through physical disturbance, loss of seeds, and spread of invasive plants.

<p>Information and monitoring activities</p> <p>Predation of shorebirds has been documented in various studies, and stock disturbance has also been noted. Feral cats are commonly observed in the coastal zone of the Ramsar site, especially between Miranda and Kaiaua, and around the Waihou River mouth.</p>	<p>Gaps</p> <ul style="list-style-type: none"> Comprehensive predator monitoring to identify key pests/predation intensity and required management action. <p>See also 3.1(iv).</p>
<p>Policy</p> <p>The current Environment Waikato RPMS includes policy on cats, mustelids and rats, but not hedgehogs. All these species are however included in the proposed 2007-2012 RPMS.</p>	<p>Gaps</p> <p>No gaps identified.</p>
<p>Implementation – consents and compliance monitoring</p> <p>Not applicable.</p>	
<p>Implementation – education</p> <ul style="list-style-type: none"> The Miranda Shorebird Centre displays information about predators. The RPMS contains information on key pest 	<p>Gaps</p> <ul style="list-style-type: none"> Widely disseminate information on key predators and control methods to the community (for example, via display

species.	boards at popular visitor sites).
<ul style="list-style-type: none"> • DOC and Landcare Research have produced various fact sheets, videos and posters on predators. • The Environment Waikato animal pest contractor visits schools and talks about the threat of predation to local wildlife. 	
Implementation – work projects and programmes	Gaps
There are no existing predator control programmes.	<ul style="list-style-type: none"> i. Design and implement a weed and predator control programme for key bird use sites emphasising local community and land owner involvement.

3.4 Human recreation and disturbance

Increasing recreational use is impacting important roosting areas along the margin of the chenier coast from Miranda to Kaiua and, to a lesser extent, intertidal feeding sites. Pressures include campervans and pedestrian activity and associated animals (for example, dogs and cats). There is also increasing aircraft activity over the Ramsar site causing direct disturbance to birds (though some informal controls have been introduced).

Information and monitoring activities	Gaps
<ul style="list-style-type: none"> • Recent reports comment on the increasing impact of recreational use on birds along the edge of the chenier plain. • Meetings and discussions during this study have highlighted the need for improved access management in the vicinity of key roosting and bird use areas. 	<ul style="list-style-type: none"> i. Identification of areas where management of human access and recreation is required to protect significant bird use areas. ii. Investigate opportunities for roost creation in undisturbed areas (for example, offshore chenier creation, open patches in mangrove forests).
	See also 3.1(iv).
Policy	Gaps
There is a mix of land ownership around the margins of the Ramsar site, and access to private land is restricted. Policies exist for control of access and use on public land, though these generally do not address disturbance of key bird use areas. FDC has recently adopted a Public Places Bylaw that prohibits camping in any public place not set aside for that purpose, which includes the Taramaire Reserve.	<ul style="list-style-type: none"> i. Review existing public access and camping policy for public land around the southern Firth of Thames to address issues of bird disturbance. ii. Investigate the need and feasibility of a 'no fly' designation zone over vulnerable bird areas in consultation with aviation groups. iii. Review dog bylaws to ensure high bird use areas are protected from disturbance.
Implementation – consents and compliance monitoring	Gaps
No resource consent is required for public access to public land (including commercial operators), though there are restrictions on camping.	<ul style="list-style-type: none"> i. Enforcement of the FDC Public Places Bylaw in important bird roost areas.
Implementation – education	Gaps
The Miranda Shore Bird Centre provides information on public access and has placed some signs (with assistance from DOC) to guide walkers and minimise disturbance.	<ul style="list-style-type: none"> i. Educate people about why access restrictions are needed to protect the birds and how to minimise disturbance impacts (for example, stay on tracks and within bird hides).

<p>Implementation – work projects and programmes</p> <ul style="list-style-type: none"> • TCDC is managing restoration and public access through the former Burke St landfill to enhance bird roosting opportunities. • The Thames Reserve Management Plan includes a concept plan for Kuranui Bay. Bollards and walkway design encourage vehicles and pedestrians (and dogs) to stay away from the area used by shorebirds. 	<p>Gaps</p> <ol style="list-style-type: none"> i. Develop and implement an access management plan to minimise or remove disturbance to current and potential shorebird roosting and breeding sites. ii. Investigate a potential walking/cycling track along the firth stopbanks to link Thames with the Seabird Coast.
---	---

3.5 Climate change

Potential climate change effects include projected sea level rise and a possible increase in storminess. There is a high level of uncertainty associated with these effects but there is potential for significant impacts on species composition and habitat.

<p>Information and monitoring activities</p> <ul style="list-style-type: none"> • The Intergovernmental Panel on Climate Change (IPCC) reviews existing information and updates climate change projections every five years. The most recent update occurred in 2007. • NIWA and MfE provide guidance notes for NZ. • Various work has highlighted the implications of projected sea level rise for the Miranda chenier plain and other low lying areas surrounding the Ramsar site (for example, Dahm and Munro, 2002). • Work has commenced identifying the implication of projected sea level rise for estuaries of the Waikato region (for example, Graeme and Dahm, 2006; Swales et al., 2007). • HDC is addressing climate change issues (late 2007) in its District Plan review process 	<p>Gaps</p> <ol style="list-style-type: none"> i. Investigate the potential impact of projected sea level rise on the Ramsar site and values, and identify appropriate management action, for example, land retirement, wetland restoration, land purchase.
<p>Policy</p> <ul style="list-style-type: none"> • The RMA has been recently amended to require management agencies to have regard to climate change. However at this stage most existing regional and district policy documents have only limited policy in regard to climate change. • The proposed FDC Rural Plan Change addresses projected sea level rise in respect to flooding hazard on the Miranda chenier plain. 	<p>Gaps</p> <ol style="list-style-type: none"> i. Relevant policy is required in most regional and district plans to address climate change effects, including the use and development of low lying land around the Ramsar site.
<p>Implementation – consents and compliance monitoring</p> <p>At present there is only limited control on the use and development of low lying land surrounding the Ramsar site, although the proposed FDC Rural Plan Change and existing TCDC building permit controls do address this issue. District growth strategies generally restrict any</p>	<p>Gaps</p> <ol style="list-style-type: none"> i. Review rules in respect to climate change for low-lying coastal land and develop appropriate plan provisions based on sound technical information.

development in the coastal zone (except for Thames and Kopu). However, there are still many loopholes, such as transferable rights for coastal zone subdivision based on “conservation block” covenants, though FDC’s Rural Plan Change precludes the use of transferable rural lot rights to create new titles in special character areas (including land adjacent to the Ramsar site). There is considerable pressure for subdivision and development on low-lying coastal land.

Implementation – education

MfE is currently preparing updated guidance notes for the management of climate change effects in coastal areas.

Gaps

- i. Prepare and disseminate information on potential local effects of climate change to inform the community as to why it is necessary to restrict development in some areas (for example, floodplains and low-lying areas potentially affected by rising sea levels).

Implementation – work projects and programmes

Stopbank design for both the Piako and Kauaeranga catchments adopt MfE guidelines of 0.5m rise in mean sea level by 2100. The stopbanks of the Waihou scheme are designed to a 200-year standard, sufficient to cover projected sea level rise to 2100.

Gaps

- i. Consider the implications of climate change projections for the area between the Waitakaruru River and Pukorokoro (Miranda) Stream.

3.6 Drainage, infilling and associated land uses

Drainage, stopbanking, infilling and associated land uses (for example, grazing and excavation) can result in both loss and degradation of intertidal and coastal habitat. Canal and stop bank management has in the past often been sporadic, and policies and approaches have sometimes been inconsistent. Stopbanks and drainage networks are being expanded without prior regard to sustainability, particularly with projected sea level rise and for very low lying areas. In addition, the geologically significant chenier shell ridges within the wider environs of the Ramsar site are being progressively modified by earthworks and shell extraction.

Information and monitoring activities

- Environment Waikato regularly monitors the height and condition of stopbanks, sedimentation in drains and around floodgates, and stock activity around infrastructure.
- Environment Waikato has recently investigated and identified restoration opportunities within the area covered by the Waihou River Catchment Works and Services Programme.
- Vegetation mapping for Environment Waikato includes comments on opportunities for improved management of stock access and drainage maintenance.
- Observations by HDC staff during maintenance of drains and flood gates suggests that in the past few years sediments in the rivers may be moving further upstream, with sediments primarily appearing to come

Gaps

- i. Analysis of the sustainability of the existing drainage network for very low-lying areas. For example, what are the potential impacts of climate change on the sustainability of the network?
- ii. Identify restoration opportunities in other lower catchments of the southern firth.

from the firth on an incoming tide.

Policy

Maintenance of existing drainage outlets and stopbanks for designated schemes is a permitted activity, while other maintenance within the CMA is a controlled activity under Environment Waikato's Regional Coastal Plan. Reclamations and other drainage activities are either restricted, discretionary or prohibited under Environment Waikato's Regional Coastal Plan.

The importance of the Miranda chenier plain is recognised in the Franklin District Council Rural Plan Change, with a variety of measures intended to better protect these features.

Implementation – consents and compliance monitoring

There are a wide range of drainage, excavation and stop-banking activities undertaken around the Ramsar site. In the past, unnecessary habitat damage has been noted due to some maintenance activity not being undertaken with sufficient care and forethought. Environment Waikato is now aiming to incorporate ecological objectives within their drainage and flood protection schemes to better reflect the full range of values in this area.

Implementation – education

Environment Waikato and Auckland Regional Council have produced guidelines for a wide variety of land disturbance activities, for example, earthworks, tracking and crossings.

Implementation – work projects and programmes

- Environment Waikato's River and Catchment Services group are developing protocols for improving management of disturbance, for example, grazing of stopbanks, particularly in the Waihou and Piako systems. The joint Environment Waikato and Waihou River Catchment Works and Services Programme is also adopting a more holistic approach to work design incorporating ecological functions.
- Environment Waikato's Clean Streams programme provides funding to assist landowners to fence and plant margins of waterways. MPDC has a similar scheme that assists farmers with fencing, pest and weed control in and around significant ecological sites.
- MPDC also has an active programme of on-site consultation and awareness raising with farmers and a 2007 Kaitiaki Zone Review to improve waterway protection along the

Gaps

- i. Review permitted and controlled activities to assess whether improved conditions are required to further limit habitat disturbance.

Gaps

- i. See gaps iii, vii and viii.

Gaps

- i. Improve communication of new integrated policy, standard practises and associated information to field operators where adverse effects are still occurring.
- ii. Improve education and guidelines for the surrounding community in respect to land use and disturbance around the Ramsar site.

Gaps

- i. Identify opportunities within the Piako River Catchment Works and Services Programme to incorporate ecological functions in work design, using the Waihou scheme as a blueprint.
- ii. Identify opportunities to work with the Environment Waikato River and Catchment Services group and form relevant partnerships to undertake ecological restoration (including community partnerships).
- iii. Other district councils could consider opportunities for supporting land owners to better protect waterways similar to the recent MPDC initiatives.

Waihou, Piako and Waitoa.

- MPDC is developing special concept plans focusing on ecological/conservation concerns for industrial and agricultural development.

3.7 Fishing/aquaculture

The firth is a highly productive feeding area and significant nursery area for various fish species. It also supports an expanding aquaculture industry. Harvesting and exploitation can result in the loss of key species through over-fishing and impact on habitat. For instance, there was extensive loss of subtidal mussel beds within the firth associated with historic mussel dredging. Historically there has been little cooperation between MFish responsible for fish stocks and regional councils and DOC responsible for marine habitat. Due to the firth's rich marine resources and its proximity to dense population centres, fishing pressure is continually increasing. However, there are not yet any marine protected areas within the Firth of Thames nor a clear assessment of whether any such measures are required. DOC has identified the upper Firth of Thames as one of 14 areas of significant conservation value within the coastal marine environment of the Waikato conservancy.

Information and monitoring activities	Gaps
<ul style="list-style-type: none">• Commercial landings of snapper, kahawai, flatfishes and gurnard are monitored by MFish and have remained fairly stable in recent years.• Recreational harvest is monitored by specific and targeted surveys including boat ramp and aerial surveys.• Monitoring of shellfish stocks is done by Environment Waikato as part of the Regional Estuary Monitoring Programme.• NIWA and others have conducted various investigations in the firth, including using side scan sonar on the sea floor and a survey of fish and invertebrate habitats.• There is a variety of historic information on fish presence and habitat features which can enable changes to be quantified, for example, accounts of extensive subtidal mussel beds.• A wide variety of investigations have studied and modelled circulation, nutrient balances, biological productivity and effects of marine farming.• Environment Waikato is investigating opportunities to enhance spawning habitat in local waterways, for example, for inanga and eels.• MFish (Research Data Management group) are now producing fisheries assessment reports that target specific information needs by locality, species and catch methods. There are also annual plenary reports on status of fisheries.• DOC is undertaking a study to assess the need for marine protected areas within the Hauraki Gulf.	No gaps identified.
Policy	Gaps

<ul style="list-style-type: none"> • The Quota Management System (QMS) manages fishing pressure and resource allocation to customary, recreational and commercial users. • There is a total prohibition on trawling and Danish seining in the Firth of Thames with other controls including total allowable catches (TACs) by area and species, and individual quota limits. • Fisheries plans are a recent management initiative of the Ministry of Fisheries. There are five plans that address the Firth of Thames: the Coromandel Scallops Plan, the North-Eastern Fin Fish Plan, the North-Eastern Shellfish Plan, the North Island Eel Plan and the Freshwater Fisheries Plan. MFish intends to develop plans to manage multiple species (and potentially ecosystems like the firth). • Recreational controls are based on bag limits, minimum legal sizes (by species), and for some species, open seasons. • A new MFish policy aims to significantly increase the number of full time salaried fishery officers to help curb the incidence of illegal recreational catches. • Environment Waikato and DOC are responsible for protecting the coastal environment and threatened species and habitats from inappropriate use. • Environment Waikato are currently considering the need for a review of the Regional Coastal Plan to provide for diversification of marine farming within the Firth of Thames. 	<ul style="list-style-type: none"> i. Any change to the Regional Coastal Plan to provide for diversification of marine farming should critically review associated biosecurity issues in the firth.
<p>Implementation – consents and compliance monitoring</p>	<p>Gaps</p>
<ul style="list-style-type: none"> • Fishery officers monitor and police fish catches. • Within the inner firth, there is one regular commercial eel fisher and about 10 commercial flounder fishers (plus a few snapper and rig fishers whose main fishing activity is north of the Ramsar site and environs) operating under MFish’s annual catch entitlement (ACE). • Extensive areas of mussel farms have been established, and environmental monitoring is carried out to satisfy consent conditions. All new aquaculture development is currently occurring at Wilson Bay. • Trigger points (setting limits of acceptable environmental change as a result of marine farming) have been developed by Environment Waikato together with NIWA and the marine farming industry. These are currently being used by Environment Waikato for managing aquaculture, and there are plans to develop them further. 	<p>No gaps identified.</p>
<p>Implementation – education</p> <p>MFish publishes catch limits and species</p>	<p>Gaps</p> <p>No gaps identified.</p>

information, provides signage at boat launching/shellfish gathering sites, and communicates directly with the public.

Implementation – work projects and programmes

- MFish is currently working on establishing an Auckland-Waikato Regional Fisheries Forum for the purpose of guiding and coordinating the efforts of iwi and hapu to establish management plans, consent criteria, permitting mechanisms and enforcement procedures for customary fishing activities and management.
- A Marine Protected Areas Policy and Implementation Plan is being developed by DOC and MFish as part of the NZ Biodiversity Strategy (and a cornerstone of the evolving revision of the NZ Coastal Policy Statement).

Gaps

No gaps identified.

4 Sedimentation

The risk analysis identified significant stressors and risks associated with accumulation of terrestrial sediment, particularly muds, in the southern Firth of Thames. Historically the Ramsar area was dominated by sandy intertidal environments and beaches which have now been extensively displaced by muddy environments. The greatest risk posed is to the tidal flats of the Ramsar site with lesser, but relatively important risks for the water column, the sub-tidal seabed, and stilt ponds.

Sediments smother the intertidal flats that wading birds are foraging on, and are a key driver of the recent expansion of mangroves, which reduces feeding and roosting habitat for many birds. Subtidal flats are also affected. Sedimentation can cause increased turbidity and reduction of light which in turn affects growth rates of phytoplankton and seabed algal communities. Deposition of mud may have short and long-term impacts by changing the structure of benthic communities (for example, from communities dominated by bivalve molluscs to communities dominated by polychaete worms). Increased concentrations of suspended sediments also influence nutrient and oxygen availability, and thereby negatively impact on filter-feeding bivalves such as horse mussels, pipi, scallops and cockles. Many nutrients and contaminants are also thought to be delivered and retained through attachment to sediments.

The sedimentation changes are thought to be associated with changes in the sediment budget of the southern firth arising from the following.

- Enhanced sediment input from terrestrial environments, particularly associated with historic land clearance activities. Current sediment supply rates from land are thought to be relatively low. However because of the large catchment area the total sediment input is still high and there are concerns associated with intensification of land use.
- Loss of wetland and other environments that once acted as sinks for large sediment volumes. For instance the drainage and development of the Hauraki Plains, and the construction of stopbanks all along the coast from the Waihou River mouth to the Miranda Stream resulted in the loss of over 32,000 ha of flood plain.
- Trapping and retention of mud from the existing sediment reservoir in the southern Firth by mangrove expansion.

These large-scale effects and changes demonstrate the potential for terrestrial inputs to significantly alter the coastal environment. The role of the existing sediment reservoir indicates that even if sediment run-off from land is reduced, trends of increasing sedimentation could continue for a while. Land use is being intensified in the catchment of the Firth of Thames, including potential conversion of large areas of pine forests to pasture (mainly along the southern margins of the catchment). The potential impact on sediment run-off is not yet known.

The highest loads of sediments, contaminants and nutrients are often associated with seasonal or periodic flood events. The frequency of these flood events may change with global climate change effects, increasing the risks.

Information and monitoring activities	Gaps
<ul style="list-style-type: none">• Intertidal sediments in the Firth of Thames are monitored in Environment Waikato's Regional Estuary Monitoring Programme, including sediment characteristics and accretion rates through buried plate measurements.• Recent NIWA research suggests that the	<ol style="list-style-type: none">i. A sediment audit of high risk catchment areas.ii. Investigate the potential for wetland restoration to create sediment sinks for land run-off and existing firth sediments.

majority of the sediments impacting on the Ramsar site are older sediments that entered the Firth of Thames when the initial clear felling of the Coromandel, Kaimai and Hunua Ranges occurred and the Hauraki Plains were drained.

- Studies have shown that marine farming can contribute to sedimentation through slowing down current speeds and hence enhancing the settling out of fine sediments, though effects are likely to be very localised.
- Various studies by NIWA, Environment Waikato and others have highlighted increased sedimentation rates in the southern Firth subsequent to European settlement.

Policy

Existing policy aims to minimise accelerated erosion and sediment supply to waterways.

- iii. Identify the key bird feeding areas, including their substrate characteristics and invertebrate species composition.

Gaps

- i. Provide policy to promote the restoration of wetlands as sediment sinks around the Firth of Thames.

Implementation – consents and compliance monitoring

Environment Waikato monitor a wide range of land use activities to minimise sediment run-off.

Gaps

No gaps identified.

Implementation – education

Environment Waikato and district councils provide a wide range of information on soil conservation and management of land uses to minimise sediment run-off.

Gaps

No gaps identified.

Implementation – work projects and programmes

- The Environment Waikato Sustainable Agriculture Strategy includes the integrated catchment management project, Clean Streams, environmental education, and various other activities that have a sediment focus. At present the focus is on Priority 1 sub-catchments and assessing whether sediment loadings will decrease if there is greater compliance with the rules.
- The Waihou Valley Scheme and the Peninsula Project promote soil conservation in collaboration with farmers.
- The Clean Streams Accord (Fonterra, regional councils, the Ministry for the Environment and MAF) aims to reduce the impacts of dairy farming on New Zealand waterways, including sediment run-off.
- Drain maintenance on the Hauraki Plains involves mechanical clearance of trapped sediments at least once every 10 years, although a number are cleaned every two to four years. Most of the sediment build up appears to be derived from existing deposits in the firth transported upstream on the incoming tides.

Gaps

See discussion under the habitat and contaminants chapters.

5 Contaminants

The risk analysis identified risks from contaminants in the southern firth associated with nutrients and other contaminants (including heavy metals, agricultural and industrial chemicals, bacteria and viruses).

These contaminants are generally derived from off-site catchment sources and reflect indirect effects of land use on the Ramsar site. The risk analysis found that agriculture was the largest source of contaminants to the Ramsar site, reflecting both the area, extent and intensity of agricultural land use in the catchment. The highest loads of sediments and contaminants are often associated with seasonal or periodic flood events. The frequency of these flood events may change with global climate change effects.

The following sections summarise the findings of the gap analysis in relation to the key stressors.

5.1 Nutrients

Elevated nutrient run-off (particularly nitrogen and phosphorus from effluent and fertilisers) can cause eutrophication of water bodies. This can lead to changes in pH, plant growth (including phytoplankton blooms and macroalgae), oxygen depletion, and increased turbidity associated with phytoplankton blooms.

Investigations and modeling show that rivers are a significant and often dominant source of nutrients for the Firth of Thames, although upwelling can also supply nutrient-rich water to the firth dependent on offshore conditions. Preliminary modelling suggests that a significant increase in long-term nutrient loading from the firth catchments (for example, in response to more intensive land use) could alter firth nutrient dynamics, including short-term increases in phytoplankton levels (for example, algal blooms).

There are also strong links with the sediment issue. Nutrient loads are often associated with sediment run-off and the effects of the nutrients can be complicated by their interaction with the high levels of suspended sediment within the firth. Suspended sediments can act to limit primary production and therefore nutrient uptake by phytoplankton and benthic algae. Nutrients may also be contributing to the trend for mangrove expansion observed over the past few decades.

Urban sewage has not been detected as a problem in the firth although there is potential for operational breakdowns and leachate from landfill sites to lead to serious water contamination.

There is concern that existing policy is not adequate to enable regulators to consider potential cumulative effects (for example, enhanced nutrient run-off) when processing consent applications.

Current information and monitoring activities	Gaps
<ul style="list-style-type: none">• Environment Waikato and NIWA have conducted various investigations and modelling, examining the magnitude of nutrient input from natural marine (for example, upwelling and plant detritus) and catchment sources. The work has also considered the implications of mussel farming for nutrient dynamics and concentrations of phytoplankton and aquatic vascular plants.• Environment Waikato has monitored water nutrient levels in the shallow subtidal firth with the results due soon.	<ol style="list-style-type: none">i. Ongoing investigation and modelling of nutrient dynamics within the Firth of Thames to determine the sustainable upper limit of nutrient input without adverse impacts (for example, algal blooms).ii. Further development of on-site mitigation techniques for the management of intensive land use (for example, reconstructed wetlands and riparian margins) and aquaculture to reduce nutrient

- Environment Waikato routinely monitors sediment nutrient levels at five intertidal sites in the Firth of Thames.

inputs.

Policy

- The Environment Waikato Regional Plan emphasises strict management of dairy shed waste, with non-regulatory approaches for the management of other nutrient and sediment runoff from agriculture. This approach will be assessed over the next few years to determine whether further rules are required.
- Environment Waikato has prioritised water bodies, and stock access to Priority 1 water bodies (for example, upper Waihou catchment, the coastal marine area and 2 km upstream of mean high water springs / high tide mark) is no longer a permitted activity.
- Environment Waikato controls industrial and municipal discharges to avoid adverse effects on water bodies.
- The New Zealand Fertiliser Manufacturers' Research Association has a code of practice for fertiliser use aimed at minimising fertiliser run-off.
- MPDC have established a Kaitiaki Zone to better protect a strip normally 20 metres wide on both sides of each of the district's three main rivers (Waihou, Piako and Waitoa, all of which drain into the Firth of Thames).

Gaps

- i. Develop and implement a local area management (LAM) strategy for catchments draining to the southern Firth of Thames, including consideration of policy changes required to better manage cumulative off-site effects of increasingly intensive land use.

Implementation – consents and compliance monitoring

- Environment Waikato recently commenced monitoring of permitted activities to document the level of compliance with permitted activity rules (for example, dairy shed discharges and on site sewage systems).
- Environment Waikato undertakes annual inspections of dairy shed discharges and associated treatment ponds, including helicopter monitoring, and faecal contamination monitoring.
- Comprehensive self-monitoring systems are in place with respect to municipal sewage plants and processing plants throughout the catchment, with periodic checks and audits carried out by Environment Waikato and the district responsible.

Gaps

- i. Ensure the use of best practice for stormwater and wastewater management.
- ii. Monitoring of cumulative effects of discharges.

Implementation – education

Environment Waikato and ARC have a variety of fact sheets and brochures about riparian management and best practices for farm, industry and urban nutrient and wastewater management.

Gaps

No gaps identified.

Implementation – work projects and programmes

- The Environment Waikato Sustainable Agriculture Strategy includes the integrated catchment management project, Clean

Gaps

No gaps identified.

Streams, environmental education, permitted activity monitoring, and various other activities focused on nutrient and contaminant run-off.

- The Clean Streams Accord is an agreement between Fonterra, regional councils, MfE and MAF which aims to reduce the impacts of dairy farming on waterways.
- The Dairy Industry Strategy for Environmental Management lists nutrient losses of nitrogen and phosphorus to water and microbial contamination of surface water as key priorities to address.
- Environment Waikato assists farms with undertaking nutrient budgets.
- Environment Waikato's catchment works and services programmes (particularly the Waihou) are adopting a more holistic approach to works design, incorporating ecological functions (for example, filtration of land run-off as well as bank stabilisation).

5.2 Other contaminants

Other potential contaminants include heavy metals, pesticides and other agricultural chemicals, bacteria and viruses.

A recent study in the inner Firth of Thames found that sediments are enriched in mercury, lead, cadmium, copper, zinc and arsenic. Arsenic and mercury were found to be present in the upper firth at concentrations oscillating around the Australian and New Zealand Environmental Conservation Council (ANZECC) low interim guideline values, indicating a level of risk to aquatic organisms from these metals.

Contaminant loads are highly linked with sediment transport, as many contaminants adhere to fine sediments. Elevated concentrations of arsenic and copper are believed to be attributable to catchment geology rather than historic mining activities. Elevated levels of mercury in the upper firth are not well understood but may be related to drainage of wetlands in the Piako River catchment. Historically, mining activities are likely to have contributed additional zinc, cadmium and lead to the firth. Currently, agricultural activity is likely to be a significant ongoing source of zinc and cadmium. Zinc is associated with facial eczema remedies, and cadmium is an impurity in superphosphate fertiliser.

In terms of agricultural chemicals, DDT still exists at elevated levels in some pastures and sediments (33%-40% of Waikato farms). Other residual agricultural chemicals potentially of concern include Dieldrin (potentially present in 7000 unused sheep dip sites remaining in the region), Paraquat and Diquat which have long half-lives, but which are highly bound up in soils and sediments. Control of sediment run-off can limit contamination of water bodies. Recent sampling by Environment Waikato indicated that total DDT levels was approximately four times the ANZECC low level guideline in the Firth of Thames. Other contaminants from various point sources (for example, domestic and industrial) were below ANZECC low guidelines. The potential for problems related to these various contaminants is very low, though DDT levels are in the range where some adverse effects may occur. DDT usage has been banned since 1970, so dilution over time is likely.

Bacterial contamination from untreated human and animal wastes can contaminate water and kaimoana. There is no direct domestic or industrial discharge from the catchment to Firth of Thames water, except for the Thames wastewater treatment plant. Nutrients from wastewater treatment plants (other than Thames) and dairy farm

pond effluents discharged to rivers and waterways are unlikely to reach the Ramsar site. Environment Waikato bathing beach surveys have frequently noted faecal contamination at beaches north of Thames, with 10% of the lower Firth samples 'unsatisfactory' due to high bacterial levels.

<p>Current information and monitoring activities</p> <ol style="list-style-type: none"> 1. Environment Waikato monitors coastal water quality at bathing beaches during summer. 2. Environment Waikato has conducted a preliminary assessment of pesticides, other organic compounds and trace elements at five sites in the southern Firth of Thames (Kaiarau, Miranda, Thames, Kuranui Bay and Te Puru). 3. A national cadmium working group convened by MAF is assessing cadmium accumulation associated with agriculture, including risks to human health, export trade, and land use flexibility. 4. A preliminary list of potential contaminated sites has been compiled by Environment Waikato and these sites are progressively being tested to assess their status. 	<p>Gaps</p> <ol style="list-style-type: none"> i. Research into sources of mercury to the firth. ii. Identification of any significant risks associated with elevated levels of mercury in the firth. iii. Further investigations of the high metal and other contaminant levels around the Moanatairi reclamation to determine any hazards to the firth ecosystem.
<p>Policy</p> <ul style="list-style-type: none"> • The Waikato Regional Plan encourages the maintenance of a contaminated site database and the rehabilitation of sites that could potentially contribute heavy metals and other contaminants. • The Waikato Regional Plan includes a range of policies and rules that encourage the development and implementation of good practice in respect of stormwater, livestock and other discharges that may contain contaminants. • The plan also has a range of policies and rules relating to discharges from treatment plants, on site sewage systems and stormwater. 	<p>Gaps</p> <p>No significant policy gaps identified.</p>
<p>Implementation – consents and compliance monitoring</p> <ul style="list-style-type: none"> • Environment Waikato monitors areas where livestock have access to water bodies to ensure performance standards are met and that livestock are excluded from identified Priority 1 water bodies. • Upgraded industrial processing plants and dairy farm ponds now minimise the risk of spills of untreated effluent. • Forward planning is occurring at district council level to upgrade municipal sewage treatment to provide adequate environmental protections while coping with fast-growing communities and large storm events. • Discharges from industrial sites that could contain elevated levels of heavy metals require resource consent and are subject to treatment and monitoring requirements. 	<p>Gaps</p> <p>No gaps identified.</p>

<p>Implementation – education</p> <ul style="list-style-type: none"> • Environment Waikato provides a variety of fact sheets and guidelines for discharges from urban and agricultural land uses. • Environment Waikato and ARC provide information on the safe practice for transport, use and disposal of hazardous substances. 	<p>Gaps</p> <p>No gaps identified.</p>
<p>Implementation – work projects and programmes</p> <ul style="list-style-type: none"> • Sixty-two tonnes of hazardous agrichemicals were collected in the Waikato region between 1992 and 1994 and there are now hazardous waste collection depots in most parts of the Waikato region. • Work is in progress on various potential contaminated sites in the Waikato region. Once this work is further advanced, a database will be developed and maintained in partnership with district councils – to ensure that potentially contaminated land is not redeveloped without the risks being assessed and managed. • Environment Waikato has various hazard management systems in place to cope with accidental spills of petroleum products or agricultural chemicals. • See also the various activities listed under ‘Nutrients and sediments’. 	<p>Gaps</p> <p>See list under ‘Nutrients and sediments’.</p>

Recommendations

The objectives of the risk and gap analyses were to identify the main risks to the Firth of Thames Ramsar site and highlight any gaps in the existing work programmes. The various risks and gaps have been outlined in the preceding chapters.

It is clear from the gap analysis and preceding work that:

- the values of the Ramsar site have been modified through an ongoing trend of habitat loss and degradation
- inaction will result in ongoing degradation of this internationally important wetland.

It is also clear that there are a number of practical and achievable on-the-ground actions that can be undertaken in the short to medium term to reverse these degradation trends.

The gap analysis has also highlighted a paucity of information with regard to the various habitats in the southern Firth of Thames and a need for a more holistic ecosystem approach to management of this area – including baseline investigations to identify the current values and community characteristics, ongoing monitoring to detect any significant change and attention to cumulative effects. There is an overarching need to develop a general ecosystem understanding, including an ability to identify and address cumulative effects.

Identified gaps have been divided into two groups based on priorities and practicalities.

- High priority – to be undertaken within 1-5 years (ideally within the term of the current 2006-16 LTCCP). These are the practically achievable actions required in the immediate future to reverse habitat loss and degradation. They largely involve on the ground action in and around the Ramsar site.
- Medium priority – required in the longer term (beyond five years) to prevent significant habitat loss and degradation, and include addressing indirect effects from the wider catchment.

Priorities were assessed based on the practicality and achievability of the recommended actions, the timelines likely to be required and the effectiveness of the action in addressing key threats and reversing existing trends for degradation. Prioritisation of the actions was based on both expert judgment and discussions with representatives of the various management agencies and community groups.

The high priority actions have been further divided into three groups (Table 3).

- A **Restoration Action Project** to implement practical on the ground actions to enhance environmental values, inform and involve local communities and arrest degradation trends. This primarily addresses the habitat loss and degradation issues highlighted in this report that require immediate action by regional and district councils over the next 1-5 years.
- **Marine biosecurity** actions required to prevent incursions of serious invasive species, to be co-ordinated by central government (for example, Mfish and Biosecurity NZ)
- **Fundamental research** required to develop a general ecosystem understanding to identify important values and threats, and to address cumulative effects – to be undertaken by Crown research agencies and universities using central government funding. It is expected that Hauraki Gulf Forum agencies will actively advocate and encourage this research.

Table 4 details the key actions required in the Restoration Action Project.

Table 5 details the key actions required to address marine biosecurity and fundamental research requirements.

Medium priority actions are listed in Table 6. These include the sedimentation and contaminant issues highlighted in the report that generally require action in the wider catchment. It is probable that many of these actions can or will be addressed through existing work programmes, which are summarised in Appendix A.

Table 3: Recommendations for implementation of high priority actions/gaps.

Action		Key agencies	Support agencies/parties
Restoration Action Project	High priority actions to address habitat loss and degradation including mangrove management, bird habitat management, community education and partnership, and ecosystem protection and restoration.	EW/DoC/HGF	TCDC WDC HDC FDC Tangata whenua Miranda Naturalists' Trust Forest & Bird
Marine biosecurity and harvesting	Actions required to protect the biosecurity of the Ramsar site and wider firth.	Central government agencies (for example, Biosecurity NZ and MFish)	Marine Farming Industry, commercial and recreational fishing interests, DOC and other environmental interest groups
Fundamental research	Develop a general ecosystem understanding.	CRIs and universities	Environment Waikato ARC

Table 4: High priority gaps to be addressed through the Restoration Action Project. Numbering correlates with the relevant section of the main text.

Bird habitat management	<p>Identification of existing and potential habitat for key species</p> <p>3.1(iv) Mapping and monitoring of wader roosting sites and use by key species to identify action required to avoid any further loss or degradation of roosting habitat (for example, mangrove expansion, invasive species, predation and human disturbance).</p> <p>4(iii) Identify the key bird feeding areas, including their substrate characteristics and invertebrate species composition.</p>
	<p>Protection and enhancement of roosting and feeding sites</p> <p>3.2(i) Identify appropriate control methods for weeds affecting roosting sites.</p> <p>3.2(xiii) Control weeds affecting significant roosting sites.</p> <p>3.3(i) Comprehensive predator monitoring to identify key pests/predation intensity and required management action.</p> <p>3.3(iii) Design and implement a weed and predator control programme for key bird use sites emphasising local community and land owner involvement.</p>

	<p>Management of human use</p> <p>3.4(i) Identify areas where management of human access and recreation is required to protect significant bird use areas.</p> <p>3.4(viii) Develop and implement an access management plan to minimise or remove disturbance to current and potential shorebird roosting and breeding sites.</p> <p><i>See also: Community education and partnership</i></p> <p>Creating new roost sites</p> <p>3.4(ii) Investigate opportunities for roost creation in undisturbed areas (for example, offshore chenier creation, open patches in mangrove forest).</p>
Mangrove management	<p>Assess need for mangrove control and appropriate control techniques</p> <p>3.1(ii) Investigate direct and indirect impacts of mangrove expansion on the availability of feeding habitat for shorebirds.</p> <p>3.1(v) Assess the costs/benefits of small-scale mangrove removal around important roosting and feeding habitats.</p> <p>3.1(vi) Investigate criteria and methods for mangrove control where appropriate.</p> <p>Address causes of mangrove expansion</p> <p>3.1(viii) Address the anthropomorphic causes of mangrove expansion where practical.</p>
Other ecosystem protection and restoration	<p>Identification and implementation of opportunities</p> <p>3.2(v) Identify factors affecting threatened plant species, set management/conservation targets relevant to plant species currently under threat and investigate possible control methods for weeds inhibiting re-establishment of native plant communities.</p> <p>3.2(xii) Restore back-swamp habitats (with special focus on threatened species) including control of <i>Carex divisa</i> and tall fescue, and reintroduce native species where the seed bank has been diminished.</p> <p>3.5(i) Investigate the potential impact of projected sea level rise on the Ramsar site and values, and identify appropriate management action, for example land retirement, wetland restoration and land purchase.</p> <p>3.5(iii) Review rules in respect to climate change for low-lying coastal land and develop appropriate plan provisions based on sound technical information.</p> <p>3.6(ii) Identify restoration opportunities in other lower catchments of the southern firth.</p> <p>3.6(iii) Review permitted and controlled activities to assess whether improved conditions are required to further limit habitat disturbance.</p> <p>3.6(vi) Identify opportunities within the Piako River Catchment Works and Services Programme to incorporate ecological functions in work design, using the Waihou scheme as a blueprint.</p> <p>3.6(vii) Identify opportunities to work with the Environment Waikato River and Catchment Services group and form relevant partnerships to undertake ecological restoration (including community partnerships).</p> <p>4(ii) Investigate the potential for wetland restoration to create sediment sinks for land run-off and existing firth sediments.</p>

	<p>Control of invasive plants</p> <p>3.2(iv) Risk assessment for known and potential invasive species to assess threat and allow for early intervention where required.</p> <p>3.2(vi) Consider adding <i>Carex divisa</i> to the RPMS if supported by further research.</p> <p>3.2(viii) Consider inclusion of saltwater paspalum within the Firth of Thames spartina control consent.</p>
Community education and partnership	<p>Reduce habitat disturbance</p> <p>3.1(vii) The causes of mangrove expansion and appropriate management action should be emphasised in any education programme developed for the area.</p> <p>3.4(iii) Review existing public access and camping policy for public land around the southern Firth of Thames to address issues of bird disturbance.</p> <p>3.4(iv) Investigate the need and feasibility of a 'no fly' designation zone over vulnerable bird areas in consultation with aviation groups.</p> <p>3.4(v) Review dog bylaws to ensure high bird use areas are protected from disturbance.</p> <p>3.4(vi) Enforcement of the FDC Public Places Bylaw in important bird roost areas.</p> <p>3.4(vii) Educate people about why access restrictions are needed to protect the birds and how to minimise disturbance impacts (for example, stay on tracks and within bird hides).</p> <p>3.6(iv) Improve communication of new integrated policy, standard practices and associated information to field operators where adverse effects are still occurring.</p> <p>3.6(v) Improve education and guidelines for the surrounding community in respect to land use and disturbance around the Ramsar site.</p> <p>Recreational opportunities</p> <p>3.4(ix) Investigate a potential walking/cycling track along the firth stopbanks to link Thames with the Seabird Coast.</p> <p>Invasive species</p> <p>3.2(xi) Educate local landowners, communities and visitors in respect of locally significant invasive species.</p> <p>3.3(ii) Widely disseminate information on key predators and control methods to the community (for example, via display boards at popular visitor sites).</p>

Table 5: High priority gaps to be addressed by external agencies (Biosecurity NZ, MFish and CRIs)

Action	Gap
Marine biosecurity and harvesting	3.2(iii) Assessment of the effect of Asian date mussels on the benthic ecology of the Ramsar site to assess whether or not control is required.
	3.2(iv) Risk assessment for known and potential invasive species to assess threat and allow for early intervention where required.
	3.2(vii) Clarification of agency responsibilities for the management of marine biosecurity.
	3.2(ix) Implement monitoring of the transfer of marine farming gear between distinctive water bodies, and the transfer of spat and 'weed' from distant locations for re-seeding of mussel culture lines.

Action	Gap
	3.2(x) Inclusion of consent conditions to address the issue of biosecurity for marine farming consents in the firth.
	Develop a general ecosystem understanding, including an ability to identify and address cumulative effects.
Fundamental research	3.1(i) Research into the potential for sediment deposits in the upper firth to drive further significant mangrove expansion and habitat change in the southern firth.
	3.1(iii) Research into the significance of mangrove ecosystems as habitat in the southern Firth of Thames.
	3.2(ii) Investigation of factors inhibiting re-establishment of native plant communities in areas dominated by exotic invasive species such as tall fescue.

Table 6: Medium priority gaps to be addressed (> 5 years).

Gap	Priority	Recommended lead agency
3.5(ii) Relevant policy is required in most regional and district plans to address climate change effects, including the use and development of low lying land around the Ramsar site.	Medium	Environment Waikato
3.5(iii) Review of rules in respect to climate change for low-lying coastal land and develop appropriate land provisions based on sound technical information.	Medium	Environment Waikato District councils
3.5(iv) Prepare and disseminate information on potential local effects of climate change to inform the community as to why it is necessary to restrict development in some areas (for example, floodplains and low-lying areas potentially affected by rising sea levels).	Medium	Environment Waikato
3.5(v) Consider the implications of climate change projections for the area between the Waitakaruru River and Pukorokoro (Miranda) Stream.	Medium	Environment Waikato Hauraki District Council
3.6(i) Analysis of the sustainability of the existing drainage network for very low lying areas. For example, what are the potential impacts of climate change on the sustainability of the network?	Medium	Environment Waikato District councils
3.6(viii) Other district councils could consider opportunities for supporting land owners to better protect waterways similar to the recent MPDC initiatives.	Medium	District councils
3.7(i) Any change to the Regional Coastal Plan to provide for diversification of marine farming should critically review associated biosecurity issues in the firth.	Medium	Environment Waikato
4(i) A sediment audit of high risk catchment areas.	Medium	Environment Waikato
4(iv) Provide policy to promote the restoration of wetlands as sediment sinks around the Firth of Thames.	Medium	District and regional councils
5.1(i) Ongoing investigation and modeling of nutrient dynamics within the Firth of Thames to determine the sustainable upper limit of nutrient input without adverse impacts (for example, algal blooms).	Medium	District and regional councils
5.1(ii) Further development of on-site mitigation techniques for the management of intensive land use (for example, reconstructed wetlands and riparian margins) and aquaculture to reduce nutrient inputs.	Medium	Environment Waikato
5.1(iii) Develop and implement a Local Area Management (LAM) strategy for catchments draining to the southern Firth of Thames, including consideration of policy changes required to better manage cumulative off-site effects of increasingly intensive land use.	Medium	Environment Waikato
5.1(iv) Ensure the use of best practice for stormwater and wastewater management.	Medium	District councils
5.1(v) Monitoring of cumulative effects of discharges.	Medium	District councils
5.2(i) Research into sources of mercury to the firth.	Medium	Environment Waikato
5.2(ii) Identification of any significant risks associated with elevated levels of mercury in the firth.	Medium	Environment Waikato
5.2(iii) Further investigations of high metal and other contaminant levels around the Moanataiari reclamation to determine any hazard to the firth ecosystem.	Medium	Environment Waikato
NOTE: Some of these will be addressed (at least in part) within the next five years through the current HDC District Plan review and the public consultation scheduled for early 2008.		

References

- Brownell, B. (Ed.) 2004: *Muddy Feet – Firth of Thames Ramsar Site Update 2004*. Pivotal Ecosystem in the Hauraki Gulf. EcoQuest Educational Reports Series No. 1.
- Brownell, B. 2007: *Muddy Feet Stage II: Working paper for the Firth of Thames Ramsar Site Gap Analysis Summary Report*. In Press: Tikapa Kahawai Marine Advisory Service.
- Elmetri, I. and Felsing, M. 2006: *Application of the Relative Risk Model (RRM) to Investigate Multiple Risks to the Miranda Ramsar Site*. Report prepared for Environment Waikato. Cawthron Report 1141.
- Swales, A.; Bell, R.G.; Oviden, R.; Hart, C.; Horrocks, M.; Hermanspahn, N. and Smith, R.K. 2007: *Mangrove Habitat Expansion in the Southern Firth of Thames: Sedimentation Processes and Coastal-Hazards Mitigation*. Report prepared for Environment Waikato. NIWA Client Report HAM2006-138.

Appendix A: Linkages to other projects in the southern firth and catchments

Hauraki Gulf Forum

The need to better understand and manage the complex interrelationships of the gulf, its islands and catchments led to the enactment of the Hauraki Marine Park ('the Act') in 2000.

The Hauraki Gulf Forum is established by Part 2 of the Hauraki Gulf Marine Park Act ('the Act') 2000.

The forum comprises of:

- representatives of the Ministers of Conservation, Fisheries and Maori Affairs
- six representatives of the tangata whenua of the Hauraki Gulf and its islands (appointed by the Minister of Conservation after consultation with the tangata whenua and the Minister of Maori Affairs)
- representatives from the 12 local authorities around the Hauraki Gulf, including Auckland Regional Council and Environment Waikato; Auckland, Manukau, North Shore and Waitakere city councils; and Franklin, Hauraki, Matamata-Piako, Rodney, Thames-Coromandel and Waikato district councils.

Purpose (as set out in the Act)

The Hauraki Gulf Forum has the following purpose.

(a) To integrate the management and, where appropriate, to promote the conservation and management in a sustainable manner, of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments, for the benefit and enjoyment of the people and communities of the Gulf and New Zealand;

(b) To facilitate communication, co-operation, and co-ordination on matters relating to the statutory functions of the constituent parties in relation to the Hauraki Gulf, its islands, and catchments and the Forum; and

(c) To recognise the historic, traditional, cultural, and spiritual relationship of tangata whenua with the Hauraki Gulf, its islands, and where appropriate, its catchments.

The Sustainable Agriculture Strategy

The Environment Waikato Sustainable Agriculture Strategy includes the integrated catchment management project, Clean Streams, environmental education programme, permitted activity monitoring and more.

Clean Streams

Clean Streams is an Environment Waikato project to encourage and support farmer efforts to reduce the impacts of farming on waterways. Advice and financial support of up to 35 per cent of farmers' costs for fencing and planting waterway margins is available.

Environment Waikato integrated catchment management project

The ICM project focuses on nutrients, sediments and contaminants. At present the project is focusing on Priority 1 catchments, and whether the rules are adequate to decrease sediment, nutrient and contaminant loadings. In the future it is expected to expand the project into Priority 2 catchments. The ICM project includes community

participation to incorporate community priorities and develop an outcome that addresses problems at farm level. The project will use models to see if anticipated actions will produce intended results.

The catchments chosen for inclusion in the ICM project are based on 50 to 100 farms, mainly dairy, upstream of Lake Karapiro. The ICM project employed 1.5 coordinators in 2006/07, and is employing an additional coordinator each year until 2016/17. Each coordinator is expected to be able to oversee activities in two catchments.

The ICM project is one approach through which Environment Waikato is effectively firming up its water quality policies and enforcement in upstream areas (above Karapiro, Morrinsville and Te Aroha). Currently the project is focusing on Priority 1 water bodies (with initial focus on two catchments) and looking mainly at non-point discharges of sediments, nutrients and faecal contaminants. Coastal catchments are Priority 2 water bodies. The ICM project includes assessing the nutrient budgeting requirements in the proposed Waikato Regional Plan.

Waihou and Piako River catchment works and services programmes

These programmes are managed by the River and Catchment Services group of Environment Waikato. They involve flood protection, water level controls, erosion control, river management, riparian management and drainage management.

The old Waihou Valley scheme and the east and west Piako drainage management schemes (funded by special scheme rates, under the overriding objective of protecting the agricultural lands of the Hauraki Plains from flooding) have gradually become part what is now a wider-reaching, integrated approach to catchment management. The new project, 'Biodiversity enhancement on Environment Waikato land', is a 10-year LTCCP project funded under the general rate, with two focal points in the initial stages: the Waihou and Piako sub-catchments, and the lower Waikato.

This new approach has been driven by such factors as the ongoing loss of wetland habitat within the region, the increasing cattle stocking units in Hauraki and Matamata-Piako districts in the past 10 years, and decreases in the quantity and quality of forest and riparian habitat. Land use has intensified due to fragmentation of some properties, greater use of feed supplements, more market gardening and new dairy conversions.

The Waihou-Piako programme includes a large scale, strategically-focused Zone Plan that will seek to reinforce the wellbeing of the community through sustainable economic, social, cultural and environmental initiatives. Under this, an environmental plan will target life-sustaining and enhancing assets such as water quality and vital habitats.

Another component is the comprehensive mapping project, 'Assessment of enhancement potential for Waihou – Piako flood protection land' (including approximately half of the area between the Piako and Waitakaruru rivers). This is beginning to provide essential information for more sustainable management of the catchment and its man-made drainage system. All of the fencing on Environment Waikato (scheme) land is being mapped, and further fencing is being encouraged on private land along the Waihou and Piako.

New lease arrangements are also being negotiated with farmers related to use of the stopbanks and seaward margins for grazing. All of these activities will be subject to scheme rates, and controlled under the biodiversity principles of the new project.

The biodiversity enhancement project is also identifying a number of sites for environmental enhancement (especially wetlands).

Regional iwi fisheries forums

These forums have been established through MFish for the purpose of guiding and coordinating the efforts of iwi and hapu to establish management plans, consent criteria, permitting mechanisms and enforcement procedures for customary fishing activities and management. To date there are forums in the Bay of Plenty and the Far North but they are still in the formation process in the Auckland and Waikato regions (including the Firth of Thames).

Peninsula Project (Environment Waikato and TCDC)

The Peninsula Project is about improving the health of the environment and reducing flood risks on the Coromandel Peninsula. In particular the project aims to:

- better protect people, property and essential services from flooding
- reduce sedimentation in rivers, harbours and estuaries
- improve water quality
- reduce animal pests such as possums and goats
- increase the number and diversity of native plants and animals
- stabilise catchments.

The project addresses river and erosion issues from the mountains to the sea by integrating three key areas of work – flood protection, river and catchment management, and animal pest control. Environment Waikato, Thames-Coromandel District Council, Department of Conservation and Hauraki Maori Trust Board are working together to carry out this work.

Blueprint Project (Environment Waikato and TCDC, with DOC and Hauraki Whanui)

The Thames-Coromandel District Council is working alongside Environment Waikato, the Department of Conservation, and Hauraki Whanui iwi representatives to develop a Coromandel Peninsula Blueprint which will provide direction on managing growth throughout the district. The Coromandel Peninsula Blueprint project is all about planning where, what, and how people can do things in and on the land and waters of the Coromandel Peninsula. A significant challenge is managing the growth demands and pressures whilst still protecting important community values. This project will build on community visions as identified in community plans and community outcomes and on anticipated environmental outcomes as expressed in regional and district RMA planning documents. .

The first step of the project is developing a 'profile' of the growth issues facing the district. The next step will involve identifying a number of options for managing growth in the district and consulting with communities. This is expected to commence in March 2008.

Coastal Compartment Plan for the Kaiaua-Miranda Coast (Franklin District Council, ARC and Environment Waikato)

This project is identifying the specific environmental, social, economic and cultural values of the Firth of Thames coast of Franklin district, and tying these together with the district and regional growth strategies, the LTCCP and the FDC Rural Plan Change 14.

Matamata-Piako Kaitiaki Zone

Matamata-Piako's Kaitiaki (Conservation) Zone (part of the District Plan) is a protection zone that applies to a strip generally 20 metres wide on both sides of each of the district's three main rivers (Waihou, Piako and Waitoa, all of which drain into the Firth of Thames).

FRST projects

PGST – C01X0307: Effects-based protection and management of aquatic ecosystems

Involves the development of predictive tools for managing contaminant effects (of sediments, nutrients, chemical pollutants, faecal microbes) in freshwater and estuarine ecosystems. Research will include the contaminant transport chain, remobilisation and bioavailability of heavy metals, building morphodynamic models that forecast the way estuaries are likely to evolve in regard to sediment infilling, the effect of stressors on structure and functioning of aquatic ecosystems, how mangroves respond to elevated sediment and nutrient loads, fish surveys to determine how fish use mangrove habitat (completed), how multiple stressors interact, model how estuary ecosystems adjust to external stressors in complex ways, develop a prototypal biotic index of sediment pollution for application in state of the environment monitoring, AEE studies and consent compliance work.

PGST – C01X0501: Ecosystem-based management of New Zealand's coastal and oceanic waters

This 12-year programme includes research within the Hauraki Gulf (coastal system), the Chatham Rise (open-ocean system), Kaikoura (a rocky reef system) and estuaries around Auckland. Three linked projects will:

- i. determine the factors that control productivity at the base of the food chain and how it is transferred to higher trophic levels
- ii. identify predator-prey relationships and interactions between extracted species and the wider ecosystem
- iii. identify the factors that determine the biodiversity and health of coastal ecosystems in response to disturbance, and how to mitigate any adverse changes.

There is a focus on effective and sustainable use of coastal and estuarine resources, based on improved definition of their ecological services and societal values, and ecological forecasting to define their limits of resilience. A new area of research is that of defining and quantifying ecosystem services, and linking knowledge of ecosystem function to environmental valuation. Fish-habitat relationships have been studied in several harbours to describe species spatial variability and assemblage patterns with different habitats.

PGST – C01X0502: Effective management of marine biodiversity and biosecurity

This large, complex research programme has several foci. The biodiversity work primarily focuses on determining the biosystematics (including genetics) of priority taxa (that is, invertebrates and macrophytes, fishes, micro- and macroalgae) and incorporates NIWA's Nationally Significant Benthic Invertebrate Collection and database. It also covers new technique development for modeling, measuring and monitoring biodiversity status, to help guide the selection of marine protected areas (MPAs). The biosecurity work focuses on providing new knowledge and tools for marine pest risk assessment and for the surveillance and monitoring of marine pests. It will also develop new and refined treatment and control technologies to prevent the introduction of new marine pests.

For marine biosecurity, a focus of the first year of the programme was on developing strategic partnerships and plans for the research direction. Alliances have been developed with partners (Department of Conservation, Ministry of Fisheries, MAF Biosecurity NZ and Ministry for the Environment), research collaborators and with key stakeholders in regional councils, shipping companies and port authorities. The biosecurity work focuses in the development of management tools in three key areas:

- marine pest risk assessments
- surveillance and monitoring
- management and mitigation.