WAIORA NORTHLAND WATER

Mangere Catchment Management Plan

August 2017

Northland REGIONAL COUNCIL

Contents

Introduction

The purpose of the Mangere Catchment Plan is to identify desired community solutions to issues/problems that are impacting on waterbody uses and values in the Mangere catchment.

A draft Mangere Catchment Plan was developed by a collaborative stakeholder group supported by Northland Regional Council and made up of members representing a range of parties with an interest in freshwater in the Mangere catchment. The Mangere Catchment Group identified catchment values, issues that impact on those values, and their objectives for improving their catchment. Both regulatory and non-regulatory methods were considered to implement the objectives sought.

The draft Mangere Catchment Plan was released for consultation with the wider public. The Mangere Catchment Group is appreciative of the time taken by the public to provide feedback on both the substance and format of the catchment plan. The feedback has been taken into consideration in revision of the catchment plan. The Mangere Catchment Plan should be read together with the Proposed Regional Plan. The Proposed Regional Plan sets out the region-wide objectives, policies and regulatory rules for fresh and coastal water management (among other things), while the Mangere Catchment Plan provides a catchment specific approach using both regulatory (rules) and non-regulatory methods. Once finalised, the regulatory methods in the catchment plan will be included in a section of the Proposed Regional Plan specific to Mangere. Once notified both the Proposed Regional Plan and Mangere specific provisions will be subject to the submission, hearings, council decisions and appeals process under the Resource Management Act 1991.

Catchment overview

The Mangere catchment has an area of approximately 81km^2 (8100 hectares) and is located immediately west of Whangārei. The catchment has four larger sub-catchments – the Waipui, Patuwairua, Mangapiu, and Mangere stream catchments which drain into the Mangere River.

The Mangere River drains via the Wairua River and Northern Wairoa River to the Kaipara Harbour on Northland's west coast. The Wairua and Northern Wairoa rivers have a high demand for water extraction. Some of the eastern arms of the Kaipara Harbour have experienced high rates of sediment deposition on beds and beaches which has altered the shellfish species present, food gathering opportunities and recreational use.

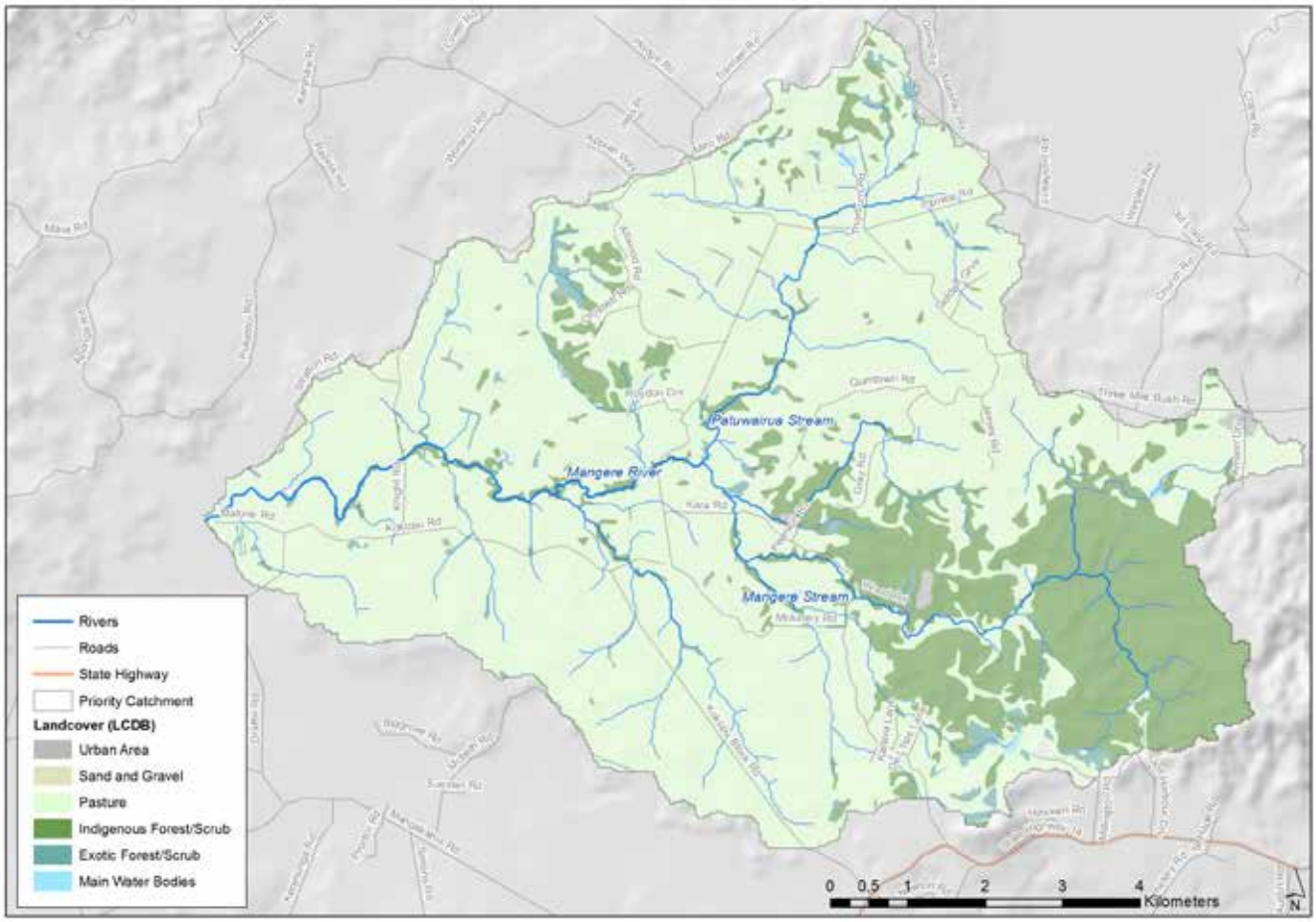


Figure 1: Mangere catchment and land cover

Catchment topography and land use

Land use/cover is predominantly pastoral farming (77%) and indigenous forest (23%) – see Figure 1. The catchment topography is a mixture of hill-country with a slope over 15 degrees (41% of the catchment) and lowlands under 15 degrees of slope (59% of the catchment) – see Figure 2. Hill-country topography is generally more prone to hill-slope erosion. Larger river reaches in lowland topography are generally more prone to streambank erosion. Types and rates of erosion also depend on the underlying geology and soils as well as overlying land use/cover and are discussed in the following chapter.

Indigenous forests occur predominantly on hill-country with a large area within the Pukenui Forest. Along the Mangere River, Mangere Stream and Patuwairua Stream is one of the largest remnant riparian indigenous forests (167 hectares) in the Whangārei Ecological District[1] which is considered of high conservation value.

Most lowland terrestrial wetlands (gumlands) have been drained and converted to pastoral use.

[1] See Page 70, Department of Conservation, *Natural Areas of Whangarei Ecological District.*

Pastoral grazing occurs predominantly on lowland topography and is undertaken for commercial and cultural ('lifestyle') purposes.

The catchment has a relatively high proportion of dairy farms compared to other Northland catchments. The majority of dairy farms occur on lowland topography south of the Mangere River – see Figure 3. Twenty of the 21 dairy farms have recently upgraded their farm dairy effluent systems to include partial/full irrigation to land.

The catchment contains a relatively high proportion of rural-residential development compared to other Northland catchments due to its proximity to Whangārei. All residential development disposes of sewage to land and there are no direct discharges to waterbodies.

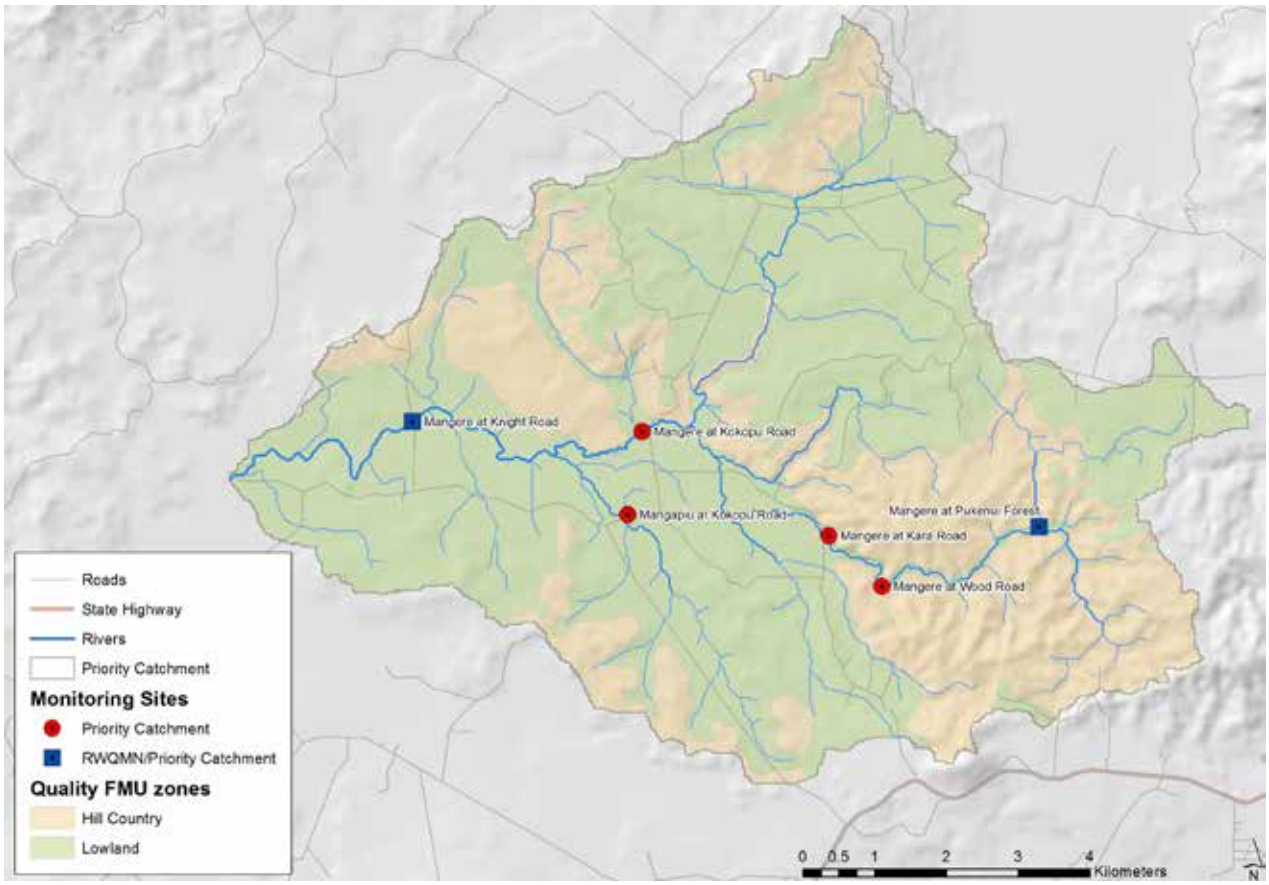


Figure 2: Water quality monitoring sites and Hill country and lowland areas

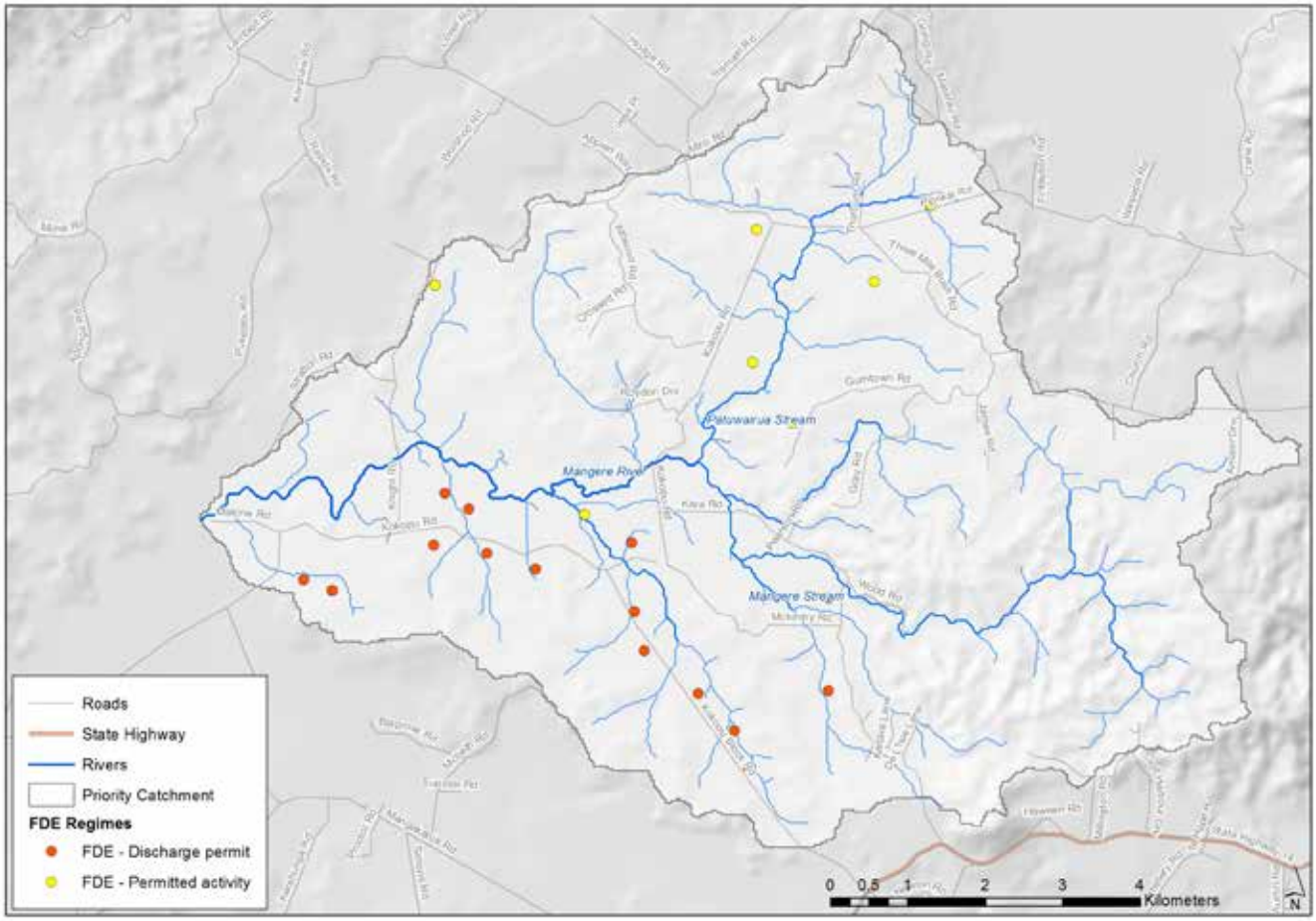


Figure 3: Farm dairy effluent discharges – Permitted Activity (land only) and Consented (land & water)

Waterbody types

Aquifers in porous basalt lava flows on the northern, western and southern edges of the catchment (Matarau, Three Mile Bush and Maunu aquifers) contribute to groundwater recharge of stream base-flows.

The catchment has a mixture of hard-bottom and soft-bottom river reach habitat. Soft-bottomed river reaches occur over soft-substrate geology and in lowland reaches where flow velocities decrease and sediment deposits. Recent alluvium soils make up a significant proportion of the Mangere Stream and Mangere River reaches and are more prone to stream bank erosion – see Figure 4. Hard-bottomed stream reaches predominantly occur in hill-country reaches (greater than 15 degree slope) to the east of the catchment where flow velocities are high with overly hard substrate geology. However, there is a hard-bottomed reach of the Mangere River which flows over an old basalt lava flow near the Mangere Falls.

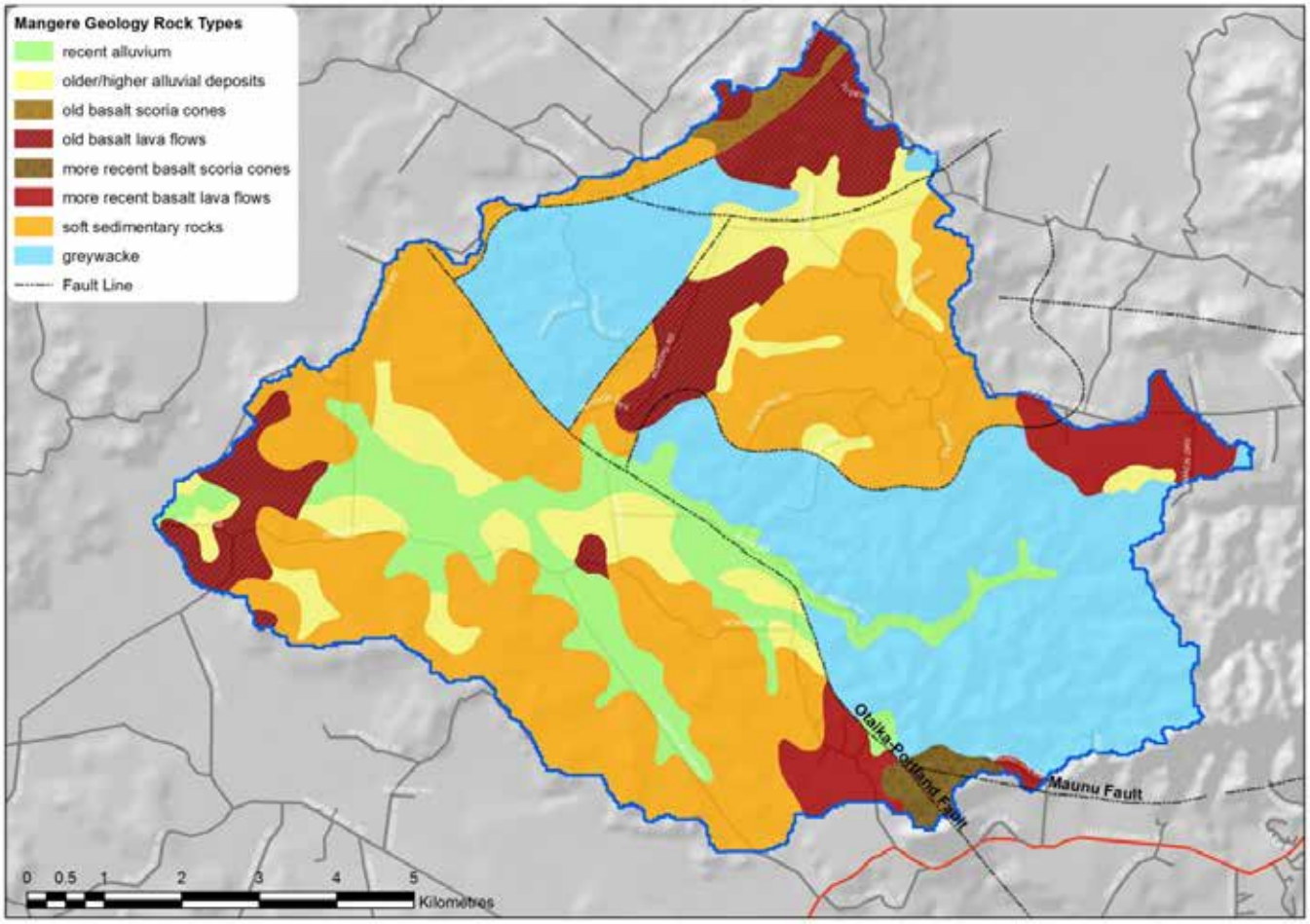


Figure 4: Geology in the catchment

Catchment river flows are not 'manipulated' – that is, flows are not controlled by intentional dam releases. River/stream base-flows are at their lowest in summer and peak in winter, with median flows in autumn and spring. Stormflows occur frequently and play an important role in providing flow variation and controlling populations of aquatic species by removing and resetting plant, periphyton, invertebrate, and exotic fish populations.

There are some remnant river wetlands (swamps, marshes) but no natural lakes. There are four privately owned in-stream dams in the catchment which capture and store seasonal base-flows and stormflows for summer extraction. The stored water in two of these dams (Millington Road and Three Mile Bush Road) is not fully utilised.

Waterbody species

Aquatic species (periphyton, plants, invertebrates, fish, birds etc) have populated suitable habitat in hard-bottom and soft-bottom river reaches.

Hard-bottomed river reaches can support periphyton growth where there is sufficient light and accrual times between flushing storm flows. Invertebrate in hard-bottom river reaches are expected to be naturally dominated by communities of mayflies, stoneflies and caddisflies.[2]

[2] Page 17, Ministry for the Environment. A User guide for the Macroinvertebrate Community Index.

Soft-bottom rivers support watercress growth where there is sufficient light. Invertebrate in soft-bottom river reaches are expected to be naturally dominated by communities of snails, worms and chromatids, which are generally more tolerant of nutrient enrichment and sedimentation.

The natural occurrence of fish species in the catchment is limited due to the climate and natural migratory barriers, including distance from the coast, the Wairua Falls (and Wairua Power Station) and the Mangere Falls.

Particular invertebrates of value that have been found in surveys include koura (freshwater crayfish – food gathering and conservation value) and the freshwater crab (conservation value).

Native fish species found in surveys include longfin eels (food gathering and conservation value), shortfin eels (food gathering), common bully (food gathering), and crans bully. Exotic fish species found in surveys include brown trout (gamefish) and gambusia (pest-fish).

Waterfowl species which are frequently observed include mallard ducks and pukeko (food gathering and game fowl).

Public Access

The catchment consists of private and public land. Most of the land and waterbody beds in the Mangere catchment are in private ownership. However, there are areas of public land (Department of Conservation reserves, paper roads, marginal strips and esplanade reserves) which provide opportunities for recreational and cultural activities in water bodies – see Figure 5. The Pukenui Forest reserve is accessible to the population of Whangārei and is popular for walking. Other forms of public access occur on some reaches of the Mangere Stream and Mangere River but public use for recreational and cultural activities is currently low.

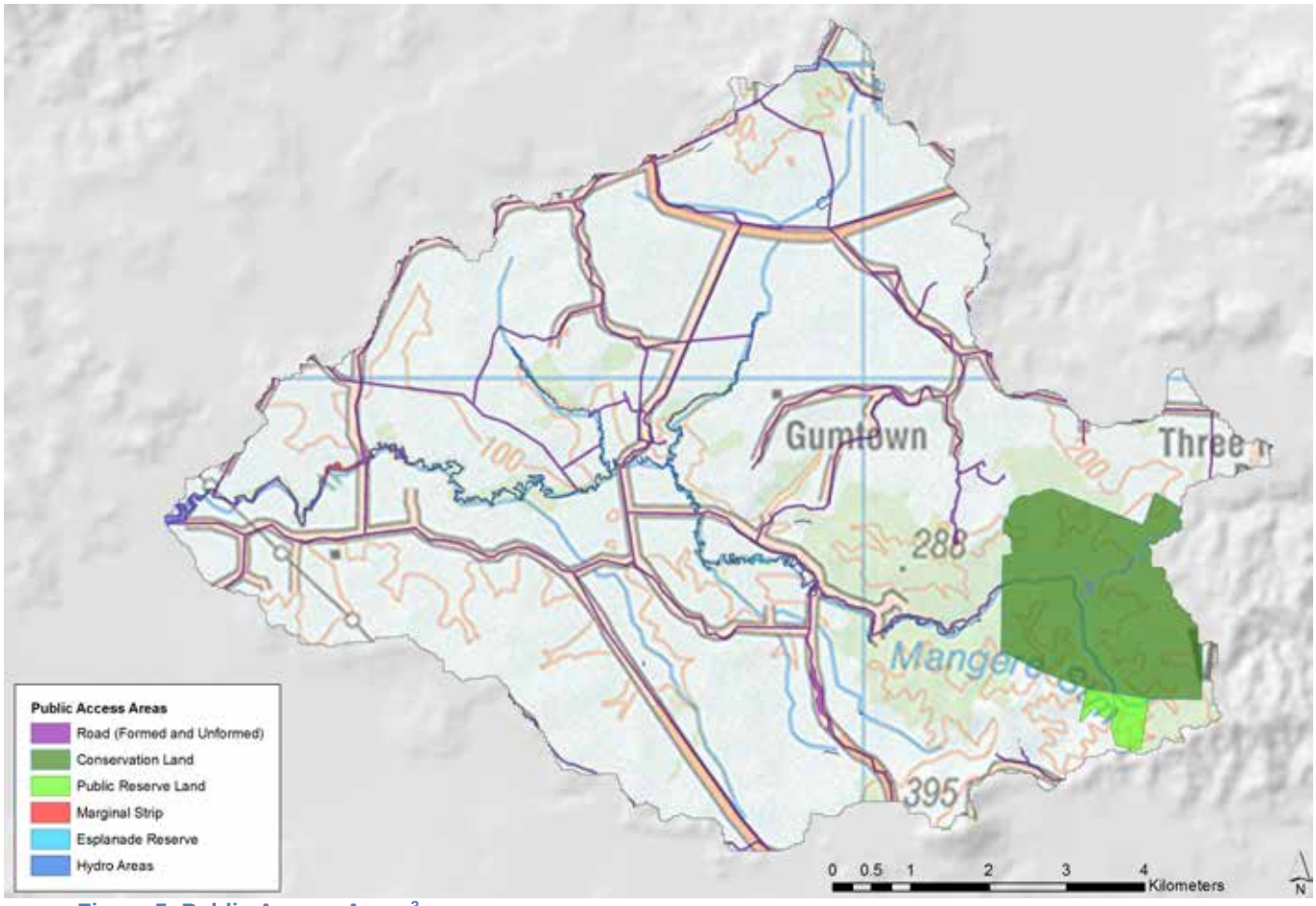


Figure 5: Public Access Areas[3]

[3] **Note:** Access to 'hydro areas' is only available when they are adjacent to public reserves – see Walking Access NZ.

Land erosion modelling

Sediment modelling (SednetNZ) has been undertaken to identify the sources of sediment in Mangere and the estimated annualised yields of soil erosion and loads entering the river network.

The SednetNZ model is useful for broadly predicting critical source areas of different types of erosion. The model then estimates annualised sediment yield from critical source areas under different types of vegetation (pasture or woody). The estimated sediment yield from that land is averaged over long-term timeframes (decadal to century). However, on-the-ground surveys are needed to identify if erosion is actually occurring and/or if sediment yield is being controlled.

The total long-term sediment yield from the whole catchment is estimated at 13,008 tonnes per year from 81km^2 (8100 hectares):

- 4032 tonnes/year (31%) of this comes from streambank erosion; *and*
- 8976 tonnes/year (69%) comes from hill-slope erosion.

Streambank sediment yield can be the result of natural or human induced factors. Natural contributions to stream bank erosion include stream bed erosion and saturation of river banks. Human induced contributions can include deforestation of riparian margins and livestock access and grazing. Sednet cannot identify contributions from various sources with sufficient accuracy and on-the-ground surveys are needed to identify if erosion is occurring and its causes.

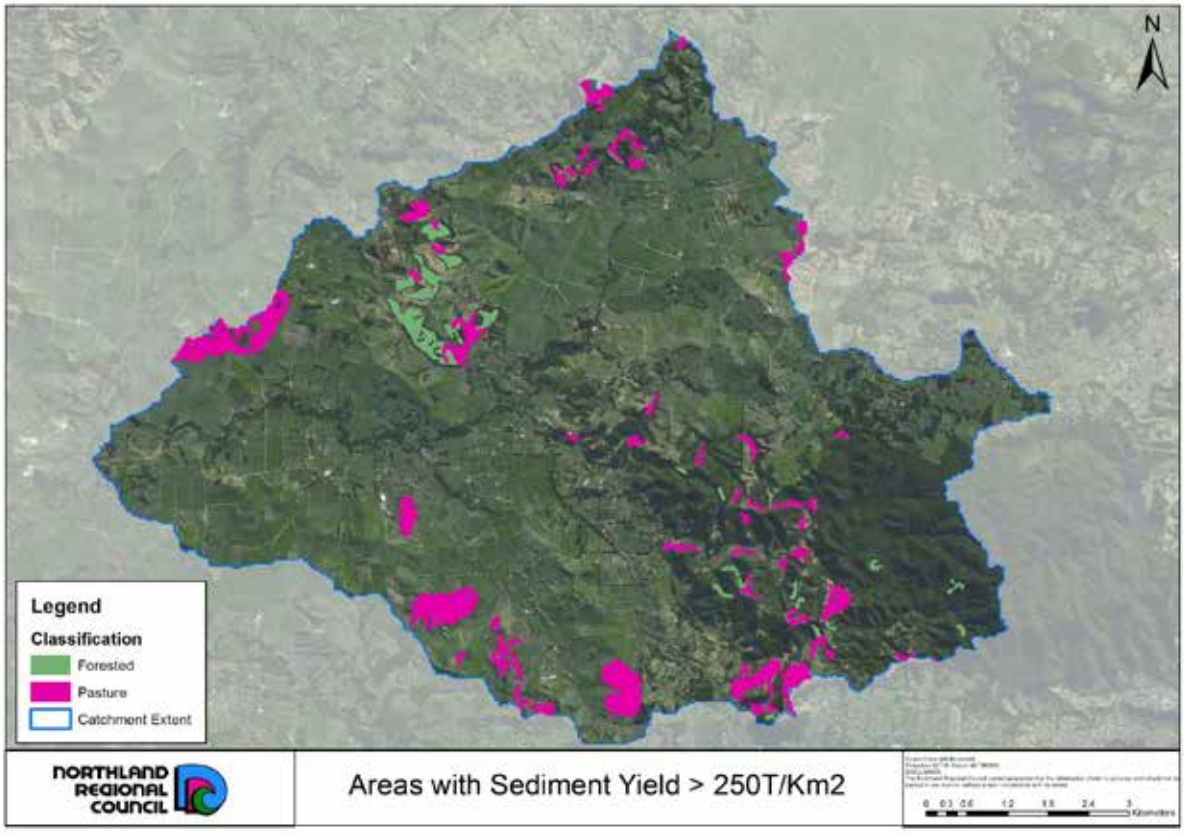
Hill-slope sediment yield is based on four main erosion processes: surficial (overland) erosion; gully erosion; earthflow erosion; and landslide erosion. Yield of gully erosion, earthflow erosion and landslide erosion is determined to a large extent by topography (lowland and hill-country), vegetation (pasture and woody vegetation) and soil type.

- 59% of the catchment (4779 hectares) is in lowland topography (less than 15 degrees actual slope):
  - 59% of the catchment (4779 hectares) is lowland vegetated in pasture – contributing 690 tonnes/year (0.14 tonnes/ha/year); and
- 41% of the catchment (3321 hectares) is in hill-country topography:
  - 23% of the catchment (1863 hectares) is hill-country woody vegetation – contributing 2065 tonnes/year (1.11 tonnes/ha/year); and
  - 18% of the catchment (1458 hectares) is hill-country pasture – contributing 6210 tonnes/year (4.26 tonnes/ha/year).

Pastoral hill-country is a significant source of hill-slope erosion – 69% of the catchment's hill-slope erosion comes from 18% of the catchment area. Figure 6 shows predicted high sediment yielding areas of land – this is based on a predicted sediment yield of more than 250 tonnes / km^2 / year. High yields are due to the soil and underlying geology but could be reduced with targeted tree planting.

Modelled rates of hill-slope erosion may be overestimated where land holders have already undertaken measures to: reduce erosion – such as afforestation or spaced planting of poplars or willows; or, to reduce sediment yield from erosion – such as construction of detention dams. The Mangere Catchment Group recommends that landowners be required to develop Erosion Control Plans if undertaking pastoral land use on areas in the catchment that have predicted sediment yields greater than 250 tonnes / km2 / year (see Figure 6).

Figure 6: High sediment yielding land in Mangere catchment (estimated using SEDNET)



Water quality monitoring

Rivers: a number of measures of river water quality have been monitored by the Northland Regional Council in the Mangere catchment to understand the condition of the water for human health and aquatic ecological health. Figure 7 shows the monitored sites. Table 1 shows the results.

The National Objectives Framework (NOF) is part of the National Policy Statement for Freshwater Management. The framework provides a nationally consistent approach to managing attributes (water quality measures) for different freshwater uses/values. The following (in bold) are substances which must be monitored under the National Objectives Framework:

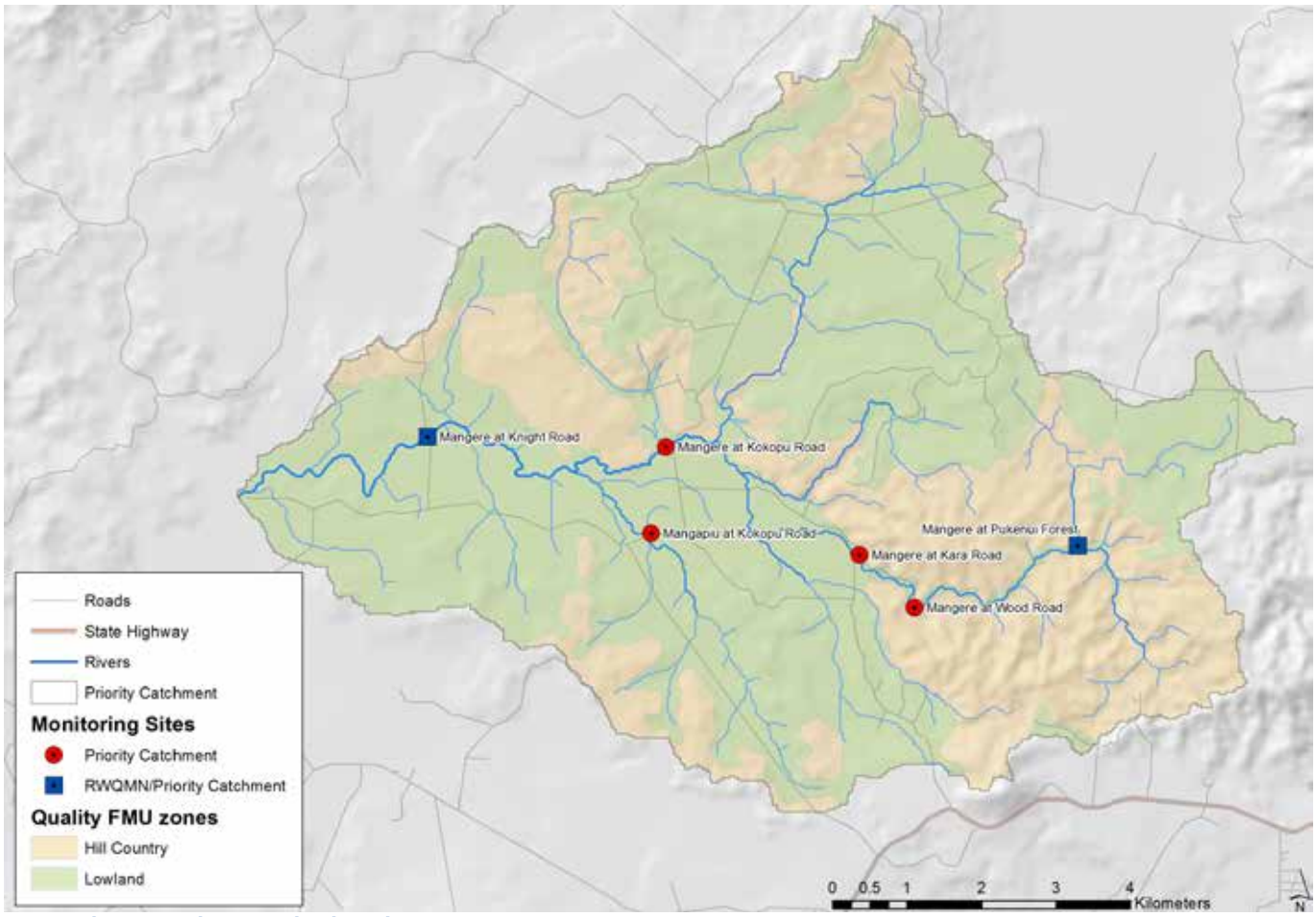


Figure 7: River monitoring sites

E.coli concentrations are an indicator of pathogen concentrations. Pathogens can cause human infections if swallowed while undertaking immersion activities and are caused by faecal matter contamination.

High concentrations of *e.coli* (or pathogen) concentrations, during river base-flows ('annual medians'), can be caused by the direct discharges of faecal matter. Potential sources of direct discharges of

faecal matter into waterbodies include farm dairy effluent, livestock access, or waterfowl. Monitoring shows that *e.coli* concentrations in the catchment are highest in the southern lowland areas where the concentration of dairy farms is highest. There are no swimming sites within the Mangere catchment which are monitored under the council's Northland Swimming Water Quality Monitoring Programme.

High ***ammonia*** concentrations and low ***dissolved oxygen*** concentrations can cause toxicity and hypoxia in sensitive invertebrate species and fish. Dissolved oxygen concentrations can vary widely due to natural causes but must be managed below point-source discharges[4]. High *ammonia* and low *dissolved oxygen* concentrations, during river base-flows ('annual medians'), can be caused by the decomposition of organic matter in water. Point-sources discharges from farm dairy effluent discharges have decreased in the catchment with increasing levels of land based application. Other potential sources of organic matter occur to land – for example domestic wastewater, silage pits and offal pits. The council also monitors sensitive macro-invertebrate populations (*MCI*) as these are a biological indicator of organic enrichment. Monitoring shows that high *e.coli* concentrations in the catchment generally coincide with high *ammonia* and low *dissolved oxygen* concentrations and low *MCI* scores.

Nitrate concentrations can cause toxicity in sensitive fish and invertebrate species.

[4] See page 26 and page 29, Ministry for the Environment. A Draft Guideline to Attributes.

High *nitrate* concentrations can be caused by the deposition of urine and its leaching through porous geology or aquifers to surface waterbodies. There are areas of porous geology in the catchment. However, monitoring shows that *nitrate* concentrations in Catchment Rivers are not at a level that could cause toxicity in sensitive fish and invertebrate species.

Periphyton 'blooms' (excess organic matter accumulation) can hinder recreational/cultural activities and water supplies. The subsequent decay of blooms can also cause *ammonia toxicity* and *hypoxia* in sensitive fish and invertebrates. Periphyton monitoring has not been undertaken in the catchment as there are few hard-bottomed river reaches with sufficient light (less than 60% shading) to support blooms[5]. *Periphyton* take their nutrients up from the water column and growth can also be managed with nutrient concentration limits (*dissolved reactive phosphorus* and *dissolved inorganic nitrogen*). However, concentrations that are necessary to limit blooms depend on the frequency of stormflows and the degree of shading.

Turbidity is a measure of water cloudiness which can be caused by the presence of organic matter or inorganic (soil) particles. Sources of *turbidity* during base-flows (annual medians), can be caused by discharges of organic matter, livestock access to streams, hill-slope erosion or works within streams. Monitoring of *dissolved reactive phosphorus* suggests catchment geology

[5] Page 56, MfE New Zealand Periphyton Guideline: Detecting , Monitoring and Managing Enrichment of Streams.

(naturally high phosphorous levels) is a significant source. *Dissolved reactive phosphorus* and sediment tend to bond and 'travel' together and concentrations are also elevated where the proportion of inorganic particles in *turbidity* are high.

Council trend analysis showed a number of meaningful improvements in *E. coli* and nutrient levels over the past 10 years. However, when the time period for analysis is reduced to the last five years, results indicate a levelling off with no meaningful improvement[6]. Dairy NZ trend analysis also identified improving trends in *E.coli*, *Ammoniacal Nitrogen*, and *Dissolved Reactive Phosphorus* from 2007 to 2010[7]. However, from 2011 – 2015 the only significant improvement was a reduction in *Turbidity*[8].

A summary of the results is shown in Figure 8.

[6] Mangere Catchment Water Quality Update; Northland Regional Council; April 2016.
[7] Water Quality Status and Trends – Mangere River; Dairy NZ; March 2014.
[8] Technical Memo; Dairy NZ; March 2016.

Table 1: river water quality monitoring sites and result.

NOF Legend

A	Similar to reference conditions
B	Slightly impacted
C	Moderately impacted (lower/upper limit national bottom line)
National bottom line	
D	Degraded/unacceptable (must be managed to C or better)

Other measures

A	Similar to reference conditions
B	Slightly impacted
C	Moderately impacted
D	Degraded/below guidelines

Water quality monitoring site	**National Objective Framework (NOF) attributes**			**RMA 1991[9]**	**Ecological indicators**		**ANZECC[10] guideline value**	
	Escherichia coli (*E. coli*/100mL)	**Nitrate nitrogen (mg/L)**	**Ammoniacal nitrogen (mg/L)**	**Dissolved oxygen (% saturation)**	**Macro-invertebrates**	**Stream habitat**	**Turbidity (NTU)**	**Dissolved reactive phosphorus (mg/L)**
	Annual median A ≤260 B >260 ≤540 C >540 ≤1000 D >1000	**95th percentile A ≤1.5 B >1.5 ≤3.5 C >3.5 ≤9.8 D >9.8**	**Annual maximum A ≤0.05 B >.05 ≤0.4 C >0.4 ≤2.2 D >2.2**	**Annual median ≥80**	**MCI score (indicator of 'organic enrichment')**	**% rating compared with reference site**	**Annual median <5.6**	**Annual median <0.01**
Mangere at Pukenui Forest	A	A	A	Above	127	100%	Below	Above
Mangere at Wood Road	C	A	B	Below	114	50%	Below	Above
Mangere at Kara Road	B	A	A	Above	122	81%	Below	Above
Mangere at Kokopu Road	B	A	B	Above	97	34%	Above	Above
Mangapiu at Kokopu Road	C	A	C	Below	64	30%	Above	Above
Mangere at Knight Road	C	A	B	Below	101	53%	Above	Above

[9] The council has monitored *dissolved oxygen* concentrations but the methodology differs from the new National Objective Framework guidelines.
[10] Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000 Guidelines)

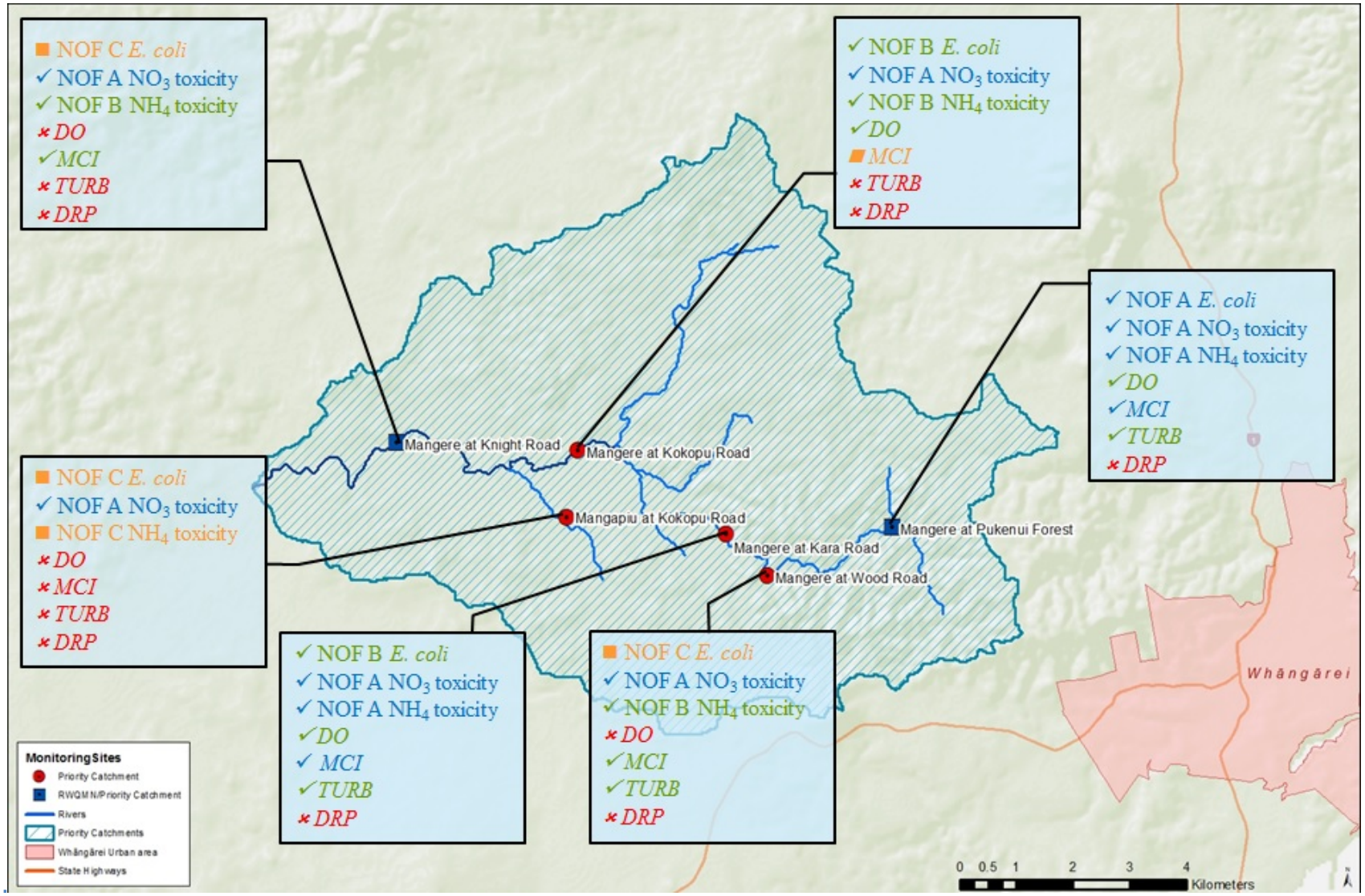


Figure 8: River water quality monitoring site results

Water quantity modelling

The taking and use of water is a regulated activity under the RMA and cannot be undertaken unless expressly authorised by the RMA or a rule in a regional plan. The RMA authorises the taking of a reasonable volume of water for specific uses – these include livestock drinking, individual domestic use and firefighting. Regional plans authorise the taking of small volumes of ground or surface water for any use without consent (a *permitted activity*). All other water takes require a consent and are classified in the Regional Plan as a *discretionary activity* (can be refused).

The greatest demand for water is for extraction from summer river base-flows. However, there are also two consented groundwater takes and four dams in the catchment. The four in-stream dams capture and store seasonal base-flows and stormflows. Stored water in three of the dams is extracted and used for on-farm irrigation – stored water in one of the dams is currently unused.

Rivers: the council has modelled what the river summer base-flows (known as Mean Annual Low Flows) would be in the catchment without extracted water takes. Modelled Mean Annual Low Flows and the location of consented water takes are shown in Figure 9. The Mangere River at Knights Road is predicted to have a mean annual low flow (MALF) of 126L/s in summer without any water extraction. The model does not account for increased river flows due to deforestation, which generally increase stormflows rather than base-flows.[11]

Maximum volumes of river extraction that occur during summer have been estimated for different uses:

- Livestock drinking is estimated to be 873m^3/day (or 10.1L/s).
- Dairy shed use is estimated to be 449m^3/day (or 5.2L/s).
- Irrigation is estimated (from consented volumes) to be 4294m^3/day (or 49.7L/s) – the two largest irrigators take 3110m^3/day (or 36L/s) of this near the bottom of the catchment.

The total estimated allocated volume of extraction for all users is 65L/s (or 52% of MALF). This indicates a high demand for water that could significantly affect in-stream flows or other users.

Requirements to maintain minimum flows in-stream during summer are imposed to limit the amount of water that can actually be taken. Conditions of existing consents held by the two largest irrigators on the Mangere River at the bottom of the catchment require water extraction to stop if it will result in river flows dropping below 90L/s (or 72% of MALF) at Knights Road.

The Northland Regional Council has grouped rivers in the region into four different Freshwater Management Units (FMU) for managing river water quantity, based on their uses, values and sensitivity to extraction. Each FMU is subject to different limits on the taking of water –

[11] Page 7, Landcare Research, Forestry and Water Yield: The New Zealand Example.

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 Proposed Regional Plan and serve to protect in-stream values and reliability of supply for water users. The limits are expressed as a percentage of the river's mean annual low flow (MALF). The Mangere catchment is identified as 'small rivers' FMU. The 'small rivers' FMU has proposed allocated volume limits of 40% of MALF or the existing allocation level, and minimum flow limits of 80% of MALF or the existing minimum flow level (see Figure 8). In the Mangere catchment the allocated volume limits would therefore be 52%; and the minimum flow limits would be 72%.

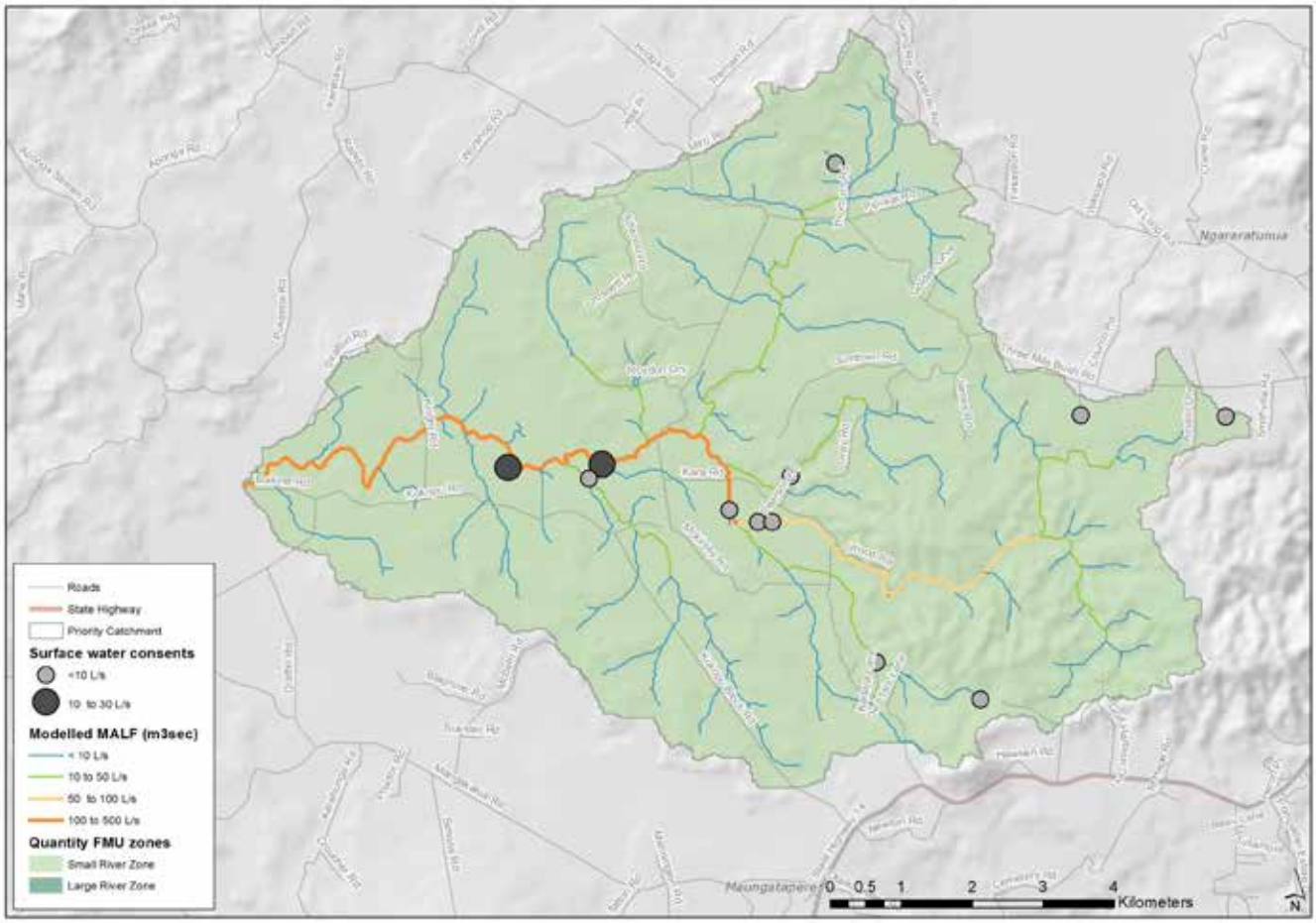


Figure 9: water quantity freshwater management unit zone – small rivers.

Catchment issues

The Mangere Catchment Group has identified the following issues and how they impact on the various uses and values in the catchment. This high-level impact analysis has helped to set objectives and the selection of methods to achieve those objectives in the following sections.

Table 2: Mangere catchment uses and values, and issues and objectives

Impacts on uses and values of waterbodies in the Mangere Catchment						
Potential Issues	impacts on **Aquatic Ecosystems** · Plants – watercress · Fish – eels, bully, banded kokopu · Invertebrates – koura	impacts on **Cultural Issues** · Kaitiaki – Transfer of native fish	impacts on **Recreational Uses** · Eeling · Duck shooting · Wading · Swimming	impacts on **Water Supply Uses** · Livestock Drinking · Farm Dairy Sheds · Damming · Irrigation	impacts on **Catchment Drainage Uses** · Groundwater - Land drainage · Surface water - Run-off and Flooding · Contaminant Removal - entrained substances	impacts on **Land Use** · Pastoral · Horticulture · Extractive Industries · Small Business
Pastoral hill-slope erosion *Hill-slope erosion rates under particular vegetation, soils and topography.*	***Negative impacts:*** *Increases erosion and risk of sedimentation of hard-substrate downstream stream/estuary beds.*					***Positive impacts:*** *Reduces planting and management of trees.* ***Negative impacts:*** *Reduces pastoral production, livestock shade/fodder, timber production.* *Increases loss of productive soils due to hill-slope erosion.*

Impacts on uses and values of waterbodies in the Mangere Catchment						
Livestock access to waterbodies *Treading sediment losses* *Discharges of faecal matter (pathogens and organic matter) and urine.* *Taking of water for livestock drinking needs.*	***Negative impacts:*** *Increases risk of habitat avoidance by turbidity sensitive fish and invertebrate species.* *Increases risk of habitat avoidance by ammonia and dissolved oxygen sensitive fish and invertebrate species.* *Increases risk of periphyton 'blooms' (on hard-substrate).*		***Negative impacts:*** *Increases pathogens and risk of immersion infections.*	***Positive Impacts:*** *Reduces need to install water supply infrastructure (dams, troughs, reticulation etc).*	***Negative Impacts:*** *Increases load of base-flow contaminants (suspended sediment, pathogens, organic matter, nutrients) in rivers.*	***Positive impacts:*** *Reduces need for access infrastructure (fences, culverts, bridges etc).*
Grazing of waterbody margins *Filtration of contaminants from storm run-off.*	***Negative impacts:*** *Reduces filtration and increased risk of sedimentation in downstream/estuary hard-substrate beds.*				***Positive impacts:*** *Reduces need for weed maintenance* *Reduces debris and risk to the free flow of water* *Reduces flood debris damage.* ***Negative impacts:*** *Increases loads of stormflow contaminants.*	***Positive impacts:*** *Increases pastoral production.*
Deforested waterbody margins *Stream bank erosion from loss of root structure.*	***Negative impacts:*** *Increases erosion and risk of sedimentation of downstream hard-substrate stream/estuary beds.* *Reduces shading and*	***Positive impacts:*** *Reduces shading. More water cress availability.*	***Negative impacts:*** *Reduces scenic and wilderness value.*		***Positive impacts:*** *Reduces debris and risk to the free flow of water.* *Reduces debris and risk of flood damage*	***Positive impacts:*** *Reduces need for planting and management of trees.*

Impacts on uses and values of waterbodies in the Mangere Catchment						
Sunlight and heat in waterbodies due to loss of canopy.	*increases risk of heat stress in sensitive fish and invertebrate species.* *Reduces shading and increases risk of periphyton blooms (on hard-bottom reaches).*				***Negative impacts:*** *Increases need for nutrient limits to control periphyton blooms (on hard-substrate reaches).*	***Negative impacts:*** *Reduces shading, fodder and wood.* *Increases loss of productive soils due to stream bank erosion.*
Populations of waterfowl in waterbodies *Grazing of pasture.* *Discharges of faecal matter (pathogens and organic matter) and urine.*	***Negative impacts:*** *Increases risk of habitat avoidance by ammonia and dissolved oxygen sensitive fish and invertebrate species.* *Increases risk of periphyton 'blooms' (on hard-substrate).*		***Positive impacts:*** *Increases hunting and gathering opportunities.* ***Negative impacts:*** *Increases pathogens and risk of immersion infections.*		***Negative impacts:*** *Increases loads of base-flow contaminants in rivers.*	***Negative Impacts:*** *Reduces pastoral production*
Farm dairy effluent discharges to waterbodies *Discharges of faecal matter (pathogens and organic matter) and urine.*	***Negative impacts:*** *Increases risk of habitat avoidance by ammonia and dissolved oxygen sensitive fish and invertebrate species.* *Increases risk of periphyton 'blooms' (on hard-substrate).*		***Negative impacts:*** *Increases pathogens and risk of immersion infections.*		***Positive impacts:*** *Reduces need for wastewater infrastructure (storage, irrigation etc).* ***Negative impacts:*** *Increases loads of base-flow contaminants in rivers.*	***Negative impacts:*** *Increases artificial fertiliser use on land.*
Waterbody wetlands *Filtration of contaminants*	***Positive impacts:*** *Reduces risk of downstream sedimentation of hard-substrate*		***Positive impacts:*** *Reduces pathogens and*		***Positive impacts:*** *Reduces stormflow volumes.* *Reduces loads of*	***Negative impacts:*** *Reduces pastoral production.*

Impacts on uses and values of waterbodies in the Mangere Catchment						
from base-flows and stormflows. *Temporary storage of peak stormflows.*	*stream/estuary beds.* *Reduces risk of down-stream habitat avoidance by ammonia and dissolved oxygen sensitive fish and invertebrate species.*		*risk of immersion infections.*		*base-flow and stormflow contaminants in rivers.*	
Water extraction from summer base-flows *In-stream (aquatic species and waterbody activities) needs.* *Out-of-stream (water supply) needs.*	***Negative impacts:*** *Reduces fish and aquatic species habitat.* *Increases risk of periphyton 'blooms' (on hard-substrate)* *Increases risk of habitat avoidance by ammonia and dissolved oxygen sensitive fish and invertebrate species.*		***Negative Impacts:*** *Reduces populations of species for fishing &hunting* *Reduces immersion opportunities.*	***Positive impacts:*** *Reduces need to install water supply infrastructure (storage).* ***Negative Impacts:*** *Reduces water available to other users.*	***Negative impacts:*** *Increases concentration of base-flow contaminants.*	***Positive Impacts:*** *Increases land production over summer.*
Damming/extraction of stormflows or seasonal base-flows (autumn-spring)	***Positive impacts:*** *Can maintain or increase habitat for fish and aquatic species.* ***Negative impacts:*** *Increases dams and risk to free fish passage.*		***Positive impacts:*** *Increases opportunities for waterbody activities on dams.*	***Negative impacts:*** *Requires construction of water supply infrastructure (storage).*	***Positive impacts:*** *Dam releases can be used to remove periphyton blooms (on hard-substrate reaches).*	***Positive impacts:*** *Enables sustained or intensified production over summer.* ***Negative impacts:*** *Requires construction and operation of individual or community infrastructure.*

Impacts on uses and values of waterbodies in the Mangere Catchment						
Populations of exotic/pest fish *Predation or competition with native fish species by trout and gambusia.*	***Negative impacts:*** *Reduces populations of native fish species due to predation and competition.*		***Positive impacts:*** *Increases recreational fishing and hunting opportunities.*			
Fishing reserves *Mataitai reserves.* *Taiapure reserves.*	***Positive impacts:*** *Increases population of breeding adults.*		***Positive impacts:*** *Reduces availability of mahinga kai for recreational or cultural harvesting.*			
Transfer of native fish *Kaitiaki activities.*	***Positive impacts:*** *Increases population of adults.*	***Positive impacts:*** *Practising of culture.*	***Positive impacts:*** *Increases availability of mahinga kai for recreational/or cultural harvesting.*			
Public reserves *Esplanade reserves.* *Infrastructure reserves.*	***Positive impacts:*** *Enables community conservation.*		***Positive impacts:*** *Enables community access and use.*	***Positive impacts:*** *Enables community owned dams and water.*	***Positive impacts:*** *Enables community wetlands and/or vegetated margins.*	***Positive impacts:*** *Enables landholder management of waterbodies.* ***Negative impacts:*** *Reduces landholder use of waterbodies.*

Catchment objectives

The Mangere Catchment Group has identified the following objectives to address the significant issues identified in the catchment. The objectives describe the outcomes sought in the catchment (broad and specific) to provide an appropriate balance between the various uses and values in the catchment.

Table 3: Mangere catchment uses and values, and issues and objectives

Uses and values	Issues that impact uses and values[12]	Broad (high-level) objectives	Specific (low-level) objectives
Ecosystem health · Hard-bottomed and soft-bottomed habitat. · Native species: birds, fish, invertebrates, plants, periphyton.	· Pastoral hill-slope erosion. · Livestock access to waterbodies. · Farm dairy effluent discharges to waterbodies. · Water extraction from summer base-flows. · Populations of exotic/pest fish species. · Deforested waterbody margins. · Transfer of native fish.	**Improve fresh and coastal habitats for native aquatic species.**	· Maintain hard-bottomed river reaches and reduce sediment loads to the Kaipara Harbour by reducing pastoral hill-slope erosion. · Improve habitat for turbidity sensitive fish and invertebrate during base-flows by reducing sediment and organic matter discharges from: o livestock access to waterbodies; and, o farm dairy effluent and domestic discharges to waterbodies. · Improve habitat for dissolved oxygen and ammonia sensitive fish and invertebrate by reducing organic matter and nutrient discharges from: o farm dairy effluent; and o livestock access to waterbodies; and, o domestic wastewater. · Maintain native fish habitat by maintaining current levels of water extraction from summer base-flows. · Improve native fish populations by maintaining the transfer of native fish.

[12] see Table 2 for more detail.

Uses and values	Issues that impact uses and values[12]	Broad (high-level) objectives	Specific (low-level) objectives
			· Improve native fish and invertebrate habitat by reducing populations of exotic/pest fish species. · Improve habitat for birds and temperature sensitive fish and invertebrates by maintaining riparian forests along the Mangere River, Mangere Stream and Patuwairua Stream.
Recreational/cultural Activities · Food gathering exotic species – watercress, ducks. · Food gathering. · Swimming. · Walking. · Wading. · Education. · Kaitiaki – transfer of native species.	· Public reserves. · Fishing reserves. · Transfer of native fish. · Farm dairy effluent discharges to waterbodies. · Livestock access to waterbodies. · Water extraction from summer base-flows.	**Improve waterbodies for recreational and cultural activities.**	· Improve access along the Mangere River, Mangere Stream and Patuwairua Stream margins by supporting the creation of esplanade reserves. · Improve native eel populations for non-commercial purposes by reducing commercial harvesting. · Improve native fish populations by maintaining the transfer of native fish. · Maintain the quantity of water available for food gathering and immersion activities by maintaining current levels of water extraction from summer base-flows. · Improve the quality of water for immersion activities by reducing discharges of pathogens from: o Effluent discharges to waterbodies; and o Livestock access to waterbodies.
Catchment drainage · Ground water (land drainage. · Surface water (storm run-off and storm flows). · Contaminant removal.	· Farm dairy effluent discharges to waterbodies. · Livestock access to waterbodies. · Grazing of waterbody margins.	**Improve the ability of waterbodies to remove contaminants in water and accommodate stormflows**	· Improve the ability of rivers to remove contaminants during base-flows by reducing: o Effluent discharges to rivers; and o Livestock access to waterbodies. o Maintaining riparian vegetation to act as a filter. · Improve the ability of rivers to remove stormflows by maintaining river bed capacity and riparian margins / wetlands.

Uses and values	Issues that impact uses and values[12]	Broad (high-level) objectives	Specific (low-level) objectives
Water supply · Domestic use. · Livestock drinking. · Dairy shed – wash-down & cooling. · Irrigation – pasture. · Horticulture. · Dams and storage. · Small business/industry.	· Water extraction from summer base-flows. · Damming/extraction, of stormflows and seasonal base-flows.	**Improve water availability and the security of water supplies.**	· Maintain the reliability of water supplies for existing users by maintaining current minimum flows and allocation. · Improve water availability by increasing the damming/extraction of stormflows and seasonal (autumn-spring) base-flows. · Increase efficient use of extracted water.
Land use · Pastoral farming . · Quarrying. · Horticulture.	· Pastoral hill-slope erosion. · Damming/extraction, of stormflows and seasonal base-flows.	**Improve the productive capacity of land in the Mangere catchment.**	· Maintain productive soils by reducing pastoral hill-slope erosion. · Improve summer production by increasing the damming/extraction of stormflows and seasonal (autumn–spring) base-flows.

Catchment methods

The Mangere Catchment Group has identified the following methods to achieve the desired objectives in the catchment. Specific regulatory measures identified by the group may be included in the new regional plan and apply specifically to the Mangere catchment in addition to those in the Regional Plan.

Table 4: Mangere catchment proposed implementation methods (regulatory and non-regulatory) to achieve objectives.

Issues and current management approach	Mangere Catchment Plan approach
Livestock access to waterbodies Currently there are no operative regional rules requiring stock to be excluded from rivers and lakes. Dairy farmers have largely excluded livestock from streams wider than 1m and deeper than 30cm through industry good practice and supplier contracts.	**Regulatory:** As per regional plan with the additional requirement that: Beef cattle, dairy support cattle and deer are to be excluded from permanently flowing rivers and drains on land with slope of >15^0 from 1 January 2025. **Non regulatory:** · Encourage stock exclusion where not required by a rule (this would mean encouraging stock exclusion from intermittently flowing streams or by an earlier date). · Encourage water quality improvement / Erosion Control Plans where not required by a rule.
Grazing of waterbody margins Currently operative regional rules permit stock access and grazing within the 'riparian management zones' (0-20m) if it is the grazing of pasture. Approximately 63% of the catchment's river reaches have pastoral vegetation. It is uncertain how many reaches have set aside grass filter strips.	**Regulatory:** · None. **Non regulatory:** · Encourage 1-2 metre setbacks from stock-excluded waterbodies.
Riparian management	**Regulatory:**

Issues and current management approach	Mangere Catchment Plan approach
Operative regional rules restrict the removal of woody vegetation in waterbody margins unless it is for the purpose of: forestry; controlling streambank erosion; maintaining river flows; or, infrastructure (200m^2). Approximately 37% of the catchment's river reaches have woody vegetation. This is predominantly in hill-country and in remnant riparian forests along the Mangere River, Mangere Stream and Patuwairua Stream. The remnant riparian forests are identified as being of significant ecological value within the Whangārei district.	· As per regional plan. **Non regulatory:** · Regional Council to help the community to create riparian forests along the Mangere River, Mangere Stream and Patuwairua Stream.
Farm Dairy Effluent discharges to waterbodies Operative regional rules provide for farm dairy effluent discharges to land as a permitted activity (subject to conditions). Where farms cannot meet the permitted activity conditions, resource consents are required for discharge of treated effluent to water in accordance with conditions. There are currently 21 dairy farms in the catchment: seven rely solely on discharge to land; 15 have consent to discharge to land and/or water – one of these has no provision for land application. There are currently no discharges of human effluent to water.	**Regulatory:** · As per regional plan. **Non regulatory:** · None.
Pastoral hill-slope erosion Currently there are no operative regional rules to manage pastoral hill-slope erosion. Critical erosion-prone areas have been modelled for the Mangere catchment (using SednetNZ). This indicates that most of the pastoral hill-slope erosion comes from a portion of hill-country (see Figure 2). The current approach to managing hill slope erosion is working with landowners to address erosion on a voluntary basis through Farm Erosion Control or Farm Water Quality Improvement Plans, with some financial assistance provided (for example, for poplars).	**Regulatory:** Erosion control plans for high sediment yielding land in pasture to be compulsory after 1 January 2025 (See Figure 5). **Controlled activity – Pastoral land use after 1 January 2025 on *High Sediment Yielding Land* in the Mangere Catchment 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**

Issues and current management approach	Mangere Catchment Plan approach
	from areas of gully, landslide and earthflow erosion. 3. **information and monitoring requirements.** *Meaning of words:* ***"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 mapped in the new Regional Plan as having high potential sediment yield from erosion processes.* (see Figure 5). **Non regulatory:** · 50-100% subsidy for poplars/willows associated with erosion control plan implementation (case-by-case basis). · Encourage erosion control plans on other areas of land subject to erosion.
Water allocation Operative regional rules apply a minimum flow (the lowest level rivers can be reduced as a result of extraction of water – typically around 70-84% of Mean Annual Low Flow), but do not provide a 'hard' limit on the total volume that can be extracted (an allocation limit). Allocation limits protect: the reliability of supply for existing water users; and, aquatic habitat (limiting the period when a river could be held at minimum flow). Currently, the total volume of water allocated for extraction from rivers in the Mangere catchment is high at around 52% of Mean Annual Low Flow. The	**Regulatory:** Retain the current minimum flow and allocation volume as limits –i.e. do not aim to reduce allocation or increase minimum flows from the current: Apply the following water quantity limits for the Mangere Catchment: · A minimum flow limit of 72% of the seven day Mean Annual Low Flow (as calculated for individual reaches).

Issues and current management approach	Mangere Catchment Plan approach
actual minimum flow that must be maintained in rivers by those extracting water is 72% of Mean Annual Low Flow.	· An allocated volume limit of 52% of the seven day Mean Annual Low Flow (as calculated for the catchment – at the Knights Road recording station). **Non-regulatory:** · None.
Damming/extraction of stormflows and seasonal base-flows Operative regional rules allow the diversion of storm run-off to an off-stream dam as a permitted activity. Any extraction or damming of stormflows in a stream or river requires consent. There is expected to be a large number of small off-stream paddock dams capturing run-off for livestock drinking. There are also four privately owned in-stream dams of significant size that have consent to divert and store water. Water stored in two of these dams is not fully utilised.	**Regulatory:** · As per regional plan. **Non-regulatory:** · Council to encourage off-stream storage and flow harvesting.
Transfer of native fish The harvest and transfer of native fish species to a location where they already exist is the responsibility of the Ministry for Primary Industries under the *Fisheries Act 1996.* The transfer of eels and banded kokopu occurs from below the Wairua falls to streams in the Mangere catchment	**Non-regulatory:** · Support the transfer of native fish species by tangata whenua within the catchment.
Fishing reserves The commercial harvest (and total allowable catch) of fresh and marine fish species is the responsibility of the Ministry for Primary Industries under the *Fisheries Act 1996*. Commercial harvesting of eels does occur in the catchment. However, the Department of Conservation, as the land holder, restricts commercial eel harvesting in public reserves (Pukenui Forest).	**Non-regulatory:** · Support the creation of a fishing reserve (taiapure or mataitai reserves) by tangata whenua within the catchment.
Exotic/pest fish species Exotic or pest fish species can be addressed through regional pest management plans. The regional council can also support community efforts	**Non-regulatory:** · Seek voluntary restrictions on the release of exotic fish species (trout) from Fish & Game.

Issues and current management approach	Mangere Catchment Plan approach
to address pests through community pest control areas (CPCAs). Fish surveys have identified the presence of Gambusia and trout. Transfer of trout is authorised by the Department of Conservation and implemented by Fish & Game. Trout have been released in the Mangere catchment in the past.	· Seek formal restrictions on the release of exotic fish species (trout) from Department of Conservation. · Support the reduction of Gambusia populations.
Public reserves The creation of public reserves (esplanade reserves) in waterbody margins is the responsibility of the district councils under the Resource *Management Act 1991*. There are public reserves in the Pukenui Forest and in reserves along the Mangere Stream and Mangere River.	**Non-regulatory:** · Support the continued identification of the Mangere River, Mangere Stream and Patuwairua Stream in the Whangārei District Plan as an esplanade priority area for the creation of esplanade reserves.

Conclusion

The recommendations of the Mangere Catchment Group can be grouped into two types – regulatory (that is, rules) and non-regulatory (that is, voluntary measures or actions). Regulatory measures only have effect once adopted into statutory documents by local authorities or other agencies with regulatory powers.

The regulatory measures identified by the Mangere Catchment Group will be recommended to council for inclusion in the Proposed Regional Plan. If adopted by Council as part of the Proposed Regional Plan, they will then be subject to the same submissions, hearings and appeal processes.

Non-regulatory measures will rely on operational initiatives by the Mangere Catchment Group members and affiliates and / or other parties or agencies. Funding for these measures will also depend on council annual / long term plan processes and / or other agency funding. Implementation of non-regulatory measures will be set out in a prioritised implementation plan.

A draft of the Mangere Catchment Plan was subject to public consultation during August to September 2016. The Mangere Catchment Group greatly appreciates the time, effort and thought provided in the feedback received. This feedback has been considered during subsequent revision of the Mangere Catchment Plan in early 2017.

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. This specifies 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 it 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.
Dissolved reactive phosphorus (DRP)	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
Escherichia coli (E. 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.