WAIORA NORTHLAND WATER

Whangārei Harbour Catchment Management Plan

August 2017

Northland REGIONAL COUNCIL

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Introduction

The purpose of the Whangārei Harbour Catchment Plan (catchment plan) is to identify measures to maintain and/or improve fresh and coastal water quality over time. The catchment plan involves the setting of catchment-specific objectives and associated methods to manage water quality and quantity based on the uses and values identified by a collaborative stakeholder group, which has been supported by staff from Northland Regional Council and Whangārei District Council.

The catchment plan has been developed alongside the new Regional Plan for Northland. These documents should be read together, as the new Regional Plan sets out the region-wide objectives, policies and rules for fresh and coastal water management (among other things), while the catchment plan provides a catchment specific approach using both regulatory (rules) and non-regulatory methods. Once finalised, the regulatory methods in the catchment plan are recommended for inclusion in a section of the new Regional Plan specific to the Whangārei Harbour catchment.

Following this introductory section, which provides information about the freshwater management units and the current state of water quantity and quality in the catchment, the plan is divided into three sections:

- The first section identifies the uses and values associated with freshwater and harbour water, and highlights the key issues that need to be managed to support these uses and values.
- The second section describes high level objectives for the catchment, and in turn specific objectives for the attributes that need to be managed to achieve these objectives.
- The final section outlines the methods that will be used to achieve these objectives. These are separated into regulatory and non-regulatory methods. Regulatory methods can be implemented through the new Regional Plan for Northland, Whangārei District Plan or through consent conditions. Non-regulatory methods will be implemented through a variety of means following development of an implementation plan.

Catchment description

The Whangārei Harbour catchment is located on the south-east coast of Northland. It has an area of approximately 300km^2; contains much of Whangārei city urban area; and has a population of around 52,000 people.

The catchment has heterogeneous geology and soils, and has a wide range of land uses, including pastoral farming, plantation forestry, native bush and urban environments (Figure 1).

The catchment is made up of a number of smaller sub-catchments (Figure 2). The three main sub-catchments are formed around the three larger systems – the Hātea River, the Otaika/Puwera streams and the Waiarohia/Raumanga streams.

The catchment flows to a drowned river valley/large estuarine harbour of approximately 105km^2, with an average high tide depth of just 4.4 metres, due to extensive intertidal flats. The harbour can be understood in three distinct areas: upper harbour (west of Matakohe/Limestone Island), middle harbour, and lower harbour (east of Manganese Point).

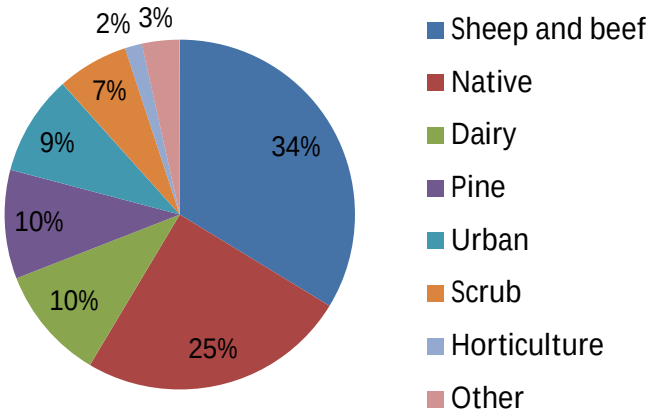


Figure 1 Land use in the Whangārei Harbour catchment.

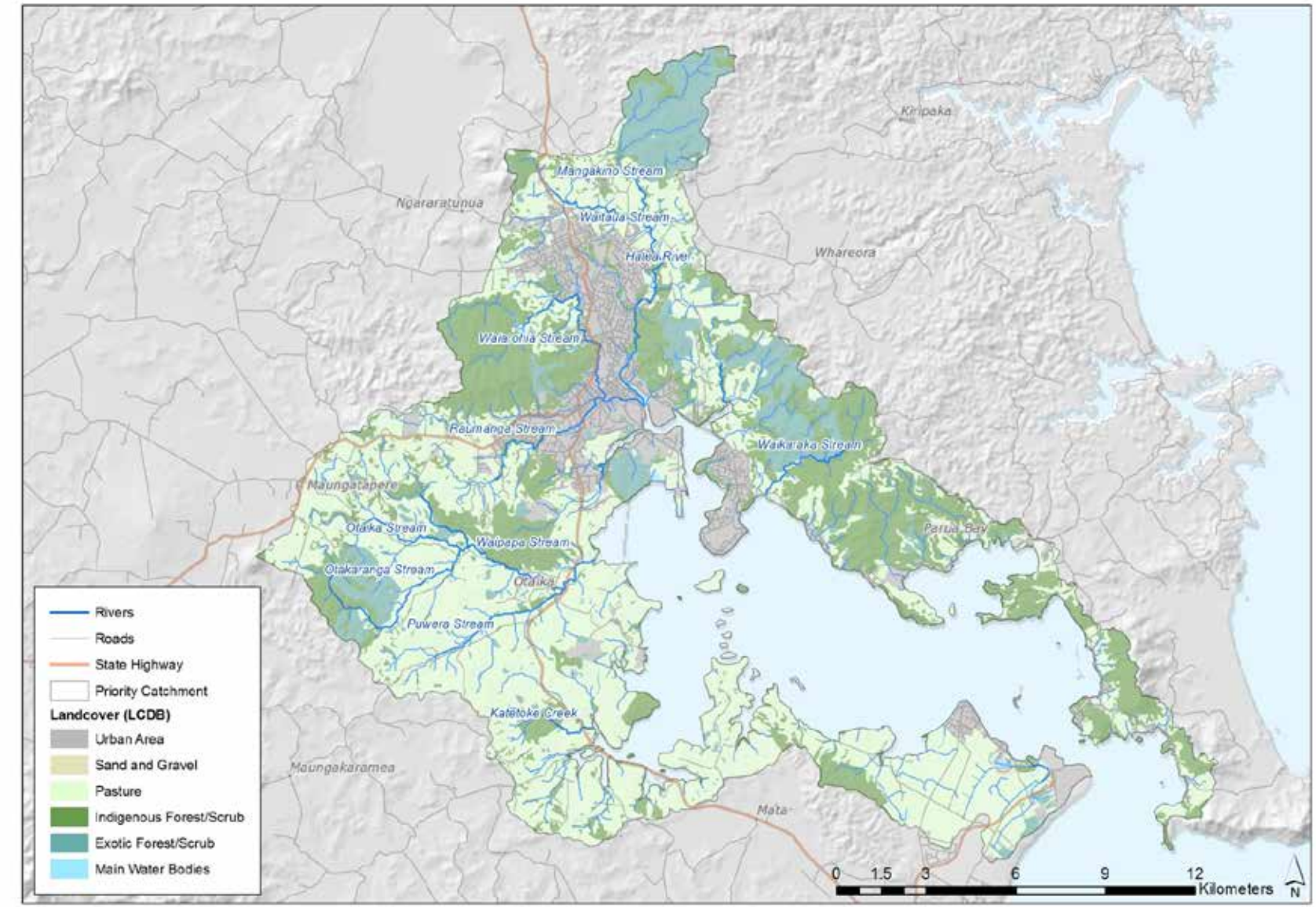


Figure 2: Whangārei Harbour catchment showing main rivers and land cover.

Fresh water quantity – freshwater management units and current state

A freshwater management unit (FMU) is defined as a water body, multiple water bodies or any part of a water body determined by the council as the appropriate spatial scale for setting freshwater objectives and limits and for freshwater accounting and management purposes. Northland Regional Council has grouped rivers in the region into four different FMUs for managing river water quantity based on their uses, values and sensitivity to extraction:

- Coastal rivers;
- Small inland rivers;
- Large rivers; and
- Outstanding rivers.

Each FMU is subject to different limits on the taking of water – how much water should remain in rivers (minimum flow) and the total amount that can be extracted (allocation limit). These limits will be included in the new Regional Plan and serve to protect aquatic habitat values and reliability of supply for water users. The limits are expressed as a percentage of the river's Mean Annual Low Flow (MALF).

Under the regional approach, all the rivers in the Whangārei Harbour catchment are designated as being a coastal river FMU (Figure 3). Coastal rivers have the highest diversity in native fish as many native fish move between fresh and coastal waters as part of their lifecycle. These rivers are sensitive to water takes given their typically small flow, which also means they have the lowest natural reliability for users. Coastal rivers have the most restrictive default allocation limits of the four – having the highest minimum flow (90% MALF) and lowest allocation (30% MALF) limits.

Figure 4 shows the current level of water allocation compared to the regional default allocation limits for coastal rivers (30% MALF) in the Whangārei Harbour sub-catchments (note allocation can change as a result of consents issued or surrendered). Most sub-catchments have either a low or moderate level of allocation (dark and light green coloured areas). However, two sub-catchments, Hātea and Otaika, have a level of allocation above the regional default allocation limit (orange areas). These sub-catchments are fully allocated and therefore 'capped' – i.e. it would be difficult to argue for more water to be allocated.

Table 1 provides water allocation details for these two sub-catchments, showing MALF, default minimum flow and allocation volumes, and the current allocation levels and uses. The current level of allocation in both these sub-catchments are dominated by one or two large takes: Whangārei District Council water takes for public water supply on both the Hātea and Otaika, and a take at the bottom of the Otaika providing water for the Golden Bay cement works at Portland. The remaining consents in these two catchments are for horticultural irrigation. It should be noted that in some cases the actual volume of water used and the volume of water allocated through consents can be quite different and full allocation does not necessarily equate to impacts on these rivers.

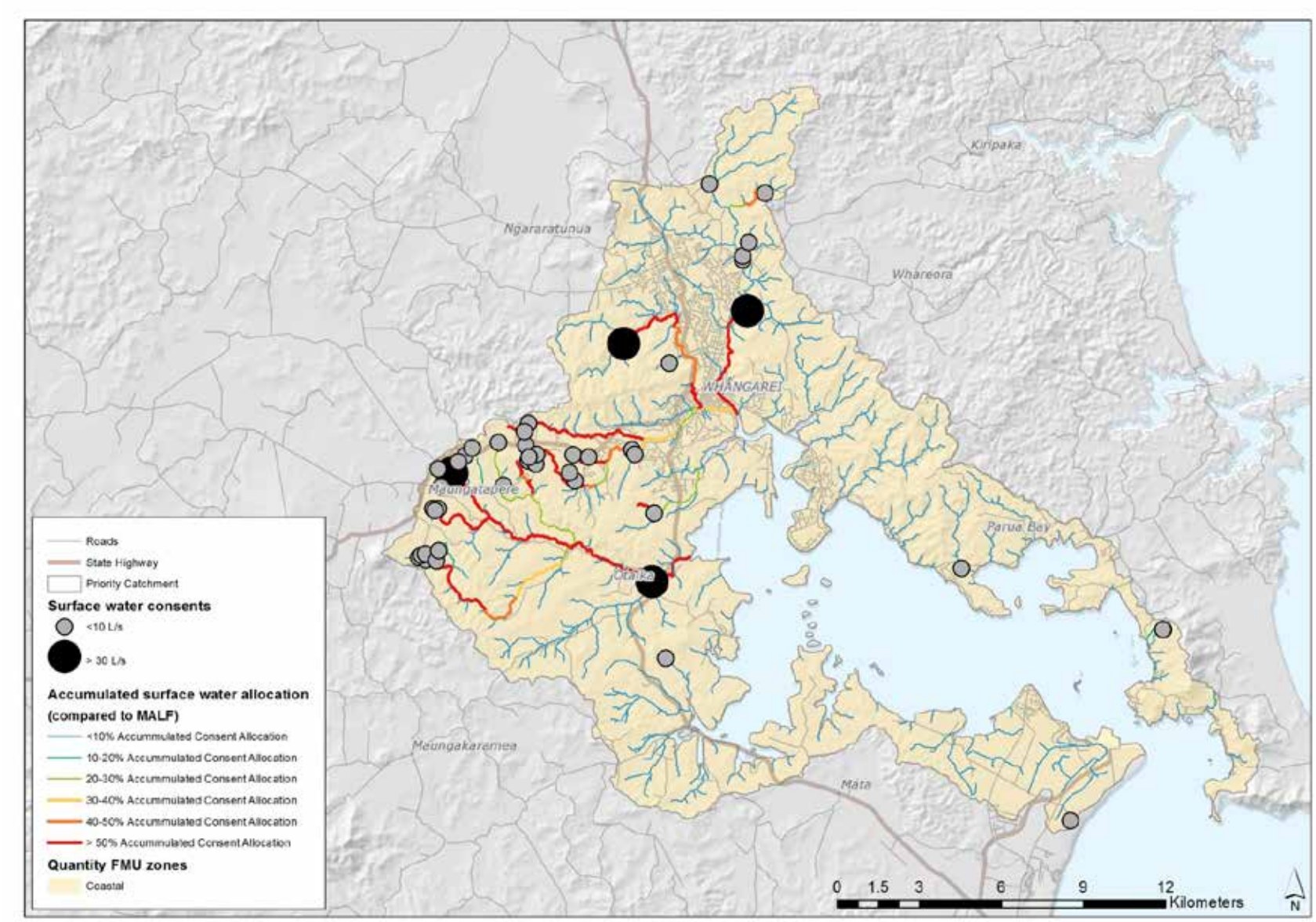


Figure 3: proposed water quantity FMUs in the Whangārei Harbour catchment **and consented surface water takes.**

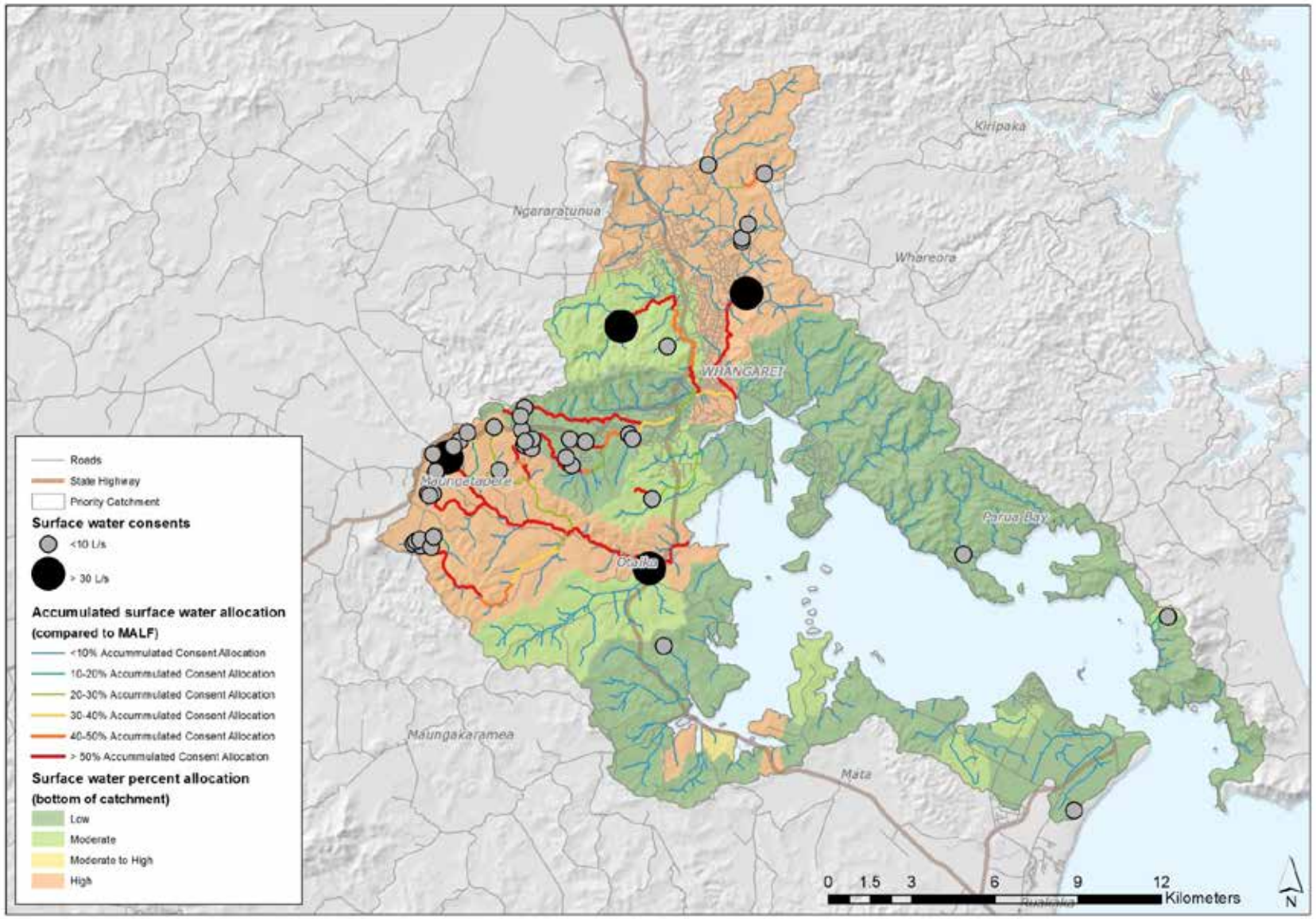


Figure 4: current state of surface water allocation in the Whangārei Harbour catchment.

Table 1: water allocation in the Hātea and Otaika sub-catchments.

Sub-catchment	7-day MALF[1]	Default minimum flow at bottom of the catchment[2]	Default allocation at bottom of the catchment[3]	Current level of allocation[4] – instant-aneous rate	Current level of allocation – 24 hour average daily allocation	Key consents	Non-consented takes	
							Stock drinking	Dairy wash-down
Hātea at Whareora Rd	**122L/s**	**109L/s** (90% MALF)	**37L/s** (30% MALF)	**123L/s** (100% MALF – high)	**110L/s** (90% MALF)	**Whangarei District Council** Max take rate **115L/s** Min flow **114L/s** (93% MALF at reach)	**1L/s** (<1% MALF)	**Not applicable**
Otaika	**135 L/s**	**121.5L/s** (90% MALF)	**40.5L/s** (30% MALF)	**160L/s** (118% MALF – high)	**61L/s** (45% MALF)	**Golden Bay Cement** Max take rate **100L/s** Min flow **36L/s** (26% MALF at bottom of catchment) **Whangarei District Council** Max take rate **31L/s** Min flow not applicable	**4.1L/s** (3% MALF)	**1.7L/s** (1% MALF)

Notes:
1. 7-day Mean Annual Low Flow (MALF) is commonly used for setting minimum flow and allocation limits because it is a measure of water availability during dry periods. MALF also standardises minimum flow and allocation by the size of the river.
2. Minimum flows are set to protect in-stream values, aquatic ecosystems in particular. For reference, the regional default minimum flow limit for small river FMUs is 80% MALF, for example, 98L/s for Hātea.
3. Allocation limits are set to cap the amount of water that can be taken from a water body above a minimum flow. For reference, the regional default allocation limit for small river FMUs is 40% MALF, for example, 49L/s for Hātea.
4. Current level of allocation includes both consented takes and an estimate of non-consented takes.

Fresh water quality – freshwater management units and current state

The new regional plan proposes identifying Lowland and Hill Country areas for the purpose of livestock exclusion rules. Lowland is land below an average15^0 slope, while Hill Country is land above an average 15^0 slope. Figure 5 shows the Lowland and Hill Country areas as they relate to the Whangārei Harbour catchment. Figure 5 also identifies the 12 sites in the Whangārei Harbour catchment that are monitored by Northland Regional Council for fresh water quality. Three of these sites (Hātea at Mair Park, Waiarohia at Second Avenue and Otaika at Otaika Valley Road) have been monitored over a longer period of time as part of Northland Regional Council's River Water Quality Monitoring Network (RWQMN). The other nine sites were established in July 2014 to assist in monitoring the catchment.

Tables 2 and 3 summarise the current state of fresh water quality in the Whangārei Harbour based on monthly sampling at these 12 monitoring sites during the 24-month period June 2014 to July 2016 for a number of different measures. The Puwera at Bennett's site is no longer considered suitable as a water quality sampling site as it ephemeral with low flows generally. This site is being relocated to an area with higher flows nearby on the Puwera. Table 2 provides the results as they relate to the "National Objective Framework (NOF)" attributes which are compulsory. In its current form the NOF does not address all the water quality issues of concern in Northland. For this reason other guidelines/indicators are used to give a more complete picture of water quality (Table 3). While the NOF and guidelines such as the Australian New Zealand Environment Conservation Council (ANZECC) 2000 Guidelines are quite different and are not directly comparable, it is useful to provide results for both to give an overall indication of water quality throughout the catchment. For example, the ANZECC (2000) guidelines outline trigger values for water quality aspects that put stress on river and stream health. This specifies a level below which there is a low risk that adverse biological effects will occur. Council also monitors stream macroinvertebrates (MCI) and stream habitat as indicators of water quality and stream health.

Results for the river water quality monitoring site on the Mangere River in the Pukenui Forest provide a reference site to allow for comparison with a native forested sub-catchment. Information on flow is available for three sites, and is summarised below.

Water quality monitoring site	**Flow (L/s)**		
	7 day MALF	**Mean Flow**	**Median Flow**
Hātea at Mair Park	122	1094	539
Waiarohia at Second Avenue	64	362	150
Raumanga at Bernard St	88	355	196

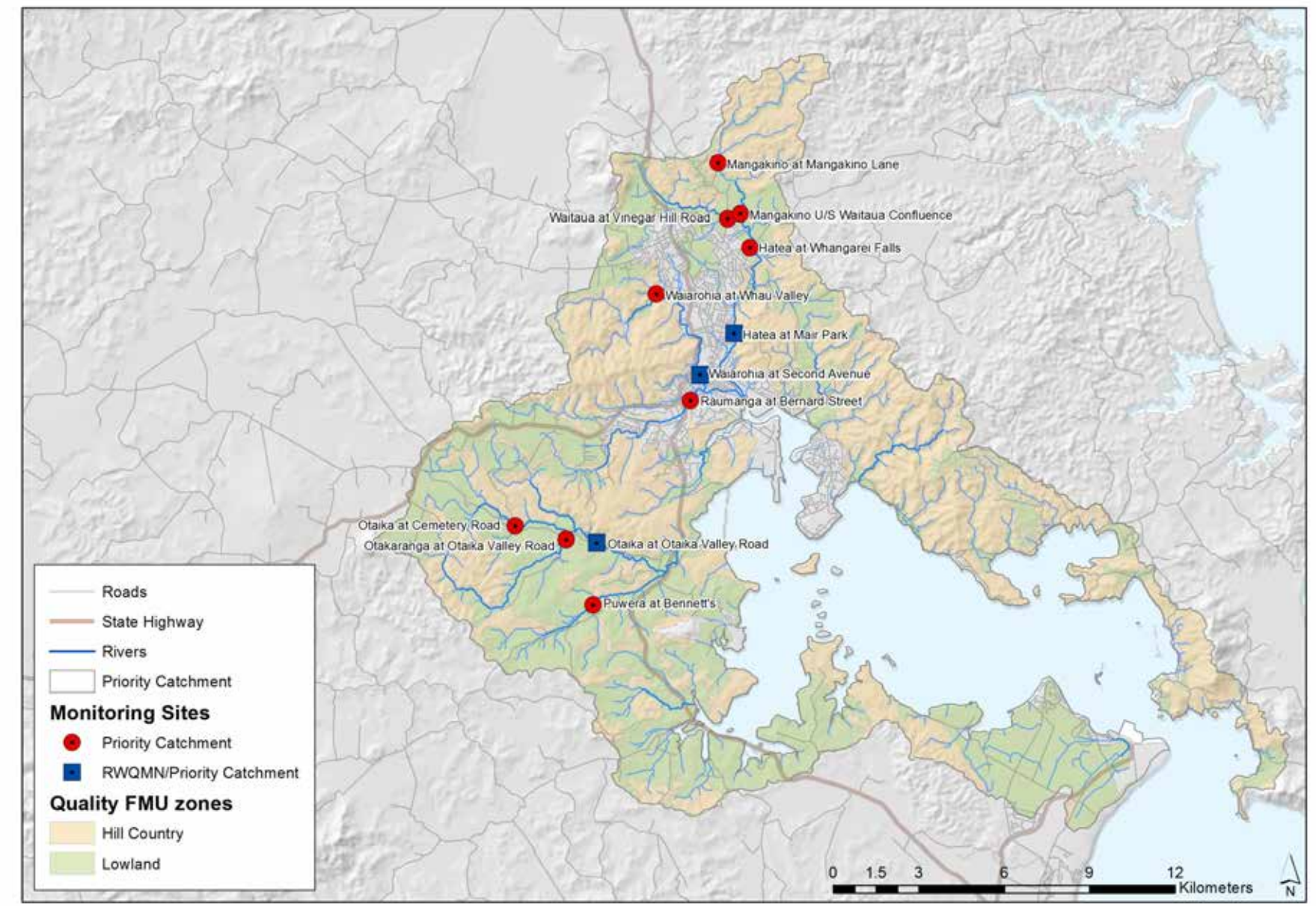


Figure 5: Water quality monitoring sites and Lowland areas (land <15^0 slope) and Hill Country areas (land >15^0 slope) in the Whangārei Harbour catchment.

Table 2: freshwater quality in the Whangārei Harbour catchment using NOF attributes.

Water quality monitoring site	FMU	National Objective Framework (NOF) attributes						
		Nitrate nitrogen toxicity (mg/L)		Ammoniacal nitrogen toxicity (mg/L)		Escherichia coli (*E. coli*/100mL)		Periphyton exceeds no more than 8% of samples[1] (Chl-a mg/m^2)
		Annual median A ≤1 B >1≤2.4 C >2.4≤6.9 D >6.9	95th percentile A ≤1.5 B >1.5 ≤3.5 C >3.5≤9.8 D >9.8	Annual median A ≤0.03 B .0.3≤0.24 C .0.24≤1.3 D.1.3	Annual maximum A ≤0.05 B >.05≤0.4 C >0.4≤2.2 D >2.2	Annual median A ≤260 B >260≤540 C >540≤1000 D >1000	Annual 95th percentile A ≤260 B >260≤540 D >540	Chlorophyll-a A ≤50 B >50≤120 C >120≤200 D >200
Mangere at Pukenui Forest	LL	A	A	A	A	A	A	ND
Mangakino at Mangakino Lane	HC	A	A	A	A	A	D	C
Mangakino U/S Waitaua confluence	LL	A	A	A	B	C	D	ND
Waitaua at Vinegar Hill Road	LL	A	A	B	B	B	D	ND
Hātea at Whangārei Falls	LL	A	A	A	B	B	D	ND
Hātea at Mair Park	HC	A	A	A	B	A	D	C
Waiarohia at Whau Valley	LL	A	A	A	B	B	D	B
Waiarohia at Second Avenue	No	A	A	A	B	B	D	C
Raumanga at Bernard Street	No	A	A	A	A	C	D	B
Otaika at Cemetery Road	LL	B	B	A	B	C	D	ND
Otakaranga at Otaika Valley Road	LL	A	A	A	B	A	D	ND
Otaika at Otaika Valley Road	LL	A	B	B	B	B	D	D
Puwera at Bennett's	LL	A	A	B	D	B	D	B

Notes:

ND = No Data: water quality monitoring site is not suitable for Periphyton chlorophyll-a sampling due to not having a stony substrate.

1. It is too early to make a definite judgement regarding the current status of Periphyton chlorophyll-a. The results provided are based on one year's worth of sampling. The NPS-FW indicates three years of sampling.

Source: Northland Regional Council (2016), *Whangārei Harbour Catchment: Water Quality Update*.

Table 2 legend

A	Similar to reference conditions
B	Slightly impacted
C	Moderately impacted (lower/upper national bottom line)
National bottom line	

D	Degraded/unacceptable (must be managed to C or better)

Table 3: freshwater quality in the Whangārei Harbour catchment using national guideline/trigger values.

Water quality monitoring site	ANZECC guidelines						RMA 1991	Ecological indicators	
	Nitrate, nitrite, nitrogen (mg/L)	Ammoniacal nitrogen (mg/L)	Total nitrogen (mg/L)	Dissolved reactive phosphorus (mg/L)	Total phosphorous (mg/L)	Turbidity (NTU)[1]	Dissolved oxygen (% saturation)	Macro-invertebrates [2]	Stream habitat[3]
ANZECC 2000 trigger	Annual median <0.444	Annual median <0.021	Annual median <0.614	Annual median <0.01	Annual median <0.033	Annual median <5.6	Annual median ≥80	MCI score	% rating compared with reference site
Mangere at Pukenui Forest	Below	Below	Below	Above	Below	Below	Above	127	100
Mangakino at Mangakino Lane	Below	Below	Below	Below	Below	Above	Above	129	90
Mangakino U/S Waitaua confluence	Below	Above	Below	Above	Below	Above	Above	99	37
Waitaua at Vinegar Hill Road	Above	Above	Above	Above	Below	Below	Below	71	34
Hātea at Whangārei Falls	Above	Above	Below	Below	Below	Below	Above	ND	ND
Hātea at Mair Park	Below	Above	Below	Above	Below	Below	Above	109	76
Waiarohia at Whau Valley	Above	Above	Below	Above	Below	Below	Above	115	78
Waiarohia at Second Avenue	Below	Above	Below	Above	Below	Below	Above	98	48
Raumanga at Bernard Street	Above	Below	Above	Above	Below	Below	Above	106	45
Otaika at Cemetery Road	Above	Above	Above	Above	Above	Above	Above	88	36
Otakaranga at Otaika Valley Road	Below	Above	Below	Below	Below	Above	Below	69	43
Otaika at Otaika Valley Road	Above	Above	Above	Above	Above	Below	Above	129	81
Puwera at Bennett's	Below	Above	Above	Above	Above	Below	Above	89	36

A	Similar to reference conditions
B	Slightly impacted

Notes:
ND = No Data as monitoring has not been done at this site.
1. Turbidity national trigger/guideline value: ≤ 5.6 NTU. This is an upper limit indicative of unmodified or slightly disturbed ecosystems in New Zealand lowland rivers.
2. Macroinvertebrate Condition Index (MCI) scoring index: Poor < 80; 80 ≤ Fair < 100; 100 ≤ Good < 120; 120 ≤ Excellent.
3. Stream habitat score: above or below 50% of reference condition.
Source: Northland Regional Council (2016), *Whangārei Harbour Catchment: Water Quality Update.*

C	Moderately impacted
E	Unacceptable

Table 3 legend

Coastal water quality – zones and current state

Northland Regional Council is proposing in the new Regional Plan to classify the region's coastal waters into four zones for managing aquatic eco-system health: open coast, estuarine (the main bodies of estuaries and harbours), tidal creeks (shallow, narrow sediment depositional areas in the upper harbour reaches of estuaries) and Hātea River. Each zone will have different water quality standards in acknowledgement that water quality differs between the zones. Water quality standards for recreation will apply to open coast and estuarine zones, and the standards for aquaculture and shellfish consumption will apply to aquaculture sites and popular shellfish gathering sites identified by council.

The proposed coastal water quality zones as they relate to the Whangārei Harbour catchment are shown in Figure 6.

Table 4 summarises the current state of coastal water quality in the Whangārei Harbour based on bi-monthly sampling at 16 monitoring sites covering the five-year period January 2010 to December 2014. Water quality in sites tested in the outer harbour is good. Sites tested in the Hātea arm and tidal creek areas could be improved.

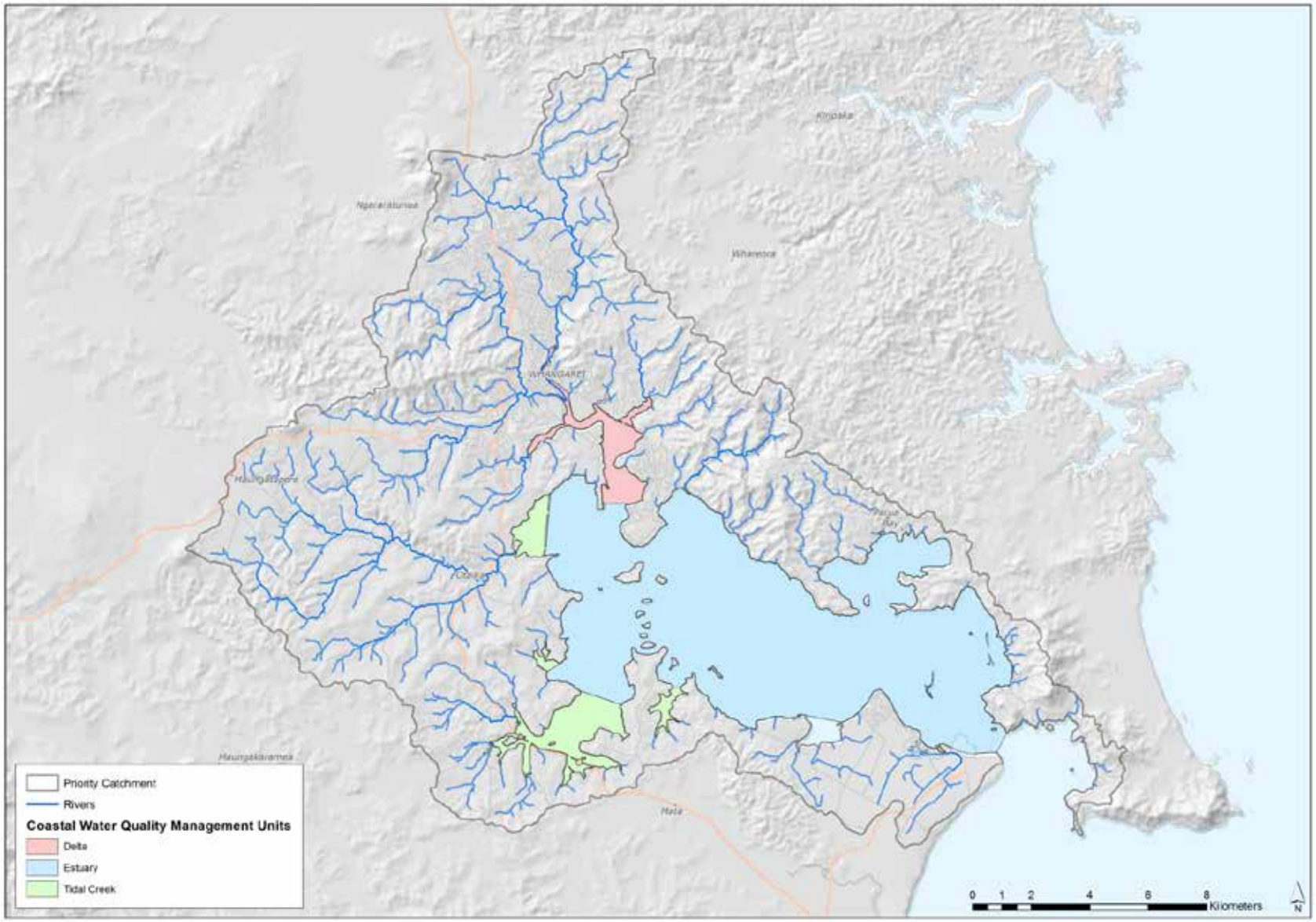


Figure 6: proposed coastal water quality zones in the Whangārei Harbour catchment.

Table 4: coastal water quality in the Whangārei Harbour.

Proposed zone	Site name	Nitrate-nitrite nitrogen	Ammon-ium	Chlorophyll-a	Enterococci (Primary contact guidelines)	Faecal coliform (Shellfish guideline)	Dissolved reactive phosphorus	Turbidity	Dissolved oxygen	Water quality index
		NNNmg/l	NH_4mg/l	mg/l	MPN/100ml	MPN/100ml	DRP mg/l	NTU	% saturation	Index
		Median	Median	Median	95th percentile	Median	Median	Median	Median	
	ANZECC 2000 trigger[1]	0.0150	0.0150	0.00400	40	14	0.0050	10.0	80%<X<110%	NA
Hātea	Town Basin	0.4100	0.0660	0.00250	393	149	0.0650	4.3	87.8	15.0
	Upper Hātea River	0.4450	0.0745	0.00280	369	79	0.0735	4.5	84.8	13.8
	Waiarohia Canal	0.5750	0.0790	0.00200	362	76	0.0885	4.3	87.6	13.6
	Limeburners Creek	0.4400	0.0835	0.00175	724	100	0.0900	6.2	85.7	11.7
	Kissing Point	0.2100	0.0650	0.00200	401	27	0.0585	5.7	87.5	16.6
	Lower Hātea River	0.1035	0.0340	0.00250	361	16	0.0380	5.2	87.4	27.0
Tidal Creek	Otaika Creek	0.3000	0.0445	0.00220	109	111	0.0080	9.1	85.9	25.9
	Mangapai River	0.0079	0.0160	0.00190	59	6	0.0145	8.5	79.4	33.2
	Portland	0.0091	0.0140	0.00225	16	1	0.0140	6.2	91.2	35.8
Estuarine	Kaiwaka Point	0.0430	0.0215	0.00175	337	1	0.0200	5.0	90.9	36.6
	Onerahi	0.0100	0.0053	0.00175	36	1	0.0135	5.0	96.7	51.2
	Tamaterau	0.0075	0.0095	0.00140	16	1	0.0100	2.7	96.5	53.8
	One Tree Point	0.0032	0.0025	0.00140	6	1	0.0075	0.9	98.5	72.6
	Snake Bank	0.0035	0.0025	0.00130	46	1	0.0080	0.9	98.7	65.1
	Blacksmith Creek	0.0024	0.0025	0.00083	10	1	0.0070	0.7	98.8	64.2
	Marsden Point	0.0030	0.0025	0.00115	8	1	0.0070	0.7	99.0	73.1
	Mair Bank	0.0028	0.0025	0.00115	36	1	0.0070	0.6	99.0	64.8

Notes:
1. Default trigger values for south-east Australia for slightly disturbed estuary ecosystems. This specifies a level below which there is a low risk that adverse biological effects will occur. The median faecal coliform bacterial concentration should not exceed 14 MPN/100mL, with no more than 10% of the samples exceeding 43 MPN/100 mL
Source: Northland Regional Council (2016), *Coastal Water Quality Monitoring: 2010-2014 results.*

Council also monitors coastal water quality for recreational bathing during the summer (end of November to end of February) to assess the risk of contamination. There are two permanent sites in the Whangārei Harbour catchment: Onerahi and Taurikura Bay. Three additional sites at McLeod Bay, Urquharts Bay and One Tree Point were monitored during the 2015/16 season. All samples taken from all five sites during the 2015/16 season – which were each sampled 14 times – were below the trigger level indicating that the water quality was suitable for swimming on all sampling occasions. Recent end-of-season grading for the two permanent monitoring sites are presented in Table 5.

Table 5: results for coastal permanent monitoring swimming sites in the Whangārei Harbour 2007/08 to 2015/16.

Site name	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Onerahi playground	100	100	100	89	100	94	100	93	100
Taurikura Bay	92	75	100	89	100	100	100	100	100

	95-100% samples within guidelines (no 'Action' result)		90-94% samples within guidelines
	75-89% samples within guidelines		<75% samples within guidelines

In addition to assessing sites for their suitability for swimming, results from sites also popular for shellfish gathering are compared to the Ministry for the Environment and Ministry for Health microbiological guidelines. These samples are collected over the summer months rather than the entire shellfish gathering season, which, excluding scallops, is all year round in Northland. Various sites within the Whangārei Harbour are assessed. Results for the last six seasons are presented in Table 6.

Table 6: Results for recreational shellfish gathering sites coastal permanent monitoring sites 2010/11 – 2015/16

	% of sample exceeding MPN of 43/100ml					
Site Name	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**
One Tree Point at Intertidal Beach	ND	13%	12%	13%	7%	7%
Onerahi playground	ND	47%	18%	13%	14%	ND
Taurikura Bay	18%	19%	6%	6%	29%	ND
Urquharts Bay	18%	ND	ND	ND	ND	0%

1. Guideline value is that no more than 10 percent of samples should exceed an MPN of 43/100ml.

Sedimentation in the Whangārei Harbour

Using sediment cores taken from eight intertidal and one sub-tidal site, NIWA (2013b) found that the upper harbour has substantially infilled with eroded catchment soils. Mud is exported from the upper to the lower harbour where it has been accumulating in the bays and inlets that indent the northern shoreline. The study identified three areas in the upper Whangārei Harbour that deposit catchment sediments and three long-term "mud sinks" east of Onerahi Peninsula (Figure 7). These are:

- Upper harbour mangrove habitats, which are assumed to be accreting at a rate that is equal to the long-term rate of relative sea-level rise (1.5 mm/y at the Ports of Auckland).
- Upper harbour saltmarsh habitats, also assumed to be accreting at a rate that is equal to the long-term rate of relative sea-level rise (1.5 mm/y at the Ports of Auckland).
- Upper harbour unvegetated intertidal flats, accreting at a spatially-averaged rate of 4 mm/y.
- Parua Bay, in the lower harbour, where rapid vertical accretion of the intertidal flats occurred until the early 1950s when reduced tidal inundation lowered sediment delivery. Today, the intertidal flat is accumulating sediment (2.9mm/year) at a similar rate to the central subtidal basin (2.2mm/year).
- Munro Bay, in the lower harbour, where mud from rivers discharging to the upper harbour has been depositing from the mid-1950s, burying the previous shell-rich sands.
- Along the northern shore from Onerahi Peninsula east to Jacksons Bay, in the middle harbour.

The study estimated that the average sediment accumulation rate (SAR) in the Whangārei Harbour is 3.4mm/year, within the range observed in other North Island estuaries (1.9-6.7mm/year) over the last century. The long-term sediment yield from the upper harbour catchment has been estimated from sedimentation data as 30,400 ±6040 tons per year over the last 50 years (1962-2012). However, this period includes the time when Portland Cement discharged large quantities of sediment to the harbour (1958-82), which will have had an effect on the 3.4mm/year figure. Sediment modelling using SedNetNZ[1] estimated a total erosion based sediment yield of 24,000 tons per year for the upper harbour catchment and 31,500 tons per year for the whole Whangārei Harbour catchment (Figure 8). Pastoral land use accounts for 43% of total erosion sediment. While land based erosion processes currently account for about 85% of total erosion in the catchment, stream bank erosion varies considerably by sub-catchment. SedNetNZ models fine sediment generated through natural erosion processes (e.g. landslide, earthflow, gully and surficial erosion). It does not account for sediment generated from activities such as earthworks.

[1] SedNetNZ is a model used to identify types of erosion processes and their relative yield to total sediment load

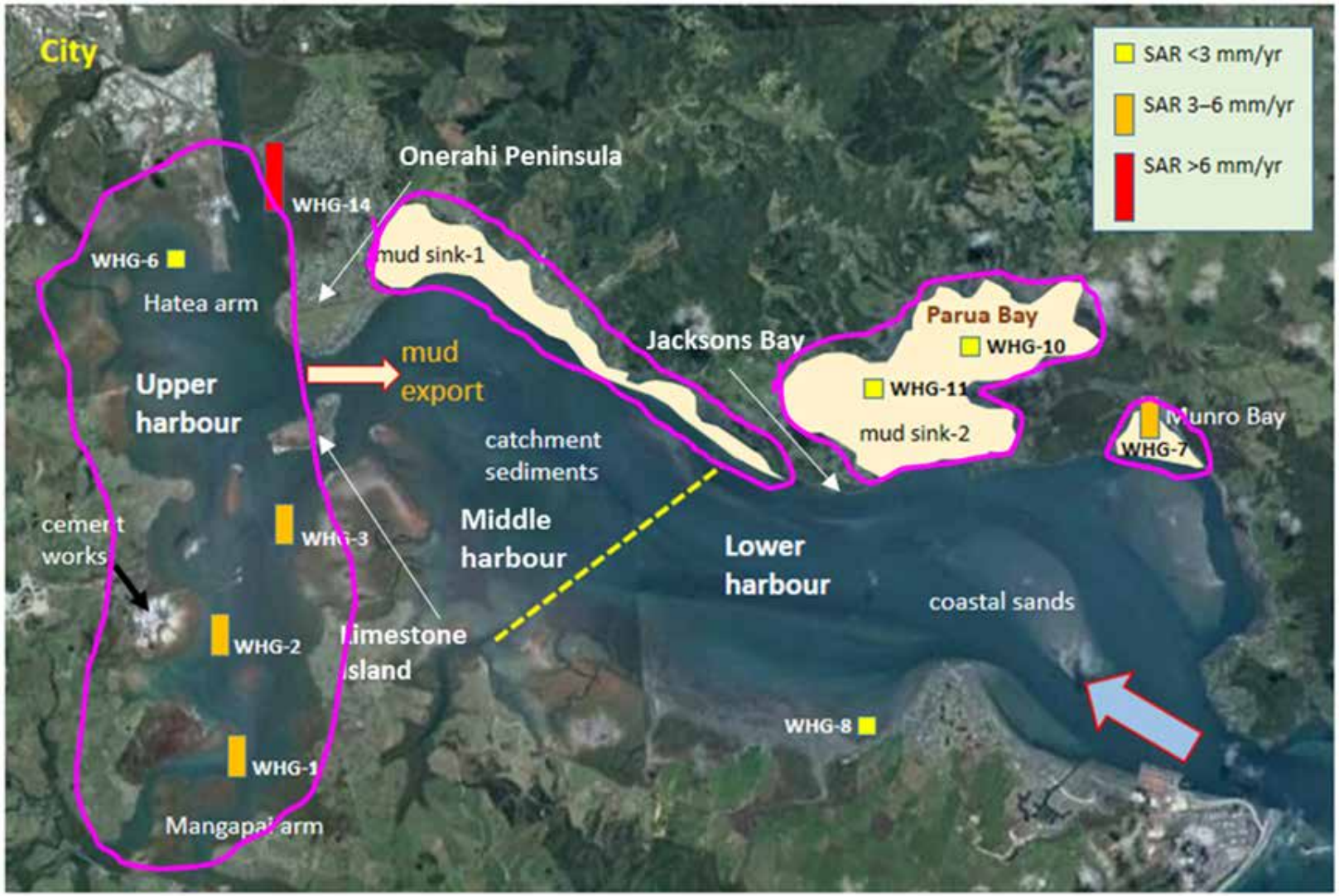
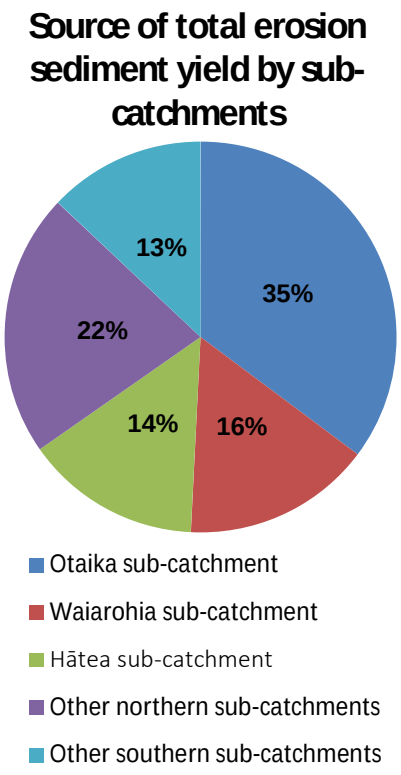
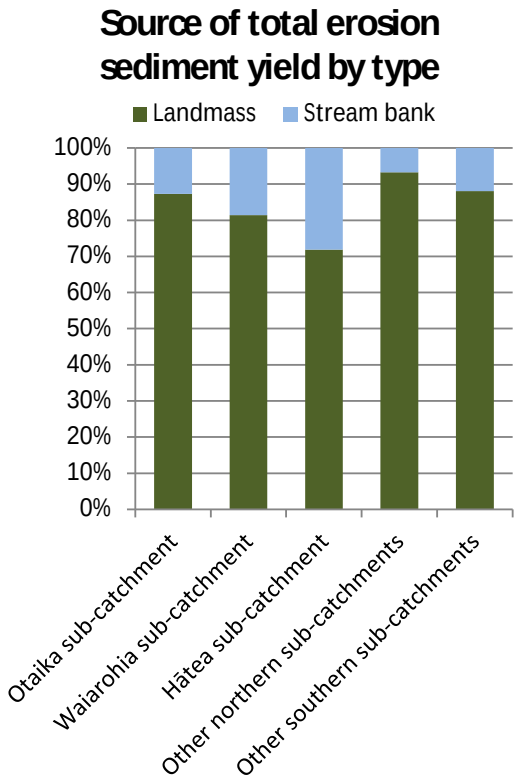
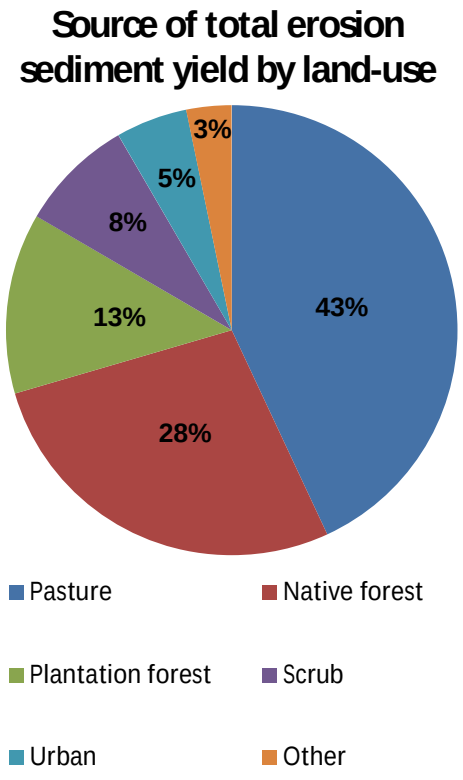


Figure 7: summary of recent sedimentation in Whangārei Harbour based on core sampling data.


Source of total erosion sediment yield by sub-catchments
35%
16%
14%
22%
13%
Otaika sub-catchment
Waiarohia sub-catchment
Hātea sub-catchment
Other northern sub-catchments
Other southern sub-catchments


Source of total erosion sediment yield by type
Landmass
Stream bank
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Otaika sub-catchment
Waiarohia sub-catchment
Hātea sub-catchment
Other northern sub-catchments
Other southern sub-catchments


Source of total erosion sediment yield by land-use
43%
28%
13%
8%
5%
3%
Pasture
Native forest
Plantation forest
Scrub
Urban
Other

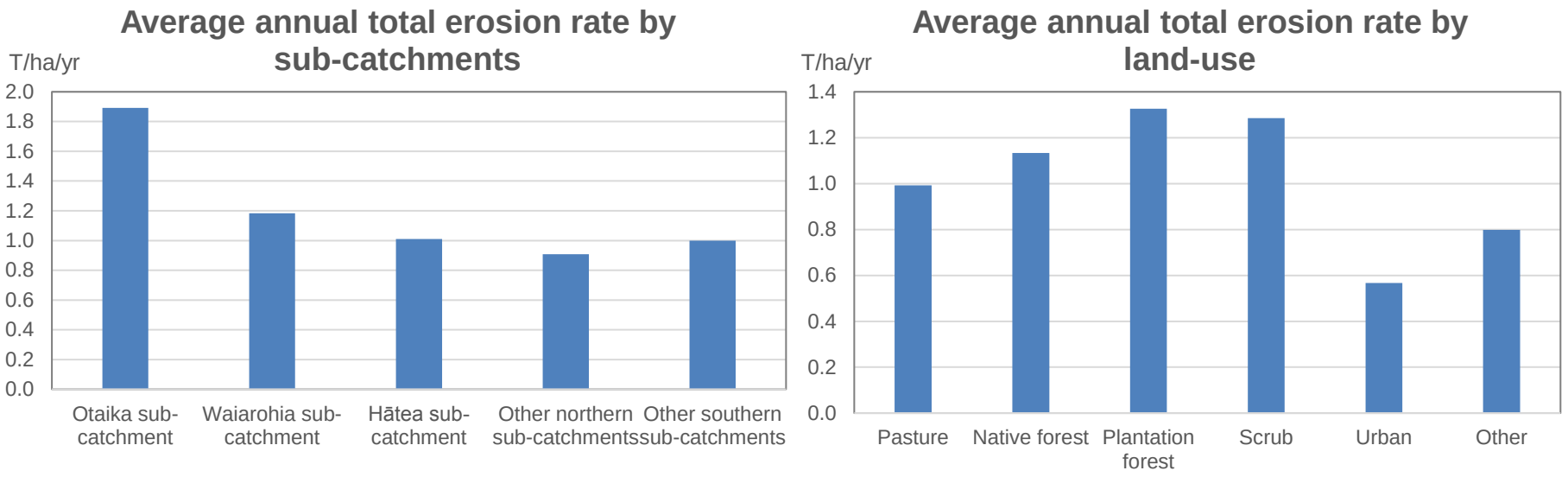


Figure 8: SedNetNZ erosion modelling results for Whangārei Harbour catchment.

The charts above show total erosion by sub-catchment and average annual total erosion rate (T/ha/yr) by land use. Plantation forestry, native forest and scrub tend to have higher erosion rates because they are typically located on the steepest, most highly erodible soil in the catchment. If pasture production was taking place on these areas of the catchment then the erosion rate would be much higher and conversely if plantation forestry was taking place on land in pasture, then annual erosion rates from these areas would be lower.

The Whangārei Harbour Catchment Plan recommends targeting high sediment yielding land for intervention to address erosion processes (i.e. a requirement for pastoral land use on these areas to develop an Erosion Control Plan by 2025). In the Whangārei Harbour catchment high sediment yielding land is land that is estimated to generate 250 tonnes of sediment/KM^2 per annum or more (refer to Appendix 5 for a map of these areas). Full implementation of the erosion control plans is modelled to reduce hill slope erosion by 23%.

Uses and values

A key step in the process used to develop this catchment plan was identification of uses and values – this identifies the matters of primary concern in the catchment. The following table lists the specific uses and values for fresh and coastal water identified by the Whangārei Harbour catchment group. These have been organised by the group into five broad categories of uses and values for determining issues and objectives for the catchment.

Table 7: uses and values for fresh and coastal water

Broad uses and values categories						
				Socio-economic		
Ecosystem health	**Natural form and character**	**Cultural health**	**Recreation**	**Potable water supply**	**Other water supply**	**Navigation**
Biodiversity and habitat. Instream values – macro invertebrate biodiversity. Contribution to maintaining natural clean environment. Essence of quality of well-being. Well-being – able to sustain life. Waste dilution/filtration. Education. Linked ecosystems from mountain to sea.	Sense of place/well-being. Natural character/landscape. Great karma/help keep sanity/aesthetics/sense of peace.	Kaitiakitanga (obligation of tangata whenua includes knowledge and guardianship). Tikanga (traditional practices in relation to everything). Mauri (protection of life force of water bodies and all within them). Mahinga kai/mataitai (fishing, shellfish gathering, tuna, koura, watercress, etc.). Wai tapu (healing waters, sites of significance associated with waterways). Cultural identity (awa, harbour named in pepeha, whakapapa, etc, important to cultural/spiritual well-being). Mātauranga Māori/Wai tukiato (gift of knowledge and resources for future generations, our own "science" practices, etc. in relation to catchment management).	Swimming Diving Kayaking Sailing Rowing Waka ama Hiking	Domestic drinking (public and private). Clean drinking water is a basic human right. Respect of mokopuna.	Irrigation. Stock drinking. Cowshed/plant cleaning and cooling. Forestry. Small industry. Firefighting.	Access historical use. Navigation. Tauranga waka. Access for boating. Anchorage. He ara haere. Port (Marsden and inner city).

Attributes

Once uses and values have been identified, the second step is to determine the factors (attributes) that affect or support those uses and values (E.g. recreational use is affected by the attributes *E.coli* and visual clarity). This in turn can be used to set attribute specific objectives to protect or improve a given value (E.g. an objective to reduce *E.coli* and improve visual clarity for the purposes of recreational use). The Table below sets out the relationship between attributes and uses and values identified by the catchment group - the greater the shaded area, the more important that attribute is determined to be in relation to supporting that use/value.

Table 8: uses and values associated with attributes

	Uses and values																							
													Socio-economic											
Attributes	Ecosystem Health			Natural form and character			Cultural Health			Recreation			Potable water supply			Other water supply			Navigation					
Nitrate nitrogen (toxicity)	■	■	■	■			■	■	■	■	■		■	■	■	■								
Ammonia (toxicity)	■	■	■	■			■	■	■	■	■		■	■	■	■								
Periphyton (trophic state)	■	■	■	■			■	■	■	■	■		■	■	■	■								
Escherichia coli (E.Coli) - [faecal indicator bacteria]							■	■	■	■	■	■	■	■	■	■								
Enterococci (Ent.) - [faecal indicator bacteria]							■	■	■	■	■	■												
Nutrients	■	■	■	■			■	■	■	■	■		■	■	■	■								
Clarity	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■				
Sediment (deposited)	■	■	■	■	■	■	■	■	■	■			■	■	■	■	■		■	■	■			
Dissolved Oxygen (below point source)	■	■	■	■	■		■	■	■				■											
Heavy metals and petrochemical compounds	■	■					■	■	■	■			■	■	■	■	■	■						
Gross pollutants (inorganic solid waste)	■	■		■	■	■	■	■	■	■	■	■	■	■		■			■	■	■			
Obstructions (including fish passage barriers)	■	■	■	■	■	■	■	■		■	■								■	■	■			
Riparian cover	■	■	■	■	■	■	■	■					■	■										
Flow	■	■	■	■	■	■	■	■	■	■			■	■		■	■	■	■					
Level of modification	■	■	■	■	■	■	■	■											■					
Water temperature	■	■	■				■	■	■	■			■											
Agrichemicals	■	■	■				■	■	■	■	■	■	■	■	■	■	■							
Odour/Taste	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
Sight - scum, film etc	■			■			■	■		■	■		■						■					

Note:
the top four (shaded) attributes are compulsory under the NPS Freshwater 2014

The issues/problems

This section outlines the key issues associated with managing water quality and quantity in the Whangārei Harbour catchment. These are arranged under the five broad categories of uses and values. Under each of the broad categories, the catchment group has identified some specific uses and values. Resolving issues that relate to one use or value may impact on other uses and values (E.g. a reduction in sediment may address ecosystem health, cultural and recreational values).

Table 9: issues relating to identified uses and values

Uses/values	**Issue (specific and/or generic)**
Ecosystem health	1. Habitat for native fish species is impacted by lack of connectivity and riparian cover, flow/abstraction, sediment, and dissolved oxygen levels. 2. All streams surveyed to date have had man-made fish passage barriers identified (Appendix 4). 3. The upper harbour has substantially infilled. Mud travels from the upper to lower harbour where it has been accumulating in the bays and inlets that indent the northern shoreline. Sub-soils that come from streambank erosion, gullying and slips and land disturbance from subdivisions/earthworks, etc., are major sources of new sediment deposited in stream beds and at river deltas in the upper harbour since the mid-1980s. Pre-1980s sediment discharges from the Portland cement factory are still redistributing through the harbour. 4. The upper harbour scores poorly in terms of overall water quality: a. Stormwater discharge and run-off from the urban environment contains contaminants including heavy metals, petrochemical compounds and other particulate matter. b. Wastewater treatment plants contribute nutrients into the marine environment while heavy rainfall-related flows from the network are a source of faecal pathogens. c. Industrial discharges from activities such as boat yards and factories contribute suspended sediments and particulate and dissolved matters into the marine environment. d. Leaching from landfills is a potential source of contaminants into the marine environment. 5. Stock access to waterways and associated discharge/disturbance to bed/stream bank/habitats. 6. Variable flow – if it is too low ecosystem health is affected, particularly during prolonged natural periods of low flows. 7. Lack of catchment-wide knowledge on the status of ecosystem health and impacts on it, for example inanga spawning sites.

Uses/values	Issue (specific and/or generic)
	8. There are cumulative effects of land use and development activity on water quality within the catchment.
Natural form and character	1. A low level of native riparian cover reduces natural character in some sub-catchments. 2. Stream channelization, culverting and piping reduce natural form. 3. Water extraction impacts on natural flow levels, and can prolong periods of low flow. 4. Gross pollutants/scum/poor clarity can have a negative impact visually on the natural character of water bodies.
Cultural health	1. The Mauri of water is in decline and needs enhancing and protection. 2. Water is perceived as a public utility and infinite resource rather than a taonga tuku iho. 3. Mahinga kai and mātaitai resources are increasingly limited due to reduced habitat/water quality. Subsequently, cultural values including, but not limited to, mana, manaakitanga, mātauranga, kaitiakitanga are impacted. 4. Mana Whenua are increasingly unable to carry out cultural and traditional activities on, within and around water resources. 5. Wāhi tapu/cultural sites of significance can be impacted by works in and next to waterways. 6. Loss of ability to practice kaitiakitanga and associated mātauranga.
Recreation	1. In-stream recreational use, in particular primary contact, is limited by pathogens across the catchment including popular swimming sites at Whangārei Falls and Raumanga Stream. 2. Marine recreational use (swimming in particular) can be restricted in the upper harbour by pathogens, particularly during or after heavy rainfall events. 3. Lack of knowledge on causes of health issues related to recreational water use due to non-reporting. 4. Visible rubbish, litter and weeds reduce amenity values.
Socio-economic	1. Two sub-catchments (Hātea and Otaika) are highly allocated for water quantity, limiting potential for economic development. 2. Large priority water takes for reticulated water supply for Whangārei and connected villages limit availability for other water takes. 3. High demand and limited availability during low flows can limit economic potential. 4. Commercial harvest of fish/shellfish is limited by water quality and sedimentation.

Objectives

This part outlines the objectives for the Whangārei Harbour catchment. These are divided into two levels. First there are high level objectives that set the broad aspirational outcomes. Below this are more detailed objectives that are set for specific attributes or other variables identified by the group that contribute to the achievement of the high level objectives.

High level objectives

The following table lists the high level objectives for the Whangārei Harbour catchment. For each objective, the uses and values that it supports are noted. The objectives take into account the fact that improvements in water quality will take time and that there are often delays in the time it takes for the ecosystem to respond.

Table 10: uses and values associated with high level objectives

High level objectives	**Uses and values supported by the objective**				
	Eco-system health	**Natural form and character**	**Cultural health**	**Recrea-tion**	**Socio-economic**
Coastal Within 10 years, faecal pathogen, turbidity, sedimentation rates, heavy metals and nutrient levels have reduced in the Hātea zone of the upper harbour, and within 30 years they have significantly reduced, so that it becomes more accessible to a wide range of water-related activities and its impact on the ecological condition of the rest of the harbour is reduced.	*ü*		*ü*	*ü*	*ü*
Within 10 years faecal pathogen and sedimentation rates have reduced in the tidal creek zones, and within 30 years they have significantly reduced, so that they become more accessible to a wide range of water-related activities and their impact on the ecological condition of the rest of the harbour is reduced.	*ü*		*ü*		

Good water quality in the estuarine zone is maintained and where practical improved for its ecological condition and high recreational, cultural, and economic uses and values.	ü		ü	ü	ü
High level objectives	**Uses and values supported by the objective**				
	Eco-system health	**Natural form and character**	**Cultural health**	**Recrea-tion**	**Socio-economic**
Freshwater Maintain and enhance habitat to support indigenous fish species by improving connectivity and riparian cover.	ü		ü		
Maintain and enhance water quality to ensure sustainable mahinga kai.		ü	ü		ü
Maintain and enhance water quality for secondary contact recreation in rivers and streams.				ü	
Improve water quality to primary contact recreation levels during the summer bathing season in regionally significant swimming sites within 10 years, and at additional sites within 30 years.			ü	ü	
Minimise adverse effects of abstractions on the ecosystem health, natural character and mauri of rivers and streams.	ü	ü	ü	ü	
Maximise the availability and reliability of water supply.					ü

Attribute level objectives

The following table lists the detailed objectives for the Whangārei Harbour catchment. Objectives are set for each of the attributes identified by the group as being important to manage in order to support the high-level objectives set above and in turn the various uses and values identified by the catchment group.
The first four are the relevant compulsory NOF attributes set under the national freshwater policy statement.

Table 11: objectives for each attribute

Attribute	Current state in Whangārei Harbour catchment	Catchment group objective
Nitrate toxicity	**Freshwater**: all results for nitrate toxicity fall into the 'A' or 'B' NOF grade band indicating that nitrate toxicity is not a problem. **Coastal**: the highest median concentration of NNN was found at Waiarohia Canal. The other five sites in the Hātea and Otaika also have higher median concentrations than the ANZECC trigger value.	Defer to new Regional Plan
Ammonia toxicity	**Freshwater**: results indicate that ammonia levels generally meet toxicity guidelines, with the maximum falling into the 'A' or 'B' NOF grade bands at all sites except Puwera at Bennett's Farm where the maximum falls into the 'D' band, exceeding the NOF bottom line. There is uncertainty around the quality of the data at this site due to its ephemeral nature. This site is no longer considered suitable as a water quality site and has been relocated nearby. **Coastal**: the highest median concentration of NH_4 was found at Limeburners Creek – the immediate receiving environment for discharges from the Whangārei wastewater treatment plant. The other five sites in the Hātea River and at Otaika Creek in Whangārei also had high median concentrations.	Defer to new Regional Plan with the exception of Puwera where it needs to be improved to a B attribute state.

Attribute	Current state in Whangārei Harbour catchment	Catchment group objective
Periphyton (trophic state)	**Freshwater**: the appropriate length of time series data (three years) is currently unavailable but Otaika has been flagged as a potential issue. **Coasta**l: sites in the lower harbour have low median chlorophyll a concentrations.	Defer to new Regional Plan but very likely need to review once an appropriate time series data is available.
Escherichia coli (*E. coli)*	**Freshwater**: Median *E. coli* levels at all sites are suitable for secondary contact (E.g. *E.coli* <1000/100mL as an annual median). However, no sites are suitable for full immersion (swimming) – that is more than 5% of samples at all sites exceed 540 *E.coli*/100mL.	Defer to new Regional Plan for secondary contact, with the addition of the following objective for primary contact: Improve *E.coli* levels so there is a less than 5% risk of infection for primary contact (*E.coli* levels of <540/100mL - 95th percentile) at the Hātea Falls and Raumanga swimming sites during the period covered by regional council's Recreational Swimming Water Quality Programme (end of November until end of February each year) excluding heavy rainfall events.
Enterococci	**Coasta**l: the highest median enterococci concentrations are recorded at sites in the Hātea and Otaika. Enterococci concentrations are low in the harbour outside of tidal creek zones.	Improve the water quality in the Hātea coastal zone for swimming during the period covered by regional council's Recreational Swimming Water Quality Programme, excluding heavy rainfall events.
Phosphorous	**Freshwater**: dissolved reactive phosphorous (DRP) levels are elevated with many sites well above the ANZECC 2000 guideline value for lowland rivers, in particular Otaika at Cemetery Road, Otaika at Otaika Valley Road and Puwera at Bennett's Farm. **Coastal**: the highest median DRP concentrations were recorded at the six sites in the Hātea River.	Defer to new Regional Plan.

Attribute	Current state in Whangārei Harbour catchment	Catchment group objective
Turbidity (suspended sediment)	**Freshwater**: of the 11 sites monitored, four have turbidity levels above the ANZECC 2000 guidelines for lowland rivers: two in the Hātea catchment and two within the Otaika catchment. **Coasta**l: the lowest median turbidity was recorded at sites close to the entrance of the Whangārei Harbour. The highest medians were recorded at Otaika and Mangapai. None exceeded ANZECC guidelines.	No numeric objectives have been set but note High level objective for reduced sedimentation.
Sediment (deposited)	**Freshwater:** no data available. **Coastal:** the average Sediment Accumulation Rate (SAR) in the Whangārei Harbour is 3.4mm/year, which is the mid-range for other North Island estuaries for which data is available.	No numeric objectives have been set but note High level objective for reduced sedimentation.
Dissolved Oxygen (DO)	**Freshwater**: DO levels are mainly within guideline with all but two of the medians (Waitaua at Vinegar Hill Road and Otakaranga at Otaika Valley Road) above RMA guidelines (80% saturation) **Coastal**: lowest medians recorded in tidal creek environments: Mangapai, Hātea, Limeburners and Otaika, although only Mangapai had a median below guidelines.	Defer to new Regional Plan
Heavy metals and industrial compounds	**Coastal**: concentrations of copper, zinc and lead exceed trigger values in the upper Hātea and Waiarohia Canal sites. Concentrations of copper also exceed trigger values at Kissing Point and lower Hātea River sites. Concentrations are below trigger values downstream of the Hātea. Sampling is taken from sediment and not the water column.	Improve our understanding of effects of heavy metals/industrial contaminants, and identify opportunities to improve on status quo and not rely on dilution.
Gross pollutants (inorganic solid waste)	**Coastal**: Sea Cleaners removed 67,350 litres of rubbish from the Whangārei Harbour over two months in November-December 2015, following 40,000 litres in one month, in late 2014.	Record a downward trend in litter accumulations in and around harbour by 2020.
Obstructions (including fish passage barriers)	**Freshwater**: five rivers/streams were surveyed over the summer 2014/15, concentrating on the Waiarohia, Otaika and Raumanga catchments. A total survey length of 24.3km. In total, 26 barriers were observed, ranging in severity from small rock dams to large concrete structures.	Remove or remediate barriers to fish migration along the Waiarohia, Otaika, and Raumanga streams by 2020.

Attribute	Current state in Whangārei Harbour catchment	Catchment group objective
Riparian cover	Approximately one-third of total catchment stream length is located within land covered with indigenous forest, exotic forest or scrub. Low cover over the remaining.	Increase riparian cover throughout the catchment.

Implementation

This section identifies current and future actions that will be undertaken for the purposes of achieving the objectives set out in section 2. These actions are divided into two tables. The first lists those to be implemented through the new regional plan as regulations, and the second lists non-regulatory actions. Appendix 3 shows the relationship between the attributes for which objectives have been set and the various actions. The diagram shows that attribute objectives will be achieved through a number of actions, and that an action can have an impact on more than one attribute. Cost-benefit efficiencies need to be considered during implementation.

Regulatory (included in regional plan as needed)

Table 12: actions to be implemented by regulatory methods

Actions	Current management approach and situation	Whangārei Harbour-specific
Minimum flow limits	Regional rules in the Operative Water and Soil Plan currently apply a minimum flow (the lowest level rivers can be reduced as a result of extraction) typically around 80% of MALF.	Defer to new Regional Plan rules
Primary water allocation limit	Allocation limits are not provided for in the Operative Water and Soil Plan	Defer to new Regional Plan rules

Actions	Current management approach and situation	Whangārei Harbour-specific
Stock exclusion	There are currently no regional rules in the Operative Water and Soil Plan requiring stock to be excluded from rivers and streams. Dairy farmers have largely excluded livestock from streams wider than 1m and deeper than 30cm through industry good practice and supplier contracts. Approximately 430km of river/streams flow through pasture in the Whangārei Harbour catchment: 57% through Lowland and 63% Hill Country. 518kms of stream bank need fencing to exclude stock – of which 313kms (64%) are in Lowland areas and 187kms (36%) are in Hill Country. At a cost of $8 per metre, this equates to $4.1 million in expenditure. Assuming that stock exclusion can reduce *E.coli* loads by up to 60%, modelling suggests that exclusion could lower *E.coli* concentrations at swimming sites by more than 50%.	Support new Regional Plan rules with the addition that dairy cows, pigs, beef cattle, dairy support cattle and deer are excluded within two years after the new Regional Plan becomes operative from all river types upstream of the swimming sites mapped on the Hātea and Raumanga (see map in Appendix 3).
Farm dairy effluent (FDE)	Regional rules in the Operative Water and Soil Plan currently provide for dairy effluent discharges to land as a permitted activity, subject to conditions such as allowing no discharge to surface freshwater, no land discharge within 20m of waterbody, etc. Where farms cannot meet the permitted rules, resource consents are required. There are 19 FDE regimes in the catchment, of which two are inactive (see map in Appendix 6). Of the 17 active, four are operating as a permitted activity. Of the remaining 13, four have resource consent to discharge treated effluent directly to water via a pond system without land application. Most consented farm dairy effluent regimes dispose to land unless weather and other conditions make this in breach of the permitted activity conditions, in which case they directly discharge treated effluent from the pond system to surface water. During the monitoring of all Whangārei Harbour catchment FDE regimes in Aug-Nov 2015, 44% were found to be fully compliant, 31% non-compliant and 25% significantly non-compliant.	Defer to new Regional Plan rules

Hill slope erosion from pasture	The current approach to managing hill slope erosion is to work with land owners on a voluntary basis through Farm Water Quality Improvement Plans (FWQIPs) with some financial assistance provided (for example, for poplars). There are currently 28 FWQIPs in the catchment, mainly on lifestyle blocks but also seven dairy farms (see map in Appendix 7). These are not necessarily farms where hill slope erosion is located. Consequently, modelling suggests that current farm plans have very little impact on reducing sediment loads but are dealing with other issues.	Require Erosion Control Plans from 1 January 2025 for pastoral land use on high sediment yielding land to target active gully, earthflow and landslide erosion (see map in Appendix 5). Controlled activity – Pastoral land use on *High sediment yielding land* after 1 January 2025 is a controlled activity if an Erosion Control Plan has not been developed for the land. Matters of control: 1. the effectiveness of measures to control or mitigate sediment from areas of gully, landslide and earthflow erosion, and 2. the location, timing and prioritisation of measures to control or mitigate sediment from areas of gully, landslide and earthflow erosion. 3. information and monitoring requirements ***See Appendix 5 for map*** ***Meaning of words:*** *"Pastoral land use means: effective grazing area and includes all contiguous land areas in herbaceous species including isolated trees. It excludes those forested areas which achieve 100% canopy closure or other*

		woody vegetation which prevents pastoral growth. *"**Erosion Control Plan** means: a plan developed by a suitably qualified professional which specifically identifies areas of gully, landslide, and earthflow erosion and measures to mitigate sediment yield from these areas. The Erosion Control Plan must be approved by Northland Regional Council".* *"**High sediment yielding land**"– land in the Whangārei Harbour catchment with estimated sediment yield of 250 tonnes/km2 per year or more.*

Earthworks	The current thresholds in the Operative Water and Soil Plan are as follows: · Outside the riparian management zone[2], the maximum volume of moved or disturbed earth must not exceed 5000m^2 in any 12-month period where the activity is not undertaken on erosion-prone land; · Outside the riparian management zone, the volume moved or disturbed must be less than 1000m^3 in any 12-month period and the surface area of the soil exposed must be less than 1000m^2 where the activity is undertaken on erosion-prone land; and · Within the riparian management zone, the maximum area of exposed soil must be less than 200m^2 and the volume moved must be less than 50m^3. Currently permitted if less than 1000m^3 in any 12-month period on highly erodible land and 5000m^3 in any 12-month period elsewhere per site. Otherwise discretionary activity.	The catchment group supports a move to an area based approach to earthworks control
Vegetation clearance	The Operative Water and Soil Plan includes rules for vegetation clearance as follows: Vegetation clearance on erosion prone land that is not in the Riparian Management Zone is a permitted activity, provided: the area of vegetation clearance is less than five hectares in any 12 month period, unless the clearance is plantation forestry; vegetation clearance by burning does not take place on peat soils; nor any contiguous area in excess of five hectares on other soils; and the site of the activity is re-established in woody vegetation within 24 months from the start of the vegetation clearance operation. Otherwise discretionary activity.	Defer to new Regional Plan rules

[2] The Regional Water and Soil Plan defines the riparian management zone as the land between the bed of a river, lake, or indigenous wetland, or the coastal marine area and a distance measured inland from the bank of the water body or from the top of the bank adjacent to the coastal marine area of: (a) 5m where the dominant slope is less than 8 degrees, (b) 10m where the dominant slope is between 8-15 degrees, and (c) 20m where the dominant slope is greater than 15 degrees.

Public stormwater network discharges	Stormwater can contain a range of contaminants, such as organic and inorganic matter, heavy metals, hydrocarbons, and faecal microbes. Generally speaking, contaminant levels in stormwater are not normally high enough to cause acute adverse effects on aquatic ecosystems. The more common situation is the build-up (accumulation) of persistent contaminants such as heavy metals in receiving environments, which can cause chronic adverse effects on aquatic ecosystems. Heavy metal concentrations in sediments at almost all estuarine monitoring sites in Northland (the main receiving environment for urban stormwater) are below guidelines levels. The Hātea River arm of the Whangārei Harbour is the only area where some heavy metals (copper and zinc) in the river bed are above recommended guideline levels. Stormwater is also a source of gross pollutants.	Defer to new Regional Plan
Public wastewater network discharges	The Regional Water and Soil Plan and Regional Coastal Plan regulate discharges of wastewater from municipal wastewater treatment plants, reticulation networks, and domestic on-site treatment systems. On the whole, the rules and associated policies are robust and do not require any major changes. Whangarei District Council has undertaken substantial investment in upgrading its wastewater treatment and network over the past six years (Appendix 6).	Defer to Regional Plan

Non-regulatory actions

Table 13: actions to be implemented by non-regulatory methods

Action areas	Specific recommendation
Farm water quality improvement	· Where land doesn't fall under the Erosion Control Plan "rule", farm water quality improvement plans should still be encouraged and promoted to improve water quality. · Northland Regional Council to work in partnership with industry to reduce rate of non-compliance and increase land application of farm dairy effluent.
Stormwater network	· Whangarei District Council investigates investing in more stormwater filtration devices/gross pollutant traps.[3] · Stormwater catchment management plans to include provisions for stormwater filtration/gross pollutants where required. · Identify the location of all pipes within the Whangārei urban stormwater network and their current state.
Obstructions	· Remove or remediate fish passage barriers within the Otaika, Raumanga and Waiarohia catchments by 2020[4] in conjunction with tangata whenua and stakeholders. · Northland Regional Council to set aside funding for this restoration work.
Gross pollutants	· Northland Regional Council to continue funding Sea Cleaners beyond the current three-year commitment (which ends in 2017/18). · Undertake a project with NorthTec to carry out an annual rubbish collection and count at 4-5 sites in the upper and lower harbour.

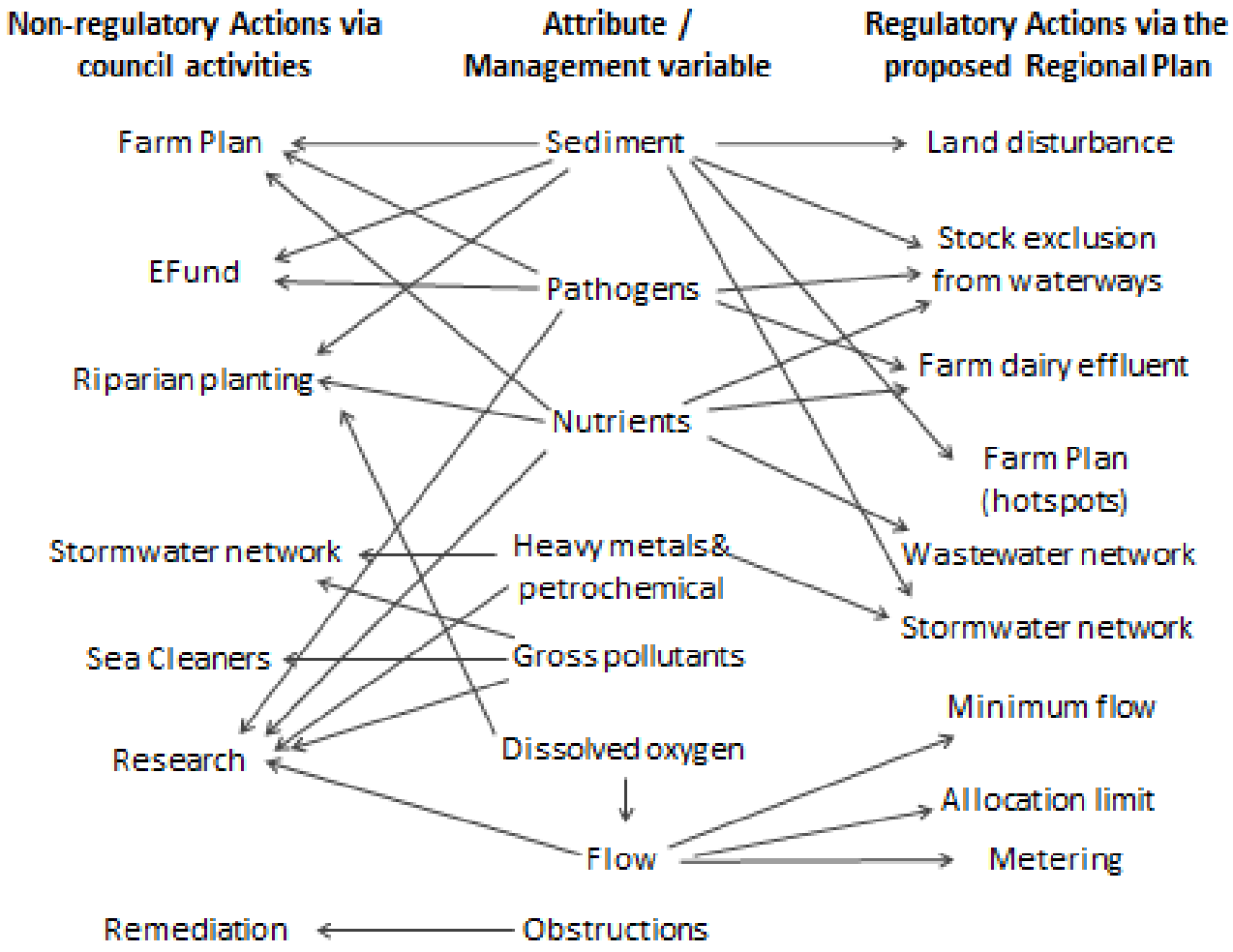
[3] District Council installed a Vortcapture Gross Pollutant Trap at Banff St in 2015 as a trial.
[4] The fish barrier identified at the bottom of the Waiarohia Stream was removed in January 2016.

Cultural sites	· Support restoration of freshwater/harbour cultural sites that have been damaged by:
	  · Working in partnership with tangata whenua and other interested parties in the development of software regarding sites of significance – history, meaning, etc.
	  · Encouraging recognition of cultural sites that have been damaged (as a positive in a consent condition) through actions such as restoration planting, fencing off, cultural interpretation or markers.

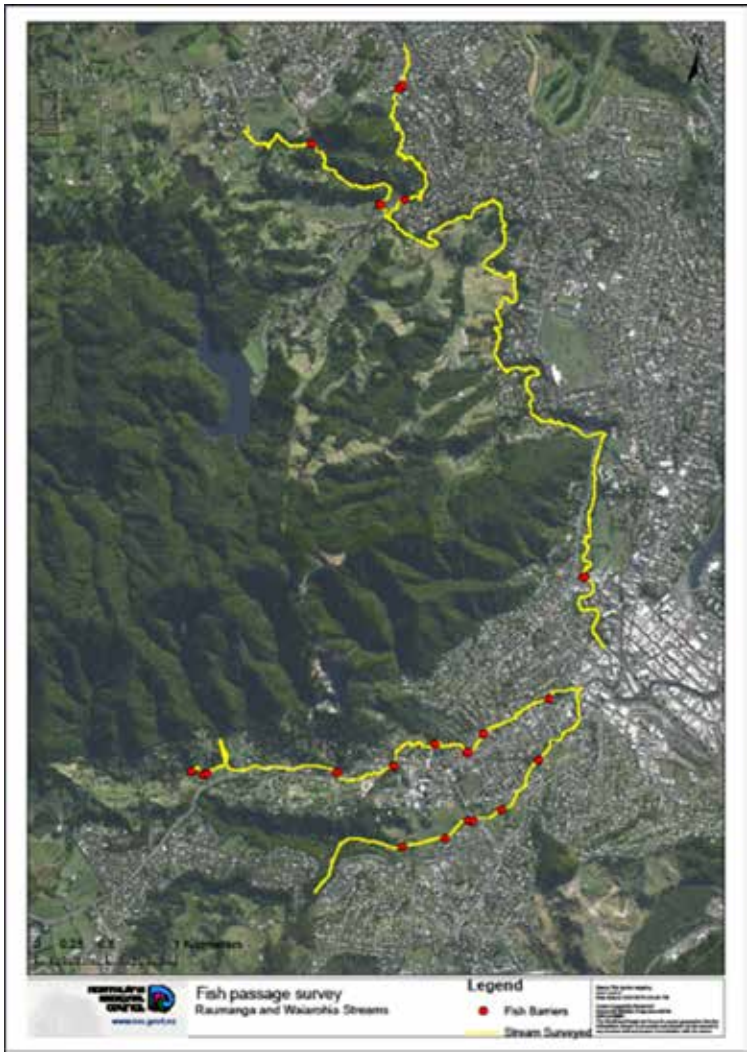
Monitoring and research	· Continue monitoring all current freshwater monitoring sites for at least five years to obtain an appropriate baseline from which long-term trends in water quality can be assessed. · Investigate the extent of health issues related to recreational use in the upper harbour in conjunction with the Northland District Health Board. · Investigate the environmental impacts of current allocation levels in the Hātea and Otaika sub-catchments to determine if there are environmental effects associated with current level of allocation. · Research into risk of microbeads/household compounds from wastewater system – perhaps look at ecological impacts at Limeburners. · Ongoing monitoring of nutrients as part of ongoing regional council monitoring in the harbour. · Investigate cause of high nitrates in Otaika. · Establish a funding pool to carry out source-tracking/one-off water quality investigations. · Promote/encourage cultural health monitoring of waterways by tangata whenua. · Continue to monitor wildfowl contribution to *E.coli* as new technology comes available. · Monitor stormwater discharges for sediment/heavy metals and other contaminants. · Investigate sedimentation rates for urban area.
Education/raising awareness	· Whangarei District Council to continue to finance public education programmes such as “Drains to Harbour”. · Publicise the 0800 number (pollution hotline) more widely and encourage community to report incidents when they happen so that issues can be resolved. · Raise awareness of wildfowl pollution issue – that is, do not feed the ducks at Whangārei Falls. · Whangarei District Council to encourage private green developments and support the use of green infrastructure.

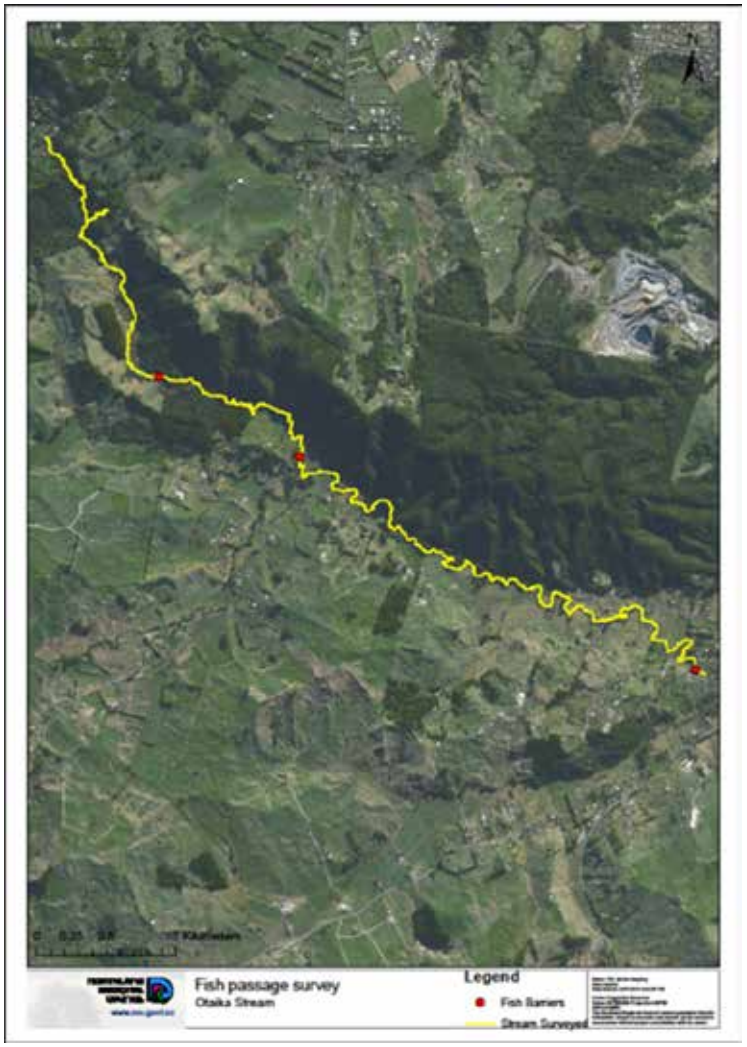
Resourcing	· Ensure staffing levels are sufficient to respond to incidents in the catchment and appropriate follow-up/investigation is taken to identify the underlying source. · Ensure Northland Regional Council's Environment Fund is sufficiently funded and supported to achieve objectives.
Revegetation	· Northland Regional Council's Environment Fund is accessible for wetland creation and encouraged to be used for this purpose. · Encourage riparian restoration by landowners and community groups. · Whangarei District Council to continue to fund community planting sites.
Water allocation	· Establish and maintain sub-catchment water user groups for highly allocated catchments.
Wastewater	· Continue improvements to the wastewater network. · Septic tank monitoring regime and compliance to be investigated.

Appendix 1: relationship diagram between attributes and actions

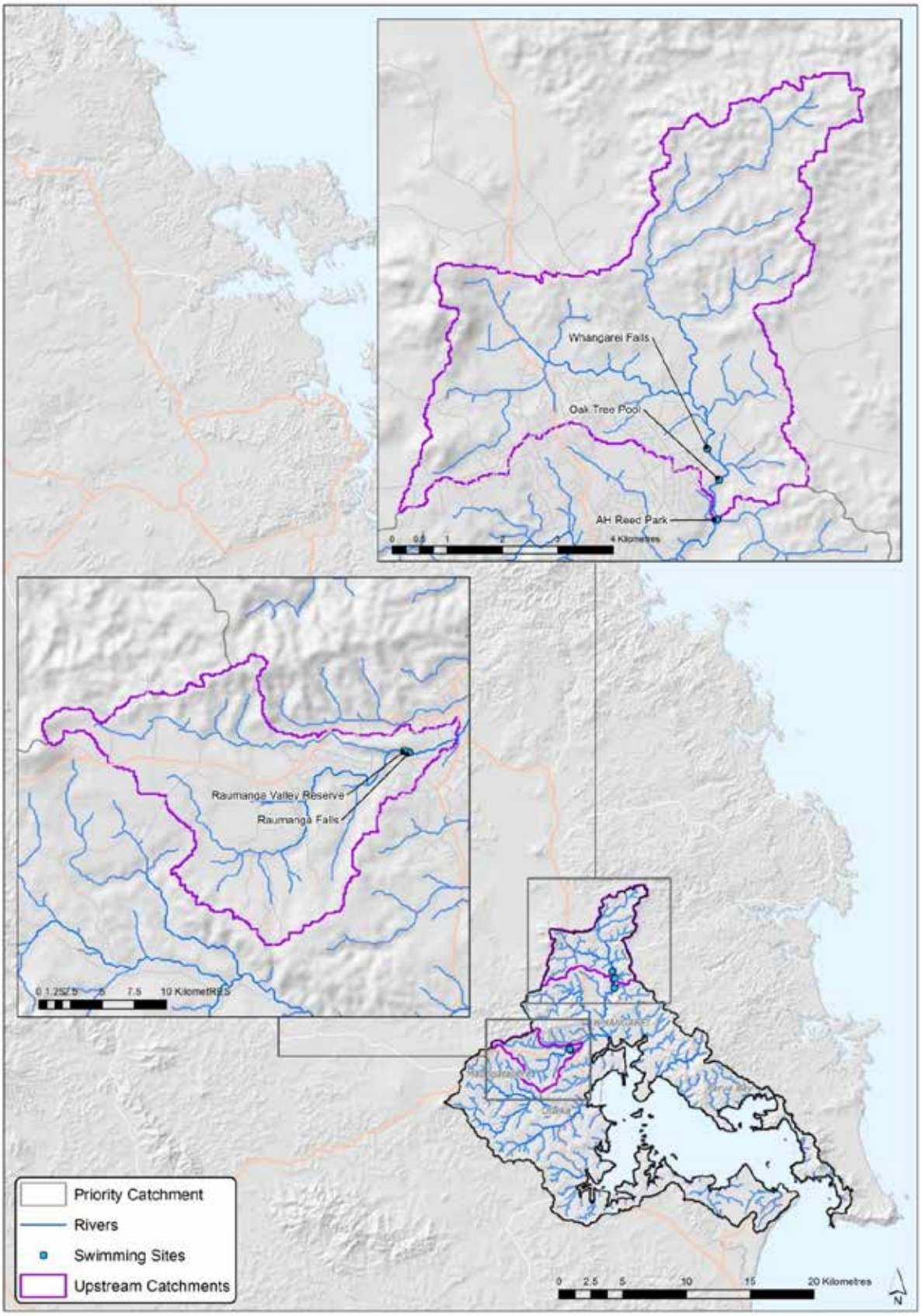


Appendix 2: mapped fish passage barriers in the Whangārei Harbour catchment

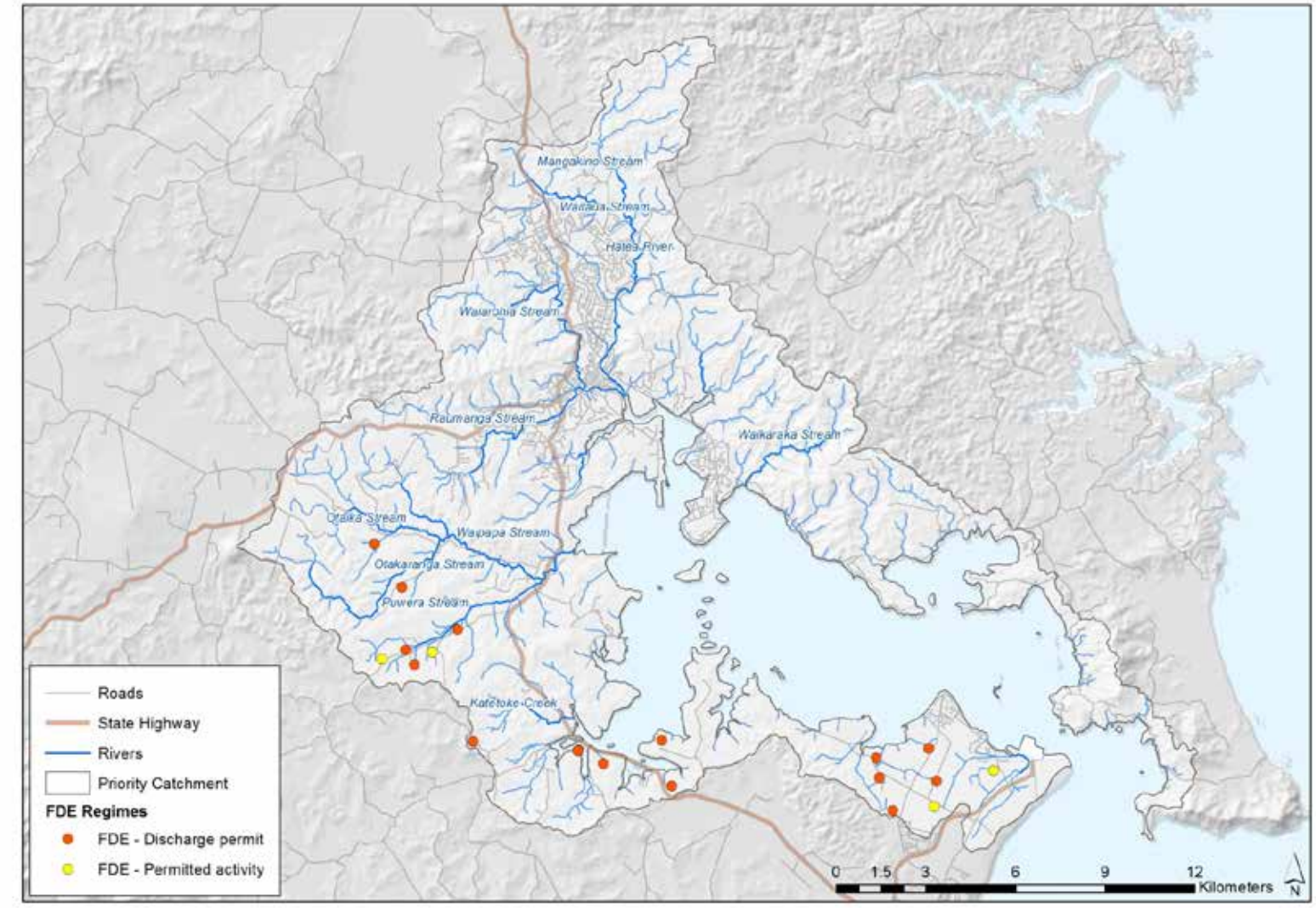




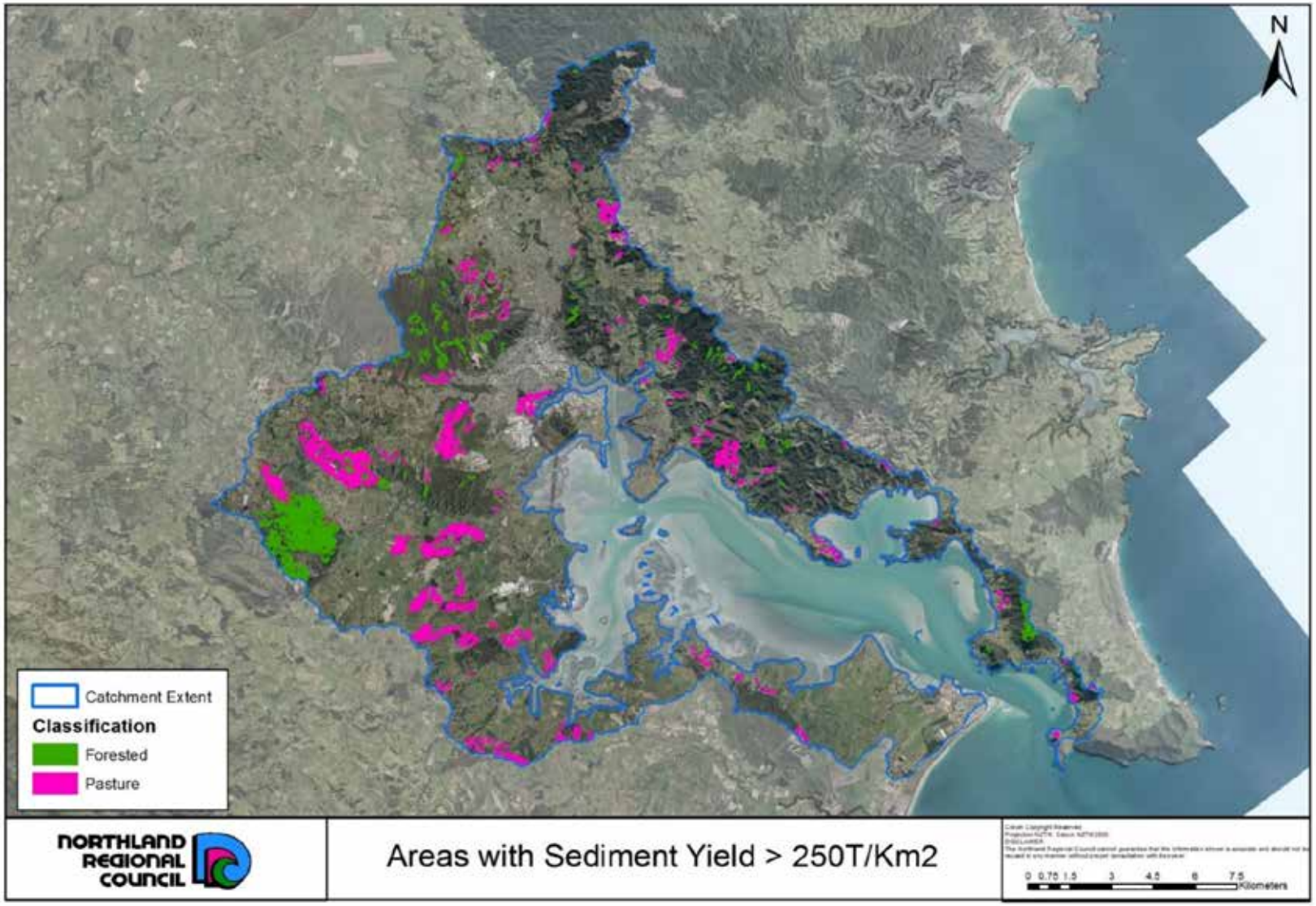
Appendix 3: freshwater swimming sites above which stock are to be excluded



Appendix 4: farm dairy effluent regimes in the Whangārei Harbour catchment



Appendix 5: High sediment yielding land (>250 tonnes/km2/yr)



Appendix 6: list of major wastewater capital works undertaken by Whangarei District Council

Year	Item	Outcome	Approximate cost
2009 - 2015	Sewer network modelling and master plan development.	Computer simulation of sewer performance developed and calibrated. Used to develop works programme to address public health risk from sewage spills in Whangārei.	$1.0M+
2010 – 2016	General improvement works. Telemetry system upgraded and remote pump stations and sites connected. WWTP equipment upgraded/replaced. Failed sewer lines replaced.	Pump station reliability greatly improved. Pump station fault response time reduced to 30 mins (city) 60 mins (rural). Sewer spills due to faulty lines reduced. Equipment reliability and safety improved.	$5.0M
2011	Okara Park pump station upgrade. This station pumps around 70% of the city's wastewater.	Bigger pumps put in and redundancy added. Pump capacity exceeds inflow rate – no more spills.	$2.5M
2011	New 750mm pipe between Okara station and treatment plant.	Provides redundancy and allows more flow to be pumped to treatment plant. Pump capacity around 1100 litres per second.	$1.5M
2012	Hatea wastewater storage and treatment system installed on Whareora Rd.	Stores most wastewater except for big events. During big events water treated and disinfected before being discharged to Hātea River. Reduces risk of spills at Hātea station and from downstream network.	$5.0M
2013	Whangārei wastewater plant reconfigured to treat all incoming flows plus allowance for growth to 2041. Storm flow disinfection system installed. Replacement consent issued.	All flow that enters plant is treated and disinfected to meet resource consent standards. Treatment capacity 1600L/s.	$2.5M
2014	Ruakaka south sewer system.	Approximately 460 properties and the Ruakaka campground connected to sewer system with waste pumped to Ruakaka wastewater treatment plant. Septic tanks abandoned.	$9.7M

Year	Item	Outcome	Approximate cost
2014	Hikurangi wetland replacement.	Replaced subsurface wetland with floating wetland to improve quality of effluent going into membrane. Approx. 50% improvement occurred.	$0.35M
2014	New Whangārei WWTP consent, new pipe to wetlands, subsurface wetland replaced with floating system.	Consent modified so that all water leaving treatment plant passes through wetland. Water quality at discharge point improved.	$2.0M
2015	Sewer lines – new pipes, upgrades and renewals.	Sewer lines renewed under Kamo Rd and Denby Crescent. New bypass line constructed down Lupton Ave. New connection made from Kensington sewer system to pipeline adjacent to Whareora Rd. New line built under SH1/SH14 intersection to provide for future growth. Reduced risk of spills.	$3.0M
2015	Rising main from Onerahi main pump station upgraded.	Pipeline replaced and upsized. Premature failure as a result of cyclic fatigue.	$1.0M
2015/16	Waipū renewals and growth related upgrades.	New screens at treatment plant, desludging of main pond, replacement of subsurface wetland with floating system. New rising main from Waipū township to plant and upgrade of other pipes in town.	$2.5M
2016/18	Tarewa Park storage and treatment system.	Similar system to Hātea to be built in Tarewa Park. Will eliminate risk of storm related spills around I- Site, reduce other local spills, and reduce risk of spills further down in sewer network.	$4.5M
2016-18	Proposed Hikurangi sewer network renewal.	Address stormwater related spills in Hikurangi and high flows to treatment plant.	$3.8M (2016)

Glossary

Ammonia	A highly soluble nitrogen compound, chemical formula NH_3, characteristically found in manure, sewage and anaerobic conditions.
ANZECC (Australian New Zealand Environment Conservation Council) 2000 Guidelines	The ANZECC (2000) guidelines outline trigger values for water quality aspects that put stress on river and stream health. These specify a level below which there is a low risk that adverse biological effects will occur. The trigger values are not designed to be used as threshold values at which an environmental problem is inferred if they are exceeded. Rather they are designed to be used in conjunction with professional judgement to provide an assessment of the state of a water body.
Chlorophyll a	A green pigment found in plants that is used to absorb sunlight during photosynthesis. *Chlorophyll a* concentrations are an indicator of phytoplankton abundance and biomass in water.
Contact recreation	Primary contact recreation refers to swimming and bathing; secondary contact recreation refers to activities such as boating, fishing and wading.
Dissolved oxygen	A measure of the quantity of oxygen in the water column. Oxygen is required by freshwater and marine organisms, with some species being more sensitive to low oxygen levels than others.
DRP (Dissolved reactive phosphorus)	The fraction of phosphorus that consists largely of inorganic orthophosphate (PO_4) form of phosphorus that can be directly taken up by algae. The amount of dissolved reactive phosphorus therefore indicates the amount of phosphorus that is immediately available for algal growth
E. coli (Escherichia coli) ()	A common form of faecal bacteria that live in the guts of mammals and birds. Although usually harmless themselves, high levels of E. coli indicate that other pathogens – invisible microbes such as bacteria, viruses, and so on that cause disease – are present.
FDE (Farm dairy effluent)	FDE systems are divided into consented or non-consented (permitted) types. Non-consented systems are visually inspected and graded depending on compliance with the criteria for "permitted activities" in the Regional Water and Soil Plan. All Northland dairy farms are inspected at least once per season. Follow-up inspections are also made to all farms found to have significantly non-compliant discharges.
FMU (Freshwater management unit)	A water body, multiple water bodies or any part of a water body determined by the council as the appropriate spatial scale.
Heavy rainfall event	50mm within six hours or greater than 100mm rain in 24 hours.
Kaitiakitanga	Guardianship, protection or preservation. Environmental management based on the traditional Māori world-view.
L/s (litres per second)	A unit of measure of river volume flow rate, that is, the number of litres of water which passes that point per second.

Mahinga kai	Food and other resources, and the areas they are sourced from.
Mahinga mātaitai	Customary seafood gathering site, shellfish bed.
Mana	Prestige, authority, control, power, influence
Manaakitanga	Hospitality, kindness.
Mana whenua	Those who have customary authority.
Mātauranga	Knowledge, body of knowledge.
Mauri	The essential life force of all things; spiritual essence.
MALF (Mean annual low flow)	A 7-day MALF is commonly used for setting minimum flow and allocation limits because it is a measure of water availability during dry periods. MALF also standardises minimum flow and allocation by the size of the river.
MCI (Macroinvertebrate community index)	An index where macroinvertebrates are used for monitoring and reporting on stream health in New Zealand. The MCI assigns a score to each species or taxon (from one to 10), based on its tolerance or sensitivity to organic pollution, then calculates the average score of all taxa present at a site.
MPN (Most probable number)	Method used to enumerate the number of bacteria in a sample.
Nitrate	A highly soluble compound of nitrogen and oxygen with the chemical formula NO_3.
NOF (National objective framework)	Established in the National Policy Statement for Freshwater Management 2014, providing a number of grades as well as “national bottom lines” – thresholds of water quality attributes that good management should prevent our waterways from reaching in a consistent way across the country.
NTU (Nephelometric turbidity units)	A measure of turbidity in water being the propensity of particles to scatter a light beam.
Periphyton	Slime and algae community growing on river and stream beds. As the primary producer in stream ecosystems, it is an important indicator of ecosystem health.
Taonga tuku iho	Treasure(s) handed down.
Turbidity	Measure of water clarity, the cloudiness or haziness of water. A measure of the degree to which light is scattered in water by particles, such as sediment and algae.
Wāhi tapu	Places and things that are sacred.

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