



# **LAKE NGAROTO RECREATION RESERVE**

## **Reserve Management Plan**

**July 2009**

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## 1.0 INTRODUCTION

Lake Ngaroto is a Recreation Reserve, gazetted under the Reserves Act 1977 (the Act). The Reserve includes an open water area of around 89ha, a considerable wetland margin of 60ha, giving a total area of 149ha. The Waipa District Council is responsible for day to day administration and management of the Reserve.

Public use of the Reserve is varied and includes: yachting, rowing, wind surfing, canoeing, game-bird hunting, ornithological interests, walking and picnicking. The lake is regarded as an important outdoor recreational asset available to Te Awamutu and adjoining rural and urban communities.

In 1979 the first Lake Ngaroto Reserve Management Plan was approved. Reviewing and updating the Management Plan is necessary to accommodate changes since 1979 and to address issues associated with water quality, water levels, management of reserve biota, archaeological sites and increasing recreational usage.

## 2.0 PURPOSE OF THE MANAGEMENT PLAN

### 2.1 Statutory Purpose

Reserve Management Plans are required under section 41 of the Reserves Act 1977 for all Reserves under the control, management, or administration of an administering body. Specifically the Act states:

“The management plan shall provide for and ensure the use, enjoyment, maintenance, protection, and preservation, as the case may require, and, to the extent the administering body’s resources permit, the development, as appropriate, of the reserve for the purposes for which it is classified, and shall incorporate and ensure compliance with the principles set out in sections 17, 18, 19, 20, 21, 22 and 23, as the case may be, of this Act for a reserve of that classification.”

- For recreation purposes, the Management Plan’s key purpose is to ensure that the use and management of the Reserve is consistent with the purpose for which the reserve has been classified.
- Management Plans must be regularly updated. Section 41(4) of the Reserves Act 1977 states:

“the administering body of any reserve shall keep its management plan under continuous review, so that, subject to subsection (3) of this section, the plan is adapted to changing circumstances or in accordance with increased knowledge...”.

## 2.2 Implementation

This document describes the history, formation, the assets and features associated with the Lake Ngaroto Recreation Reserve and recreational use, both past and present. More importantly, it highlights investigations and actions required to retain water contact recreational use opportunities and to enhance the natural, archaeological and landscape features.

Lake Ngaroto remains a popular recreational asset, however its ability to provide for water based recreation longer term, requires changes in current land use practice within the lake catchment to reduce contaminants and nutrients from entering the lake, the adoption of an environmentally appropriate water level management regime, the manipulation of marginal habitats and pest control within the Reserve. These are all complicated matters to address and will require a high degree of collaboration between Council, landowners, researchers, and those agencies that have statutory responsibilities for managing land, water and natural resources.

This Plan will be reviewed again in 2013. At that time a new resource consent for the management of the lake level will have been granted to Council and reviewing progress on achieving the objectives and implemented policies detailed in this plan, will be appropriate.

## 2.3 The Statutory Process

Section 41 of the Reserves Act 1977 prescribes the process by which a reserve management plan shall be reviewed. Where the administering body resolves to undertake a comprehensive review of its management plan, as is the case with Lake Ngaroto, the administering body shall follow the following procedure.

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*Figure 1: Reserve Management Plan Comprehensive Review Procedure*

## 3.0 LINKAGE WITH OTHER DOCUMENTS

### 3.1 Long Term Council Community Plan

Council's Long Term Council Community Plan was adopted in June 2006. Public submissions to the plan recognised the contribution natural heritage and recreation reserves make towards environmental and community health and well-being. Council in turn recognises the protection of Lake Ngaroto and other lake reserves, together with outstanding landscapes, waterways and indigenous forests, is important and has dedicated funding for a five year restorative programme aimed at protecting the recreational opportunities and heritage values associated with lake reserves.

### **3.2 Waipa District Plan**

The District Plan was adopted in December 1997. The Plan is a requirement of the Resource Management Act 1991 and outlines the controls necessary to regulate and manage the development of land and any associated environmental effects. The Plan identifies policies and rules necessary to achieve a range of environmental objectives, including policies relating specifically to peat lakes.

*Policy RU38 states:* To prepare management plans for each of the protected areas (particularly the lakes within the District), to ensure that their unique qualities are protected.

### **3.3 Heritage Policy and Implementation Strategy**

This Policy was adopted in 2004 and has as a goal to:

- Safeguard and enhance the heritage of the Waipa District

Supporting this goal are a number of objectives. Those that relate to peat lakes are:

- To regulate and protect heritage values;
- To promote heritage advocacy and education;
- To develop heritage advocacy and protection initiatives;
- To develop and maintain heritage partnerships; and
- To promote responsible ownership of heritage values.

### **3.4 Community Leisure Plan**

Waipa's Community Leisure Plan was adopted in May 2002. It is the guiding strategic document for the provision and development of the District's recreational facilities.

The Community Leisure Plan articulates the following Vision:

"Waipa is a District with vibrant and diverse leisure opportunities based on its natural environment, quality infrastructure, strong tradition and partnerships, and timely innovation".

The Plan states that Waipa District Council will, amongst other things:

- Support the community's physical well-being by making physical activity opportunities accessible, attractive and affordable.
- Support the community's mental, social and cultural well-being by providing and promoting programmes, services and facilities that foster creativity, achievement, excitement and involvement, giving residents a

strong sense of belonging and pride in their local community and District.

### **3.5 Regional Policy Statement (RPS)**

The RPS, prepared by Environment Waikato (the Waikato Regional Council) has identified 'peat lakes' as important ecological sites and has introduced policies that will avoid, remedy and mitigate environmental effects resulting from resource use and development.

### **3.6 Regional Plan**

The Water Module of the Regional Plan proposes policy that will work towards a net improvement in water quality, preservation of 'natural' and/or 'indigenous' character through the adoption of water classes and standards, controls on effluent discharges within the catchments of sensitive, closed water systems, and the setting of minimum levels for lakes. There are also restrictions on drainage with 200m of peat lakes.

### **3.7 Peat Lake Reserves Management Plan**

In March 2008 Council adopted a Plan for the management of the Lake Mangakaware and Lake Cameron Recreation Reserves and other Reserves adjoining peat lakes managed by the Department of Conservation. The objectives and policies in that plan are consistent with those proposed in this Management Plan, although the primary focus at Lake Ngaroto will be providing and retaining recreational opportunities, namely boating and other water contact recreation.

### **3.8 Lake Arapuni and Karapiro Reserves Management Plan**

This Management Plan was adopted by Council in December 2004. It pertained to lakeside Recreation Reserves and provides objectives and policies for the management of these reserves, infrastructure and landscapes, for public enjoyment. The objectives and policies governing public access, infrastructure, concessions and public safety are consistent with those proposed in the Lake Ngaroto Recreation Reserve Management Plan.

### **3.9 Waipa District Dog Control Bylaw**

Dogs controlled on a leash may have access to any park, reserve or public place within the District other than the dog-prohibited areas identified in the Dog Control Bylaw.

Dogs are permitted within the Lake Ngaroto Recreation Reserve.



## 4.0 PHYSICAL AND BIOLOGICAL RESOURCES

### 4.1 Location

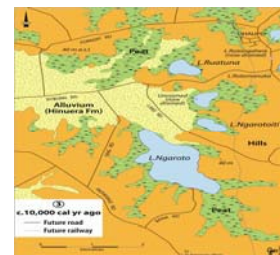
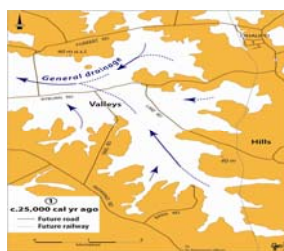
Lake Ngaroto is located 6km due north of Te Awamutu. Sealed road access from Paterangi Road and Bank Road takes visitors to the 'Domain' on the lakes southern margins.

Walking access is also available from Lake Road – unformed - to the eastern margins of the lake, following the Lake Ngaroto–iti inflow. (*Refer to Diagram One*).

### 4.2 Geology and Formation

Lake Ngaroto is the largest of the Waipa Peat Lakes and was formed around 19,000 year ago after the Waikato River abandoned its course through the Hinuera Valley to the Firth of Thames and flowed into the Hamilton basin. Vast quantities of alluvial sands and gravels up to 80m thick in places were deposited in a broad fan north and west of the Karapiro Gorge. This material in-filled and blocked the mouths of valleys in the older hilly landscapes and lakes formed in the valleys behind these gravel bars.

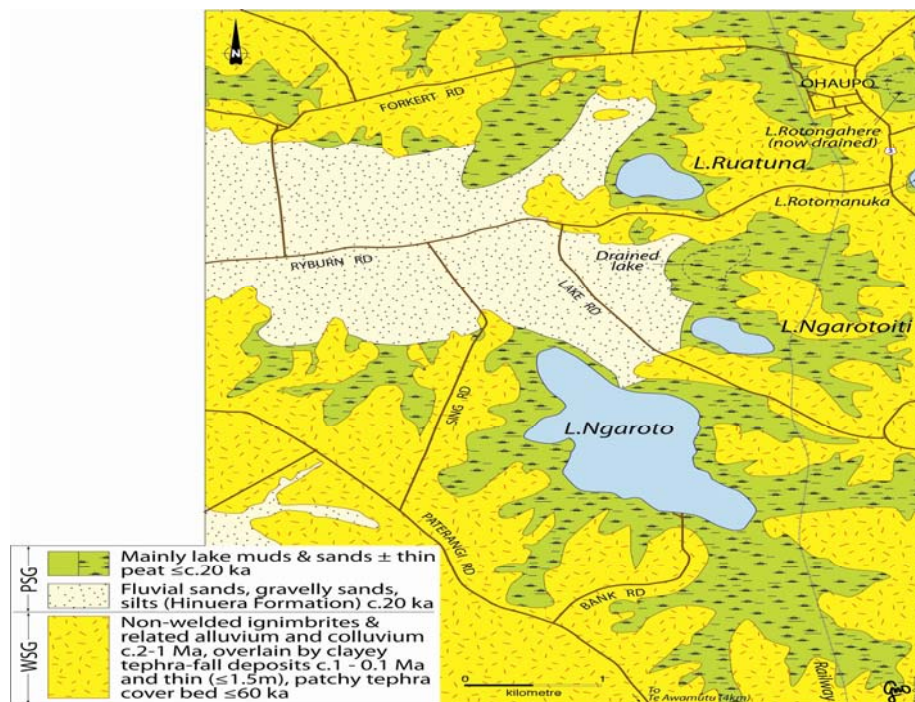
As the climate warmed (<14,700 years ago) a succession of vegetation cover ensued. Across the drier areas of the alluvial plains grew dense forest while the wet hollows and lake margins supported swamp and peat forming vegetation. Peat continued to 'grow' and expand, encroaching on the surface of the original lake. It also induced changes in water quality, introducing tannins leached from peat substrates and turning the shallow clear water to more acidic brown water. (*Refer to diagrams two and three*).



*Diagram Two: Formation of Lake Ngaroto  
(Courtesy of Dr David Lowe, Waikato University)*

More recent influences from Lake Taupo eruptions (1,800 years ago) changed the landscape, felling and burying forest in volcanic ash and pumice and altering drainage patterns (Green J.D. 1988). Remnants of these forests have been uncovered by landowners digging drains in the southern lake catchment (Ian McKay pers com.) and stumps and fallen logs have surfaced as the peat has settled.

Cross sections through the lake basin, revealed peat depths from <0.5m to over 2.0m. These soft substrates are made of lenses of oxidised peat, generally the upper 0.25m; sedgy peat, marshy peat and silt/inorganic sediments. The lake bed is soft organic sediments with areas of firmer sands and silts (*Refer to Diagram Three*).



*Diagram Three: Sediments Within Lake Ngaroto Basin  
(Courtesy of Dr David Lowe, Waikato University)*



Key

**Diagram One - Location of the Lake Ngaroto**

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### 4.3 Lake Bed and Open Water

Lake Ngaroto has a surface area of around 90ha, a maximum depth of less than 4.0m and an average depth of less than 2.0m. A weir holds summer levels some 0.45m above winter levels. It is described as eutrophic (having a high or very high nutrient supply given the volume of water); it is phytoplankton dominated; there is little evidence of submerged plants (de Winton 2005), the water is turbid and oxygen levels are depressed, particularly during summer months.

Historically however, the lake is likely to have been much less nutrient rich, the water more transparent with native plant communities such as *charophytes* (*Chara* and *Nitella*) and low-density growths of tall pond weeds like *Potamogeton cheesemanii* carpeting the lake bed. However, from the 1940's as with most Waipa lakes, these communities were replaced by the introduced oxygen weeds (*Lagarosiphon major*, *Egeria densa* and *Elodea Canadensis*) and hornwort (*Ceratophyllum demersum*).

These introduced plants, while rooted in the lake bed, can easily grow to the surface of shallow lakes and form dense mats. This post native community phase subsequently impacted on recreational yachting and rowing. From 1976 through until the 1980's the plant beds were deemed to be a 'pests' and were controlled with the herbicide 'diquat'.

The combination of a shallow lake, large wind fetch and wave action, regularly re-suspends organic and inorganic bottom material into the water column. This re-suspended material gives the appearance of 'dirty' water, reducing water clarity and affecting the penetration of that portion of the light spectrum required for plant photosynthesis. The compromised light climate has undoubtedly influenced the re-establishment of submerged plants and this, together with an abundance of nutrients, favoured the growth of phytoplankton. In particular those algal species that are adapted to enhance light capture and/or are positively buoyant and collect near the water surface. Unfortunately some of these species like *cyanobacteria* and *flagellates*, are generally undesirable and will form dense blooms under specific environmental conditions (CBER Report 54).

### 4.4 Marginal Plant Communities

The marginal communities occupying the zone between open water and dry land, consist of a diverse array of plants which change according to the degree of "wetness" and soil mineralisation. The dominant communities are:

#### 4.4.1 Raupo Reedland

The lake perimeter is fringed by a broken band of emergent reeds, primarily raupo (*Typha orientalis*) and in parts by tall spiked rush (*Eleocharis sphacelata*).

This band expanded as drainage and sedimentation reduced the depth of water and encroachment into the open water zone is evident in the southern and northern sectors and the delta of the Ngaroto-iti inflow.

Associated species include the introduced water purslane (*Ludwigia peploides*) and gypsywort (*Lycopus europaeus*), with native willow weed (*Periscaria decipiens*) and further inland, a range of exotic grasses and herbs.

#### **4.4.2 Willow Treelands**

Behind the immediate fringe of reeds, is scattered crack willow (*Salix fragilis*) and grey willow (*S. Cinerea*). In places a dense canopy has formed. Areas of scattered, sparse infestation have an understorey of introduced grasses, and in the wetter places, *Ludwigia sp*, and parrots feather (*Myriophyllum aquaticum*). Beneath the dense stands where growth is inhibited by shading, native *Carex* sedges, native willow weed, buttercup (*Rununculus flammula*) and *Juncus* rush species persist.

Often associated with willow are native woody natives such as *Coprosma sp.*, cabbage tree (*Cordyline australis*) and manuka.

#### **4.4.3 Swamp Meadow**

Where willow has not established, are species that float, prefer soft saturated substrates and tolerate seasonal inundation like primrose willow (*Ludwigia peploides*), water milfoil, *Carex geminate*, *Eleocharis acuta* and swamp millet (*Isachne globosa*). Amongst exotic grasses other smaller patches of natives species persist, including *Baumea articulate*, raupo, and sphagnum moss with *Baumea arthrophylla* and *B. rubiginosa*. On the landward margins of this vegetation type boarding manuka stands ring fern (*Paesia scaberula*) is common.

#### **4.4.4 Manuka Scrubland**

From 1995 large numbers of manuka plants were planted around the lake. At that time manuka was thought to be a common feature of all peat lakes and when planted in high densities, would prove effective in suppressing the growth of troublesome weeds like blackberry and gorse.

However, the presence of manuka around peat lakes, is now thought to be a consequence of lowered ground water levels, drying peat margins and fire-induced changes. Under natural circumstances, the marginal plant communities were likely to have been dominated by rushes, sedges, ferns many of which are peat forming plants, with lesser amounts of woody plants. The dense monoculture of manuka has likely reduced both the extent and variety of rushland and sedgeland.

Among the stands of manuka are karamu (*Coprosma robusta*), mahoe (*Melicactus ramiflorus*), putaputaweta (*Carpodetus serratus*), totara (*Podocarpus totara*), broad leaf (*Griselinia literalis*) and lowland ribbonwood (*Plagianthus regius*). The understorey is a mixture of native ferns including ring fern, swamp kio kio (*Blechnum novae-zelandiae*), silver fern (*Cyathea dealbata*), black mamaku (*Cyathea medullaris*) and wheki (*Dicksonia squarrosa*).

#### 4.5 Fish and Invertebrate Communities

Prior to human induced changes, Lake Ngaroto is likely to have supported a productive indigenous fishery. Unlike most of the smaller peat lakes, it has a permanent outlet - the Mangaotama stream - connecting the lake with the Waipa river. This connection is important, as many of the NZ indigenous fish are migratory and require access to and from the lake to complete their life cycle.

Original populations would have included high numbers of eel, particularly short finned 'lowland' eel (*Angilla australis*) and lesser numbers of long finned eel (*A. deiffenbachii*), most of the lowland *galaxiids*, like inanga (*Galaxias maculatus*); giant kokopu (*G. argenteus*) and banded kokopu (*G. fasciatus*); grey mullet (*Mugil cephalus*); common smelt (*Retropinna retropinna*), common bully (*Gobiomorphus cotidianus*) and possibly lamprey (*Geotria australis*).

Surveys undertaken in 2001 revealed a rather depauperate fish community consisting of eel; common bully and very occasionally common smelt. The most numerous were exotic species which have been either intentionally or self introduced. Species recorded were bullhead catfish (*Ameiyrus nebulosus*); rudd (*Scardinius erythrophthalmus*) with lesser numbers of goldfish (*Carassius auratus*) and koi (*Cyprinus carpio*). Mosquito fish (*Gambusia affinis*) a small <50mm aggressive predator, is likely to be the most abundant exotic specie.

The very low variety of native fish encountered is likely to be a result of poor habitat quality, particularly depressed levels of oxygen, and the inability of many species to adapt to environmental change. Commercial fishing pressure has altered the structure of the eel populations by removing the larger eels, and predatory pressures and competition from exotic species has undoubtedly influenced both the availability of habitat and food.

The outlet weir positioned under Sings Road bridge in 1971 obstructs fish migration into the lake from the Waipa River. Closing the weir between 1 October and 30 April coincides with the upstream migration of eels (December - February); smelt (October and November), inanga (October to January) and common bully (October to February). When closed only the very adept climbers such as eel and banded kokopu, could negotiate the wetted surface of the vertical concrete structure.

Little is known of the invertebrate fauna within the lake. Work completed by the University of Waikato in 1977 and again in 1987-88 records a dominance of *Oligochaetes* and *Chironmids* in the bottom fauna, with beds of the freshwater mussel (*Hyridella menziesi*), axe head caddis (*Oxyethira albiceps*) and snails (*Potamopyrgus sp.*) amongst the weed and algal communities. Most species recorded were typical of those associated with modified and eutrophic conditions.

#### 4.6 Water Bird Communities

Historically Lake Ngaroto and its swampy margins would have offered outstanding habitat for water birds. As with the fish fauna, there has been a reduction in both the diversity and abundance of water birds and waders regularly frequenting the lake environs as water quality has degraded and wetted margins recede.

Twenty nine species of “wetland” birds have been recorded recently from Lake Ngaroto. Groups represented are grebe (1), shag (3), heron/bittern/egret (4), ibis (1) water fowl (7), raptor (1), rails/gallinule (4), wader (3), gulls/tern(3), king fisher (1), and wetland passerine (1). Refer Appendix 1).

The open water zone today provides food such as introduced fish and eel, for large black shag (*Phalacrocorax carbo*), little shag (*P. melanoleucos*) and little black shag (*P. sulcirostris*); caspian tern (*Sterna caspia*) the largest of NZ’s terns; and the occasional black backed gull (*Larus dominicanus*). New Zealand scaup (*Aythya novaeseelandiae*) and New Zealand dabchick (*Poliocephalus rufopectus*) have been recorded very infrequently on the lake.

The open lake together with the margins provides feeding, nesting and loafing areas for water fowl like black swan (*Cygnus atratua*), Canada geese (*Branta canadensis*), mallard (*Anus platyrhynchos*), grey duck (*A. superciliosa*), grey teal (*A. gracilis*); shoveler (*A. rhynchotis variegata*) and molting aggregations of paradise shelduck (*Tadorna variegata*).

Swamp margins are frequented by Australasian bittern (*Botaurus poiciloptilus*) a threatened native; spotless crake (*Porzana tabuensis*); pukeko (*Porphyrio porphyrio melanotus*) and marsh crake (*Porzana pusilla affinis*). Marsh crake although known in the Waikato, had not been recorded for many years until two birds were observed beneath a canopy of grey willow adjoining the southern lake margins, in the summer of 2005. Banded rail (*Rallus philippensis*) have also been recorded at the lake, but not in recent years (M. Dench pers com).

Wetted margins and meadows/wet pasture offer feeding opportunities for white heron (*Egretta alba*), white faced heron (*Ardea novaehollandiae*); cattle egret (*Bubulus ibis*) a regular Australian migrant; pied stilt (*Himantopus himantopus*); spur-winged plover (*Vanellus miles*); and, occasional South Island pied oyster catcher (*Haematopus ostralegus*).

## 4.7 Terrestrial Fauna

Wetland plant communities generate abundant food, insect life, seed and vegetable matter, cover and nesting/breeding opportunities. This, combined with a farming landscape, provides habitat for the more common passerines (perching birds) and possibly the occasional forest gecko (*Hoplodactylus sp*) and copper skink (*Cyclodina aenea*).

Native passerines commonly found within the reserve include grey warbler (*Gerygone igata*), silver eye (*Zosterops lateralis*); fantail (*Rhipidura fuliginosa*); occasional tui (*Prothemadera novaeseelandiae*), welcome swallow (*Hirundo tahitica*); NZ king fisher (*Halcyon sancta*); morepork (*Athene noctua*) and shining cuckoo (*Chrysococcyx lucidus*) a seasonal migrant. Native and introduced fauna in turn provide food for the Australian harrier (*Circus approximans*).

## 5.0 HUMAN HISTORY AND USE

### 5.1 Maori Settlement

The area of Ngaroto is steeped in ancient history and one of the first areas to be settled post the migration of Maori inland from Kawhia (circa 1400-1500AD). Over the next two to three hundred years, resident Iwi included Ngati Apakura, Ngati Hikairo and Ngati Puhiawe. These tribes remained in occupation until the departure of Ngati Hikairo to Kawhia in 1820/21 and the eventual departure of Apakura to the Taupo region as a consequence of the land wars and land confiscation from 1864.

The late 1700's and early 1800's saw a period of turmoil and warfare. Raid and counter raid between tribal factions and inter-Iwi conflicts with external tribes in the North island, lead to a large force of Ngati Toa warriors, including groups from Rotorua and Urewera believed to total 7000, converging south of lake Ngaroto to engage in battle with 1600 warriors from the Waikato and Maniapoto tribes of Tainui. This battle was to be known as the battle of Te Mangeo or Hingakaka (the fall of the parrot's). The large loss of life and resulting tapu over the area influenced the settlement of the Ngaroto area for many years (Maniapoto H. 2006).

Tribes or Hapu occupying the margin of the lake are also believed to have initiated environmental changes by raising lake levels. Archaeological investigation suggest lake levels could have been manipulated (raised) to assist in the defence of Swamp Pa either built on natural or man made mounds around the lake margins.

### 5.2 Archaeological Sites and Investigations

Five Pa have been recorded on the margins of Ngaroto and details are held on the Historic Places Trust's archaeological records. These are:



### **5.2.1 Banks Road Pa**

A natural mound, likely to have been an island some 2.0m above the lake where the Sailing Club House now stands. Deposits of ash, charcoal and stone to 0.5 – 1.0m, suggest a long period of settlement. An interesting feature of this Pa were underwater palisades possibly to impede the approach of canoes. These have since been removed to prevent damage to recreational craft. A few metres south of the Pa was a site local people referred to as the “canoe harbour” further emphasising the long use of the lake and its importance in supplying food and materials.

### **5.2.2 N65/15 (Unnamed) Pa**

Situated on the west side of Bank Road, 100m from the Domain. It has largely been destroyed although traces of charcoal and stone chips are still evident.

### **5.2.3 Steighs Pa**

This is another island mound, 0.4ha in area, some 2.0m above the lake level. Test excavations by the Waikato Archaeological Group suggested a long and continuous occupation, with ash, charcoal, shell and oven stones to 1.8m. There was a line of posts about 5.0m apart along the lake frontage suggesting a fence or taiapa, but no palisade fortification.

### **5.2.4 Ngaroto Pa**

This was a man-made island built on the peat substrate some 200m from the original shoreline. The materials used to construct the mound were excavated from the surrounding hill sides, which still show signs of quarrying. Oven and grinding stones were believed to have been carried from Te Rore, 10km north west. The Pa was not fortified, but again a fence or taiapa stood around the perimeter in 1920.

Excavations by the Waikato Archaeological Group, revealed 25 layers of ash, charcoal, sands, clays and living floors covering approximately 2.0m of peat. Evidence suggests this Pa pre-dates the others and that the lake was manipulated (raised) for defensive purposes. Resulting levels were higher than the other natural mounds that were later used for Pa.

### **5.2.5 Turanga - miru - miru Pa**

This Pa is 100m west of the lake straddling a north south orientated ridge line. It consisted of 12 or more whare sites, terracing, ditches and pits. Early signs of cultivation on the northern slopes (varying shades of grass colour) together with the Pa's physical features have largely been destroyed by farming.

This Pa was mentioned by Kelly's in his book “Tainui” as the gathering place of the Waikato Tribes before the battle of Hingakaka in 1807.

### 5.3 Recreational Use

From the early 1900's local farmers, landowners and residents from Te Awamutu have utilised the lake for swimming, power boating, water skiing and game bird hunting. Over the years a wharf and boat ramps were built, a large public toilet erected and the foreshore of the Domain has been raised using dredged material from the lake, leveled and sown in grass.

#### 5.3.1 Yachting

By 1952-53 yachtsmen were using the lake and the Ngaroto Boating Club had 58 members in 1958-59. The Club house was completed in 1967.

Recreational yachting continues to be popular with events scheduled every weekend (Sundays) between September and April each sailing season and less frequent during the winter. Membership of the Ngaroto Sailing Club stands at 50 financial members and the Club hosts a number of local, regional and national events. These include:

- Learn to sail programmes for all ages, plus coaching and training courses for junior and senior sailors;
- Annual trailer yacht Regatta (September);
- Joker Owners Association Regatta (October);
- Paper Tiger Association Lakes Series (November);
- Secondary Schools 420 Teams Coaching and Racing Regatta (annual);
- Waikato Thames Yachting Association. Centre board Regatta (2<sup>nd</sup> or 3<sup>rd</sup> year);
- NZ Trailer Yacht Association. Regatta (annually);
- NI Trailer Yacht Championships (annually); and,
- South Pacific Masters Games (every three years).

Concerns about both the quality of the lake water and water depth have over recent years, been reported to Council by the Sailing Club. Both are crucial to the ongoing use of the lake by sailors and in particular, larger sailing craft.

#### 5.3.2 Rowing

About 1964 the Rowing Club established itself in a disused school "prefab" on the Domain. In the same year the first regatta was held. In 1974 the present Rowing Club facilities were completed.

Rowing crews practice on the lake 5-6 days per week between December and March, reducing to 3 days between October and December and weekly over the winter. There is a core of 25 competitive rowers with a further 20 social or recreation rowers associated with the Club.

In past years both the Secondary Schools and Waikato Rowing Regatta were held on the lake, however the unpredictability of algal blooms and potential health risks, made it difficult to host events. The Waikato Masters Regatta is still held in April.

### **5.3.3 Game Bird Hunting**

Game bird hunting is still popular although the number of hunters has reduced. In 1976, 32 hunting stands had been claimed by hunters. In 2007 this had reduced. Observations taken during the 2007 hunting season recorded a total 558 visits by water fowl hunters totaling some 4629 hours (M. Dench pers com).

### **5.3.4 Waka Paddling, Wind Surfing and Canoeing**

Other canoe and sail board use varies from intense to infrequent depending on time of year, weather conditions and water quality/appearance. Waka paddlers train on the lake prior to Waka Ama events and the number of canoeist (competitive and leisure) is increasing.

### **5.3.5 Walking, Picnicking, Fishing**

The Domain continues to be popular as a leisure destination, picnic site, for over night camping by mobile homes and fishing for 'course fish' – catfish, rudd and koi – from the wharf.

The walking track around the lake has substantially increased public use. Use is approximately 400 persons per month (recorded by track counter). It provides a one hour flat walk, suitable for those seeking exercise or leisure, through planted and open margins with occasional views of the lake and two swamp Pa sites.

### **5.3.6 Future Public Use**

The primary purpose of a Recreation Reserve is to provide for outdoor recreation and sporting activities and to promote physical welfare and the enjoyment of the open countryside by users.

Lake Ngaroto Reserve is well placed to meet this purpose and specifically, it is of a size and geographically well placed, to provide the communities of western Waipa District with a wide range of water based recreation opportunities. It also provides for activities and interests associated with ornithology and conserving and protecting the cultural and archaeological sites and features.

Ensuring that a diverse range of water based and other recreation is available to visitors will require an improvement in the quality of the lake waters, ensuring there is sufficient water depth to float the larger sail boats, a well maintained infrastructure of tracks, facilities, signage and interpretative material and a healthy lake ecosystem.

These outcomes are not easily achieved. At best, improvements in the quality and appearance of the lake water, must be viewed in the medium to longer term. Existing, and possibly worsening conditions may be experienced until the benefits of changes in land use practices within the Lake Ngaroto catchment and various onsite management, become apparent.

## 6.0 STATUS AND ADMINISTRATION

### 6.1 Legal Status

Eight blocks, totaling an area of 149.0913ha, comprising reserve or crown land have been identified as land subject to this management plan. These are identified in Table One.

A paper road encircles all but one (54 A, SO 14307, Rec. Res.) of these land parcels. In 1995 Council approved the closing of this road and adding same to the Lake Reserve. This was never completed due to difficulties in settling access to land adjoining the western lake margins.

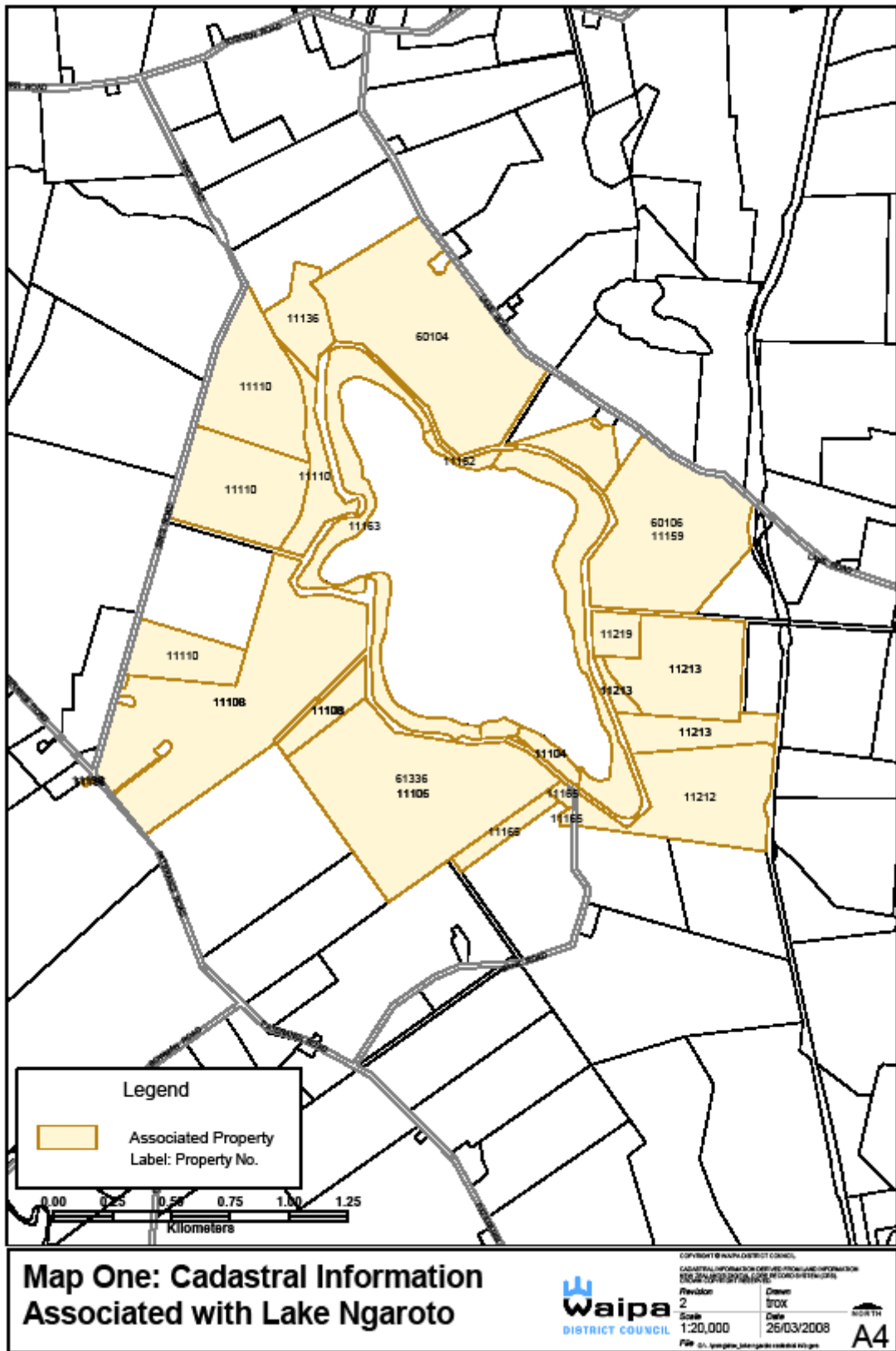
Land exchanges were proposed for two adjoining properties to secure Pa and improve public access to the Recreation Reserve on the lake's eastern margin. Again these have never been completed. It is Council's intention to review both proposals.

**Table One : Status of Land Comprising the Lake Ngaroto Recreation Reserve**

Parcel No	Legal Description	Area	Title Ref	Acquisition History	Classification
1	Allot. 481 Ngaroto Parish	107.5000	NA	Crown land set apart as a recreation reserve and Waipa County appointed to control and manage NZ Gazette notice 1984 p.853	Recreation Reserve. NZ Gazette 1984 p.853.
2 3	Allot 461 Ngaroto Parish Allot 462 Ngaroto Parish	17.5000 16.0000	Req	Crown land set apart as recreation reserve and vested in Waipa County Council NZ Gazette 1975 p.97 (Document H.028726)	Recreation Reserve. NZ Gazetted 1979 p.462 (Document H.222328)
4 5 6 7 8	Allot 454 Ngaroto Parish Allot 460 Ngaroto Parish Section 1 Blk XVI, Hamilton SD Section 2, Blk XVI, Hamilton SD A lot 54A, Mangapiko Parish	0.9156 0.1241 1.9273 1.5631 3.5612	Req	Formerly part of (Crown owned) Te Awamutu Domain deemed recreation reserve and vested in Waipa County Council by NZ Gazette 1974 p.328 (Document S.646950A)	Recreation Reserve NZ Gazette 1979 p.462 (Document H.222328)
	Total Area	<b>149.0913</b>			

Seven freehold properties in 12 blocks, adjoin the lake "Reserve". Map 1 provides cadastral information.

On 26 May 2007 a draft Agreement in Principle for the settlement of the Waikato River claim by Tainui Iwi, was released. The definition of Waikato River included the bed of Lake Ngaroto. The Waikato Raupatu Trust has requested on behalf of Tainui Iwi, that Waikato-Tainui be separately consulted in regards to the day to day management of the Lake Reserve and any intention to dispose of Crown land being part of the Reserve.



## 6.2 Administration

### 6.2.1 History of Land Administration and Key Events

The Te Awamutu Borough Council administered a small portion of Crown land adjoining Bank Road as a public domain. This land parcel provided public access to the lake. The bed of the lake and remaining Crown land inside the paper road, was administered by the Department of Lands and Survey.

In 1974 the Te Awamutu Borough relinquished control of the Domain land and in March of that year, the Minister of Lands declared the land to be a Reserve, pursuant to Section 42 (4) of the Reserves and Domains Act 1953. The Reserve was then vested with the Waipa County Council.

The Minister also approved the setting apart for recreation purposes, 34.0ha of Crown land adjoining the lake bed. Vesting conditions required Council to ensure that the areas of historic and archaeological significance were preserved and that wildlife habitat associated with the lake was protected as far as possible. Waipa County Council accepted the vesting and conditions in a letter to the Commissioner dated 7 May 1974, and agreed to prepare a management plan, acceptable to the Department of Lands and Survey, Wildlife Division of the Department of Internal Affairs and the NZ Historic Places Trust.

The Waipa County Council then approached the Marine Division, Ministry of Transport to gain control of the waters of Lake Ngaroto in order to manage a growing use of the lake for sailing and rowing. Both the Auckland Acclimatisation Society and the Wildlife Division of the Department of Internal Affairs objected to this proposal. Both agencies stated the lake was a significant wetland and water bird habitat, and promoting recreational use would not in their view, recognise the lake's ecological significance. They suggested the bed of the lake be classified a Government Purpose Reserve (Wildlife Management) and management responsibilities be retained by the Crown.

This matter was resolved by Waipa County Council agreeing to:

"...Provide an advisory body to which such matters as public relations promotion, appointment of inspectors under a proposed bylaw and the integration of the many other aspects of management can be referred to expert opinion. It is felt that the cooperation of this committee would give full weight to the balanced use of the lake with the Acclimatisation Society's aims being protected while controlling public usage of the facilities already established". Both the Acclimatisation Society and the Wildlife Division of the Department of Internal Affairs would be represented on the Committee.

The Committee's role was to coordinate:



- The retention of an ecological balance in the lake and the surrounding Domain having regard to the recognised importance of the lake as a breeding ground for wildlife. This study would examine the problem of weed control and the effect on lake waters and shellfish life of nutrients from farm lands; and
- Sporting activities to ensure only uses compatible with the above are permitted on the lake.

The Management Plan was completed and approved by the Waipa County Council in August 1979. It is this plan that is being reviewed.

The County Council was granted in November 1982, control of the foreshore, lake bed and water, for a period of 21 years by an Order in Council under the Harbours Act 1950. The Lake Ngaroto Bylaws 1983 were subsequently promoted and approved.

Local Government Review in 1989 transferred responsibility for the management of the Lake Reserve to the Waipa District Council.

In 1991 the Resource Management Act 1991 was enacted. The Order in Council made under the Harbours Act 1950 to control boating use was subsequently repealed, and responsibility for managing surface water activities now rests with the Regional Council, Environment Waikato.

On 26 May 2007 a draft Agreement in Principle for the settlement of the Waikato River claim by Waikato-Tainui was released. The bed of lake Ngaroto is deemed to be part of the Waikato River and will therefore be affected by the settlement agreement.

### **6.2.2 History of Reserve Management**

Prior to 1989 the Waipa County Council erected boundary fences using the Government subsidised work schemes, controlled nuisance weeds, upgraded the foreshore/wharf (1991), erected a public toilet, maintained the foreshore in front of the clubhouse and controlled nuisance plants in the lake.

By 1994 concerns were being registered about degrading water quality and impacts on recreational activities, a loss of water bird habitat around the lake margins and management of the lake levels. In response to the issues raised and with the resource consent to operate the outlet weir due to expire in 1995, Waipa District Council hosted a public meeting (April 1995) to discuss the long term preservation of Lake Ngaroto. Some 20 agencies, Iwi, landowners and interests groups were represented. As a result of the meeting, and subsequent meetings with land owners and user groups, Council committed to a range of restoration initiatives. These were identified in a report prepared by JC Greenwood (1995) and included:

- defining the reserve boundaries;
- Incorporating the unformed Road Reserve around the lake perimeter into the Lake Reserve;
- Treating sediment and nutrient inflows;
- Removing grey and crake willow;
- Restorative planting within the moist soil margins;
- Recognising and protecting Pa within the Reserve;
- Constructing a round the lake walking track;
- Forming legal access to the eastern lake margins; and,
- Retaining other public access (formed and unformed).

These activities were approved by Council in July 1995 and the programme continued through until 2002. The restorative works cost \$1.3m.

In 2005 Council and Environment Waikato agreed on a five year programme to protect priority peat lakes from intensive agriculture land use in lake catchment. The five priority lakes included Lake Ngaroto.

### **6.2.3 History of Water Level Management**

The original surface area of Lake Ngaroto was thought to have been around 218ha at the turn of the 20<sup>th</sup> century. Maps prepared in the 1880's by Colonial Troops, clearly show an extensive area of open water and subsequent research on sedimentary profiles suggests the original lake footprint to be much larger than today (Dr D. Lowe, unpublished data 2007).

A survey plan prepared in 1907 (Council files) identified some 50ha of privately owned "swampy land" that could be "reclaimed" for agricultural purposes. To realise these gains, required the outlet channel to be enlarged and deepened to both lower the mean lake levels and to accommodate increased flows in times of flood. The works were undertaken and the lake area reduced to 145ha.

Drainage endeavours continued over the years under the oversight of the Ngaroto Drainage Board. This included works to again enlarge the outlet drain and by 1962 the surface area was further reduced to 90ha.

Sailing became difficult in 1964 due to low summer lake levels and when the Ngaroto Sailing Club could not guarantee suitable lake levels in order to host the North Island Moth Class Yachting Championships, an approach was made to both the Te Awamutu Borough Council and the Waikato Valley Authority, to seek an increase in the lake level.

After considerable dialogue between the agencies involved, it was agreed to consent the construction of a weir across the lake outlet where it passes under Sings Road. The weir was completed in 1971 with funding from the Te Awamutu Borough Council and the Auckland Acclimatisation Society.



The purpose of the weir was to maintain a fixed summer and winter water level. The summer level was to enable recreational use between October and May and the winter level was to maximize water storage and prevent flooding of adjoining land.

#### **6.2.4 Renewing the Resource Consent to Manage the Weir**

On 20 March 1995, Council applied to renew the consent to authorise the operation of the outlet weir. No changes or alteration were suggested. Consultation raised issues such as drainage of neighbouring land, protecting archaeological sites, restoration of the lake margins, recreational use and the need to update the Reserve Management Plan.

In assessing the draft application Environment Waikato recommended a greater level of consultation with landowners and interest groups was required given the interest in the management of the lake.

In 1998 Environment Waikato advised of their requirements for additional information before the weir consent (950168) could be considered. Over the period from 2001 to 2005, Council engaged Opus International Consultants to undertake a feasibility study to re-position the weir, design a structure that would enable a minimum lake level to be maintained and provide for fish passage.

Opus suggested a 'V' shaped, rock rubble/gabion basket weir could be positioned at the lake outlet to maintain a fixed minimum level for the lake. Discussion with Environment Waikato, Council and Opus staff, suggested a minimum lake level of 34.34m (Moturiki) was appropriate and Opus subsequently reported on the hydrological regime that would operate behind such a weir. This information was in turn circulated to stakeholder groups and adjoining land owners asking for comment.

Of the 15 submissions received, 5 agreed, 8 disagreed and 2 requested more information. Those disagreeing, raised concerns over the lack of water storage over the winter months and potential flooding of their land. Those supporting the proposal were largely recreational users (sailors and hunters) and welcomed the increase winter levels.

At the invitation of the Advisory Committee for Regional Environment (ACRE), Council, Environment Waikato and Opus staff presented the 34.34m minimum level proposal to the August 2003 ACRE meeting. The Committee generally agreed with the proposal sighting the ecological benefits to the lake, but suggested more investigation was required to demonstrate the affects of a higher water level on adjoining land owners.

Opus prepared a contour plan of the immediate lake basin and investigated further, the affects of a fixed summer level on land surrounding the lake. A letter, dated 12 April 2003, was sent to stakeholders advising them of the additional investigation in hand.

In February 2006 Environment Waikato requested additional information on the down stream erosion effects should a new structure and fixed minimum level be adopted.

After further consideration of the issues Council again wrote to adjoining landowners, asking whether a compromise level midway between the winter and summer level would win favour. Of those responding, the adjoining land owners request the status quo remain and recreational sailing groups wanted the higher level in winter.

### **6.2.5 Current Position**

A resource consent was approved on 23 November 2007 to legalise the existing operation of the weir. The term however will be for a period of only six years.

Conditions attached to the consent require Council to:

- Within six months of 19 November 2007, design and install a fish pass. The design for the fish pass is to be submitted to Environment Waikato by 15 March 2008 for approval;
- Design a plan for monitoring elver migration over the weir. This plan to be lodged with Environment Waikato by 15 March 2008;
- Continuously monitor water levels in Lake Ngaroto and provide records to Environment Waikato on a six weekly basis;
- Continuously monitor water level at the lake outlet (weir) to derive outflow data, and to provide records to Environment Waikato on a six weekly basis;
- By 1 June 2008, provide Environment Waikato with an investigations plan, detailing current and proposed investigations into the appropriate lake level management regime for Lake Ngaroto, including timelines for investigations and consultation with landowners and interested parties;
- By 1 October 2010, provide Environment Waikato with a report detailing the results of the investigations, including recommendations regarding the most appropriate lake water level considering ecological, social, cultural and economic factors, including the most appropriate regime to promote the greatest ecological diversity around the edge of the lake.

## **7.0 MANAGEMENT ISSUES**

In a geological time scale, wetlands are a temporary feature of the landscape. Their ultimate fate is to become infilled with sediment and eventually to be supplanted by grassed or forested land. Those that become infilled are replaced by new wetlands created through geological events, scouring and depositional action, land sinking and volcanic activity.

Settlement and use of the land has accelerated the infilling process, controlled many of the natural process like flooding, that maintained and recharged many lowland wetlands. It has also introduced a range of alien plants and animals, many of which are now pests. The result has been a net loss in the area of wetland (less than 1% remaining with in the Waipa District) and many of those that remain have been substantially modified and degraded.

To avoid further loss and degradation, management must focus on minimising the impact of adjoining land use, retaining indigenous biodiversity and the structure of habitats, controlling pest threats and managing public use.

The key management issues to be addressed are summarised as follows.

### **7.1 Legislative Responsibilities Under the Reserves Act 1977**

The lake bed and surrounding Crown land has been formally classified a Recreation Reserve, with control and management vested in the Waipa District Council.

Recreation Reserves are areas for recreation and sporting activities, physical welfare and enjoyment, and for the protection of the natural environment, open space and beauty of the countryside.

Visitors have freedom of entry and access to all Recreation Reserves and heritage (natural, archaeological, historic and spiritual) assets and features must be protected.

The administering authority is required, using the means at its disposal, to ensure the use, enjoyment, development, maintenance, protection and preservation of the Reserve for the purpose it was classified. It has the discretion to allow or disallow activities within the Reserve according to the impact or effect those activities may have on the Reserve's 'recreation' purpose or, the ecological, heritage and cultural values within the Reserve.

On accepting day to day control and management from the Crown, Council agreed to prepare a management plan that was acceptable to the Auckland Acclimatisation Society (now Auckland Waikato Fish and Game Council) and the Wildlife Division of the Department of Internal Affairs (now Department of Conservation) given their historical interest and involvement in the lake.

Over recent times concerns have been expressed by interest groups and visitors regarding deteriorating water quality, degrading habitats, loss of indigenous biodiversity, inappropriate water levels and the invasion of pest plants and animals. Those voicing concern believe Council has ignored the provisions of the Act and permitted detrimental influences to continue.

## **7.2 Improving the Reserve Boundaries**

When the Reserve boundaries were surveyed little recognition was given to topography or substrate type, how the lake was formed, or the hydrological processes now required to maintain it. A concerted effort has been made over past decades to incorporate Crown land into the Reserve and/or to exchange Crown land for private land containing valued sites or features, but further boundary adjustments are required. There remains significant areas of low lying or swampy land being part of the old lake bed, which if not added to the Reserve will reduce the opportunities available to Council to improve in-lake health or adopt a more environmentally friendly water management regime.

Since 1970 adjoining landowners have received drainage relief by the “lower” winter lake level (weir is set 0.4m below the summer level) and direct connection of drains on private land to the lake.

Draining and converting peat substrates into pasture will induce peat oxidation and surface settlement. Subsidence rates will vary according to the intensity of farming (cultivation, application of fertilisers) but rates from 2-7mm annually can be expected until the surface approaches the ground water table and peat oxidation is slowed or prevented (Thompson & Greenwood 1997). The presence of aquatic/moist soil plants on many of these low lying areas suggests effective drainage is already being compromised by surface settlement.

While agricultural use of the peat substrates has in the past been seen as legitimate and justifiable, it is clearly a finite resource and current land use practice are not sustainable given the inevitability of peat oxidation and surface settlement. As settlement continues flooding from the lake will become more frequent and water will pond for longer periods. Agricultural production from these areas will diminish and this will influence land values.

The Reserve Act 1977 provides the administering authority with the discretion to allow or disallow activities within the Reserve, depending on the affects of that activity on the Reserve’s primary purpose or associated values within the Reserve. The administering authority must first and foremost, give effect to the provisions of the Act and particularly so, if the values within the Reserve are being degraded or compromised.

## **7.3 Lake Level Management**

Ngaroto has a long history of lake levels being lowered to both reclaim land for agriculture and to prevent subsequent inundation of that reclaimed land.

The present lake level management regime established in 1970, set a minimum summer level of 34.34m (Moturiki Datum) and a minimum winter level 33.89m (Moturiki Datum).

The summer level was based on a lake depth prior to the 1970's that enabled competitive and recreational sailing on the lake. The winter level, some 0.45m below the summer level, was selected to maximise storage of water within the lake basin and prevent flooding of private land.

In setting these levels, little consideration was given to the ecological consequences of reversing the natural water level regime.

Lake water levels and water depth play an important role in:

1. enabling boating and in particular sailing larger yachts;
2. controlling the colonisation/spread of emergent plants like raupo and *Eleocharis sp.* These are aggressive colonisers capable of growing in water to 1.5m and will continue to reduce the area of open water unless levels are increased;
3. determining the extent of the marginal/littoral zones and in turn plant/animal communities living within these zones;
4. governing the re-suspension of bottom sediments (organic and non-organic). Nutrients particularly phosphorous and nitrogen compounds are often bound to clay/soil particles. When re-suspended these nutrients are available for uptake by algal communities. In an algal dominated lake, this can contribute to algal blooms. Re-suspended bottom material will also significantly effect water colour/transparency. This in turn affects habitat for fish, the ability for diving birds to forage and human perception of lake water quality;
5. determining shoreline erosion; and,
6. retaining saturated soils (anaerobic conditions) that will help preserve wooden artefacts associated with archaeological sites around the lake margins.

Surveys undertaken in October 1977 using a boat mounted 'Marlin' echo sounder (Council files) indicated a large portion of the lake was under 2.0m in depth with a maximum of 4.0m. Since that time, sediment inflows have undoubtedly reduced water depth. A survey completed by Council in November 2006, indicated a reduction of as much as 0.5m may have occurred, although this is difficult to quantify given the imprecision of the 1977 survey data due to weed growth.

The relationships between lake levels, inflows and outflows, water quality and plant/algal response to nutrients are very complex. It is important that these relationships are understood and the role water level manipulation can play in mitigating adverse effects are identified.

#### **7.4 Managing the Marginal Zones**

Around 25ha of the Reserve is marginal wetland. Marginal wetlands exhibit the features of both land and water and as such are varied and productive areas. They provide habitat for a diverse range of wildlife, help treat non-point source inflows and contribute to the aesthetic appeal of the lake.

During the period from 1995 to 2002 significant areas of the marginal zone was planted in manuka and other woody shrubs. The decision to adopt this approach was influenced by similar plant communities around other peat lakes such as Maratoto, the availability of plants at that time, and the desire to suppress the growth of blackberry and gorse. Blanket planting in a limited range of woody species has likely reduced the area of sedgeland and rushland, changed vegetation patterns and structure and removed habitat opportunities for waders and water fowl.

Targeted use of machinery, vegetation clearing and planting, could increase habitat opportunities for wildlife and fish, improve biodiversity and ensure lake views are available to visitors walking the circuit track.

## **7.5 Managing Nutrient Inputs**

Urban and agricultural development has led to the widespread increase in the levels of nitrogen and phosphorus in lowland lakes and the subsequent increase in nuisance growths of both algae and introduced aquatic plants. These nutrients enter the lake through either point sources (drains) or non-point sources (over land flow and ground water). Wide, well vegetated marginal zones are effective in reducing non-point source flows. It is the 'point source' inflows and ground water that will contribute the highest volumes of nutrients and in turn are the greatest cause for concern.

Lake Ngaroto is already a nutrient rich and phytoplankton dominated system. *Cyanobacteria* being the most abundant of the phytoplankton present. When environmental conditions are favourable (available nutrients and sufficient light) algal growth can be prolific resulting in blooms and green scum on the water surface.

Algal blooms, particularly species that are associated with toxins, impact on recreation use of the lake and will contribute to anoxic conditions in deeper waters. Reducing the nutrient levels within the lake will be difficult and success must be viewed in the medium to longer term.

### **7.5.1 Treatment Options**

The Ngaroto catchment is divided roughly into three sub catchments:

1. The southern sector with a catchment area of around 755ha;
2. The eastern Ngaroto-iti sector with a catchment area of 621ha; and,
3. The western sector of around 303ha (Refer to Diagram Three)

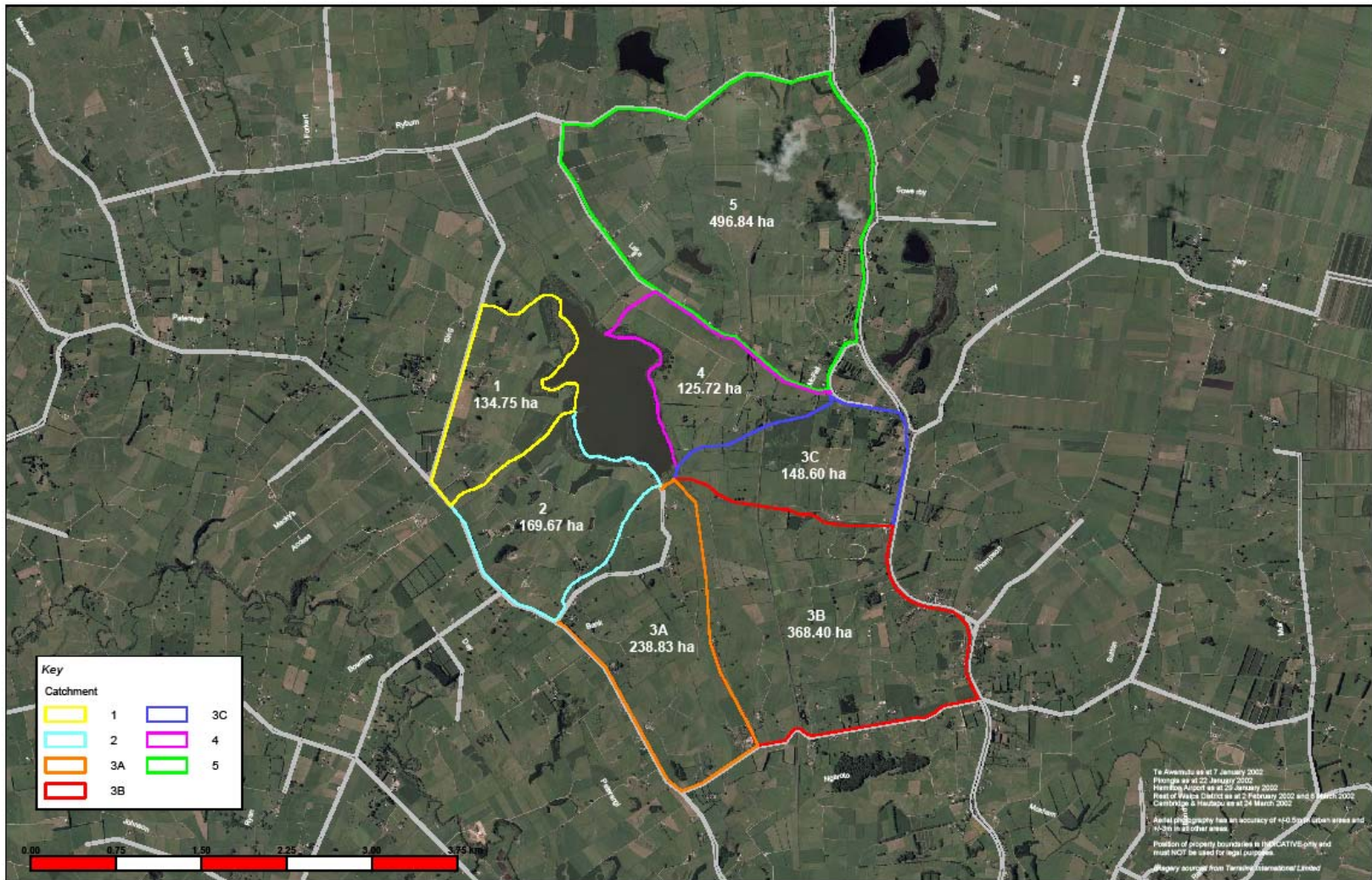
Research on catchment derived nutrient, suggests treatment for nutrient contamination is best undertaken within the catchment proper (on farm), rather than at the lake edge.



This is the most logical approach and significant reductions have been achieved through a combination of fertiliser budgets, riparian management, retaining wet areas, planting and reducing the speed of runoff through ponding. Adopting more sensitive land use practice will require a high degree of collaboration between landowners, Council and Environment Waikato.

There are opportunities to consider 'limited' lake edge treatment (within the Reserve's marginal zone) by intercepting drains and forcing inflows through planted wetland vegetation. "Constructed" or "treatment" wetlands can be effective in removing sediment and lowering nutrient levels (Ministry for the Environment 2002). Treatment wetlands can also be designed to provide additional water bird and fish habitat.

Nutrient analysis suggest the Ngaroto-iti catchment contributes the highest concentrations. Two options are available to manage this inflow. The first is to re-route the inflowing drain around the eastern lake edge to the outlet. The second is to manage Lake Ngaroto-iti as the treatment wetland. It is a small 7.84ha lake and could be managed as a nutrient sink by manipulating levels and promoting desirable plant communities. The latter option will require the consent and co-operation of the Department of Conservation.



**Lake Ngaroto**  
Catchments

Diagram Four: Lake Ngaroto Sub Catchments



## **7.6 Securing the Swamp Pa**

There are six Pa in close proximity to the lake and three of these are Swamp Pa. The sites utilised either existing high margins on the lake edge or they were physically built using imported fill to create an earth island. Of the three Swamp Pa, two could be managed, preserved and interpreted. The first is on the Finch property (N65/15) and the second Ngaroto Pa, on the property of Mrs Smyth (N65/18).

There is interest from local Iwi in developing these sites, particularly site (N65/18) for interpretation purposes. Such development would compliment the 'around the lake' walkway experience. Advice will be sought from the Historic Places Trust to ensure the sites and the artifacts held within them, are protected from both land use and aerobic effects.

## **7.7 Recreation Use**

Trends in recreational use of the lake environs, the walkway and domain/foreshore, show a steady increase. Historically, sailing, rowing and waterfowl hunting were the primary activities, but today waka paddling, canoeing, walking for leisure and exercise, dog exercise, fishing, picnicking, over night camping and wind-surfing are growing in popularity.

The experience and enjoyment of a lake/Reserve visit is significantly influenced by the quality of the natural environment and the facilities provided.

## **7.8 Animal and Plant Pests**

Wetlands tend to harbour diverse and abundant pest populations of small mammals, fish and plants. While controlling all pests is desirable, the priority should be on those species that have the greatest impact on the Reserve's primary purpose, the significant heritage sites and features and indigenous biota. In this case, it will be a combination of meeting pest control as required under the Regional Pest Management Strategy and focusing on key ecological pests. These may include mammal pests such as possum (*Trichosurus vulpecula*); mustelids (*Mustela* sp) and feral cats (*Felis catus*); aggressive plant pests such as yellow flag (*Iris pseudacorus*) and alligator weed (*Alternanthera philoxeroides*), plus more terrestrial species like crake and grey willow and Japanese honeysuckle (*Lonicera japonica*); and, fish pests such as rudd, koi and bull head catfish, that contribute to poor lake health and lake water quality.

## **8.0 MANAGEMENT AIMS AND OBJECTIVES**

### **8.1 Aims**

The Heritage Policy and Implementation Strategy and the Peat Lake Reserve Management Plan, signaled the general direction management will take for peat lake reserves administered by Council.

Management aims to:

- ensure the primary purpose for which the reserve was classified under the Reserves Act 1977, is met;
- focus resources on those tasks and actions that provide the greatest benefits and will achieve quality outcomes;
- work collaboratively with all agencies that have statutory responsibilities to manage lakes in public ownership, land owners and interest groups;
- promote peat lakes as sites that are exciting and interesting places that offer opportunities for passive recreation, learning and exercise all of which have mental and physical health benefits.

### **8.2 Objectives**

Lake Ngaroto is the largest of the peat lakes and the only lake reserve within the Te Awamutu District of a size and with the necessary facilities to cater for a broad range of water contact recreation, particularly sailing, rowing, waka paddling and canoeing. It is also a valued ecological resource, has immense cultural and spiritual significance to local Iwi and the lake environs are popular with people seeking an outdoor experience, enjoyment and exercise.

The popularity of the Lake Reserve is expected to increase as Te Awamutu and other urban centres in the western Waipa continue to grow and residents balance their working lives with outdoor leisure activities.

Management Objectives for the Lake Ngaroto Recreation Reserve are to:

- improve the quality of water in Lake Ngaroto to ensure ongoing water based recreation opportunities are available to users and visitors;
- ensure sufficient water depth to enable ongoing competitive safe recreational sailing of yachts;
- ensure sufficient length of water course is available to enable competitive rowing, waka paddling and canoeing;
- protect and enhance the indigenous plant and animal populations;
- maintain the ecological processes that will ensure the survival of the Reserve's indigenous biota;
- secure and protect the cultural and historic sites and features around the margin of the lake;

- recognise the spiritual importance of the Lake to Iwi;
- promote Lake Ngaroto as a interesting and enjoyable destination; and,
- maintain the infrastructure (tracks, wharf, boat ramps, toilets, signage and interpretation) to a high standard.

## **9.0 POLICY FOR THE MANAGEMENT OF LAKE NGAROTO RECREATION RESERVE**

### **9.1 Policy One: Adjoining Land Use and Development**

#### Justification

The lake and the marginal zones, together with the plant and animal communities they support are sensitive to land use practices that result in excessive drainage, introduce nutrients and contaminants, sediment runoff and potentially fire. Managing these threats is best achieved by creating a physical barrier or buffer that will separate the reserve (lake and its margins) from adjoining land use.

- 9.1.1 Buffer zones around the lake will be extended either through vesting of land on sub-division (Reserve Strip and Esplanade Reserves), the use of Environment or Heritage Protection Lot provisions in the District Plan, to encouraging land owners to voluntarily retire land or, through the purchase of land.
- 9.1.2 Manage any buffer zone created in a manner that will reduce impacts on the physical and biological processes operating within the reserve.
- 9.1.3 Work with Peat Lake Accord members, adjoining land owners and other stakeholders in achieving these outcomes.

### **9.2 Policy Two: Managing Lake Levels**

#### Justification

The depth of water in the lake and how the lake fluctuates seasonally, is crucial in ensuring ongoing use and enjoyment of the lake by the boating public. It is also an important factor in improving water quality; restoring and maintaining indigenous plant and animal communities; and protecting the historic and cultural features and artifacts around the lake margins. Identifying and adopting an appropriate minimum lake level and seasonal operating regime is a priority task.

- 9.2.1 Investigations that will identify the most appropriate water level regime for Lake Ngaroto will be undertaken. These investigations will take into account recreational, ecological, social, cultural and economic factors.

- 9.2.2 An application to renew or change the water management regime will be lodged with Environment Waikato before 31 October 2010 when the existing consent expires.
- 9.2.3 The existing outlet weir will be maintained in a functioning state and resource consent conditions for the operation of that weir will be met.
- 9.2.4 New drainage activity within the Reserve or land administered by Council, which may impact on lake levels or ground water levels will be prohibited.
- 9.2.5 Council will work with adjoining landowners to promote controls on drainage within 200m of the Reserve to avoid excessive peat settlement and peat loss and to promote sustainable land use practices.

### **9.3 Policy Three: Managing Contaminants, Nutrients and Sedimentation**

#### Justification

Contaminants, nutrients and sediment generated within the Reserve or flowing from catchment sources, can change water chemistry, biological communities and physical processes. Ultimately they will contribute to a loss of indigenous biodiversity and environmental health and through degraded water quality, restrict human recreational opportunities.

The relationships between contaminants, nutrients and sediments and how they cycle within a shallow lake system are very complex. Understanding these relationships and determining the most appropriate management action, requires factual information and professional advice.

- 9.3.1 A monitoring programme to identify management actions that are necessary and/or will contribute to an improvement in water quality and general in-lake conditions for recreational users and an improvement in habitat for indigenous wildlife, fish and game birds will be implemented.
- 9.3.2 Management actions capable of generating contaminants, nutrient and sediment within the Reserve, or having potential to harm the environment or visitors will be avoided.
- 9.3.3 Council will work with adjoining land owners to reduce or eliminate contaminants, nutrients and sediment passing from private land into the Reserve.
- 9.3.4 Council will recognise that discharge of contaminants to water and diversion of waterways is culturally offensive.
- 9.3.5 The District Plan will be used to promote land use practices within Lake Ngaroto catchment that will reduce or eliminate sediment flowing into lake reserves.

## **9.4 Policy Four: Managing Introduced Pests (Plants and Animals)**

### Justification

Pest plants and animals threaten indigenous species and communities, interfere with natural processes, the structure of terrestrial and aquatic habitats and generally erode landscape quality. Of particular concern are browsing and predatory mammals, pest fish (koi, bullhead catfish, and rudd); and, aggressive colonising plants.

- 9.4.1 Obligations for the control and management of pest plants and animals under the Regional Pest Management Strategy 2007 – 2012 and Bio-security Act 1993 will be met.
- 9.4.2 Contractors employed to undertake pest control operations must be suitably qualified and certified for handling and applying toxic chemicals and adhere to approved methods for storage, handling and delivery of such chemicals.
- 9.4.3 Regular pest surveillance within the Reserves will be undertaken and an annual control programme to target pests that pose the greatest threat will be implemented.
- 9.4.4 Options for the control of koi, bullhead catfish and rudd will be evaluated and a control programme implemented when deemed appropriate.
- 9.4.5 Pest eradication and control initiatives undertaken by Environment Waikato and Department of Conservation on land around the reserves will be supported.

## **9.5 Policy Five: Fostering Agency and Community Involvement**

### Justification

Wetlands are catchment “sinks” and their condition reflects how well the land within the lake catchment is managed. It is therefore essential adjoining landowners and interested parties are involved in the management of the Reserve and their support and co-operation is sought whenever possible in realising the restoration objectives for the lake.

- 9.5.1 Landowner and community involvement in the management of the Lake Ngaroto Reserve will be encouraged
- 9.5.2 Council will work with Environment Waikato, Department of Conservation, Iwi, Auckland Waikato Fish & Game Council, Queen Elizabeth II Trust, Landcare Groups and other interested parties to promote changes in land use practices that will reduce environmental impacts on lake environments.
- 9.5.3 Advice and incentives will be offered to landowners, community and user groups to encourage the implementation of sound land use practices that will reduce or eliminate adverse environmental impacts on lake environments.

9.5.4 The Ngaroto Lake Care Group will be supported. This Group will represent catchment land owners, lake users, members of the existing yachting and rowing clubs and Auckland Waikato Fish and Game Council.

## **9.6 Policy Six: Promoting and Managing Use and Visitation**

### Justification

Use of Lake Ngaroto was traditionally limited to game bird hunting and recreational boating. Today, Lake Ngaroto is recognised as a culturally interesting and biologically diverse place that offers both passive and active experiences which compliment the more traditional sports and outdoor activities.

There exists a infrastructure of tracks, boardwalks, bridges, toilets, picnic facilities, litter control bins, interpretive signage and information, all of which adds to the experience and enjoyment visitors receive. These facilities will be maintained and if necessary upgraded to cater for any increase in visitation and to ensure appropriate health and safety standards are met. Every effort will be made to minimise public risk on the Reserve.

Hosting large events like sailing and rowing regattas, may require controls on public access to the lake and or restrictions or prohibitions on recreational activities that conflict with such events. Under such circumstances the event organiser must seek authorisation from Council to host the event. Council in turn will assess the request and if necessary implement control measures.

- 9.6.1 The existing round-the-lake track will be maintained and where necessary upgraded to meet the national 'day walk standard'.
- 9.6.2 Existing and any new structures and buildings including jetties and retaining walls that will prevent erosion of the Domain shoreline, that prevent ecological degradation, directly support recreational use or required for management purposes. New structures must meet the provisions of the Building Act 2004, the District Plan, the Reserves Act 1977 and Resource Management Act 1991 and amendments.
- 9.6.3 Persons wishing to use the Reserve for large events are required to seek authorisation from Council.
- 9.6.4 Overnight camping within the Domain, for persons involved in or associated with recreational events for periods not exceeding five (5) consecutive days will be permitted;
- 9.6.5 Up to a maximum of 2 consecutive nights, short term independent overnight parking will be permitted for self contained motor homes and camper vans certified in accordance with NZS 5465:2001 (NZ Standard for Self Containment of Motor Caravans).
- 9.6.6 Dog access for exercise and game bird hunting purposes will be permitted, provided the provisions of Council's Dog Control Bylaw 2004 are met.

- 9.6.7 The use of power boats other than those used in association with managing yachting, rowing, waka paddling events; for erecting and managing hunting stands prior to and during the hunting season, or for management and safety purposes, is prohibited.
- 9.6.8 Authority will be issued to licensed game bird hunters to carry firearms within the Reserve during the game bird hunting season. Licenced hunters must comply with the annual game bird hunting regulations, in particular the siting of hunting stands and use of non toxic shot.
- 9.6.9 Hunting stands built within the Reserve must conform with the “Maimai Construction Guidelines” produced by the Auckland Waikato Fish and Game Council and approved by Land Information NZ, the Department of Conservation and Environment Waikato.
- 9.6.10 The taking of any indigenous fauna for any commercial purposes is prohibited. This includes short and long finned eel.
- 9.6.11 Health and safety risks to persons visiting Lake Ngaroto will be well notified.
- 9.6.12 Interesting and informative interpretive signage will be provided and maintained at key sites and features and the signage and interpretive aids will be of a high standard.

## **9.7 Policy Seven: Managing Indigenous Flora and Fauna**

### Justification

Robust, healthy wetland eco-systems support a greater variety and abundance of species and communities. They also provide the greatest opportunities for human appreciation and interaction.

Anecdotal comment from Reserve users (hunters and ornithologists) suggests there has been a loss in both the diversity and abundance of species utilising the lake. While predation by introduced pests is recognised as the primary cause of extinctions and declining populations of indigenous birds in NZ, habitat deterioration is also a significant threat. Deteriorating water clarity will impact diving birds like NZ scaup, NZ dabchick and shags and, preventing natural seasonal fluctuations in lake levels will influence the availability of food in the marginal zone for waders like Australasian bittern.

- 9.7.1 An inventory of plants and animals within the Reserve will be completed and maintained.
- 9.7.2 Colonisation of native plant communities will be encouraged. Where necessary colonisation will be assisted by controlling undesirable species, using machinery to manipulate shoreline contours and impounding and managing water.
- 9.7.3 Where appropriate, rushlands, sedgelands and herb fields will be re-established to increase water bird habitats.
- 9.7.4 Initiatives taken by community groups and agencies to increase the populations of some species, or to reintroduce species lost from the site through human or pest pressures, will be supported.



- 9.7.5 Plants selected to restore sites will be sourced from appropriate genetic stock.
- 9.7.6 Rare and threatened species, as determined by the Department of Conservation, are a priority for protection and management and Council will support specie recovery programmes where Lake Ngaroto Recreation Reserve can play an important role.

## **9.8 Policy Eight: Managing the Landscape**

### Justification

Lake Ngaroto is a very prominent landscape feature visible from SH 3, Paterangi Road and Lake Road. Protecting this diverse, vibrant rural setting will help retain Waipa's identity and generate a 'sense of place', to which local communities can relate.

- 9.8.1 All landscaping will endeavour to enhance the appearance of the reserve.
- 9.8.2 Appropriate indigenous species will be used when planting.
- 9.8.3 When planting tall trees viewing corridors and wind patterns must be considered.
- 9.8.4 Landscaping will endeavour to retain natural patterns, colours and textures.
- 9.8.5 Natural features that make a significant contribution to landscape features will be protected.
- 9.8.6 Only building materials and styles consistent with that commonly used in the area will be used.
- 9.8.7 The lake must remain visible from transport corridors.

## **9.9 Policy Nine: Managing Historic and Cultural Heritage**

### Justification

Lake Ngaroto played an important role in the lives of Maori providing food, materials for habitation and security from attack. Evidence of Pa and 'kaianga' can be found on the western lake shores and the Mangeo ridge.

Early European settlers also exploited the lake for food, taking waterfowl and fish and using the lake for recreational boating.

- 9.9.1 The Historic Places Trust and tangata whenua will be consulted on the protection and management of known heritage assets and features.
- 9.9.2 A conservation plan will be prepared for the known sites to ensure recreational or other use of the Reserve does not conflict with the protection of those assets and features.
- 9.9.3 Interpretation of sites and features will be informative and of a high standard.
- 9.9.4 Statutory obligations under the Historic Places Act 1993 will be met.



## 9.10 Policy Ten: Concessions

### Justification

A 'concession', being a lease, a license, a permit or easement, is a contractual agreement between the concession holder and Council for the exclusive use of land within a public reserve for a prescribed period. This will include land on which private buildings and/or other structures are located.

Lake Ngaroto is within a Special Landscape Character Area. While retaining open space is one of the purposes of establishing the reserve, some buildings such as toilets, store rooms and clubrooms are considered necessary for the enjoyment and full utilisation of the Reserve. There are already several buildings on the Reserve that are used by either the Ngaroto Sailing Club or the Te Awamutu Rowing Club.

Providing a service or retailing a product can compliment some recreational experiences. If these activities are carefully controlled, do not impact on the legitimate use of the reserve by others and, are not contrary to the principles of the Act, Council may grant a concession for these purposes.

- 9.10.1 Ensure that only those buildings and structures essential for the health and enjoyment of visitors are established.
- 9.10.2 Any proposal to establish a building structure or installation shall be subject to Council approval.
- 9.10.3 The design of a proposed building or structure shall be subject to Council approval. In every instance, the design should be sympathetic to the quality of the surrounding landscape.
- 9.10.4 The owners of existing buildings will ensure condition assessments are prepared for each building owned, and copies of each building assessment will be supplied to Council.
- 9.10.5 Concessions approved by Council for the lease of land will typically be for a period of five years, with a right to renew the concessions after five and ten years. In accordance with the specifics of the lease documentation, conditions attached to the concession may be altered or terminated during the review periods.
- 9.10.6 The Reserve shall not be used to house commerce or industry.

## 9.11 Policy Twelve: Reserve Classification

### Justification

Not all land purchased by or vested in Council for the purposes of protecting or managing the lake reserve, has been formally reserved and classified. Those parcels awaiting reservation and classification will be formally processed as a priority. As reservation is a prerequisite to management planning, management of those land parcels will be guided by and in general accordance with this Plan.

9.11.1 Reservation and classification of Council administered land deemed important in managing and conserving Lake Ngaroto Recreation Reserve will proceed as a matter of priority.

## **9.12 Policy Thirteen: Policy Review**

### Justification

The Reserves Act 1977 requires reserve management plans be reviewed.

Use of the Reserve is expected to increase over the next five years and expected growth in population and more intensive use of land, pressures on and use of reserves associated with peat lakes is likely to increase. Policies may need to change to adequately manage these changes.

9.12.1 The policies outlined in this reserve management plan will be reviewed every 5 years, or as changing circumstances dictate.

9.12.2 The provisions of Sec 41 of the Reserve Act 1977 will be met.

## APPENDIX ONE

### Bird Fauna recorded at Lake Ngaroto

Common Name	Scientific name	Origin	Status
Water fowl			
mallard duck	<i>Anas platyrhynchos</i>	introduced	game bird
grey duck	<i>Anas superciliosa</i>	native	game bird
grey teal	<i>Anas gracilis</i>	native	protected
NZ Shoveler	<i>Anas rhynchotis</i>	endemic	game bird
paradise shelduck	<i>Tadorna variegata</i>	endemic	game bird
black swan	<i>Cygnus atratus</i>	introduced	game bird
Canada goose	<i>Branta canadensis</i>	introduced	game bird
pukeko	<i>Porphyrio porphyrio</i>	native	game bird
large black shag	<i>Phalacrocorax carbo</i>	native	protected
little shag	<i>Phalacrocorax melanoleucos</i>	native	protected
pieb stilt	<i>Himantopus himantopus</i>	native	protected
whitefaced heron	<i>Ardea novaehollandiae</i>	native	protected
spur-winged plover	<i>Vanellus miles</i>	SI native	protected
marsh crake	<i>Porzana pusilla</i>	native	protected
spotless crake	<i>Porzana tabuensis</i>	native	protected
banded rail	<i>Rallus philippensis</i>	native	protected
Australasian harrier	<i>Circus approximans</i>	native	protected
grey warbler	<i>Gerygone igata</i>	endemic	protected
fantail	<i>Rhipidura fuliginosa</i>	native	protected
welcome swallow	<i>Hirundo tahitica</i>	SI native	protected
morepork	<i>Ninox novaeseelandiae</i>	native	protected
NZ Kingfisher	<i>Halcyon sancta</i>	native	protected
silvereve	<i>Zosterops lateralis</i>	native	protected
chaffinch	<i>Fringilla coelebs</i>	introduced	unprotected
yellow hammer	<i>Emberiza citrinella</i>	introduced	unprotected
dunnock	<i>Prunella modularis</i>	introduced	unprotected
blackbird	<i>Turdus merula</i>	introduced	unprotected
song thrush	<i>Turdus philomelos</i>	introduced	unprotected
greenfinch	<i>Carduelis choris</i>	introduced	unprotected
goldfinch	<i>Carduelis carduelis</i>	introduced	unprotected
redpoll	<i>Carduelis flammea</i>	introduced	unprotected
house sparrow	<i>Passer domesticus</i>	introduced	unprotected
starling	<i>Sturnus vulgaris</i>	introduced	unprotected
myna	<i>Acridotheres tristis</i>	introduced	unprotected
Australian magpie	<i>Gymnorhina tibicen</i>	introduced	unprotected

SI Native = self introduced native

## APPENDIX TWO

### Mammals and fish found within the Lake Ngaroto Recreation Reserve

Name	Scientific Name	Origin	Status
ferret	<i>Mustela furo</i>	introduced	pest
stoat	<i>Mustela erminea</i>	introduced	pest
weasel	<i>Mustela nivalis vulgaris</i>	introduced	pest
house cat	<i>Felis catus</i>	introduced	pest
hedgehog	<i>Erinaceus europaeus occidentalis</i>	introduced	pest
black rat	<i>Rattus rattus</i>	introduced	pest
Norway rat	<i>Rattus norvegicus</i>	introduced	pest
house mouse	<i>Mus musculus</i>	introduced	pest
brush tail possum	<i>Trichosurus vulpecula</i>	introduced	pest
European rabbit	<i>Oryctolagus cuniculus</i>	introduced	pest
brown hare	<i>Lepus europaeus occidentalis</i>	introduced	pest

### Fish recorded within the Lake Ngaroto Recreation Reserve

Name	Scientific Name	Origin	Status
common bully	<i>Gobiomorphus cotidianus</i>	endemic	not protected
smelt	<i>Retropinna retropinna</i>	endemic	not protected
short finned eel	<i>Anguilla australis</i>	native	not protected
long finned eel	<i>Anguilla dieffenbachii</i>	endemic	not protected
bullhead catfish	<i>Ictalurus nebulosus</i>	exotic	not protected
goldfish	<i>Carassius auratus</i>	exotic	not protected
koi	<i>Cyprinus carpio</i>	exotic	pest

Note: The harvest of long and short finned eel is controlled - (6) per person

## APPENDIX THREE

### Detailed History of Decision on Lake Level Management Regime

In response to concern expressed by the Ngaroto Boating Club, via the Te Awamutu Borough Council, representatives from Waipa County Council, Ngaroto and Ohaupo Drainage Boards and Waikato Valley Authority passed, in September 1968, the following resolution:

“Providing that the Ngaroto Drainage Board does not raise any objection then it be recommended that a temporary control be constructed by the Ngaroto Boating Club at no cost to the Drainage Board. The control is to temporarily maintain a lake level of 130.50 feet and such work shall be to the approval of the Waikato Valley Authority and construction be supervised by the Waipa County and Te Awamutu Borough Engineers. Further, should any damage arise to privately owned farmland then the control shall be removed “.

Chief Engineer HCC Jones, reported to the Waikato Catchment Authority in a report dated 28 October 1969 and highlighted the following:

- The National Water and Soil Conservation Authority acting under the recently enacted Water and Soil Conservation Act 1967, now has a mandate to take into account the present and future needs of primary and secondary industry, water supplies of local authorities and all forms of recreation, and to have due regard to scenic and natural features and to fisheries and wildlife habitats when planning and advising on the allocation of natural water;
- Under Section 20 of the 1967 Act the Waikato Valley Authority as the Regional Water Board has a recommendatory function in relation to lake levels and it can exercise that function only after consultation with all interested bodies and interested persons known to the Board; and,
- At this early stage all that can be done is to adopt tentatively a minimum level with interested parties.

With regard to adjoining land, surface levels and water levels, the Engineer stated that:

- For the greater part the ground levels around the lake are quite flat, with ruling gradients in these flatter areas running at 1 in 300 to the foreshore of the Reserve boundary then reduce to even lower gradients. In the extreme, in one swamp area the ground level remains practically even over a distance of 2,700 feet inland from the Reserve boundary in the RL range 132.3 – 133.3ft

He records the lowest level as 128.18 (January 1962) and the highest level 133ft. On 23 October 1969 the level had fallen to 129.1ft.

These levels based on water depth taken around the boating course, were deemed too low for boating, however any level adopted would be a compromise between boating and drainage interests.

With regard to water level control, he stated that:

- Beneath the Sings Road bridge was the preferable site for a weir. The soft substrates and difficult access ruled out a site closer to the lake;
- A weir be constructed and the weir crest be 129.5; and,
- Interested parties be consulted regarding the recommendation.

The Authority/Water Board adopted the Engineer's report and advised the Te Awamutu Borough Council that:

- A Committee had been established to consider any submissions and to report to the Board on 26 November 1969.

The Board reaffirmed the recommendation to set a minimum lake level of 129.5 feet. It was noted this level was some 0.9 feet lower than the level recommended in the application lodged by the Domain Board on 26 June 1968.

The report of the Committee to the Regional Water Board reported, on 24 November 1969, that:

- 19 submissions were received from interested parties. Seven were from farming interests who advocated a maximum level of between 129 and 129.5 ft. Eight were from recreational interests who advocated a summer level of 130.5 ft, and four were from Government agencies.

Following consideration of the submissions the Committee concluded:

1. A weir was not appropriate and that a controllable 'gate' was required to achieve more precision to meet the varying needs; and,
2. A minimum level of 130.0 ft be adopted from 1 October to 1 May and a level of not lower than 128.5 ft during winter.

The Waikato Valley Authority/Water Board advised the Te Awamutu Domain Board on 23 December 1969 of the decision and proposed conditions and these were subsequently adopted. They were:

- In so far as inflows to the Lake Ngaroto permit the minimum level of RL 130.0ft shall be maintained during the period 1 October to 1 May in each year.
- Where possible during the winter periods free flow of water shall not be allowed, but with due regard to maintaining a lake level not lower than 128.5 ft with preparatory steps being taken during the month of September to facilitate the minimum summer level of 130 ft by 1 October.

- At all time including the period 1 October to 1 May overflows through the radial arm control gate shall be at the discretion of the Regional Water Board.

	Levels in Feet	Bass Gauge	Waipa Datum (m)	Moturiki Datum (m)
Summer/Autumn	130	34.55	39.62	34.34
Winter	128.5	34.10	39.17	33.89

In 1970 engineering plans were completed and the weir constructed across the lake outlet beneath the Sings Road bridge. Interestingly, funding for this work was provided by the Te Awamutu Borough Council, Department of Lands and Survey, Auckland Acclimatisation Society and others. The Ngaroto Drainage Board, although responsible for the low lake levels and subsequent lake use by boating public, made no financial contribution.

A resource consent to control lake levels was considered and granted to the Te Awamutu Borough Council in 1969. The original consent was renewed by consent (840376). There were no changes or modifications to the original conditions and the structure had been operated as intended.

The Lake was formally Reserved and Classified as a Recreation Reserve, by NZ Gazette 1984 p.853 and the Waipa County Council was appointed to control and manage the Reserve.

Works to stabilise erosion of the public domain were undertaken in 1991 by the Ngaroto Boat Club. These works were funded by Council.



## APPENDIX FOUR

### History of Aquatic Plant Management

By the early 1970's the lake weed *Egeria densa* was deemed to be interfering with sailing and rowing activity and a consent was granted to use the herbicide "diquat" to control infestations

Two consents were granted to spray Lake Ngaroto with herbicide. The first was granted on 15 January 1976 (expired 15 January 1981) and authorised the spraying of 5.6 litres of diquat, twice per annum, for five years. The second consent was granted on 10 February 1982, and authorised the spraying of up to 50 litres of diquat (diluted to 1000).

Records from Environment Waikato record that in both consents the area sprayed each year included the total area of the lake, including the littoral margins.

Reports on water quality prepared by Waikato Catchment Authority when reviewing the resource consent to apply diquat, described the lake as " ... highly eutrophic with nutrient and chlorophyll *a* concentrations very high and reduced water transparency. High algal production was evident in winter as well as summer, including the presence of blue green algae...". Some parameters measured, namely phosphorous and nitrogen, were considerably higher than values measured in 1977, some 10 years previously. This is likely the period when submerged plants began to collapse and algal communities began to dominate.

In 1976 (15 January) a resource consent was granted to spray submerged aquatic plants with 'diquat' twice per annum. This consent expired on 15 January 1982. A second consent was granted on 1982 and this consent expired on February 1987.

The purpose of control was to control plants within the boating and rowing zones although little monitoring was undertaken to determine either the effectiveness of the programme or the effects on other environmental factors. By the late 1970's plants were rare within the lake and problems were being experienced with water quality and nuisance algal blooms.

In 1978 Council funded a range of research initiatives aimed at documenting the water quality and biological attributes of the Waipa Peat Lakes. This work was overseen by M Chapman and J Boubee (Biological Sciences, School of Sciences, Waikato University of Waikato). This was the first attempt to visit and record data on the peat lakes and it provided a very useful base line to compare change.

In 1981, as part of a broader lakes survey, the quality of Lake Ngaroto waters was surveyed. The water was described as dark brown, with transparency affected by algal turbidity. Twenty two species of algae were recorded. It was recorded that "...on the bases of the high algal productivity, restricted light penetration and history of herbicide application, Lake Ngaroto will likely remain algal dominated".

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