Environment Waikato Technical Report 2005/44

Estuarine Vegetation Survey - Raglan Harbour

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Environment Waikato
PO Box 4010
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ISSN: 1172-4005

29 November 2004

Document #: 1010796

Environment Waikato
REGIONAL COUNCIL

Peer reviewed by:
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Approved for release by:
Peter Singleton Initials  Date July 2005

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1 Introduction

A 1997 pilot study of Whangamata, Wharekawa, and Otahu harbours determined that it is feasible to map vascular estuarine vegetation using aerial photography. The success of this work encouraged Environment Waikato to continue with this method within the Coromandel region. The estuarine vegetation of Tairua, Coromandel, Te Kouma, Manaia and Whitianga harbours were mapped in 1998 and 1999. Port Waikato was recently mapped in 2004.

Mapped vegetation is in the Coastal Marine Area (CMA) and includes the spatial cover of mangrove, seagrass, sea meadow, and saltmarsh communities. The results of harbour surveys are included in Environment Waikato's Global Information System (GIS) database and are used for State of the Environment investigations and assessing consent applications that may affect estuarine vegetation.

This report details results from the estuarine vegetation survey of Raglan Harbour. Comments are included on the areas' vulnerability to degradation, and other field notes of interest. .

2 Methodology

The survey was undertaken from the 15th – 20th November 2004 by foot at low tide and by boat and kayak over high tide. The same methodology for mapping saltmarsh, mangrove, seagrass and weed communities was followed as that previously used to map East Coast estuaries (see Graeme, 1997, 1998a, 1998b, 1999).

A 1:10,000 scaled aerial map of the harbour was laminated and overlayed with another clear acetate sheet. Colour-coded lines were drawn on the overlay to define the spatial extent of wetland vegetation types and to allow transferral to GIS. These boundary lines were ground-truthed to establish their accuracy. Field notes were made of estuarine wetland characteristics and vulnerability. An estimate was made of historical estuarine vegetation extent where there had been reclamation.

2.1 Wetland Vegetation Classification

For the purpose of this investigation, native wetland species influenced by the tidal cycles were split into four groups: saltmarsh, mangrove, seagrass and weed communities.

1. **Saltmarsh -** a broad community in which three sub-communities are distinguishable. They are:

    a) **'Rush community'** - generally oioi *(Apodasmia similis)* and the less colourful sea rush (*Juncus maritimus* var *australiensis*);

    b) **'Saltmarsh ribbonwood community'** - this includes areas where rushes are interspersed with saltmarsh ribbonwood *(Plagianthus divaricatus)*, sea primrose *(Samolus repens)*, remuremu *(Selliera radicans)*, the silver tussock grass *(Stipa stipoides)*, and glasswort *(Sarcocornia quinqueflora)* giving a patchy appearance compared with the uniformity of the 'rush community';

    c) **'Sea meadow community'**, - this is devoid of tall plants such as rushes and saltmarsh ribbonwood, with the exception of silver tussock grass. The salt meadow community includes sea primrose, remuremu,, glasswort, and in more brackish areas bachelor's button (*Cotula coronopifolia*), leptinella (*Leptinella doica),* sharp spike-sedge (*Eleocharis acuta*)*,* slender clubrush *(Isolepis cernua)*, and arrow grass (*Triglochin striata*).

2. **Mangrove** *(Avicennia marina* var. *resinifera)* - usually a monospecific community but sometimes seagrass beds can be found below trees.

3. **Seagrass** *(Zostera* sp.) - usually a monospecific community.

4. **'Weed community'** - in the Waikato Region the most significant estuarine weeds are saltwater paspalum *(Paspalum vaginatum)* and cord grass *(Spartina* spp*.).* Both of these weeds grow in the open estuary, and trap sediment greatly increasing the harbour's infilling rate. These weeds also compete with the native wetland communities.

3 Field Notes

3.1 General Observations

The following observations give a general overview of estuarine vegetation in Raglan Harbour.

- The silver tussock was usually found on headlands and exposed areas, as well as in patches behind other sea meadow species.
- A thin band of remuremu, sea primrose, slender clubrush, and leptinella was often found along more sheltered edges of bays. Less common was the arrow grass.
- There are scattered young mangroves up the head of some south – south western bays/arms. Larger mangroves were found to the north – north east of harbour especially up the Waingaro arm where trees reached 3-4m high.
- Seagrass was restricted to around the town peninsula, except for small patches in Birds Bay/Marotaka Bay and the upper Waingaro arm.
- Saltmarsh ribbonwood communities were uncommon in the Raglan Harbour.
- It was difficult in some areas to separate oioi/sea rush from scattered marsh clubrush. In such instances the whole area was defined as within the saltmarsh community.
- Saltwater paspalum was common around the harbour edge, and often dominated the saltmeadow community zone.
- Two small Spartina sites were found in addition to the existing three known sites.

Table 1 presents the common and dominant estuarine and freshwater vegetation species that were surveyed in Raglan Harbour. The 'vegetation community' for the estuarine species corresponds to the different colour codes on the maps.

Table 1:Common and dominant estuarine and freshwater species in Raglan Harbour.

Estuarine Species:

Common/Maori name	Scientific name	Vegetation Community
arrow grass	*Triglochin striata*	sea meadow
bachelor's button	*Cotula coronopifolia*	sea meadow
glasswort	*Sarcocornia quinqueflora*	sea meadow
leptinella	*Leptinella dioica*	sea meadow
oioi	*Apodasmia similis (=Leptocarpus similis)*	rush/sedge
remuremu	*Selliera radicans*	sea meadow
saltmarsh ribbonwood	*Plagianthus divaricatus*	saltmarsh ribbonwood
saltwater paspalum	*Paspalum vaginatum*	weed
sea primrose	*Samolus repens*	sea meadow
sea rush	*Juncus krausii subsp. australiensis*	rush/sedge
seagrass	*Zostera novazelandica*	seagrass
sharp spike-sedge	*Eleocharis acuta*	sea meadow
shore lobelia	*Lobelia anceps*	sea meadow
silver tussock	*Austrostipa stipoides*	sea meadow
slender clubrush	*Isolepis cernua*	sea meadow
spartina	*Spartina sp.*	weed
three-square	*Schoenoplectus pungens*	rush/sedge

Freshwater Species:

crack willow	*Salix fragilis*	weed
giant umbrella sedge	*Cyperus ustulatus*	rush/sedge
marsh clubrush	*Bolboschoenus fluviatilis*	rush/sedge
pampas	*Cortaderia selloana and C. jubata*	weed
raupo	*Typha orientalis*	rush/sedge
mingimingi	*Coprosma propinqua*	shrub

The following descriptions begin on the north side of Raglan Harbour near the harbour mouth and move clockwise around the harbour.

Small patches of seagrass were found in Birds Bay and Marotaka Bay. The succulent herb *Peperomia urvilleana* grew on the limestone blocks. The limestone edges also supported puka, astelia, karaka, puriri, olearia, kowhai and kanuka (Figure 1), but no estuarine vegetation as they usually drop steeply into deep water.

Moving up-harbour boneseed was found on the inside of Horongarara Point. The forest around the small bay and out to the large headland with houses had some climbing asparagus and Mexican daisy. Further up Ponganui Creek on the true right bank (TRB) climbing asparagus had established on the forested headland (inside the large bend in the creek). Birds seen in the Ponganui Creek included kingfisher, heron, cuckoo, black-backed gull, caspian tern, and Canadian goose. As the tide rose schools of yellow-eyed mullet fed in the upper creek. Coming down on the true left bank (TLB) stock had access to the upper reaches of the creek flats and around the edges of Paihere Creek. The rush fringe up the arms included sea rush, oioi, marsh

clubrush and three-square. Batteries (for electric fences?) were found discarded beside and in the upper Paihere Creek upper TR arm. Mexican daisy was also found on the TL headland joining with the main harbour.

The coastline from Tokatoka Point (opposite the monument) to Matanewe Point (near Whatitirinui / Sugar Loaf Island) had characteristic steep limestone/sandstone edges that were not supportive of estuarine vegetation. They were also exposed to rough seas. Hence there was only scattered thin bands of rush or silver tussock except in the upper heads of larger bays. These particular harbour cliffs were dominated by pampas. The farmed hills and valleys had remnant cabbage trees and puriri, as well as patches of regenerating forest with kanuka and kowhai common.

Farmland around the next bay (Tarata and Mokoroa Creeks) had a single wire electric fence hard against much of the harbour edge providing protection from direct stock damage to the harbour edge but no filtering of land run-off. Stock footprints were also seen to the north of the limestone blocks at the homestead (Tarata Creek) inlet indicating the fencing must not be complete. Sea meadow patches still survived amongst the dominant saltwater paspalum. A number of large mangroves were in the homestead inlet. The small arm south-east of the homestead had large healthy mangroves on the western side but large dead mangroves on the eastern side looked as though they had been sprayed with herbicide.

The next small embayment to the west had some mature coastal forest. There was a large black shag colony in mature tawa and karaka. Stock had access into the forest and to the harbour's edge (Figure 2). There was sign of mangrove browse (Figure 3).

Oyster banks were found on the flats and at the mouth of Kotoku Bay opposite Whatitirinui / Sugar Loaf Island. This bay had the worst stock damage to the CMA noted in this survey. Patches of sea meadow, rush and saltwater paspalum were trampled. This may be exacerbating the spread of saltwater paspalum as fragments can be dispersed by hoof or the tide. A lot of the mangroves (0.5m high and smaller) showed signs of die-back or were dead. Many had cropped tips and signs of browse. This seemed to be stock browse as there were cattle prints in the mud leading to mangroves. A few thick bands of leptinella were found (usually associated with riparian shade) and patches of slender clubrush and glasswort. There were many Canadian geese on the estuary and surrounding hills. A dead cow and sheep were found along the estuary edge. The south western edge had some fencing but this was usually only 5 m or less from the bank providing only limited potential to establish riparian vegetation to help absorb nutrient and pathogen run-off, let alone provide shade and edge habitat.

Tawatahi River arm had stock access to the harbour on the lower TRB. Figure 4 shows a thin band of oioi and a section of fenced harbour edge along the TRB. Many goats were seen in regenerating native bush along the lower TLB.

The Waingaro River arm was characterised by thick stands of mangroves lining this narrow arm (Figure 5). The mangroves generally reached a height of 3-4m. There was an interesting gradient in the upper reaches of oioi with marsh clubrush patches, then oioi with raupo, then monospecific oioi, and back into oioi with marsh clubrush (Figure 6). Seagrass beds were another feature in the upper reaches of the main arm. Stock (including goats) had access on the TRB in the upper reach and along most of the TLB in the middle reach. The lower arms were filled with mangroves. The regenerating forest contained kowhai, titoki, some tawa, and lots of kanuka (Figure 7). There was a beautiful lagoon at the mouth of the Waingaro River on the TRB that had high natural character. It had a sand spit with some silver tussock and remuremu, a rush fringe and coastal forest behind (Figure 8). Lots of small fish were disturbed in the lagoon shallows. Unfortunately stock had access to this lagoon as well. Stock also had access to the beach along the lower TLB and further around the coastline of the main harbour.

Oruawhau Creek arm had stock access to the harbour from the TLB at the mouth. There were a couple of mangrove stands. The lower TRB was characterised by kowhai-dominated forest. Pukeko and paradise duck were seen. Upstream the main weed was Himalayan honeysuckle. Riparian vegetation included hebe, karamu, flax, grey willow, totara, mingimingi, raupo, gorse, and tall fescue.

Pairere Point was characterised by steep eroding bluffs with no estuarine vegetation. The exposed wave-swept platforms and coastline are not conducive to supporting estuarine vegetation.

Downstream from Te Uku Landing on the TLB there was a remnant freshwater swamp forest grading into estuarine wetland (Figure 9). This freshwater swamp was highly significant as there was very little of this vegetation type and the intact sequence from estuarine to freshwater left in the Raglan Harbour catchment. In fact this is the largest such remnant. The freshwater swamp contains mingimingi, flax, raupo and kahikatea. The inland natural extent of this freshwater swamp was highly degraded through farming. Small patches of bachelor's button and sharp spike-sedge were found along the river edge of the lower freshwater swamp.

Further downstream, the large rush community on the TLB of the Waitetuna River mouth was unusual in that marsh clubrush was present in quite large patches on the seaward edge of oioi rather than the landward edge. It has therefore been included in the 'rush zone'. A fernbird was heard in this rush/saltmarsh ribbonwood habitat. Sea meadow on the TRB of the river mouth included slender clubrush, leptinella, sea primrose, bachelor's button, and remuremu.

Opposite 'The Neck' on Paratata Peninsula, and up the channel towards the mouth of the Waitetuna River, extensive Pacific oyster beds were encountered (Figure 10). A number of birds including oystercatchers and herons were utilising the beds for feeding. Figure 11 shows the extensive mudflats of the Waitetuna River arm of the harbour and the different land uses around the harbour's edge.

The small bay to the east of Haroto Bay had a patch of spartina showing on the 2002 aerial, but this has since been sprayed and there are now only scattered clumps left surviving.

Raised sandstone beds are prominent at the mouth of Haroto Bay. Haroto Bay (and most of Raglan Harbour) has an abundant titiko population. There was stock access to Haroto Bay at its head. The forest-covered Finger provides a natural coastal forest backdrop to the characteristic thin band of rush and patches of silver tussock on its edge. This forest seemed to be fenced from stock and is a valuable natural asset to the harbour.

Stock had access to the harbour from a number of places along the Paritata Peninsula (e.g. opposite the Finger, the western headlands), however it looked as though the northern side of the peninsula had been recently fenced to restrict stock access to the harbour. The edge of the Paritara Peninsula had sparse forest that includes a few remnant puka leaning out over the harbour.

Stock had access to the harbour on the southern side of the Narrows via the three small bays (Figures 12 & 13). A new small patch of spartina was found at the head of the western of these small bays, near to the existing spartina site amongst the limestone headland of the bay. Figure 14 shows silver tussock on a limestone headland on the southern side of the Narrows. Headlands and shell banks are characteristic habitat for the silver tussock.

Okete Bay – Stock have access to the harbour margin at the northern headland and along the coast moving clockwise around the bay. The large spartina patch at the back

of the bay has been sprayed since the 2002 aerial photo was taken but approximately 10 small clumps were surviving (Figure 15). The margin near the waterfall had a lot of weeds including eleagnus and climbing asparagus. Birds seen were mallard ducks and shags. The largest, most intact patch of sea meadow found in the Raglan Harbour was on the southern side of the spit with houses. This patch contained mainly sea primrose and glasswort (Figures 16 & 17). However it was threatened by the presence of a new small area of short-statured spartina (Figure 18). Sea meadow areas like this example seem to be rare as they are often out-competed by saltwater paspalum.

Stilts and a spur-winged plover were seen further down the harbour at the sand 'hook'. Further towards Raglan town there are areas of boneseed up a paddock drain and along steep eroding cliffs.

The TLB coastal forest edge of the Three Streams arm was distinguished by large akeake trees and hebe. On the left hand side of the small forested peninsula was a little arm almost entirely edged by forest, although the forest had a high proportion of tree privet and hawthorn. There were also a couple of banana passionfruit plants present. A large spit downstream on the TRB that was now in pasture would have been coastal forest. The lagoon behind the spit supports a large area of saltmarsh (and around 55 mangroves) backed by a small freshwater wetland with cabbage trees. This wetland was not fenced. Stock could also access the harbour past a fence in the upstream TRB bay.

The town edge - Seagrass beds were intermingled with clay outcrops and shingle fans east of Lorenzen Bay (Figure 20) and west past the wharf. The harbour edge was urbanised along this stretch with boat sheds and armouring of the foreshore. The development, and the urban weeds mean that the harbour edge has very low natural character. Boneseed was noted amongst the other weeds along the shoreline immediately east of the wharf (Cox Bay). Armouring of residential sections continued around into Aroaro Bay (Figure 19).

The zonation of Aroaro Bay, bisected by Wallis St was artificially restricted by the road culvert. Upstream of the road is a rushland which was probably restricted in size by historical infilling, while downstream of the road is open mudflats.

Continuing around the town waterfront, saltmarsh was nearly non-existent from the Wallis St causeway to the walking bridge. Patches of seagrass occured along the flats off Cliff St. A disjointed band of rush, and patches of seagrass on the open flats, extended from the foot bridge up towards Wainui Rd bridge.

Between the Wainui Rd bridge and the mouth of Kaitoki Bay were the largest seagrass beds in Raglan Harbour (Figure 21). Only a few small patches were found further up the Opotoru River arm. Small patches of sea meadow lined the school playing field headland. Kaitoki Bay had a saltmarsh (and some freshwater wetland) where the stream enters the estuary (Figure 22). There may be potential for wetland restoration in this area.

Scattered mangroves and narrow bands of rush characterised most of the Opotoru estuary edge. The Opotoru River mouth had a very good example of rushes grading into saltmarsh ribbonwood and then up into freshwater wetland with flax, giant umbrella sedge, cabbage trees, mingimingi and manuka. However the extent of the freshwater wetland was diminished through farm activities (Figure 23). A school of whitebait were seen in a rush pool waiting for the afternoon spring tide to access up into a creek along the TLB of the Opotoru River arm upstream of the causeway. On the TRB a band of leptinella lay above a fringe of sea primrose.

Most of the Opotoru Creek margins were fenced (usually 5-10m) and have been planted or they are regenerating in native forest (Figures 24 & 25). The exceptions are a stretch along the upper northern side (Figure 26) and the eastern headland of Kaitoki

Bay. There was also part of the northern margin between these two areas that has native regenerating forest cover but is grazed to the edge underneath.

Garden weeds were dominant along the small arm south of the causeway (golf course arm) where houses were close to the harbour edge. The only saltmarsh of notable size was at the head of the arm.

A road culvert limits the upstream extent of the estuarine vegetation along Pokohui Creek. Two boneseed bushes were noted on the TLB immediately downstream of the road. Planting of the upper riparian edges has greatly enhanced the wetland vegetation sequence. The lower reaches of this arm are closely bordered by road, farm, airstrip or housing and are lined by the typical narrow band of rush. Patches of three square (a short saline-tolerant sedge) are found on the lower side of sea rush in the lower reaches. A large bed of seagrass lines the main Opotoru River channel at the junction with Pokohui Creek.

Approximately 55 mangrove plants and seedlings were seen in the Opotoru Creek system. Very little saltmarsh ribbonwood was found apart from around the river mouth of the Opotoru Creek, and scattered small patches often associated with tall fescue. Where small streams entered the harbour arm marsh clubrush and small patches of raupo often back the rush zone, otherwise a thin band of rush along the harbour margin abruptly boarders coastal forest/farm on the steep harbour edge.

Common coastal forest species found around the Opotoru Creek margins are:

Native	**Introduced**
five finger	wattle
kawakawa	Chinese privet
bracken	tree privet
prickly mingimingi	climbing asparagus
Gahnia sp.	woolly nightshade
Olearia sp.	gorse
hangehange	hawthorn
mingimingi	boneseed
karamu	pampas
kowhai	
red matipo	
pohutukawa	
silver fern	
mamaku	
kanuka	
manuka	

Birds:
Birds seen or heard during the surveys were:
kingfisher, shag, Canada geese, swan, white-faced heron, mallard duck, paradise duck, black backed gull, stilt, spur-winged plover, fernbird, .

Weeds:
Spartina:

- Small bay to the east of Haroto Bay - scattered clumps survive.
- Small patch at the head of the western bay on the southern side of the Narrows.
- About 10 small clumps remaining at large sprayed site in Okete Bay .
- ~0.5m^2 patch of short spartina in the sea meadow on the southern side of the Okete spit with houses.

Boneseed: Various sites (see site descriptions above) but mainly concentrated about the town. There is one site directly across from town at Horongarara Point.

Tree privet: Is a major component of the 'coastal forest' in some areas. This will require control for the natural regeneration of native forest species.

Banana Passionfruit: A few plants are present up the little forest-edged arm of the Three Streams inlet (as well as tree privet and hawthorn).

Mexican daisy, climbing asparagus etc: see site descriptions in report above.

4 Discussion

All saltmarsh is significant in Raglan Harbour due to its limited extent – primarily dictated by the harbour geology, but also due to past infilling. Similarly all remaining freshwater wetlands/swamp forest that backs onto estuarine wetland should be actively preserved and enhanced due to its scarcity and habitat value.

Saltmarsh ribbonwood is uncommon in the harbour which is also a reflection of the harbours geology providing little flat land extending inland on which estuarine communities can grade into freshwater communities. The relatively small amounts of habitat available for saltmarsh ribbonwood have also often been modified for farming (either through grazing or infilling).

It would also be beneficial to the integrity of ecological linkages and biodiversity if the remnant coastal forest areas around the harbour were protected in perpetuity. Assistance for fencing can be available through Environment Waikato's Clean Stream programme or if natural features are protected via a QEII covenant.

The establishment of mangroves is likely to assist in reducing the wave erosion of the harbour edges as well as stabilising sediments, and therefore will help improve water quality. However, it is unlikely mangroves would be hardy enough to become established along the most open wave prone coastlines (e.g. around Pairere Point).

The two most significant future threats to the harbour's estuarine vegetation (and water quality) are weeds and stock.

- Spartina is being controlled by the Department of Conservation but no action is being taken against the spread of saltwater paspalum. As this weed is so widespread, it is recommended that saltwater paspalum be controlled initially around significant habitats (such as the sea meadow on the house spit at Okete).
- Farms, with the assistance of the Whaingaroa HarbourCare Group are progressively being fenced and planted along their stream and harbour margins. This will go a long way to improving the ecological health of the harbour and those involved should be congratulated. However, there are still landowners who are allowing stock access to waterways. The activities of these people are having an adverse effect on the harbour environment and therefore the local communities .

At the 1:10,000 map scale it was difficult to accurately show the thin band of saltmarsh ribbonwood that sometimes occurred behind a band of rushes. Where only scattered individual bushes were found amongst rushland, the saltmarsh ribbonwood has been incorporated into the rush community. However in other areas where saltmarsh ribbonwood is marked, the extent of saltmarsh ribbonwood is sometimes probably over-estimated due to the thickness of the pen line.

Generally, the bands of saltmarsh and sea meadow are usually only 0.5-1m wide along the coastal edge (which often rises steeply up into a band of coastal forest, gorse/pampas, or pasture). Therefore the thickness of the pen width means that this thin saltmarsh or sea meadow band is likely to be over-estimated.

References

Graeme, M. 1997: *Estuary Vegetation Survey Pilot Study: Whangamata, Otahu*, *Wharekawa*. Report prepared for Environment Waikato.

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Appendix I – Figures 1 - 27

1. Raglan Harbour map with place names.
2. Limestone outcrops are a characteristic of Raglan Harbour. Puka, astelia, karaka, puriri, olearia, kowhai and kanuka are common along the northern side of the harbour opposite the town, but there is no estuarine vegetation as the land usually drops steeply into deep water.
3. The small embayment west of Tarata and Mokoroa Creeks has mature coastal forest down to the waters edge. There is a large black shag colony in mature tawa and karaka. Unfortunately stock have access into the forest and out the harbour.
4. Stock damage to mangroves in the small embayment west of Tarata and Mokoroa Creeks.
5. Stock have access to the Tawatahi River arm from various points but here a thin band of oioi is backed by a fenced section of the harbour edge. The retired margin is only just wide enough to allow a vegetation strip to establish that will help absorb nutrients, pathogens and sediment washed from the land. Note the variability in the colour of oioi between the left and right hand stand in this photo.
6. Mangroves line the banks of the Waingaro River.
7. Mixed beds of oioi, marsh clubrush and small amounts of raupo form a mosaic along the upper banks of the tidal Waingaro River.
8. The regenerating forest along the lower banks of the Waingaro River consists mainly of kowhai, titoki, kanuka some tawa.
9. This lagoon at the mouth of the Waingaro River has high natural character due to the diversity of relatively intact communities. It has a sand spit with some silver tussock and remuremu, a rush fringe and coastal forest behind. Unfortunately stock have access to the forest and lagoon.
10. Upstream of the saltmarsh at the mouth of the Waitetuna River, the estuarine vegetation reduces to a patchy thin edge of bachelor's button and sharp spike-sedge backed by freshwater swamp. This swamp contains flax, mingimingi, raupo and kahikatea.
11. Pacific oyster beds opposite the Neck on Paratata Peninsula. Similar oyster beds extend up the channel towards the mouth of the Waitetuna River.
12. The Waitetuna River opens out into extensive mudflats. Farming and cropping are the main land uses around the harbour's edge.
13. Stock have access to the harbour on the southern side of the Narrows via the southern three small bays. Here stock are down by the harbour's edge of the second bay south of The Finger.
14. An unfenced and eroding section of the harbour margin – southern side of the Narrows.
15. Silver tussock on a limestone headland - southern side of the Narrows.
16. White pegs mark the sprayed spartina patch in Okete Bay. Only small clumps of spartina remain.
17. The sea meadow on the landward side of the Okete Bay spit. This extensive sea meadow patch is dominated by glasswort and sea primrose, with scattered plants of knobby rush and silver tussock.
18. A close up of the sea meadow showing the glasswort in the foreground and sea primrose flowering in the background.
19. A small patch of short spartina invading the sea meadow on the Okete Bay spit.
20. The armoured harbour edge of Aroaro Bay.
21. Seagrass beds are intermingled with clay outcrops and shingle fans in Lorenzen Bay.
22. These are the largest seagrass beds in the harbour. The Wainui Rd bridge is to the right and the mouth of Kaitoki Bay is to the left of the picture.
23. The saltmarsh at the head of Kaitoki Bay.
24. This paddock is flooded during spring tides and would have supported freshwater swamp with a small estuarine influence as indicated by the oioi in the picture.
25. A recently fenced and planted margin along the Opotoru Creek arm.

26. A thin margin with more mature vegetation. The width of the margin limits its ability to absorb land run-off.
27. Rushes back straight onto pasture in this unfenced paddock along the upper northern side of the Opotoru Creek arm.

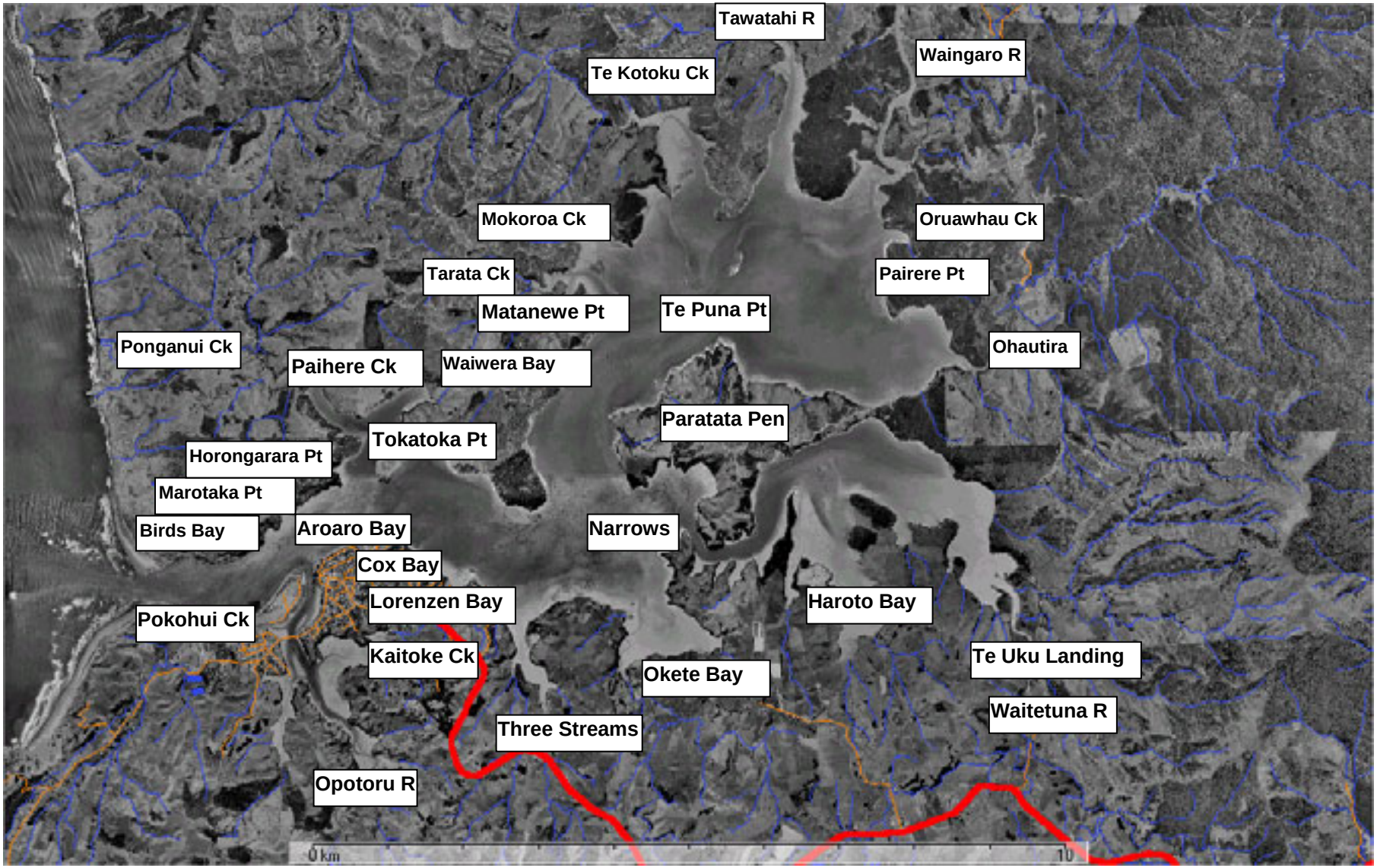

Figure 1: Raglan Harbour – points of interest relating to the Estuarine Vegetation Mapping 2004 report.


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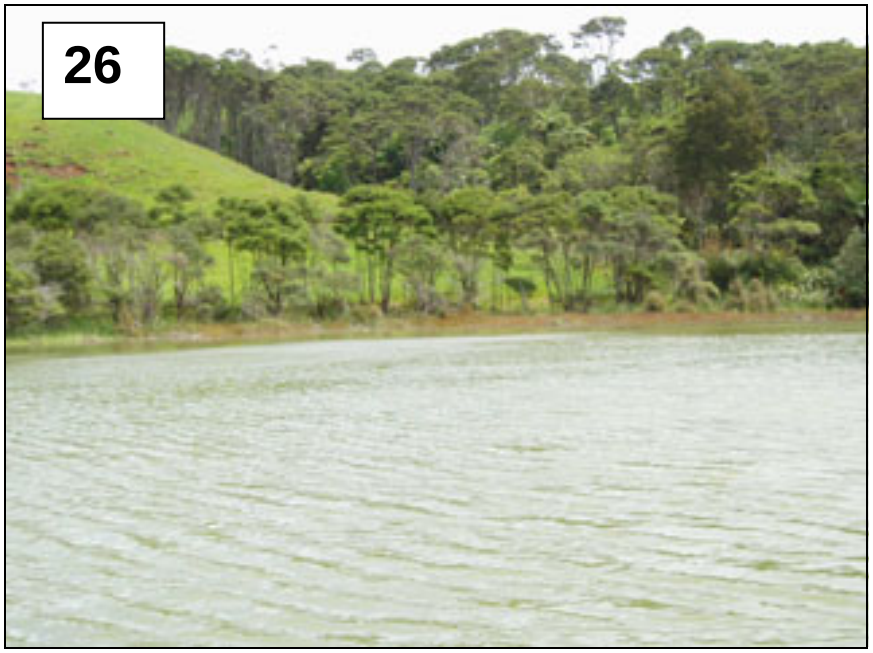

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