

Waikato region shallow lakes management plan: Volume 1

Objectives and strategies for shallow lake management

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Executive summary

This Shallow Lakes Management Plan draws together information about the 71 shallow lakes of the Waikato region and the policy and legal framework for their management.

Volume I identifies the key management issues for shallow lakes, with a specific focus on matters that WRC has responsibility for (i.e. water quality, lake water levels and biodiversity values). Nine objectives (summarised below) have been identified for implementation within Waikato Regional Council's shallow lake management programme over the next 10 years.

Volume 2 is a complementary resource statement that summarises available information and knowledge for shallow lakes in the Waikato Region and identifies specific key management actions for individual lakes at a greater level of detail. It is anticipated that this volume will be relevant and useful to a wide range of stakeholders and individuals.

Policy & planning objectives

- Appropriate objectives, targets and limits are established for the future management and enhancement of shallow lakes
- Water levels of shallow lakes and associated wetland margins are adequate to support hydrological and ecological processes and functions, and maintain or enhance the values associated with these.
- The hydrology of shallow lakes (and their associated wetland margins) is protected from the effects of further wetland drainage.
- Shallow lakes and their associated wetland margins are protected from the effects of stock access.

Information & monitoring objectives

- Sufficient information is collected by WRC to assess and rank the biodiversity (SNA) values of all shallow lakes, and this information is analysed, reported, and used as the basis of effective lake management programmes.
- Sufficient information is collected from shallow lakes to assess and report upon their condition (water quality and ecological health), and to assess the effectiveness of WRC's policy and planning framework and shallow lake management programmes.
- WRC's lake level setting programme is underpinned by quality information, to ensure that shallow lake water levels are adequate to support hydrological and ecological processes and functions, and the values identified at these lakes.

Lake restoration & rehabilitation objectives

- WRC supports the development, testing and implementation of methods and techniques to maintain and/or enhance the values of shallow lakes.
- In conjunction with co-management partners, other agencies, stakeholders and landowners, WRC develops and implements integrated management and restoration programmes to protect and enhance priority shallow lakes, or valued aspects of these sites.

1 Introduction

Seventy one (71) lakes in the Waikato region are classed as 'shallow lakes', in that they have a maximum depth of less than 10 m. More than half of these are less than 5 m deep.

These lakes provide for a range of values - as habitat for native flora and fauna including taonga and game species, and also for water supply, flood control, commercial and traditional fisheries, and recreation. Shallow lakes also perform nutrient cycling and other ecosystem processes that contribute to the life supporting capacity of the wider environment.

Shallow lakes function differently to deep lakes in that their depth provides for them to be:

- Capable of supporting submerged aquatic plants over most of the lake bed as their shallow depths allow sufficient light penetration for plant growth;
- Regularly stirred up by wind and wave action which prevents long periods of thermal stratification and serves to recycle nutrients from the bottom sediments. The large interface between the lake bed and water column acts to amplify the influence of lake bed sediments
- Very susceptible to changes in hydrology due to catchment land use; and
- More heavily impacted by invasive species

As a result of these features, they are particularly vulnerable to deterioration, and require a specific management approach.

Recent legislative and policy changes affecting freshwater management provide Waikato Regional Council (WRC) with some new tools, approaches and opportunities for managing shallow lakes. These include co-management with Waikato River Iwi, National policies for freshwater management that require targets and limits to be established for water bodies, co-ordination with other agencies, a greater focus on catchment management to reduce landuse effects on waterbodies, and new funding opportunities for lake restoration projects.

The development of a WRC Shallow Lakes Management Plan was a performance measure in the Council's Long Term Plan 2009-2019. However, its completion was delayed as a result of a focus on the development of multiagency agreements and stakeholder relationships. Since that time, and in response to the land and water challenges faced in the region, Council established a Land and Water Portfolio (2012) to develop and implement an enhanced policy framework that sustainably manages the effects of resource use on land and water resources. Strategic goals and objectives have been developed within work streams (domains), as a principal implementation tool for delivering the Regional Policy Statement objectives for land and water management. This plan has been identified as a key tool for guiding WRC's future shallow lake management work programmes.

Whilst future policy and plan changes are likely to go some way to address the ongoing threats to shallow lakes in Waikato region, their likely timeframes necessitate the development of this plan to identify current pressures and opportunities, and guide WRC work priorities and programming in the short-medium term. It provides a suite of objectives and management actions that assist Council in implementing the methods in the Regional Policy Statement, and to give effect to the Vision and Strategy for the Waikato River.

This Shallow Lakes Management Plan draws together information about the shallow lakes of the Waikato region, the policy framework for their management, and the associated management challenges and opportunities. Volume 1 identifies objectives and high level management actions to address the key management issues for the lakes, with a specific focus on matters that WRC has responsibility for (i.e. water quality, lake water levels and biodiversity values). Volume 2 is a complementary resource statement that summarises available information and knowledge for shallow lakes in the Waikato Region and proposes key management actions for individual shallow lakes at a greater level of detail.

This plan has a term of 10 years, and will be reviewed after 3 years (in 2018).

2 Management context

2.1 Location

The Waikato region contains 96 lakes greater than 1 ha in size. Of these, 71 are classed as shallow lakes with maximum depths less than 10 m. The majority of shallow lakes have been formed in association with the Waikato River system and its floodplain, the region's coasts and cave systems, and the formerly extensive peat bogs of the region (Figure 1).

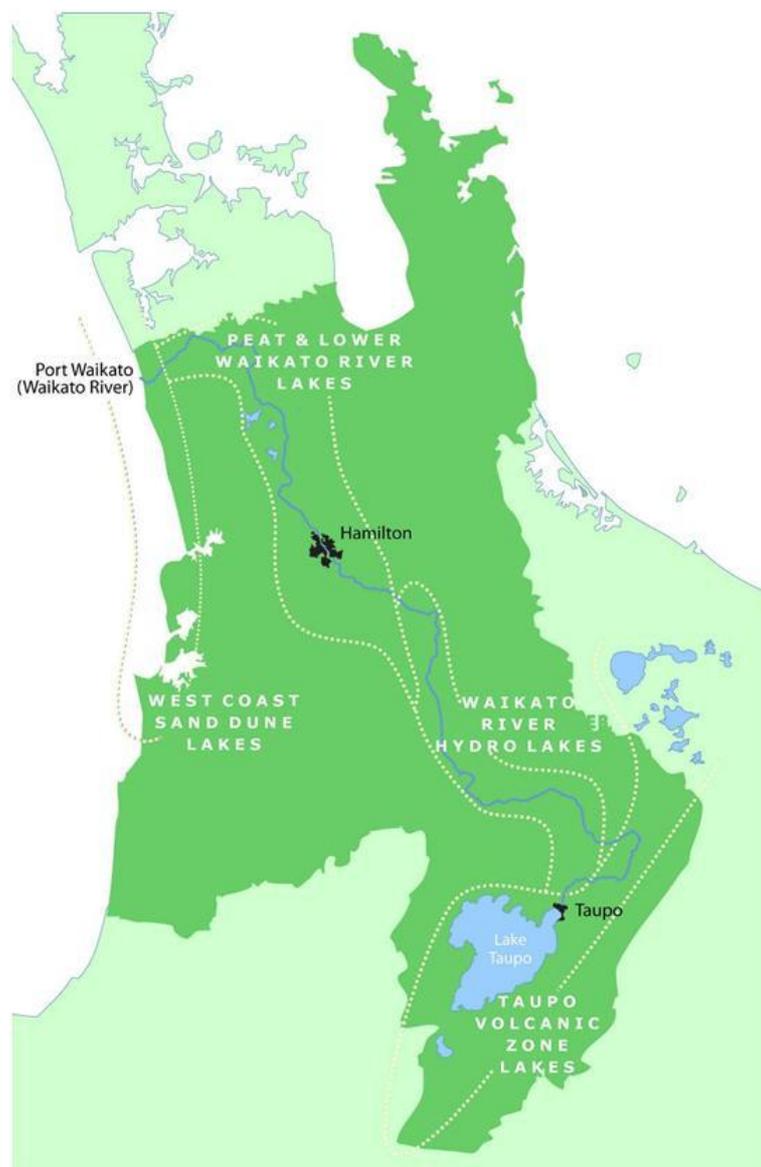


Figure 1 Location of lake groups within the Waikato Region

Shallow lakes are found throughout the region, with 'hotspots' in the Waikato District (peat, riverine, dune and karst lake types), Waipā (mostly peat lakes) and Waitomo (mostly dune lakes). Most dune lakes and all peat, riverine and karst lakes in the Waikato Region are shallow lakes.

2.2 Lake types

Peat lakes

There are 37 peat lakes in the Waikato Region that are predominantly concentrated within the Waikato and Waipā Districts. They represent the largest collection of this wetland type in New Zealand.

These lakes represent some of the few remaining wetland areas associated with the formerly extensive Komakorau, Rukuhia and Moanatuatua peat bogs. Peat lakes have unique characteristics that reflect their association with these peat formations, including having naturally acidic water that is low in nutrients and dissolved oxygen, and is highly coloured or tannin-stained. As a result, the lakes provide critical habitat for a number of specialised, and often rare and threatened, plant and animal species and communities.

Waikato peat lakes are mostly small to moderate in size (1-33 ha) and are located within predominantly small pastoral catchments¹. Lakes Rotokauri (42 ha), Rotoroa (55 ha) and Ngaroto (108 ha) are the largest of the peat lakes, which have catchment sizes up to 1800ha. As a result of agricultural conversion, few peat lakes retain the extensive marginal wetlands that would have existed in the past.

Before European settlement, most of the peat lakes had no inlets or outlets. Water entered the lakes by subsurface flow from adjacent peat bogs and from rainfall, and was lost primarily through evaporation. Drainage of the surrounding peat bogs has lowered water tables and lake outlets have been created or deepened. Subsequent farming activities have resulted in substantial peat shrinkage. Reduced lake levels and the loss of adjoining wetlands to filter nutrients and sediments from surrounding land has resulted in many of the lakes becoming much smaller, shallower and nutrient enriched.

Peat lakes are regarded as internationally unique and important ecosystems. They represent some of the oldest lakes in the Waikato, having formed between 18,000 and 22,000 years ago (McCraw 2011).

Dune lakes

There are 14 dune lakes in the Waikato Region, located in the Waikato, Otorohanga and Waitomo districts. Lake Te Rotopupu is also likely to be a dune lake, so has been included as such in this plan.

The Waikato dune lakes are mostly small to moderate in size (0.2 – 22.4 ha) with the exception of Lake Taharoa (216 ha). Catchment sizes are small (<134 ha) except for the Taharoa lakes (including Lakes Taharoa, Numiti and Rotoroa) that have a combined catchment area of 4226 ha. All of the dune lakes in the Waikato Region are located within predominantly pastoral catchments.

Sand dune lakes are formed by wind-blown sand deposits that block valleys or depressions to create lake basins (Viner 1987). In New Zealand, dune lakes are most commonly found on the West Coast of the North Island, where they formed (usually less than 5000 years ago) between dune belts. However, the dune lakes in the Kawhia-Aotea Harbour area (e.g. Lakes Parangi, Rotoroa, Rototapu, Harihari, Numiti Taharoa) are thought to be much older, having formed c. 50,000 years ago (Viner 1987).

¹ Around half of the peat lakes have catchment sizes smaller than 200 ha

Riverine lakes

Riverine lakes have been formed through fluvial (river) processes that can enlarge existing water bodies, establish natural levees that isolate new waterbodies, or create remnant waterbodies (i.e. oxbow) when a river changes course (Viner 1987)

There are 14 riverine lakes in the Waikato region that are associated with the Waikato River (12 lakes), Waipā River (Te Otamanui Lagoon) and Piako River (Patetonga Lagoon). The riverine lakes within the lower catchment of the Waikato River are part of an extensive river floodplain wetland system that includes Lakes Whangape, Waahi, Waikare and the internationally important Whangamarino Wetland. Together, these environments create a nationally significant, interconnected system of open water, wetlands and swamp environments that provide important habitat for native plants and animals. Lake ecosystems associated with large river basin floodplains are highly productive, diverse and interconnected. Their ecology (i.e. nutrient dynamics and biological diversity) is highly dependent upon riverine hydrology and flood frequency, so needs to be considered within the wider context of the Waikato River processes.

The riverine lakes share common properties with the peat lakes in terms of depth, catchment influences and vulnerability to change. All of the Waikato riverine lakes are naturally shallow (<5m depth) and their higher wind fetch have led to increased internal sediment re-suspension and reduced water clarity, especially following collapse of submerged vegetation. This group of lakes contains some of the largest shallow lakes in the region including Lakes Waikare (3442 ha), Whangape (1450 ha) and Waahi (522 ha).

Volcanic lakes

In New Zealand, volcanic lakes are largely confined to the Taupō Volcanic Zone and the area around Auckland. Whilst there are a large number of volcanic lakes within the Taupō Volcanic Zone, many fall within the Bay of Plenty region or are too deep to be classified as shallow lakes. Only 3 of these lakes (Lake Rotopounamu, Ngahewa and Tutaeinanga) are known to be less than 10m deep.

All three lakes are less than 10 ha in size with moderate to large catchments (500-750 ha). Land cover in these catchments ranges from <1 % (Tutaeinanga) to 84% (Rotopounamu) cover of indigenous forest.

Karst lakes

Lakes associated with karst (limestone) landscapes are rare in New Zealand, and often form in enclosed depressions that are known as sinkholes, poljes and dolines (Viner 1987).

There are only two shallow karst lakes in the Waikato Region. Lake Disappear forms in the largest known example of a polje in New Zealand. It is located near Aotea Harbour, and the lake periodically forms after wet weather when inflows are greater than the sinkhole can discharge. It is reported to reach depths of up to 15m (although is frequently shallower). Lake Koraha is very small (0.8 ha) in comparison, and is a permanent waterbody that is located within an almost fully forested catchment.

2.3 Condition

A recent scoring and ranking exercise was undertaken by Wildlands Consultants (2011) to assess the biodiversity values of lakes within the Waikato Region in order to prioritise them for biodiversity management. This process involved assessment of 4 categories –

(i) Ecological Significance; (ii) Ecological Condition (including water quality); (iii) Vulnerability; and (iv) Potential Outcomes.

This process highlighted information gaps and issues of concern for lakes of similar types, which are summarised below (by lake type). A fuller explanation is included in Volume 2.

Peat lakes

Almost 20% of peat lakes had insufficient information² to rank them for biodiversity management (Wildlands Consultants 2011).

The majority of peat lakes had ecosystem condition scores that reflect their poor water quality, the presence of pest fish, the small size of their wetland margins and the extent of hydrological modification that has arisen from changes to catchment land use (i.e. drainage).

A very small number of peat lakes (Lakes Maratoto, Rotokawau, Ngaroto, Rotomanuka and Rotopiko) had high ecological significance scores. These lakes still retain submerged plants and/or have moderately sized wetland margins that retain a high degree of indigenosity.

Lake Milicich, Pataka and Posa were identified as being the most vulnerable to change. These are small lakes where land intensification has very recently occurred or is likely to occur as a result of further drainage.

Dune lakes

Less information is available for dune lakes than any other lake type. Nine³ of the 14 known dune lakes did not have sufficient information overall to rank them for biodiversity management.

The Taharoa lakes (Lakes Taharoa, Numiti and Rotoroa), Lake Harihari and Lake Otamatearoa had the highest ecological significance and condition scores but also scored highly for vulnerability.

All dune lakes with sufficient data to enable scoring, had moderate to high scores for restoration potential which can be partly attributed to all surveyed dune lakes retaining submerged plant communities, which can be very difficult to re-establish once they have collapsed.

Riverine lakes

More is known about riverine lakes than any other lake type partly due to comprehensive biological surveys carried out in the 1980's and 1990's. This information is becoming dated however.

The large riverine lakes have some of the highest ecological significance scores for shallow lakes. Their size generally confers a high diversity of habitats and they tend to have large marginal wetlands that sustain a diversity of species, many of which are threatened.

All riverine lakes had low-moderate ecosystem condition scores as a result of their poor water quality. Most of these lakes experience regular algal blooms, and their interconnectedness facilitates the spread of pest fish and weeds so that almost all riverine lakes have high levels of pest fish and wetland weeds. The poor condition of the lakes translates into low vulnerability scores as most of the threats to these lakes have already occurred.

² Data deficient (DD) lakes are categorised as those lakes with more than 5 criteria that had to be estimated or couldn't be scored (Wildland Consultants 2011).

³ Lakes Waitamoumou, Puketi, Rotoiti, Unnamed 3, Numiti, Piopio, Rotoroa, Rototapu, Te Rotopupu

Potential outcome scores are mostly low which reflects restoration difficulty due to highly modified hydrological regimes and large catchment sizes.

Volcanic lakes

Sufficient information was available to rank all of the shallow volcanic lakes for biodiversity management, although recent information was scarce for Lake Rotopounamu.

Lakes Rotopounamu and Ngahewa scored moderately for ecological significance and condition, unlike the highly modified Tutaeinanga which scores low for both criteria. Lake Ngahewa is far more vulnerable than the other two volcanic lakes, due to its deteriorating water quality and invasion by exotic submerged and wetland plant species. Rotopounamu's location within a National Park provides considerable security for surrounding land use and protection.

Karst lakes

Further information is required to more accurately assess the biodiversity values and condition of these lakes. Insufficient information was available to rank Lake Disappear for biodiversity management, while the information for Lake Koraha was derived from a single visit. Lake Koraha is situated within a largely intact catchment and scores very highly for ecological condition.

3 Co-governance & co-management

Waikato Regional Council has several co-governance and co-management agreements with iwi⁴ regarding natural resource management decision making. These agreements are largely derived from Treaty settlement processes and legislation, and are incorporated into policy and operational decision making processes to become a core element of Council business.

Three Acts of Parliament relate to the Waikato River catchment, which give effect to Deeds of Settlement signed by the Crown and River Iwi. They are:

- Waikato Raupatu Claims (Waikato River) Settlement Act 2010;
- Ngati Tuwharetoa, Raukawa and Te Arawa River Iwi Waikato River Act 2010; and
- Nga wai o Maniapoto (Waipā River) Act 2012.

These Acts set out the requirement for co-management of the Waipā/Waikato River catchments for the overarching purpose of restoring and protecting its health and wellbeing for future generations. All three Acts define the requirement for Integrated River Management Plans (IRMP) to be jointly developed⁵ for the relevant geographical area of the Act. Some Environmental Management Plans have also been prepared by Iwi groups for their tribal areas

WRC is also currently working on the Healthy Rivers Plan Change 1 (*Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai*) which is being undertaken jointly with Waipā and Waikato River Iwi, to meet the requirements of recent legislation and Government policy (i.e. NPS-FM, Waikato Iwi Settlement Acts). The intention is for Council and Iwi to jointly recommend a Plan change that reduces contaminants entering waterbodies (including groundwater) in the Waipā and Waikato River catchments.

3.1 The Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act

The Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010 provides for an enhanced co-management arrangement for the Waikato River and its catchment, including:

- Establishment of a co-governance body, the Waikato River Authority (WRA) with equal representation of Crown and iwi appointees;
- The development of a direction setting document (“The Vision and Strategy”) for the restoration and protection of the Waikato River;
- Preparation of the Waikato River Independent Scoping Study (WRISS) to identify and prioritise actions to restore the health and well-being of the Waikato River and its catchment⁶

⁴ Currently Raukawa, Te Arawa river iwi, Ngati Maniapoto and Waikato-Tainui.

⁵ IRMP are scheduled to be completed within 3 years of the settlement dates for each Act – i.e. November 2010 for Waikato Tainui Raupatu Claim (Waikato River) Settlement Act; October 2010 for Ngati Tuwharetoa, Raukawa and Te Arawa River Iwi Waikato River Act; and April 2012 for the Nga Wai o Maniapoto Waipā River Act 2012.

⁶ which identifies specific goals and recommended actions to restore shallow lakes. A phased restoration programme was also recommended with costed restoration scenarios provided for 6 lakes, including Lakes Serpentine, Ohinewai, Otamatearua and Whangape.

- Establishment of a “Clean-up Trust” for the river - a \$210M contestable fund that is administered by the WRA for initiatives that contribute to improving the condition of the Waikato River; and Recognition of river-related customary activities that are undertaken by Waikato-Tainui (i.e. fisheries management).

Waikato-Tainui, and the Waikato River Authority’s, vision statement for the Waikato River is:

For a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come⁷⁸.

The Waikato-Tainui Environmental Plan – Tai Tumu, Tai Pari, Tai Ao was launched in September 2013 to provide “a map or pathway that will return the Waikato-Tainui rohe to the modern day equivalent of the environmental state that it was in when Kiingi Taawhiao composed his maimai aroha”. The plan identifies objectives, policies and methods for the future co-management of water, wetlands, and land that are directly relevant to factors affecting shallow lakes within the rohe of Waikato-Tainui.

3.2 Nga wai o Maniapoto (Waipā River) Act 2012.

The overarching purpose from the Nga Wai o Maniapoto (Waipā River) Act 2012 is: “to restore and maintain the quality and integrity of the waters that flow into and form part of the Waipā River for present and future generations and the care and protection of the mana tuku iho o Waiwaia.”⁹

The Ngati Maniapoto Iwi Environmental Management Plan (2007) contains the following broad level goals for water way environments within the Tribe’s rohe:

- “The restoration and preservation of coastal and waterway environments together with the maintenance of access to them”.
- “The improvement of air, soil and water quality together with the enhancement of the natural environment”

A second generation Environmental Management Plan is currently under development.

3.3 Ngati Tuwharetoa, Raukawa and Te Arawa River Iwi Waikato River Act 2010

The overarching purpose of the Ngati Tuwharetoa, Raukawa, and Te Arawa River Iwi Waikato River Act 2010 is to “restore and protect the health and wellbeing of the Waikato River for present and future generations”.

In their Iwi Environmental Management Plan (2003), Ngati Tuwharetoa established the following goals for the future management of water:

- To assert and exercise rangatiratanga and kaitiakitanga over waters within the Tūwharetoa rohe;
- Protect and enhance the mauri for future generations;
- Achieve statutory recognition of Ngāti Tūwharetoa rangatiratanga over water through the Waitangi Tribunal claims process.

⁷ Waikato-Tainui Environmental Plan, page 85

⁸ <http://www.waikatoriver.org.nz/about-the-waikato-river-authority/purpose/>

⁹ Nga Wai o Maniapoto (Waipā River) Act 2012 s3(1).

In their Fisheries Management Plan¹⁰ (2012), Ngati Raukawa has expressed the following overarching vision for fisheries in their takiwā: *“To protect, restore, enhance and rehabilitate freshwater fisheries and fisheries habitat for present and future generations”*. The Rauwaka Trust Board is currently developing an Environmental Management Plan.

The beds of Lakes Ngahewa and Tutaeinanga¹¹ are owned and administered under the Te Arawa Lakes Settlement Act 2006 by the Te Arawa Lakes Trust. The mission of the Trust is to *“Support sustainable cultural, social, health, environmental and economic development for Te Arawa Iwi and Hapu members”*. The pursuit of (i) the restoration of the Te Arawa lakes and waterways to a pristine state, and (ii) the ownership of the water, have been identified as strategic goals for the Trust.

Lakes Ngahewa and Tutaeinanga fall within the rohe of Ngati Tahu-Ngati Whaoa and are described within the Ngati Tahu -Ngati Whaoa Iwi Environmental Management Plan. This Plan identifies a number of short and long term management goals for the future management of water resources, including: The restoration of lake margins and associated wetlands; wetland protection and re-instatement; Stock exclusion from waterways; restoration of river/stream banks and lake edges; and restoration of water quality.

¹⁰ To be recognised as (i) An environmental plan for the purposes of the *Ngati Tuwharetoa, Raukawa, and Te Arawa River Iwi Waikato River Act 2010*; (ii) A planning document for the purposes of the Resource Management Act 1991

¹¹ As well as Lakes Ngapouri, Rotowhero, Whangioterangi, Ngakoro, Orotu and Rotokawa which are also in the Waikato Region but are more than 10m deep (i.e. not shallow lakes)

4 Legislative & policy context

This Shallow Lake Management Plan is a tool for implementing WRC's responsibilities, that stem principally from the Resource Management Act 1991 (RMA). The plan also assists Council in giving effect to:

- The Te Ture Whaimana o te Awa o Waikato (The Vision and Strategy for the Waikato River);
- The New Zealand Coastal Policy Statement;
- The National Policy Statement for Freshwater;
- The provisions of the Waikato Regional Policy Statement & Waikato Regional Plan.

Te Ture Whaimana o te Awa o Waikato (The Vision and Strategy for the Waikato River) is deemed in its entirety into the Waikato Regional Policy Statement, which must be given effect to through regional and district plans prepared under the Resource Management Act 1991. Importantly, if the provisions of any RMA planning documents (including national policy statements) are inconsistent with it, then Te Ture Whaimana o te Awa o Waikato prevails.

Detailed descriptions of these policy drivers can be found in Appendix 1.

4.1 Waikato Regional Policy Statement

The operative Waikato RPS (2000) identifies a number of significant resource management issues related to shallow lakes, and describes the objectives of the RPS in relation to them, and the results that are anticipated (Appendix 2). It also provides examples of important ecological areas in the region, identifying the lower Waikato Wetlands (including lakes Whangape, Waikare and Waahi), Waikato peat lakes, and unique Lower Waikato dune lakes amongst these.

Various reviews of the Waikato RPS have been undertaken in the past, that have identified impediments to policy effectiveness for freshwater quality and biodiversity (Enfocus 2007; EW 2007; Thompson 2008). These reviews identified increasing pressure on freshwater resources (including the health and wellbeing of the Waikato River) and their recommendations reinforce the need for:

- Integrated regional and district plan controls (including an appropriate mix of regulatory and non-regulatory methods);
- Practical and operational planning and implementation methods that involve a variety of tools and options available to agencies and stakeholders, and
- Robust information to be available to support policy and regulation

4.2 Proposed RPS

The proposed Waikato RPS has new objectives for managing the mauri and health of freshwater (3.13), ecological integrity and indigenous biodiversity (3.18), and new policies regarding the management of freshwater bodies (Chapter 8) and indigenous biodiversity (Chapter 11). Whilst some of the provisions of the proposed Waikato RPS are presently under appeal to the Environment Court, Chapter 11 (indigenous biodiversity) is now beyond challenge.

A list of high value fresh water bodies and wetlands is included in section 8A of the proposed RPS which identifies high value lakes, and provides an indication of their vulnerability to deterioration.

High condition & low vulnerability	High condition & high vulnerability
L. Rotopounamu L. Koraha	L. Maratoto L. Harihari L. Taharoa L. Rotopiko L. Otamatearoa L. Ngahewa L. Parangi

Review of the Waikato Regional Plan is the principal means of giving effect to the new biodiversity and freshwater policy directions of the Proposed Waikato Regional Policy Statement.

4.3 Waikato Regional Plan

The Waikato Regional Plan¹² identifies a suite of issues, objectives, policies and implementation methods (including rules) for the management of the region’s water resources. Appendix 3 documents the relationship between these issues, and the relevant WRP policies and implementation methods.

The Waikato Regional Plan contains a number of generic policies, rules and methods that are relevant for the management of water quality and quantity, indigenous biodiversity and social and cultural values. Specific direction is provided for some aspects of shallow lake management, including:

- Methods to maintain or establish minimum water or bed levels for significant peat lakes and wetlands;
- Rules to prevent the creation or deepening of drains within 200 m of significant lakes and wetlands (21 shallow lakes are listed);
- Rules and non-regulatory methods to exclude stock from mapped waterbodies;
- A requirement to adopt an inter-agency approach to managing wetlands and adjacent areas (see section 3.7).

4.4 Healthy Rivers: plan for change/ Wai ora: He rautaki whakapaipai

WRC is currently working on Plan Change 1, known as *Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai*, which is being undertaken jointly with Waipā and Waikato River Iwi, to meet the requirements of recent legislation and Government policy (i.e. NPS-FM, Waikato Iwi Settlement Acts). The intention is for Council and Iwi to jointly recommend a Plan change that reduces contaminants entering waterbodies (including groundwater) in the Waipā and Waikato River catchments to:

- Seek to improve water quality;
- Focus on defining the issues and options relating to water quality;
- Develop a range of possible land management scenarios, including options for targets and limits for the river/water bodies – derived from sound environmental, cultural, scientific and economic information;
- Assess a mixture of methods (i.e. rules, education, incentives, including industry self-regulation) available to WRC to support the achievement of targets and limits.

¹² WRP became operative (in part) on 28 September 2000

WRC intends to publicly notify the proposed plan change for the Waikato and Waipā River catchments late in 2015. Equivalent projects are planned to start in 2014 for the Waihou-Piako and Coromandel catchments, and in 2017 for the West Coast catchments.

A region-wide review of other aspects of shallow lake biodiversity and ecosystem functioning will be undertaken as part of a full review of the Waikato Regional Plan which is expected to commence in 2014/15 but is unlikely to become operative until at least 2022/23.

5 Inter-agency approach to shallow lake management

Two inter-agency agreements have been formalised for lakes and wetlands in the Waikato and Waipā Districts – The Waipā Peat Lakes and Wetland Accord, and Waikato District Lakes & Freshwater Wetland Memorandum of Agreement (MOA).

Waipā Peat Lakes and Wetland Accord

This Accord was signed by representatives of Waikato Regional Council, Department of Conservation, Waipā District Council, Auckland-Waikato Fish and Game Council and Nga Iwi Toopu O Waipā in February 2002. The purpose of the Accord is: “To align the activities of management agencies when working with landowners, tangata whenua and interested parties when working towards the restoration and enhancement of lakes and wetlands in the Waipā District”.

Waikato District Lakes & Freshwater Wetland Memorandum of Agreement

This MOA was signed by representatives of Waikato Regional Council, Department of Conservation, Waikato District Council, Auckland- Waikato Fish and Game Council and Waikato-Tainui in June 2011. The purpose of the MOA is: “To recognise the values of the freshwater lakes and wetlands of the Waikato District, and to protect, enhance and restore these through alignment of our activities when working with communities, landowners, tangata whenua and interested parties”.

6 Strategic direction for WRC

Waikato Regional Council confirmed its strategic direction and priorities for the current triennium on 27 February 2014, taking into account the recent Local Government Act 2002 amendments and other future change drivers. The Strategic Direction document¹³ states:

- The future change drivers, internal and external
- Council's strategic direction, including, the vision, mission, interim council outcomes, priorities, values and critical success factors.

Council's Vision is:

Competing globally, caring locally

Council's Mission is:

Working with others to build a Waikato region that has a healthy environment, a strong economy and vibrant communities.

The development of a WRC Shallow Lakes Management Plan was a performance measure in the Council's Long Term Plan 2009-2019. The Shallow Lakes Management Plan will assist Council to:

- Manage the region's water resource to meet the communities' needs for today and the future.
- Protect and improve the quality of Waikato's natural environment.
- Encourage our communities to appreciate and take pride in the region's heritage, landforms, freshwater and marine environment.
- Protect our people, property and economy from hazards and pests.
- Encourage community partnerships for greater participation and investment in the region.
- Collaborate with others to achieve integrated land use and infrastructure planning.

Land & water portfolio

In 2013 a cross organisational team developed ten-year goals for each of the four domains that sit within the Land and Water Portfolio (Water quality; Aquatic and terrestrial biodiversity; Water quantity; Soil quality, versatility and stability).

The water quality and biodiversity domains have particular relevance to shallow lake management with water quality objectives making reference to the priorities in the shallow lake management plan. The water quantity domain contains objectives relating to lake level setting.

¹³ DM # 2988118

7 Challenges for shallow lake management and progress to date

Shallow lakes in the Waikato region make up a large proportion of the 30% of monitored New Zealand lakes that have undergone substantial declines in ecological condition and have poor to extremely poor water quality (Hamill 2006). Ninety-five percent of the monitored shallow lakes in the region have an average TLI score of 4 (i.e. eutrophic) or worse and most shallow lakes in the Waikato region are no longer able to support submerged aquatic plants (Hamilton et al. 2010, Hamill 2006, Edwards et al. 2010).

Shallow lakes are particularly vulnerable to regime shifts where they “flip” from a vegetated, clear-water state, to a turbid, phytoplankton dominated (de-vegetated) state. These shifts in New Zealand lakes are known to be positively correlated with the conversion of catchments from forest to pasture; the presence of invasive oxygen weeds (e.g. *Egeria densa*), and the presence of catfish and coarse fish populations (Schallenberg & Sorrell, *in press*).

The Waikato River Independent Scoping Study (WRISS) identifies the following factors as being associated with the ongoing decline of the health and wellbeing of many Waikato shallow lakes (NIWA 2010):

- Diffuse catchment inputs of nutrients, sediment and bacteria;
- Internal re-generation¹⁴ of nutrients from the beds of the lakes;
- Impacts of invasive species (i.e. pest fish or aquatic weeds);
- Reduced water depth and flushing rates arising from hydrological modification;
- Removal of vegetation filtering potential within the catchment (due to loss of wetland vegetation within the catchments as a result of agricultural development).

Waikato Regional Council has recently undertaken a scoring and ranking process to assess the biodiversity values of lake ecosystems in the region (Wildlands Consultants 2011). This process identified considerable information gaps, and scores were estimated for 36 shallow lakes on the basis of best available information (i.e. maps) and expert opinion. Eighteen shallow lakes¹⁵ could not be scored and were identified as “data deficient”.

Existing WRC programmes

WRC has a key role in the future management of shallow lakes in the region due to its statutory obligations. Through non-statutory agreements (e.g. Accord agreements for Lakes and Wetlands in the Waipa and Waikato Districts), WRC has also confirmed its commitment to work collaboratively with Iwi, stakeholders and other agencies to improve the condition of lakes and wetlands in the region.

To date, WRC has undertaken a number of shallow lake management and enhancement initiatives, including:

- Development, implementation and review of policy and regulatory frameworks for shallow lake management (i.e. WRPS and WRP)
- Lake Level Setting Programme to establish minimum summer water levels for vulnerable peat lakes;

¹⁴ Via wind induced resuspension, benthic fish feeding or anoxic events

¹⁵ Including Dune lakes Puketi, Rotoiti, Numiti, Rotoroa, Piopio, Rototapu, Te Rotopupu, Waitamoumou, Unnamed 3; Peat Lakes - Opuatia, Kopuatai Burn Pools, Okoroire*, Rotokaraka, Rotokotuku*, Te Kapa, Waiwhata; Karst Lakes – Disappear; Riverine Lakes - Patetonga

- Undertaking and incentivising works in priority lake catchments (particularly fencing, weed control, and planting of lake margins) in conjunction with landowners, iwi partners, other agencies and stakeholders;
- Support for development and testing of shallow lake management tools (e.g. invasive fish management techniques; sediment and nutrient attenuation tools);
- Support for research programmes (e.g. Waikato University OBI);
- Development of and participation in inter-agency working groups (e.g. Lakes Accord Groups);
- Survey and monitoring of shallow lakes;
- Identification of significant natural areas (SNAs) for biodiversity planning purposes;
- Restoration planning and support (advice, funding, project management) for restoration programmes at priority lakes;
- Supporting catchment management initiatives (e.g. farm scale planning and detailed inflow monitoring) in sensitive lake catchments;
- Promulgation of best practice in shallow lake catchments.

In addition to these work areas, WRC has ongoing shallow lake monitoring programmes that collect information about the condition of shallow lakes, including their water quality, and other indicators of ecological condition (e.g. the presence and condition of submerged aquatic plants).

Challenges & opportunities

Hamilton et al. (2010) highlight the need for a long term approach to shallow lake management and restoration that incorporates an integrated management strategy, involving: protection from increased catchment nutrient loads; restoration of lake margins; and in-lake management (i.e. exotic fish and plant removal and re-establishment of native species).

Some lake restoration programmes overseas have focussed on restoring turbid, algal-dominated lakes to a clear-water, plant-dominated state for amenity, recreational, and biodiversity purposes. These programmes have required substantial (and ongoing) investment and effort, and have involved: reducing external nutrient inputs; re-establishing stable aquatic plant communities¹⁶, and limiting internal nutrient resuspension (Scheffer 1998). However, the results have been variable, due to the complex inter-relationships and ecological feedback mechanisms that occur in shallow lakes, and which may be highly individualised (Sondergaard *et al.* 2007; Jeppesen *et al.* 2007). The financial investment associated with these types of programmes, coupled with the uncertainty of outcome, underscore the importance and efficacy of protecting and enhancing lakes that retain natural values (including submerged aquatic plants) and reasonable water quality.

International research has also found that catchment nutrient loads need to be reduced to substantially lower levels than previous conditions (i.e. clear water conditions) in order for lakes to revert to that state again (Scheffer 1998). Nutrient reductions are likely to take in the order 5-15 years to manifest (Anderson et al. 2005; Jeppesen et al. 2007), with recovery times related to historical loads (Sondergaard *et al.* 2005). A recent study on the West Coast of the South Island suggests similar timeframes of c. 10 years to detect stream water quality changes arising from farmer activities (Wilcock et al. 2013).

¹⁶ sometimes involving control of benthivorous fish control, limiting sediment resuspension, and lake level manipulation

Major reductions in nutrient loading to northern hemisphere lakes are reported to have taken 5-10 years (for N) and 10-15 years (for P) to establish new equilibria (Anderson et al. 2005; Jeppesen et al. 2007). Variability in lake recovery rates is related to internal P loading¹⁷, retention times¹⁸, and prior loading rates¹⁹(Anderson et al. 2005; Jeppesen et al. 2005; Sondergaard *et al.* 2005).

The restoration project being undertaken at Lake Waiwhakareke (Horseshoe Lake) by Hamilton City Council is an important test-case for shallow lake restoration. Initial modelling indicates that the water quality of Lake Waiwhakareke could improve in the next 10-20 years from its current hypertrophic state to a moderate (meso-trophic) trophic state as a result of the retirement and revegetation of 76% of the lake catchment (Duggan 2012).

Jenkins & Vant (2007) have assessed the extent to which it would be possible to reduce the external sediment and nutrient loads to 44 shallow lakes in the region through improved land use practices. They estimated that average nitrogen and phosphorus loads could be reduced by 7% and 18% respectively, if farm management regimes improved from from “average” to “accepted best practice”. If farm management practices were shifted from “average” to “potential” practices (i.e. a step further than best practice at that time) then nutrient reductions of 36% (N) and 39% (P) were calculated.

WRC is required to set targets and limits to reduce sediment, nutrient and contaminant losses to waterbodies (including shallow lakes) as part of its planning and regulatory framework in order to maintain or improve fresh water quality within the region. Plan review processes are underway currently, and are likely to result in a mixture of methods (i.e. rules, education, incentives, industry self-regulation) being applied in shallow lake catchments in future. These plan change processes are also an opportunity for some of the current rules and policies that affect shallow lake management (e.g. lake level setting, stock exclusion, significant wetlands, drainage) to be updated.

It will be important for future target and limit setting processes to take account of the likely timeframes for changes to take place. It will also be important for the results of these programmes to be carefully monitored (over appropriate time scales) in order to maximise learning opportunities for application to other sites.

The University of Waikato have a 10 year Lake Ecosystem Restoration Research Programme that aims to develop new methods and technologies to effectively manage harmful algal blooms and pest fish to restore indigenous biodiversity in lakes. WRC staff have actively participated in this programme with a view to testing and applying the tools and technologies to Waikato lakes using an “adaptive management” approach. To date the University’s programme has focussed on developing:

- New models and technologies to effectively manage harmful algal blooms (IO1) - including genetic tools for identification of cyanobacteria (blue-green algae); modelling applications to address future land use and lake water quality scenarios; and examination of chemical treatments for nutrient inactivation.
- New pest fish management and control technologies (IO2). The key components of this have involved understanding the dispersal mechanisms of pest fish, chemical control, developing genetic tools to improve biosurveillance, and predictive modelling of water bodies at risk from pest fish invasion.

¹⁷ Internal P loading reduces and delays the rates of nutrient reduction

¹⁸ Lakes with shorter retention time have been observed to recover faster

¹⁹ Historically higher loads acting to delay recovery

Various funds are available (in addition to other programmes) to help protect and restore lake ecosystems within the Waikato region (i.e. the Community Conservation Partnership Fund, Waikato River Clean Up Trust and the Waikato Catchment Ecological Enhancement Trust). WRC has successfully obtained funding from these sources to undertake a number of lake and wetland restoration projects (e.g. at Lakes Mangahia, Maratoto, Harihari, and the Opuatia Wetland).

Fortunately, there is a growing community of interest in shallow lake restoration in the Waikato region, involving Iwi, agencies, landowners, NGOs and industry. This represents a real opportunity to undertake a range of activities at individual lakes to target different pressures at a range of scales.

Inter-agency projects that address multiple threats to waterbodies to achieve improvements in lake health and habitat values have the potential to attract substantial external funding. The implementation of a multi-agency action plan at Lake Areare²⁰ (led by DOC), the design and construction of silt traps at Lake Mangakware (led by Waipa DC), the installation of a koi carp trap at Lake Waikare (led by WRC), and various other lake restoration projects that are being led by Iwi, other agencies, NGOs and stakeholders (eg. wetland and lake margin restoration at Lake Waahi, catchment planning at the Rotomanuka lakes, and restoration works at Lake Ngaroto) have been funded through the Waikato River Clean Up Trust.

It is evident that there is considerable scope for WRC to expand its lake restoration and management programmes – particularly those being undertaken in conjunction with Iwi, other agencies, stakeholders and private landowners. Current inter-agency initiatives (e.g. Waikato RiverCare, Waipā Peat Lakes and Wetland Accord, Waikato District MOA) and relationships provide a good platform to access external funding for projects where priorities can be aligned.

²⁰ involving habitat enhancement, nutrient attenuation, establishment of cultural harvesting areas, and recreational planning. The project subsequently attracted further substantial funding from the dairy industry (under the DOC- Fonterra partnership) to undertake catchment planning (at a property scale)

8 Future objectives for shallow lake management & restoration

8.1 Policy and planning

Policy effectiveness reviews of the RPS and the Waikato Regional Plan (Enfocus 2007; GHD 2011, OAG 2011) indicate that:

- Water quality has continued to decline as a result of the effects of non-point source pollution associated with agricultural land use;
- Wetlands are continuing to decline in size and (probably also) in quality;
- Progress in enhancing public access to waterbodies has been modest; and
- Despite some isolated successes the overall policy approach for biodiversity and natural heritage has not effectively addressed the ongoing loss of indigenous biodiversity.

Shallow lakes in the Waikato region are particularly degraded in terms of their ecological condition and water quality with 95% of monitored lakes²¹ being at least moderately nutrient enriched²² (Hamilton et al. 2010, Hamill 2006, Edwards et al. 2010). Their condition and ongoing deterioration has been attributed, at least partly, to the effects of intensive agricultural land use within their catchments and WRC's heavy reliance on permitted activity rules and non-regulatory methods to manage the effects of drainage activities and agricultural non-point source discharges (Thompson 2008, OAG 2011).

WRC are working towards addressing these issues via:

- The Proposed Waikato Regional Policy Statement.
- A programme of review of the Waikato Regional Plan
- Strategic approaches to land, water and biodiversity management (within the Land & Water Portfolio)
- Collaborative projects with partners, stakeholders and other agencies

It is anticipated that these initiatives will improve the policy and planning framework for shallow lake management, whilst WRC's recent Land & Water Portfolio initiative will provide a more strategic cross-organisational policy framework for the sustainable management of land and water (including biodiversity) values. A Shallow Lakes Liaison Group has also been established within WRC to achieve better co-ordination of lake management, science, and policy programmes.

8.1.1 Setting objectives, targets and limits for the future management of shallow lakes

Recent legislation and government policy (NPSFM, River Iwi Settlement Acts) requires WRC to set objectives, limits and targets for all waterbodies. This mandate provides an opportunity to address catchment land management practices that generate diffuse pollution that are affecting the health of shallow lakes in the region. The water quality '*Healthy Rivers*' plan change currently being developed by WRC will apply to the Waikato and Waipā River catchments only which does not include many of the dune lakes or karst lakes. Equivalent processes are planned for other areas of the region starting with the Waihou-Piako and Coromandel catchments in 2014 and the West Coast catchments in 2017.

²¹ 18 of the 19 monitored lakes

²² i.e. eutrophic or worse

In these processes, it will be important to set realistic objectives and limits and take into account current and developing scientific knowledge about what is achievable for shallow lakes, and the likely timeframes for improvements to be detected.

Limit setting may require the development of catchment and lake models to assess and analyse various catchment management scenarios, which may require detailed catchment, water quality and landuse information (or augmentation of existing data).

Objective 1

Appropriate objectives, targets and limits are established for the future management and enhancement of shallow lakes

Strategies

- 1.1 Iwi, other agencies, stakeholders and landowners are actively engaged and involved in WRC's planning processes for the future management and enhancement of shallow lakes
- 1.2 WRC's Shallow Lakes Liaison Group (SLLG) co-ordinate lake programmes within Council
- 1.3 Realistic shallow lake health objectives are established on the basis of the known values of individual lakes (e.g. water quality, biodiversity, and value-based uses)
- 1.4 WRC staff working on shallow lakes participates in cross-organisational policy and collaborative processes to establish realistic objectives (including targets and limits for WRP "Healthy Rivers Plan Change") for the future management of shallow lakes in the Waikato region
- 1.5 The effectiveness of a range of realistic catchment management tools and scenarios are assessed and best practice is developed and implemented to maintain and/or improve the water quality and values of key nutrient loaded shallow lakes.

8.1.2 Lake level setting

Lake level setting is a key aspect of the protection of shallow lakes, due to the impacts of previous drainage, and their susceptibility to further drainage. The WRP has set minimum lake levels for 15 shallow peat lakes, and requires that minimum levels are set for a further 15 lakes. Significant progress has been made to identify minimum lake levels for most of the lakes identified (based on existing water level scenarios), and these levels should now be incorporated (by variation) into the WRP. Completing lake level setting processes for the remaining lakes remains a priority.

It is important to recognise that these processes have established minimum levels in relation to the current water level regime of these lakes, which may not be adequate to sustain particular ecological values in the long term. As such, it may be necessary to review these levels as part of future management planning processes for individual lakes. It may also be appropriate to consider undertaking lake level setting processes for other shallow lakes have also been affected by hydrological modifications (e.g. the lakes associated with the Waikato River), although implications for drainage, flood control and adjoining land uses would need to be carefully considered.

Objective 2

Water levels of shallow lakes and associated wetland margins are adequate to support hydrological and ecological processes and functions, and maintain or enhance the values associated with these.

Strategies

- 2.1 WRC's lake level setting programme is reviewed and updated to better address ecological considerations and lake management objectives
- 2.2 A lake level setting programme is established, and regularly reviewed that:
 - i. Continues to establish minimum lakes levels for those lakes identified in s. 3.7.4.5 of the WRP using the best available information and methodology.
 - ii. Identifies lakes that are vulnerable to lake level changes that require lake level setting processes or additional policy or regulatory intervention – including some large riverine lakes with highly modified hydrological regimes.
 - iii. Monitors the results of lake level setting processes to ensure that lake levels are appropriate to maintain the ecological and hydrological functions and processes, and associated values of the lakes

8.1.3 Wetland drainage rules in the WRP

The implementation of wetland drainage rules has been particularly problematic for shallow lakes, with substantial amounts of new drainage evident around a number of lakes in the region. Enforcement activities are limited by the high burden of proof that requires detailed survey information and the prohibitive cost of undertaking baseline drain invert surveys, and the technical complexities associated with determining the extent of deepening (vs. Maintenance levels of vegetation and sediment removal).

Whilst rule 3.7.4.6 in the WRP focuses on managing drainage activities within 200m of significant wetlands, the list of significant wetlands in section 3.7.7 is not comprehensive²³ and does not include many of the privately owned sites that are often the most vulnerable. Furthermore, wetland hydrology may be affected at some sites by drainage activities further than 200m away.

Objective 3

The hydrology of shallow lakes (and their associated wetland margins) is protected from the effects of further wetland drainage.

Strategies

- 3.1 The regulatory framework (WRP) is improved and implemented to better protect the hydrology of shallow lakes and their adjoining wetlands from the effects of drainage, including rules that are enforceable and protect all shallow lakes in the region.
- 3.2 A more comprehensive suite of shallow lakes are identified as significant wetlands (in section 3.7.7 of the WRP) for protection from the impacts of drainage activity.

²³ Forty four (44) shallow lakes have been omitted from the list of significant wetlands (in section 3.7.7) for protection from drainage through Rule 3.7.4.6

- 3.3 Private landowners are encouraged and supported to protect shallow lakes and their margins from the effects of drainage activities.

8.1.4 Stock exclusion

The WRP requires stock to be excluded from mapped waterbodies including 25 shallow lakes. Whilst the list of stock exclusion lakes is not comprehensive, 17 of the identified lakes have been fully fenced, 7 have been partially fenced and the state of fencing is unknown for the remaining lake (Taharoa). Whilst progress has been considerable in recent years, the riparian margins are unsatisfactorily narrow in some instances and further gains could be made by fence realignment.

Management agencies (e.g. WRC, TLAs and DOC) continue to work collaboratively with landowners to acquire land, or incentivise landowners to retire and revegetate the riparian margins of shallow lakes. Other recent industry initiatives (e.g. the Sustainable Dairying Water Accord) also require landowners to exclude stock from waterways²⁴, lakes and wetlands²⁵ according to their own specifications.

Sections 3.9.4.7 and 3.9.4.9 of the WRP indicates that Waikato Regional Council had intended to expand the livestock exclusion provisions of the WRP to Priority 2 sites - including Lakes Ngaroto, Whangape, Waahi and Harihari. This did not occur, but livestock exclusion is now widely accepted as being an effective means to create vegetated filters²⁶ to attenuate diffuse pollution (McKergow et al. 2007) and stock exclusion has become an industry requirement for some of these sites.

Objective 4

Shallow lakes and their associated wetland margins are protected from the effects of stock access.

Strategies

- 4.1 The regulatory framework (WRP) is improved and implemented to protect all shallow lakes and their adjoining wetlands from the effects of stock access.
- 4.2 All shallow lakes, their margins, and tributaries are identified as Priority waterbodies for stock exclusion.
- 4.3 Private landowners are encouraged by Council, Industry and other stakeholders to protect shallow lakes on their properties from the effects of stock access

8.2 Information and monitoring

8.2.1 Assessing lakes for biodiversity management

Reliable information is required to identify the specific biodiversity values and threats of the shallow lakes in order to assess their priority for restoration and biodiversity management, and determine their management requirements. In a recent process that scored and ranked the biodiversity values of 71 shallow lakes, insufficient data was available for eighteen “data deficient” shallow lakes²⁷. No information at all was available for 11 of these lakes. Information was also lacking or dated for some lakes that were

²⁴ Rivers, streams, drains and springs over one metre wide and 30cms deep that permanently contain water

²⁵ Wetlands identified as being significant in Regional Plans

²⁶ i.e. grassed or planted buffer strips

²⁷ Including Dune lakes Puketi, Rotoiti, Numiti, Rotoroa, Piopio, Rototapu, Te Rotopupu, Waitamoumou, Unnamed 3; Peat Lakes - Opuatia, Kopuatai Burn Pools, Okoroire*, Rotokaraka, Rotokotuku*, Te Kapa, Waiwhata; Karst Lakes – Disappear; Riverine Lakes - Patetonga

included in the biodiversity scoring process with scores being estimated for 36 shallow lakes based on best available information (i.e. maps) and expert opinion.

Data deficiencies were particularly evident for the dune lakes, which is of concern as these lakes have generally retained their submerged plants and water quality to a greater extent than other lakes, but are vulnerable to ecological deterioration. It is therefore a high priority for these sites to be visited and assessed using methods that complement other WRC lake monitoring programmes where possible.

Objective 5

Sufficient information is collected by WRC to assess and rank the biodiversity (SNA) values of all shallow lakes, and this information is analysed, reported, and used as the basis of effective lake management programmes.

Strategies:

- 5.1 WRC works with co-management partners and stakeholders to assess the values, threats and vulnerabilities of shallow lakes (to determine their management requirements), and this information underpins co-ordinated lake management programmes.
- 5.2 The SNA process for ranking the biodiversity values of shallow lakes is updated and reviewed every 5 years.

8.2.2 Lake indicators

Waikato Regional Council currently monitors and reports (on the WRC website) on two environmental indicators for shallow lakes:

- Nutrient enrichment of shallow lakes (reported every 2 years) - This information has been collected from WRC's (i) Lake Trophic State/Water Quality and (ii) Shallow Lake Health Indicators programmes.
- The condition of aquatic plant communities (Lake SPI) that uses submerged plant indicators to assess and monitor trends in the ecological condition of New Zealand lakes (Clayton et al. 2002). This indicator is reported every 5 years and is next scheduled to report on the condition of aquatic plant communities as an indicator in 2015/16.

These programmes and the information collected in them are explained in Volume 2 in more detail, including for individual lakes. No water quality information has been collected by WRC for 50% of shallow lakes in the region²⁸.

Water quality monitoring programmes generally report upon current state and trend detection, although shallow lake water chemistry can change significantly over short periods of time, may not always reflect the ecological values of lakes, and requires regular and ongoing sampling to assess status and trends which can be cost prohibitive. The development of new technologies in water quality monitoring such as remote sensing, and lake monitoring buoys may enable expansion of the monitoring network in future once sensors for nutrient monitoring are developed and proven. Other cost-effective monitoring methods and indicators of lake ecosystem "health" are also required.

²⁸ Including the following dune lakes - Parkinsons, Rotoiti, Unnamed 3, Waitamoumou, Piopio, Rototapu, Rotoroa, Te Rotopupu, Numiti; and peat lakes – Hotoananga, Komakorau, Pikopiko, Rotokauri, Waiwhata, Hendersons Pond, Ngaroto-iti, Pataka, Posa, Rotongata, Rotopotaka, Opuatia, Kopuatai Burn Pools, Rotokaraka, Leesons pond.

Objective 6

Sufficient information is collected from shallow lakes to assess and report upon their condition (WQ and ecological health), and to assess the effectiveness of WRC's policy and planning framework and shallow lake management programmes.

Strategies:

- 6.1 WRC's water quality and environmental indicator monitoring programmes are reviewed to ensure that they are adequate for:
 - SOE reporting;
 - Reporting upon the effectiveness of shallow lakes management & restoration programmes;
 - NPS reporting (i.e. monitoring shallow lakes with eutrophic or better WQ).
- 6.2 WRC uses efficient and effective methods²⁹ to gather information about the water quality and ecological health of priority shallow lakes and detect significant changes.
- 6.3 Shallow lake health indicators continue to be developed and tested in order to
 - assess the condition of shallow lakes, and
 - develop monitoring programmes for individual lakes (related to management objectives).
- 6.4 WRC staff work with co-management partners to assess opportunities for cultural health monitoring for shallow lakes.
- 6.5 The use of Lake SPI as an indicator is reviewed, and an appropriate programme of Lake SPI surveys is established for lakes that: (i) held submerged aquatic plants when last surveyed³⁰; (ii) are considered to be particularly high value³¹; (iii) recently supported submerged plants³²; (iv) are considered likely to support submerged plants; (v) are under management; and/or (vi) where there is a likelihood of change³³.
- 6.6 Shallow lake information is held in corporate databases and is analysed and reported at sufficient intervals to detect significant changes in lake condition.

8.2.3 Lake level setting

Lake level setting processes undertaken by WRC normally involve surveys, lake level monitoring, technical assessment, consents and compliance, and construction phases. This work involves co-ordinating work programmes amongst WRC groups.

Minimum lake levels have normally been set on the basis of 90% exceedance levels (derived from previous lake level records) on the basis of the approach that Stockdale (1995) recommended for the Lake Rotomanuka and Rotopiko complexes in Ohaupo³⁴. This approach has shifted to selecting minimum water levels that are exceeded for a greater amount of the time (i.e. 80% of the time), or that can be achieved without causing unacceptable inundation of surrounding land and vegetation.

²⁹ Including the use of new best practice methods (e.g. remote sensing/satellite, monitoring buoys) to extend water quality monitoring coverage for shallow lakes

³⁰ Lakes Rotopounamu, Rotoiti, Parangi, Puketi, Ngahewa, Otamatearoa, Parkinson, Serpentine Lakes

³¹ Lakes Rotopounamu, Lake Taharoa, Rotopiko/Serpentine Lakes

³² Lakes Kainui and Mangakaware

³³ including vulnerable lakes like Taharoa, Harihari and Ngahewa, or lakes where access or use arrangements may have changed to increase the risk of invasives

³⁴ Stockdale (1995) recommended maintaining water levels in wetlands adjoining peat lakes are set at levels that enable peat formation. She suggested that water levels should be maintained within 20cm of the ground surface for 90% of the time – as a starting point for discussion

With growing concerns about the long-term viability of shallow peat lakes and their wetland margins, it has been suggested that WRC should adopt a more “ecological” approach to lake level setting processes that is not so reliant upon available lake level data that incorporates the effects of contemporary drainage. This type of approach would involve incorporating (and giving greater weight to) the ecological requirements of key values of the lakes and their adjoining wetlands in lake level setting processes.

Objective 7

WRC’s lake level setting programme is underpinned by quality information, to ensure that shallow lake water levels are adequate to support hydrological and ecological processes and functions, and the values identified at these lakes.

Strategies:

- 7.1 Sufficient information is collected and maintained to assess shallow lake water levels, and develop recommendations for future lake levels to protect, maintain or reinstate hydrological and ecological processes and functions of the lakes, and their specific values.
- 7.2 WRC staff work collaboratively to review the progress and methods of the lake level setting programme, and ensure that processes are updated to reflect best practice and use the best available information.

8.3 Lake restoration & rehabilitation

Many shallow lakes would have initially supported rich aquatic vegetation and clear water, but have become de-vegetated and turbid as a result of land use changes, invasive fish and other anthropogenic pressures. When the plants have been lost from shallow lakes, turbidity often markedly increases due to algal blooms and sediment resuspension (due to wave and wind action). Other components of the lake ecosystem are affected by the loss of aquatic plants, since the vegetation provides important habitat and food for fish, birds, and invertebrates. Fish with benthic feeding habits, whose feeding activity promotes further sediment disturbance and resuspension, can dominate fish communities – thereby further increasing nutrient concentrations and turbidity levels. At this point, re-establishment of submerged plants is unlikely to occur naturally due to insufficient light penetration and ongoing sediment disturbance. (Scheffer, 1998).

Historically, most lake “restoration” projects have aimed at rehabilitating particular lake features or attributes for social, ecological, recreational or customary purposes. Holistic lake restoration has often been considered to be too complex, uncertain, practically difficult and/or expensive.

Globally, some lake restoration programmes have focussed on restoring turbid, algal-dominated lakes to a clear-water, plant-dominated state for amenity, recreational, and biodiversity purposes. These ambitious programmes have required substantial (and ongoing) investment and effort, and have involved:

- Reducing external nutrient inputs³⁵; and
- Re-establishing stable plant communities to provide habitat for animal communities, and assist with sediment stabilisation (sometimes involving control of benthivorous fish control, limiting sediment resuspension, and lake level manipulation); and

³⁵ Nutrient targets have often been below the levels that existed before the lake condition deteriorated

- Internal nutrient control to prevent the release of nutrients³⁶ (particularly phosphorus) from lake sediments. (Scheffer 1998).

There is considerable uncertainty about the outcomes of restoration programmes as a result of the complex inter-relationships and ecological feedback mechanisms that occur in shallow lakes, and which may be highly individualised. The uncertainty coupled with the financial investment that is required for a robust lake restoration programme (including monitoring), can be disincentives for lake restoration projects, but do serve to emphasise the efficiency of protecting and enhancing lakes that retain natural values (including submerged aquatic plants) and reasonable water quality.

Hamilton et al. (2010) highlight the need for a long term approach to shallow lake management and restoration that integrates catchment land use, hydrology, and nutrient and sediment management. They recommended that high value sites (e.g. Lakes Maratoto and Serpentine/Rotopiko) should be subject to an integrated management strategy that includes protection from any increases in catchment nutrient loads, restoration of lake margins, and in-lake management (i.e. exotic fish and plant removal and re-establishment of native species).

In the Waikato region, where shallow lakes are known to be amongst the most degraded nationally, the majority of shallow lake restoration projects have involved:

- Establishing minimum lake levels;
- Riparian retirement coupled with fencing;
- Enhancement of marginal habitat, including re-vegetation and weed control;
- Pest fish management;
- Reduction of nutrient and sediment inputs; and
- Improving access to the sites for recreation and management purposes.

Acquisition of agricultural land has been largely cost-prohibitive, although some District Council's (e.g. Waipa) have made real progress in acquiring esplanade reserves through direct purchase³⁷, and subdivision planning processes.

Whilst water quality restoration is a difficult prospect for many of the smaller shallow lakes, it will be substantially more difficult to achieve in the larger, turbid lakes (e.g. Whangape, Waahi and Waikare) as a result of their highly modified hydrological regimes and large catchment sizes. However, protection and/or restoration of other aspects of the biology and/or ecological function of these lakes may be more feasible, and/or important given their position and role within the floodplain of the Waikato River.

8.3.1 Nutrient & sediment load reduction

Reducing external nutrient and sediment inputs to water bodies through fencing and retirement of wetland margins has been a key focus for WRC to date. Whilst these actions go some way towards buffering the lakes from the effects of surrounding land use, and improving biodiversity and wildlife values, they do not reduce catchment inputs sufficiently to improve water quality in highly eutrophic lakes (Hamilton et al. 2010)

Options³⁸ to manage internal (i.e. within lake) nutrient loads were assessed for Waikato peat lakes, but were not recommended until substantial (>50%) external nutrient loads could be achieved (Faithfull et al. 2006). Fish removal and macrophyte re-establishment was also recommended as part of an integrated restoration and management strategy to improve water quality and transparency in the lakes

³⁶ which can drive phytoplankton populations when external nutrient loading has been reduced

³⁷ Including indirect funding from WRC via the Natural Heritage fund

³⁸ Sediment removal, application of dissolved organic carbon, or sediment capping compounds

As a result, recent shallow lake management and restoration projects have involved a more comprehensive suite of tools to increase nutrient and sediment attenuation rates, including – wetland construction/enhancement³⁹; riparian planting⁴⁰; silt trap construction⁴¹; stock exclusion⁴², riparian retirement; and farm system planning⁴³.

Objective 8

WRC supports the development, testing and implementation of methods and techniques to maintain and enhance the values of shallow lakes.

Strategies:

- 8.1 WRC supports research and testing of restoration tools and options to maintain and enhance the health of shallow lakes (e.g. lake modelling, constructed wetlands, floating wetlands, silt traps, pest fish management, and farm system management tools).
- 8.2 Best practice guidelines are developed and disseminated for reducing inputs sediment, nutrient, pathogens and other contaminant inputs to shallow lakes in the Waikato region.
- 8.3 WRC staff participate in the University of Waikato lake Restoration Programme (OBI) and identify and capitalise upon opportunities to test methods and tools to enhance Waikato shallow lakes.
- 8.4 WRC staff participate in national and international lake management networks to maintain a current knowledge of best practice and available tools for application in the Waikato region.
- 8.5 Best practice is promulgated amongst WRC staff who work within shallow lake catchments.
- 8.6 Research on methods for attenuating diffuse pollution are supported.
- 8.7 Management and restoration programmes are developed for high value shallow lakes⁴⁴ in conjunction with co-management partners, other agencies, stakeholders and landowners. These programmes use best available science to identify and implement nutrient and sediment objectives for these lake catchments.
- 8.8 WRC monitors shallow lake management and restoration programmes and uses this information to measure and improve the effectiveness of these programmes.

8.3.2 Shallow lake restoration and enhancement

Shallow lakes are used and valued for a range of different reasons and purposes, so it is essential that there is a good understanding of the values and pressures on individual lakes as the first step in the development of lake restoration or rehabilitation plans and projects.

The development of integrated management strategies has been recommended for shallow lakes, that involve (i) reduction of catchment nutrient loads, (ii) re-vegetation of lake margins, and (iii) in-lake controls (e.g. exotic fish removal to re-establish submerged aquatic plants). The establishment and maintenance of submerged macrophyte

³⁹ to slow inflows, encourage the absorption of nutrients and denitrification processes.

⁴⁰ to absorb nutrients from ground or surface water run-off and protection from bank erosion

⁴¹ to encourage suspended sediments to drop out of the water column before entering the lake

⁴² to prevent direct loss of nutrients and bacteria to lakes and protect lake shore vegetation from stock effects

⁴³ to identify opportunities to modify farm management practices to reduce nutrient, sediment, and contaminant losses to waterbodies

⁴⁴ Including the high condition and high vulnerability lakes identified in the Proposed RPS – Lakes Maratoto, Taharoa, Otamatearoa, Ngahewa, Parangi and the Rotopiko/Serpentine Lakes

communities is also thought to be a pre-requisite for maintenance of shallow lakes in a clear water state.

Techniques for enhancing wildlife habitat and biodiversity values in adjoining wetlands and lake margins are well developed although some aspects are challenging and costs (particularly for re-vegetation⁴⁵) may be high⁴⁶. Natural regeneration can substantially reduce habitat enhancement costs, but ongoing weed and pest control is likely to be required.

Various funds are available (in addition to other programmes) to help restore the biodiversity and condition of lake ecosystems. Examples include the Biodiversity Condition Fund⁴⁷, Waikato River Clean Up Trust and the Waikato Catchment Ecological Enhancement Trust.

Objective 9

In conjunction with co-management partners, other agencies, stakeholders and landowners, WRC develops and implements integrated management and restoration programmes to protect and enhance priority shallow lakes, or valued aspects of these sites.

Strategies:

- 9.1 WRC continues to work with Iwi and other agencies on the Waipā Peat Lakes and Wetland Accord, and Waikato District Lakes & Freshwater Wetlands MOA to identify and progress initiatives for the protection and management of shallow lakes in the Waipā and Waikato districts.
- 9.2 All funding sources available for shallow lake management and restoration within WRC (e.g. Catchment new works, SNA, lakes management) are identified and options for assisting land owners and other agencies with habitat enhancement projects are clarified and communicated.
- 9.3 Co-ordinated WRC programmes are established (including analysis of options) to:
 - maintain or improve the water quality of shallow lakes with eutrophic or better water quality; and
 - protect and/or enhance the priority values of all shallow lakes.
- 9.4 In conjunction with Iwi, other agencies, stakeholders and landowners, options for lake restoration are reviewed for high priority shallow lakes⁴⁸.
- 9.5 Native submerged plant communities are protected and maintained in shallow lakes that retain them, and actions are taken to restore submerged plant communities in high value lakes where practicable.
- 9.6 Options are assessed, and implemented where practicable, to restore submerged plant communities in those lakes where plants are in decline, or have recently collapsed.
- 9.7 Collaborative lake management and restoration projects are identified and action plans are developed in conjunction with Iwi, other agencies, stakeholders and landowners for shallow lake projects that can be submitted to funding agencies e.g. WRA Clean Up Trust, WCEET, BCF etc.

⁴⁵ Revegetation costs can vary from \$15,000-40,000 per hectare depending on site preparation, planting densities, survival rates and maintenance regimes

⁴⁶ e.g. The costs to restore marginal wetland habitat at Lakes Rotongaro and Rotongaroiti are estimated at \$3.2 million (Wildlands Consultants 2011b).

⁴⁷ Now replaced with the Community Conservation Partnership Fund

⁴⁸ Including the high condition and high vulnerability lakes identified in the proposed RPS – Lakes Maratoto, Harihari, Taharoa, Otamatearoa, Ngahewa, Parangi and the Rotopiko/Serpentine lakes

- 9.8 WRC actively engages with the Te Arawa Lakes Trust and the Taharoa Lakes Trust to identify future management objectives, priorities and projects for these lakes.
- 9.9 WRC engages in lake restoration initiatives undertaken by the Waipā and Waikato District Inter-agency agreements for lake management and restoration, and provides support as appropriate e.g. the Lake Areare Restoration Project funded by WRA Clean Up Trust.
- 9.10 WRC provides assistance to other agencies and stakeholders (including care groups) for restoration projects at key sites – including Lakes Rotomanuka, Ruatuna, Kaituna and Areare.
- 9.11 Capacity is increased within WRC to secure funds and implement lake restoration and management projects.

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Appendix 1 Legislative and policy drivers for the Shallow lakes management plan

Resource Management Act 1991 (RMA)

The purpose of the RMA (section 5) is to promote the sustainable management of natural and physical resources. An important component of this section for shallow lakes is the requirement to safeguard the life-supporting capacity of ecosystems and water (S5(2)(b)).

Section 30 of the RMA sets out the functions of regional councils to give effect to the Act. These functions include developing objectives, policies and methods for the maintenance of biodiversity and control of land use in order to maintain and enhance water bodies and water quality.

Section 6 of the RMA outlines matters of national importance that need to be recognised and provided for in relation to managing the use, development, and protection of natural and physical resources- including

- Preservation of the natural character of wetlands, and lakes and rivers and their margins, and their protection from inappropriate subdivision, use, and development;
- Protection of significant indigenous vegetation and significant habitats of indigenous fauna;
- The maintenance and enhancement of public access to and along lakes and rivers;
- The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

In exercising their powers under the RMA, councils must also have particular regard to Section 7 (Other Matters) including: (d) the intrinsic value of ecosystems; and (f) maintenance and enhancement of the quality of the environment. The principles of the Treaty of Waitangi must also be taken into account (Section 8).

The New Zealand Coastal Policy Statement (NZCPS)

The most recent version of the New Zealand Coastal policy Statement (NZCPS) came into force on 3 December 2010. The NZCPS establishes policies to promote the sustainable management of natural and physical resources in relation to New Zealand's coastal environment, which are given effect to by local authorities (via plans and policy statements), and by resource consent decision-makers.

Under the Proposed Waikato Regional Policy Statement, several dune lakes are located in the coastal environment - Lakes Harihari, Rototapu, Piopio, Rotopupu, Waitamoumou, and Unnamed 3. The most relevant policies in relation to the sustainable management of these lakes include the following:

- Taking into account the Treaty of Waitangi, Tangata whenua and Maori
- Protect indigenous biological diversity;
- Preserve the natural character;
- Restore natural character;
- Protect natural features and landscapes; and
- Improve water quality

- Sedimentation
- Discharge of contaminants

The National Policy Statement for Freshwater Management (NPS-FM)

The National Policy Statement for Freshwater Management (NPS-FM) 2011 came into effect on 1 July 2011 although subsequent changes have been effective from 1 August 2014.

The Freshwater NPS sets out the objectives and policies for freshwater management under the Resource Management Act 1991. It establishes a limits-based regime for freshwater management that requires Councils to establish objectives, limits and targets for water quality in all waterbodies.

RMA decision-makers have been required to have regard to the provisions of the NPS from 1 July 2011, which requires amendments to regional policy statements, plans, and variations to give effect to the NPSFM. Councils must fully implement the Freshwater NPS as soon as reasonably practicable, or no later than 31 December 2025 (whichever is earlier).

Waikato Regional Council has adopted a staged approach to the implementation of the Freshwater NPS that involves working collaboratively with stakeholders to develop proposed plan changes for:

- the Waikato and Waipā River catchments (to be notified in 2015);
- the Waihou-Piako and Coromandel catchments (to be notified in 2018);
- West Coast catchments (to be notified in 2021); and
- Reviewing other matters in the Waikato Regional Plan (not covered above) for notification in 2017/18.

The 2014 amendments provide specific direction on how objectives and limits should be set through the National Objectives Framework. This framework has a standardised list of possible values for which a particular freshwater body could be managed (e.g. swimming, fishing, irrigation) that would be determined locally. The minimum states for waterbodies would then be assigned at the national level through the framework (on the basis of their values), which incorporates Iwi considerations and aspirations.

Waikato Regional Policy Statement (WRPS)

Specific policies in the proposed RPS for freshwater bodies (including lakes) and indigenous biodiversity provide for:

- Establishing measurable limits and targets (Policy 8.1)
- Protection and enhancement of high value freshwater bodies and wetlands (Policy 8.2)
- Managing adverse effects of activities to maintain or enhance the values of all freshwater bodies and coastal water (Policy 8.3)
- Catchment based interventions (Policy 8.4)
- Recognition and implementation of Te Ture Whaimana o Te Awa o Waikato – The vision and strategy for the Waikato River (Policy 8.5)
- Managing allocation of freshwater (Policy 8.6);
- Efficient allocation and use of freshwater (Policy 8.7).
- Maintenance and enhancement of indigenous biodiversity (Policy 11.1)
- Protection of significant biodiversity (Policy 11.2)
- Collaborative management (Policy 11.3)

Some of the provisions of the proposed Waikato RPS are presently under appeal to the Environment Court, although Chapter 11 (indigenous biodiversity) is now beyond challenge.

Implementation of Policy 8.2 of the proposed RPS requires high value freshwater bodies and wetlands to be identified (on the basis of their water quality) and protected from adverse effects under implementation methods 8.2.1 and 8.2.2, respectively. To that end, a list of high value fresh water bodies and wetlands is included in section 8A of the proposed RPS which identifies high value lakes, and provides an indication of their vulnerability to change from their clear water and vegetated current state to an algal dominated state where submerged plants no longer occur.

High condition & low vulnerability	High condition & high vulnerability
L. Rotopounamu L. Koraha	L. Maratoto L. Harihari L. Taharoa L. Rotopiko L. Otamatearoa L. Ngahewa L. Parangi

Implementation of Policy 8.3 requires that:

- Regional Plans identify lakes and wetlands requiring water level protection, and (i) specify the bed and water levels required to protect the limits, targets or values of those lakes or wetlands, and (ii) control activities to protect lake and wetland levels and natural hydrological functioning (Method 8.3.5);
- WRC collaborates with territorial authorities, tangata whenua and other stakeholders to identify lakes that are or could become degraded, ascertain the causes of degradation and investigate options to maintain or enhance the limits, targets or values of the lakes (Methods 8.3.6).

Chapter 11 takes a comprehensive and ecological “network-based” approach to address biodiversity decline. Policies 11.1 and 11.2 are particularly relevant to shallow lakes in that they seek to:

- Maintain the full range of ecosystem types necessary for continued ecosystem functioning - which is particularly important for depleted and fragmented (e.g. coastal and lowland) ecosystems⁴⁹ (Policy 11.1)
- Protect Significant Natural Areas (SNAs) as a subset of Policy 11.1. This policy recognises the importance of maintaining, protecting, and re-constructing (if necessary) functional connections, buffers and linkages to enhance ecosystem functioning and resilience. This policy is particularly relevant for all shallow lakes given their status as SNAs, and the influence of their surrounding catchments on their overall condition (Policy 11.2)

Implementation of these policies will take place through the collaborative development of local biodiversity strategies (Method 11.1.10). Territorial authorities are obliged to have regard to these strategies when considering the most appropriate mix of regulatory and non-regulatory methods for each district.

⁴⁹ where enhancement/ restoration of ecosystems and ecological functions/processes may be required to maintain biodiversity in the long term

Appendix 2 Key policies, issues, objectives and outcomes in the operative Waikato Regional Policy Statement (RPS) relevant to shallow lake management

RPS section	Policy/issue	Objective	Anticipated outcome
3.3.7	Accelerated erosion of soil resulting in degradation of water quality	Net reduction in the effects of accelerated erosion and those effects avoided where practicable	Reduced severity of accelerated erosion resulting in increased water quality
3.3.11	Destabilisation of the beds and banks of lakes	Net reduction in the adverse effects of the destabilisation of lake beds	Reduction in instability of lake beds and banks
3.4.5	Reduction in water quality from the cumulative effects of discharges , land uses and from the taking and impounding of water	Net improvement of water quality across the Region	Protection of outstanding waters, and maintenance and/or enhancement of other less intact waters. Riparian margins maintained and enhanced
3.4.8	Human activities in and around wetlands have the potential to further adversely affect their natural character	An increase in the quantity and quality of Region's wetlands	Unique habitat of wetlands protected, wetland areas are protected and enhanced and no net loss of total wetland characteristics
3.4.9	Public access to water bodies		
	Enhancement of public access to and along lakes and wetlands and their margins except in certain defined circumstances	Public access is maintained and enhanced	
3.4.10	Mauri of water	Tangata whenua concerns relating to the mauri of the water recognised and provided for	The quality of water bodies are maintained and enhanced, and tangata whenua satisfaction that their concerns regarding the mauri of

			water are being recognised and appropriately addressed regionally
3.8.4	Adverse effects of natural hazards		
	The adverse effects of natural hazards are minimised (including maintenance of the existing flood control, land drainage and catchment schemes)	Reduced risk to the community from natural hazards, including maintenance of the existing flood control, land drainage and catchment schemes	
3.11.4	Maintenance of biodiversity		
	Biodiversity within the region is maintained or enhanced	Maintenance and enhancement of biodiversity in the region; and areas of indigenous vegetation and significant habitats of indigenous fauna are identified, protected, and managed	
3.14.3	Adverse effects of mineral exploration and development	Integrated management of the adverse environmental effects of mineral exploration and development	The adverse effects of mineral exploration and development activities are addressed in an integrated and effects based manner, in conjunction with the community

Appendix 3 Overview of the relevant policies and implementation methods from the WRP in respect of the issues identified in the Waikato RPS

Section	Issue	Relevant policies	Relevant implementation methods
3.2	Water management classes & standards	<ul style="list-style-type: none"> • Manage all waterbodies to provide for a range of water use activities whilst achieving a net improvement in water quality over time. • Enhance the water quality of degraded waterbodies. • Recognise and provide for the preservation of the natural character of lakes & rivers and their margins and their protection from inappropriate use and development. 	<ul style="list-style-type: none"> • Water management classes & standards. • Standards for maximum and minimum flows and levels. • Investigation of: <ul style="list-style-type: none"> ○ Community (incl. tangata whenua) uses and values for water quality; ○ Standards required to protect identified values; ○ Water quality status; ○ Methods for improving degraded water bodies.
3.5	Discharges	<ul style="list-style-type: none"> • Enabling discharges to water that will have only minor adverse effects (via permitted and controlled activity rules). • Managing discharges to water with more than minor adverse effects. • Promoting alternatives to direct discharge to water. • Maximising the re-use of nutrients and water from discharges to land. • Minimising the adverse effects of land discharges on ground water quality. • Recognising and providing for the relationship of tangata whenua (as Kaitiaki) with water • Encouraging at-source management and 	<ul style="list-style-type: none"> • Environmental education. • Promote industry research into effluent management practices. • Enforcement. • Rules: <ul style="list-style-type: none"> ○ Permitted activity rule 3.5.4.4 -Discharges of water to water ○ Discretionary activity rule 3.5.4.5 Discharges ○ Non-complying Activity rule 3.5.4.6 - Discharges to other waterbodies.

		treatment of stormwater discharges to reduce adverse effects on receiving waters.	
3.6	Damming & diverting	<ul style="list-style-type: none"> • Damming and/or diverting of water undertaken in a manner that: <ul style="list-style-type: none"> ○ Is consistent with water management objectives in s.3.1.2. ○ Is consistent with the river and lake bed structures objectives in s.4.2.2. ○ Does not obstruct fish passage where it would otherwise naturally occur. ○ Does not increase the adverse effects of flooding or land instability hazards. ○ Does not reduce aquatic habitat as a consequence of river channelisation ○ Increases the use of off-stream dams for water supply purposes (cf. dams in perennial streams). 	<ul style="list-style-type: none"> • Rules: <ul style="list-style-type: none"> ○ Permitted activity rule 3.6.4.7 – Existing lawfully established diversions and discharges. ○ Controlled activity rule 3.6.4.12 – Wetland & lake level control structures.
3.7	Wetlands	<ul style="list-style-type: none"> • Control land drainage in areas adjacent to identified wetlands and within wetlands (Policy 1 in s.3.7.3) • Use a mix of non-regulatory methods to achieve an increase in the extent and quality of the Region's wetlands (Policy 2 in s. 3.7.3) • Establish minimum water and/or bed levels for the purpose of promoting the sustainable management of significant peat lakes and wetlands in the Region (s. 3.7.4.5) • Promote an inter-agency approach to managing wetlands. 	<ul style="list-style-type: none"> • Promote an inter-agency approach to managing wetlands • Promote creation/ enhancement/ remediation of wetlands • Environmental education • Economic incentives • Water or bed level setting for significant peat lakes and wetlands (s. 3.7.4.5) • Rules <ul style="list-style-type: none"> ○ Discretionary activity rule 3.7.4.6 – Creation of new drains and deepening of drain invert levels ○ Discretionary activity rule 3.7.4.7 – Drainage of wetlands

			<ul style="list-style-type: none"> ○ Controlled activity rule 3.6.4.12 – Wetland & lake level control structures
3.9	Non-point source discharges	<ul style="list-style-type: none"> • Reduce the adverse effects of non-point source discharges arising from land use practices and activities (Policy 1 s.3.9.3); • Promote the use of streamside (riparian) management (Policy 2, s.3.9.3); • Use non-regulatory methods (education & incentives) and a permitted activity rule to manage the adverse effects of livestock access to waterbodies (Policy 3, s.3.9.3). 	<ul style="list-style-type: none"> • Good practice guidelines. • Environmental education programmes. • Integration with territorial authorities. • Economic incentives. • Streamside enhancement fund. • Risk-based investigations. • Nutrient research. • Review (in 2005) progress in reducing adverse effects on waterbodies identified in Method 3.9.4.6 associated with livestock access and/or fertiliser reaching ground and surface water, including consideration of the need to implement rules as part of a plan review/change. • Enforcement activity. • Rules <ul style="list-style-type: none"> ○ Permitted activity rule 3.9.4.11 – Fertiliser application ○ Permitted activity rule 4.3.5.4 – Livestock on the beds and banks of rivers and lakes
4.2	River and lake bed structures	<ul style="list-style-type: none"> • Enable low impact structures. • Management of structures with adverse effects. • Enable (through rules) the use or alteration of existing lawfully established structures where significant adverse effects are avoided, remedied or mitigated. • Seek the removal of some derelict, unlawful or non-functional structures. • Recognise, and where relevant, provide for the preservation of the natural character of river 	<ul style="list-style-type: none"> • Environmental Education • Rules <ul style="list-style-type: none"> ○ Discretionary activity rule 4.2.4.4 – Structures in, on, under or over the beds of rivers and lakes ○ Permitted activity rule 4.2.5.1 – Existing lawfully established structures ○ Controlled activity rule 4.2.5.2 – Existing lawfully established structures ○ Permitted activity rule 4.2.7.1 – Maimai, game

		<p>and lake beds and their margins from the use and management of structures in, on, under or over river and lake beds.</p> <ul style="list-style-type: none"> • Recognise the positive benefits that can arise from the use, development and protection of river and lake beds whilst controlling adverse effects. • Manage suspended solids discharges to water bodies arising from permitted activities/works associated with a structure. 	<p>bird hunting structures</p> <ul style="list-style-type: none"> ○ Permitted activity rule 4.2.9.1 – Culverts for catchments not exceeding 5 Ha ○ Permitted activity Rule 4.2.9.2 – Culverts for catchments not exceeding 100 ha ○ Controlled activity rule 4.2.9.3 – Culverts for catchments not exceeding 500 Ha ○ Permitted activity rule 4.2.10.1 – Discharge and intake structures <ul style="list-style-type: none"> • Suspended solids discharge standards set in 4.2.21 for permitted activity rules in chapters 4.2 and 4.3.
4.3	River and lake bed disturbances	<ul style="list-style-type: none"> • Manage the effects of river and lake bed disturbances, including: <ul style="list-style-type: none"> ○ Bed and bank alterations and extraction of sand, gravel and other bed material, ○ Introduction of vegetation, ○ Clearance of vegetation, ○ Livestock access to water bodies, ○ Enforcement of livestock access to water bodies rule (4.3.5.4), ○ Recognising, and where relevant providing for, the preservation of the natural character of river and lake beds and their margins, ○ Recognising the positive benefits of use, development and protection of river and lake beds whilst controlling adverse effects. 	<ul style="list-style-type: none"> • Disturbances of the beds of lakes & rivers <ul style="list-style-type: none"> ○ Environmental education ○ Good practice ○ Economic incentives ○ Rules <ul style="list-style-type: none"> ▪ Discretionary activity rule 4.3.4.4 – Bed disturbance activities ○ Good practice ○ Economic incentives • Livestock access to water bodies <ul style="list-style-type: none"> ○ Environmental education ○ Enforcement activity ○ Rules <ul style="list-style-type: none"> ▪ Permitted activity rule 4.3.5.4 – Livestock on the beds and banks of rivers and lakes ▪ Discretionary activity rule 4.3.5.5 – Livestock on the beds and banks of priority one waterbodies ▪ Non-complying activity rule 4.3.5.6 – Livestock on the beds and banks of rivers

			<p>and lakes.</p> <ul style="list-style-type: none"> • Disturbance of river and lake beds associated with the maintenance of a lawfully established structure <ul style="list-style-type: none"> ○ Rules <ul style="list-style-type: none"> ▪ Permitted activity rule 4.3.6.1 – Extraction of bed material and disturbance of river and lake beds associated with the maintenance of a legally established structure ▪ Controlled activity rule 4.3.6.2 - Extraction of bed material and disturbance of river and lake beds associated with the maintenance of a legally established structure • Sand & gravel extraction <ul style="list-style-type: none"> ○ Rules <ul style="list-style-type: none"> ▪ Permitted activity rule 4.3.7.1 ▪ Controlled activity rule 4.3.7.2 • Introduction or planting of vegetation and tree layering on the beds and banks of rivers and lakes <ul style="list-style-type: none"> ○ Rules <ul style="list-style-type: none"> ▪ Permitted activity rule 4.3.8.1 – Introduction and planting of plants ▪ Prohibited activity rule 4.3.8.2 – Introduction and planting of plant pests • Clearance of vegetation in, on or under the beds of rivers and lakes • Enforcement Activity <ul style="list-style-type: none"> ○ Rules <ul style="list-style-type: none"> ▪ Permitted activity rule 4.3.9.2 – Vegetation clearance ▪ Discretionary activity rule 4.3.9.3 – Clearance of vegetation in natural state water bodies and wetlands
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5.1	Accelerated erosion	<ul style="list-style-type: none"> • Managing activities that cause or have the potential to cause accelerated erosion and encouraging appropriate land management practices. • Promote good practice. 	<ul style="list-style-type: none"> • Environmental education • Investigation • Good practice • Economic incentives • Property management plans/environmental management systems • Enforcement activity • Rules <ul style="list-style-type: none"> ○ Permitted activity rule 5.1.4.12 – Soil cultivation adjacent to water bodies
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