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Annex 3

Lake Waikare & Whangamarino

Catchment Plan

A report prepared for

Primary Stakeholders Catchment Trust

By

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BRIEF

A trust (Primary Stakeholders Catchment Trust (PSCT) has been established by landowners in the Lake Waikare-Whangamarino catchment to facilitate their involvement in the development of a Catchment Management Plan (CMP).

The Trust has asked agKnowledge Ltd to:

1. Liaise with the Waikato Regional Council and obtain, digest and distil the information they have already collected in relation to the preparation of the Lake Waikare Whangamarino Catchment Management Plan.

2. Liaise with the Waikato River Authority (WRA) to obtain and digest information related to the Waikato Waipa River Restoration Strategy.

3. Translate the information into a digestible format and filtered for relevance to farmers.

4. Identify problems, gaps and limitations in the available information.

DESCRIPTION OF CATCHMENT

The Lake Waikare-Whangamarino Catchment comprises 7 sub-catchments and within the catchment there are five Waikato Regional Council (WRC) water quality monitoring sites (Table 1 and Figure 1).

Table 1: Sub-catchments within the Lake Waikare-Whangamarino catchment

Sub-catchment	Area (ha)	Area monitored (ha) [1]
Mangatangi	19,454	19,452
Maramarua/Kopuera	13,106	0
Matahuru	10,806	10,653
Waikare	10,688	0
Waerenga	2,032	1,951
Whangamarino Jefferies	9,705	9,602
Whangararino Island block	14,723	14,723
Total	*80,652*	*56,382 (70%)*

Note 1) area upstream of the monitoring site

All the sub-catchments, except for Maramarua/Kopuera and Mangatangi, drain through the monitoring site at Whangamarino (Island Block) and the whole catchment drains into the Waikato River prior to the Mercer Bridge.

CATCHMENT MANAGEMENT PLAN

The Waikato Regional Council (WRC) has commenced the process to develop a Catchment Management Plan (CMP) for the Lake Waikare-Whangamarino catchment.

To-date three documents have been prepared:

5. The "Lake Waikare & Whangamarino Wetland Catchment Management Plan: Part One – Catchment Over View – Draft for Consultation, March 2017." This report documents the resources in the catchment.

6. A data-base (Excel spreadsheet) listing all known Projects (64 on-ground activities such a riparian planting), Studies (72 Research Reports), and Monitoring programs, completed or in progress in the catchment, as at the end of 2016.

7. Based on this data-base, a further report "Lake Waikare & Whangamarino Wetland Catchment Management Plan: State of Understanding report – draft for consultation, March 2017", assesses this body of work in the catchment and identifies important gaps in the current knowledge.

THE WRC 'STATE OF UNDERSTANDING' REPORT

It is made clear that this report is a 'work in progress' and importantly, it is noted that the Landowners are key stakeholders and that their input "needs to be incorporated" in the ongoing development of the CMP.

After reviewing all the work in the catchment up to the end of 2016, the report notes that, "a significant amount of research and on-the ground projects have occurred to date within the catchment, however many of these have tended to focus on the Lake Waikare and the Whangamarino wetland and not the wider catchment subject to the CMP. " In other words the focus has not been directed to issues related to agricultural activities in the catchment.

Despite the large body of research and activities in the catchment the report identifies 19 issues/gaps in the state of current knowledge. Leaving aside those relating directly to the internal management of the Whangamarino Wetland and Lake Waikare, there are a number that relate to land use and farming activities in the broader catchment. These can be condensed down as follows:

8. Farming effects on the wetlands where farms abut the wetlands and feeder streams.

9. Management and rehabilitation of land in the headwaters of the catchment.

10. Management and mitigation of the stream-channel erosion in the lower reaches of the catchment.

11. Quantification of the sediment and nutrient input and outputs within the catchment.

12. Defining measurable water quality targets for the sub-catchments within the catchment.

There are some issues relating to the internal management of the Lake Waikare, and Whangamarino Wetland, which may indirectly influence land management and farming, in the wider catchment. Of particular importance are:

13. The effect of pests (koi carp and catfish) on the re-suspension of sediments in the lower reaches of the lowland streams and in the Whangamarino Wetland and Lake Waikare.

14. The ongoing management of the control gate on Lake Waikare and the Whangamarino Wetland weir.

The report concludes by listing 23 "potential investigations" identified to fill the gaps in the preparation of a CMP. Three of these are relevant to the issues/gaps identified above and in fact should be condensed into one overarching investigation.

15. Summarise all the water quality (nitrogen, phosphorus, pathogens and sediments) monitoring data collected by the WRC and the Department of Conservation (DOC) with a view to developing a Catchment Nutrient Plan (CNP) as a subset within the CMP.

THE WAIKATO RIVER AUTHORITY

The Waikato River Authority (WRA) was established in 2010 as a result of the Treaty Settlement between Waikato-Tainui and the Crown. The WRA is the sole trustee of the Waikato River Clean-up Trust and is responsible for administering a $220m fund over a 30 year period. The Trust generally has up to $7m available each year to support river restoration activities throughout the Waikato and Waipa River Catchments. The Trust will not fund activities explicitly required by the Healthy Rivers Plan Change (see next section) unless they go beyond the minimum standard e.g. through fencing wider set back of streams.

In the recent 2017 funding round the WRA priorities relevant to farmers and farming in the Lake Waikare – Whangamarino Catchment include:

16. Projects that improve water quality in streams, wetland and lakes and drains that flow into the Waikato River and its catchment.

17. Restoration of catchment headwaters of the Lower Waikato, in particular the Matahuru and Mangawara sub-catchments.

18. Projects that improve the health of the Whangamarino wetland.

19. Habitat and water quality enhancement of high priority lakes including Lake Waikare.

20. Retirement and restoration of wetlands associated with lakes including the Matahuru and Awaroa wetlands.

21. Projects that protect and restore currently existing wetland and the creation of new wetlands throughout the catchment.

The WRA has already funded a number of activities in the catchment over recent years. These are captured in the WRC data-base, noted earlier.

THE WAIKATO AND WAIPA RIVERS RESTORATION STRATEGY

The Waikato Regional Council, Waikato River Authority and DairyNZ will be jointly releasing a forward-looking strategy in 2018 entitled "Waikato River & Waipa River Restoration Strategy." This will set out funding and restoration priorities for "a wide-range of non-regulatory activities related to the restoration and protection of the Waikato and Waipa Rivers. Huka Falls to Port Waikato and the Waipa River." The focus is broad and covers the whole catchment and includes consideration of iwi cultural priorities, erosion and sedimentation, water quality, biodiversity, fish, and access and recreation

HEALTHY RIVERS: PLAN CHANGE ONE

Plan Change One (PC1) is a Regional Plan change now in a statutory process, details of which, including timeline, can be found on the WRC website. It is not clear at this stage when hearings before the Commissioners will be heard, or importantly, when the finalized plan will be ready for implementation.

In the context of this report it is emphasized that, relative to the CMP and the WRA, the PC1 has a narrow focus – it is solely concerned with water quality as expressed by the four contaminants: nitrogen, phosphorous, pathogens and sediments.

WATER QUALITY

Trends

Based on the data from the five water-quality monitoring sites in the catchment, the trends in the water quality are summarized in Table 2 (page 8).

22. There has been deterioration in the physical quality of the water (turbidity and clarity) in 3 of the 5 sub-catchments reflecting an increase in sediments in the water.

23. There have been some improvements in total nitrogen in some sub-catchments (3 of 5) and deterioration in others (2 of 5). All five catchments, have improved with respect to ammonia.

24. There have been no practically important or statistically significant trends in phosphorus.

Current Situation

The water quality (median values, 2010 to 2014 incl. WRC Technical Report 2015/15) at each of the monitoring sites is summarized below (Table 3). To give some perspective to the data, the water quality in the Waikato River at Huntly, Mercer and Tuakau is also provided (*in italics*).

Table 3 Water quality attributes in the five sub-catchments (2010-2014). The water quality attributes at three of the monitoring sites in the lower Waikato River are provided to given some perspective to the data.

Site	Median Clarity (m)[1]	Median total nitrogen (mg/m^3)	Median total phosphorous (mg/m^3)	Median ecoli (n/100ml)
Mangatangi	0.50	490	72	380
Matahuru	0.27	1310	98	600
Waerenga	0.75	1120	46	500
Whangamarino (Jefferies)	0.39	1090	89	600
Whangamarino (Island Road)	0.20	1830	152	180
Huntly Tainui[2]	*0.9*	*562*	*45*	*Not known*
Mercer Bridge[2]	*Not measured*	*631*	*52*	*80[3]*
Tuakau[2]	*0.6*	*571*	*53*	*Not known*

Notes 1) the higher the number the clearer the water.
2) figures are the 10 year goals from Plan Change One
3) 95 percentile not median.

25. All the sub-catchments have poorer clarity than the three sampling sites in the lower reaches of the Waikato River.

26. The median total nitrogen concentrations of the water in four of the five sub-catchments are higher than in the lower reaches of the Waikato River.

27. The total phosphorus concentrations are higher within the catchment than in the lower reaches of the Waikato River

28. The clarity of the water entering the Whangamarino wetland from the Matahuru and Jefferies catchments is better than in the water leaving the wetland at Island Road.

29. The total phosphorus and nitrogen concentrations in the water entering the Whangamarino wetland from the Matahuru and Jefferies catchments are lower than in the water leaving the wetland at Island Road. The reverse is true for e coli.

30. The total phosphorus concentrations are higher within the catchment than in the lower reaches of the Waikato River

31. The clarity of the water entering the Whangamarino wetland from the Matahuru and Jefferies catchments is better than in the water leaving the wetland at Island Road.

32. The total phosphorus and nitrogen concentrations in the water entering the Whangamarino wetland from the Matahuru and Jefferies catchments are lower than in the water leaving the wetland at Island Road. The reverse is true for e coli.

Table 2 Trends in water quality (1993 to 2012, WRC Technical Report 2013/20) in the six tributary streams in the Waikare-Whangamarino Catchment.

Tributary	Attribute							
	Temperature	**Dissolved oxygen**	**Turbidity**	**Visual clarity**	**Total nitrogen**	**Ammonia**	**Total phosphorus**	**E coli**
Mangatangi	ns[1]	ns	deterioration	deterioration	improvement	improvement	ns	-
Mangatawhiri	ns	ns	ns	ns	improvement	improvement	ns	-
Matahuru	ns	ns	deterioration	deterioration	ns	improvement	ns	-
Waereanga	ns	ns	deterioration	deterioration	deterioration	ns	ns	ns
Whangamarino (Jefferies Road)	ns	ns	ns	ns	improvement	improvement	ns	-
Whangamarino (Island Block)	ns	ns	improvement	ns	deterioration	ns	ns	-

Note 1) ns = not statistically significant or not of any practical importance

Plan Change One Targets

It is not possible to discuss the development of a CMP for this catchment without being cognizant of Plan Change One (PC1) – the now notified plan to 'clean-up' the Waikato and Waipa Rivers. PC1 is focused on enhancing water quality (i.e. reducing the concentrations of nitrogen (N), phosphorus (P) pathogens and sediments).

It is noted that PC1 specifically identifies the Whangamarino Wetland for its international significance and accordingly it is has been given a high priority in terms of restoration.

PC1 has set water quality targets or each of the 5 sub-catchments to be achieved in 10 years and 80 years. These are set out in Table 4 together with the current situation. Note that there are **no targets in respect to phosphorus**.

33. For nitrate N the current concentrations in all the sub-catchments, except Whangamarino, are the same as the targets set for years 10 and 80. A modest reduction is required in 10 years in the Whangamarino.

34. There are **no targets set for total** N (as distinct from nitrate N) in these sub-catchments although there are targets for total N in the Waikato River. (This is so for all the sub-catchments in the Waikato-Waipa catchment).

35. The goals set for e coli in year 10 require modest reductions in the Waerenga and the two Whangamarino sub-catchments. However over 80 years large reductions are required in all sub-catchments.

36. The changes in clarity required to meet the 10-year targets appear to be modest, but larger improvements are required over 80 years.

37. It follows that of the 4 contaminants (nitrogen, phosphorus, pathogens and sediments) the main focus in this catchment as far as PC 1 is concerned should be on reducing sediments and e coli, noting that reducing sediment loads (and hence improving clarity) will have a concomitant effect on reducing P concentrations (see also para 40 and 41).

Table 4 Current water quality measurements and the targets required in Plan Change One (PC1) in 10 and 80 years for five sub-catchments.

Sub-catchment	Attribute	Current	PC 1 (10yr)	PC1 (80 yr)
Mangatangi	Nitrogen (median nitrate, mg/m^3)	110	110	110
	Ecoli (95th percentile, n/100 ml)	6125	5567	540
	Clarity (m)	0.5[1]	0.5	1.0
Matahuru	Nitrogen (median nitrate, mg/m^3)	720	720	720
	Ecoli (95th percentile, n/100 ml)	6770	6147	540
	Clarity (m)	0.3[1]	0.4	1.0
Waerenga	Nitrogen (median nitrate, mg/m^3)	820	820	820
	Ecoli (95th percentile, n/100 ml)	5605	5098	540
	Clarity (m)	0.8[1]	0.9	1.0
Whangamarino (Jefferies)	Nitrogen (median nitrate, mg/m^3)	650	620	620
	Ecoli (95th percentile, n/100 ml)	5175	4712	540
	Clarity (m)	0.4[1]	0.6	1.0
Whangamarino (Island Road)	Nitrogen (median nitrate, mg/m^3)	750	750	750
	Ecoli (95th percentile, n/100 ml)	668	655	540
	Clarity (m)	0.2[1]	0.3	1.0

Note 1) from Table 3 and rounded up to be consistent with the PC 1 targets.

Phosphorus load

From a land management perspective it is valuable to consider not only the concentrations of the contaminants but also their loads at various locations within the catchment. We have attempted to do that for P, focusing on the sources of the P load passing the Whangamario Island Road monitoring site.

The total P load (tonnes/year) is estimated to be about 49 t/yr. This includes the inflows from the Waikato River into Lake Waikare, which occurs as part of the flood control scheme and from rainfall.

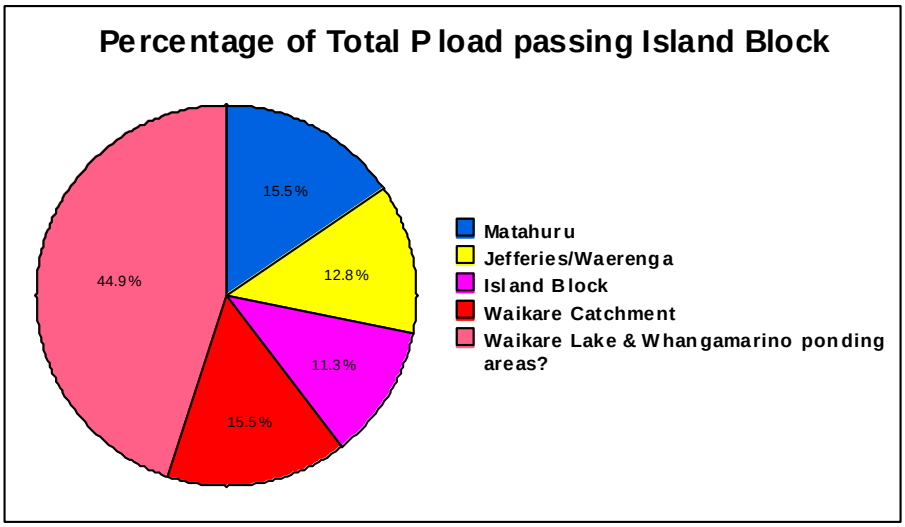
Table 5 and Figure 2 show the estimated P loads from the various sources contributing to the total load, in both absolute and relative terms.

Table 5 Estimates of the phosphate loads from various sources to the Whangamarino Island Road monitoring site.

Inflows of P from land and rainfall to Whangamarino Island Road	Tonnes P/year[1]	Proportion (%)
Matahuru	7.6	15.5
Whangamario Jefferies including Waeranga	6.3	12.8
Lake Waikare excluding Matahuru	7.6	15.5
Whangamarino Island Road	5.5	5.53
Total P accounted for	26.9	55.1
Balance from non-land activities	21.9	44.9

Note 1) These are 'best estimates' given the currently available data. The absolute numbers depend on what assumptions are made but this should not greatly affect the proportions.

Figure 2 Sources of the Total P at Whangamarino Island Road monitoring site.



38. The total P load discharged at Island Road into the Waikato River is about 49 tonnes/year representing about 5% of the total P loading in the Waikato River at Mercer (964 tonnes/year).

39. About half of the P leaving the catchment at Whangamarino Island Road is from agricultural land use and the balance from within the Waikare Lake and Whangamarino Wetland.

Conclusions: Water Quality

Notwithstanding the limitations in the data, several conclusions can be drawn from this analysis:

40. Sediments, ecoli and P (indirectly - see 41 below) appear to be the major contaminants limiting water quality in this catchment.

41. There are no goals set for managing P in this catchment. However P concentrations and sediment loadings in waterways are linked because most of the P is particulate P (i.e. attached to soil particles). For this reason reducing sediments will also reduce P concentrations.

42. Reducing N losses in this catchment is not a high priority.

43. The current evidence suggest that about half of the P leaving the catchment at Whangamarino Island Road is from agricultural land use and the balance from within the Waikare Lake and Whangamarino Wetland.

Limitations of the Information

There are some limitations in the available data that need to be acknowledged:

44. The water quality data is gathered monthly from five sites, which represent about 70% of the overall catchment. Two catchments are not sampled at all (Lake Waikare and Maramarua/Kopuara).

45. The frequency of sampling, and the fact that flow rates are only recorded at 2 sites, means that the accuracy in the mass flow calculation of the contaminants is unlikely to be better than +/- 15%.

IMPLICATIONS FOR THE CMP

The Regional Council's CMP should logically be informed by the requirements of PC1 and the priorities in the Waikato and Waipa River Restoration Strategy. Conceptually the situation can be envisaged as Figure 3 showing how the three components overlap and interact. From the farmers perspective the endpoint should provide sufficient information to prepare a well-informed, farm-specific Farm Plan.

The WRC "State of Understanding Report" identified 19 issues/gaps in the current state of knowledge, which were condensed down earlier in this report (see Para 8-12) to 5 topics of relevance to farmers. It is useful to restate these:

1. Farming effects on the wetlands where farms abut the wetlands and feeder streams.

2. Management and rehabilitation of land in the headwaters of the catchment.

3. Management and mitigation of the stream-channel erosion in the lower reaches of the catchment.

4. Quantification of the sediment and nutrient input and outputs within the catchment.

5. Defining measurable water quality targets for the sub-catchments within the catchment.

Points 1, 2, and 3 above overlap with a subset of the activities identified as funding priorities in the (yet to be released) 2017, Waikato and Waipa River Restoration Strategy (see Points 16, 17, 18, 19, 20 and 21). It is sensible therefore to encourage support for these activities as a component of the CMP.

Quite independent from the CMP process, a set of water quality targets has been developed for the 5 sub-catchments via PC1. These may be modified as PC1 goes through the hearing stages but it is assumed that these targets will take precedence over any goals that the WRC may wish to include in their CMP, unless they desire a higher standard. In other words point 5 above is completed.

The limited analysis in this report on the sources and flows of P in this catchment highlights the importance of this type of forensic investigation. Thus point 4 above is an important initial step in the development, prioritization and implementation of a robust CMP.

RECOMMENDATIONS FOR PSCT

The analysis above identifies two gaps in the existing knowledge and proposed activities within the catchment.

Recommendation 1: It is suggested that the PSCT should seek funding to implement a catchment-wide, robust, water-quality monitoring system.

From this information the movements and loadings of the contaminants in and through the 7 sub-catchment catchments can be determined. This will not only inform the CMP about the priority activities for the catchment but, once in place, an ongoing monitoring system will also enable the effectiveness of any mitigation options implemented by the CMP to be measured.

It is acknowledged that the CMP is a 'work in progress' and that there is a need to seek input from farmers.

Recommendation 2: It is suggested that the PSCT seek funding to hold meetings with the farmers in this catchment to seek their input into the ongoing development of the CMP. This report could be used as the background document for this purpose.

ACKNOWLEGMENTS

The technical input from Drs Bill Vant and Eloise Ryan of Waikato Regional Council and the assistance from Dr Keri Neilsen of the Waikato River Authority are gratefully acknowledged.

Figure 1: The Whangamarino Catchment

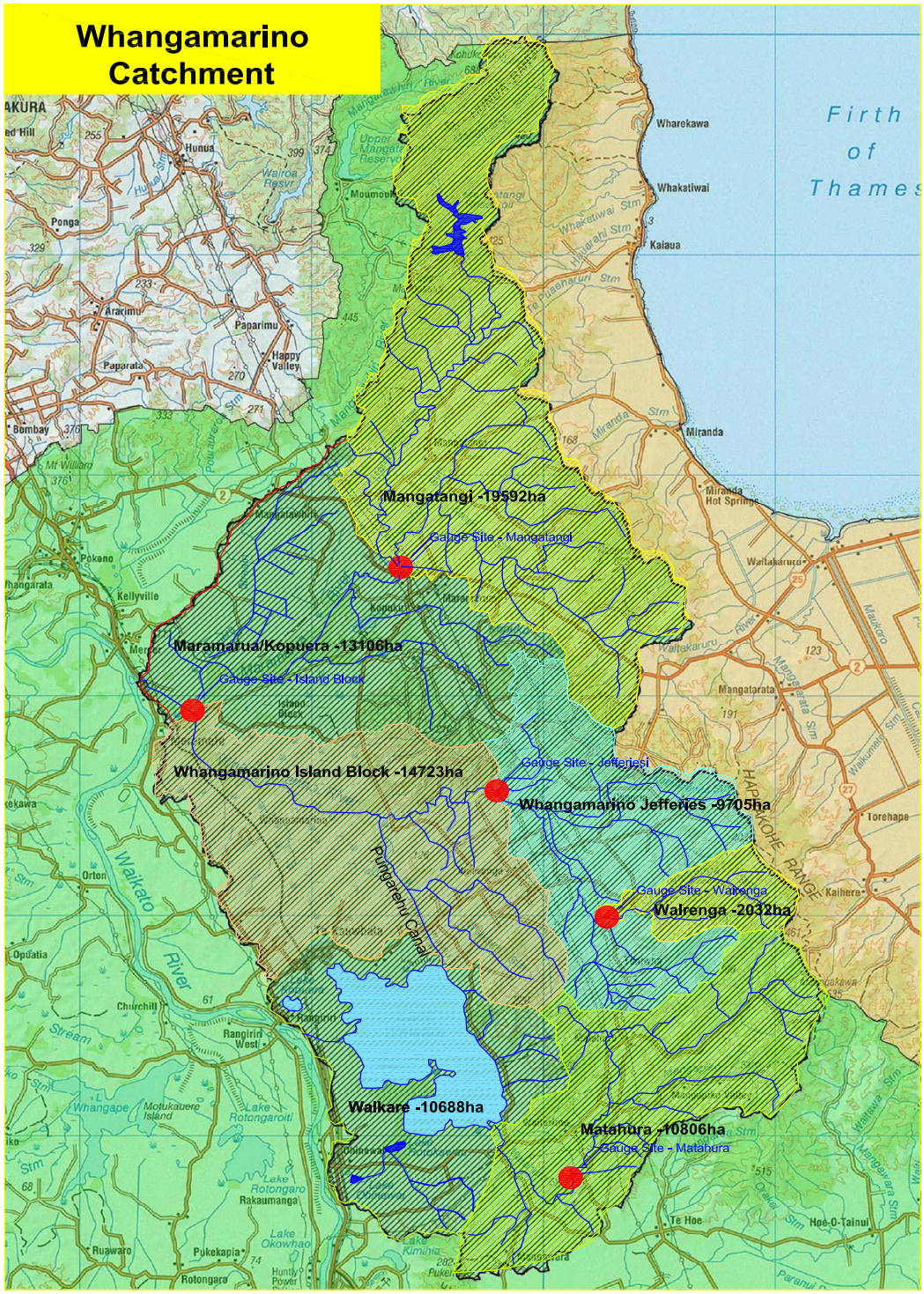


Figure 3: The Catchment Management Plan will be informed in part by Waikato and Waipa Restoration Strategy and the requirements of the Healthy River Plan.