



Ministry for the
Environment
Manatū Mō Te Taiao



LAKE NGAROTO RESTORATION

A CASE STUDY

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MANUKA PLANTED IN RETIRED GRAZING LAND

foreword

The Ministry for the Environment is currently coordinating the update of the Lake Managers' Handbook. This Lake Ngaroto case study is part of that update. As well as this stand-alone format, the following will also be included in the handbook itself in the revised Land/Water Interactions chapter.

Presenting as it does a realistic idea of what is involved and may be expected in such a project, it is hoped that the Ngaroto case study will provide a reference and example for other groups considering a similar lake restoration project.

Further details and discussion of issues and techniques relating to lake restoration can be found in the relevant chapters of the revised handbook.

introduction

Located northwest of Te Awamutu, Lake Ngaroto is the largest of the lakes in the Waipa District and, like the other lakes, it is a valuable landscape and recreational amenity. Ecologically Lake Ngaroto shares similarities with the other peat lakes of the Waikato basin.

Lake Ngaroto has been the subject of a number of studies — in terms of its ecology and its potential for restoration and enhancement. The studies provide a picture of the original ecology of the lake and its surrounding vegetation. In particular, the work of Chapman and Boubee highlights the potential for restoration.

The lakes of the Waipa district were formed at the end of the last glaciation, 1700 years ago, when river valleys were blocked with silt and sand from the ancient Waikato River. Small lakes formed behind these shingle and sand bars to become the Waipa peat lakes. Dense forests formed around these lakes, and sedges, submerged plants and aquatics established in the lake fringes. The peat lakes became very productive to a variety of wildlife and native fish.

Maori undoubtedly found the lakes a productive and useful area in which to live. Eels, fish and birds would have been plentiful in the lake and surrounding forests. The lake also served as an area of refuge in times of war, and two island pa were built at Lake Ngaroto to provide a degree of security that may not have been available elsewhere.

LAKE HISTORY

The arrival of the European and the development of the surrounding land into productive farmland resulted in radical change in the lakes and their surrounding riparian margins. Lake Ngaroto is no exception. Vegetation around the lake has been dramatically modified. The tall forests that once surrounded the lake were felled and burned to clear land for farming. The swamplands that surrounded many of the peat lakes were drained and, in the process, the lake level was lowered.

Prompted by the availability of Government-subsidised employment schemes in the 1980s, some attempts at ecological restoration were made. Unfortunately, this programme gave insufficient consideration to the ecological implications of the work. A major source of flax was then available from a closing flax farm, so flax was planted extensively.

As time passed, however, blackberry overran the flax, making it impenetrable and reducing access to the lakes. The few other species that were planted at the same time struggled to survive and were also overrun by blackberry and convolvulus.

Fences were erected around much of the lake although, with one minor exception, not on the legal boundaries of the lake reserve. Areas outside these fences were cleared of most vegetation, primarily invasive willow species or other noxious plants. Neighbouring farmers had free grazing of many hectares of reserve and the legal road.

In one small area, planting was carried out by a school group using PEP labour, but this wasn't maintained and effectively became a liability with the invasion of weeds, particularly the blackberry.

Lake Ngaroto is the largest of the lakes in the Waipa District and is a valuable landscape and recreational amenity

Today the lake and the remaining riparian margins bear little relation to the original lake environment.

Ecologically, the lake has been degraded since the arrival of the European settlers.



MANUKA PLANTED IN RETIRED GRAZING LAND

THE CURRENT SITUATION

Today the lake and the remaining riparian margins bear little relation to the original lake environment.

The level of Lake Ngaroto no longer fluctuates naturally with the passing of the seasons. This is due to the construction of a weir on the outlet of the lake. The weir was intended for drainage and control of lake water levels for recreational purposes. As a result, the current regime for lake water level control is contrary to the original natural regime. The levels now fall in the winter and rise in the summer for the benefit of the recreational users, which limits the movement of native fish and accelerates the ecological deterioration of the lake. Flood waters no longer “flush” the lake periodically. Silt has built up and exotic water plants have become established.

Cowshed and industrial pollutants have discharged into Lake Ngaroto, reducing the water quality. Farming runoff drains into Lake Ngaroto. Silt, from farm development and road construction, has contributed to the gradual infilling of the lakebed and resultant lowered levels; much of the lake is now less than one metre deep.

The introduction of exotic plants has impacted negatively on the marginal vegetation. Where once manuka and raupo associations predominated with kahikatea forest outside this, grey willow and crack willow now cover most of the areas around the lake that were not easily farmable. Blackberry is a major problem in some areas, with convolvulus and pampas also evident.

Ecologically, the lake has been degraded since the arrival of the European settlers. This deterioration continues as the willows

and other semi-aquatic plants intrude further into the lake waters.

To compound this, the lake is surrounded by farmed peat lands. The majority of this peat is only about one metre deep but is nevertheless being oxidised by grazing and cultivation. This will result in lowering the peat level to the point where either there will be demands for further lowering of the lake level or, alternatively, the adjacent land will become untenable for normal farming purposes without stopbanking and expensive pumping to keep the land dry.

Recreational use

Recreational use of the lake is varied. Yachting, windsurfing and rowing are enjoyed, particularly in the summer months.

Duck hunting is perhaps the most traditional of all the lake activities. The duck hunters have a longstanding arrangement with other users (yachties and rowers) for exclusive use of the lake during the duck hunting season (May and June). The lake has been very productive for this purpose but has become less so in recent years.

The southern access is popular for picnickers and also as a place where local people can exercise their dogs. Many are happy just to drive to the lake, take in the view and leave again. Local residents value the lake for its visual properties, notwithstanding that it contributes to the frequency of fogs which are common in the Waipa/Waikato basin.

The picture that emerges of Lake Ngaroto in the Waipa context is a visual and recreational asset of considerable value to the local and regional communities. As such, its restoration and enhancement was considered a desirable goal.

RESTORATION PROPOSALS

In early 1995, Waipa District Council commissioned a plan for the restoration and enhancement of the lake. A study of the existing situation was carried out, identifying the various components of the lake and its ecology. The Lake Ngaroto Recreation Reserve includes the lakebed as it was originally surveyed, measuring 107.5 ha, and the area of open water, approximately 74.86 ha. Surrounding the lake reserve there is an additional recreation reserve of 41.5913 ha, and there is a legal road right around the lake reserve with an area of approximately 11.4 ha. In total, about 80 hectares around the lake were available for this restoration project.

All adjoining owners were visited and asked their views on the lake and its management.

There was general support for the proposals. All the farmers agreed to relinquish their free grazing so long as everyone around the lake was treated equally.

Iwi groups with an interest in the lake were consulted and agreed in principle with the restoration proposals. Ongoing liaison with these groups was agreed.

All the recreational lake user groups were consulted and their concerns and questions were addressed. One of the concerns of the yacht club was the interference with wind patterns if large trees were planted close to the lakeshore. Duck hunters were concerned that an increase in public use of the lake could result in pressure to limit their access to the lake.

Lake Ngaroto in the Waipa context is a visual and recreational asset of considerable value to the local and regional communities.

the restoration plan

The restoration plan proposed the following:

- 1 The boundary of the lake to be recognised as the outside boundary of a legal road that encircles the Lake Ngaroto Recreation Reserve.
- 2 The entire boundary of the reserve to be fenced on the proposed new legal boundary. This required progressive survey of the boundary and ongoing commitment to adjust the status of the legal road to become part of the reserve.
- 3 Water discharges to the lake to have some form of silt and nutrient filtration before final discharge into the lake in an attempt to limit the infilling and nutrification of the waters.
- 4 Grey willow to be removed totally from the lake reserve over a period of time. Other species of willow, with the exception of weeping willow, to be progressively controlled also.
- 5 Restoration plantings to be primarily native, with some exotics, in groupings for aesthetic reasons and for wildlife feed. Larger trees to be restricted to areas away from the direction of the prevailing wind (south/west) to avoid wind disturbance to the recreational pursuits (yachting) on the lake. Manuka *Leptospermum scoparium* to be the prime species planted.
- 6 A track to be constructed around the perimeter as part of the restoration proposals to allow and encourage the public to view the work being done and to enlist public support for the restoration work.



TWO SEASONS PLANTINGS

Fencing and revegetation

The fences around the reserve were, where possible, to be relocated to the true boundary of the legal road encircling the reserve, the goal being that the buffer of vegetation around the lake should be wide enough to fully filter any cross-land run off.

Plantings in the areas retired from grazing were to be predominantly native. Plants were to be selected from a relatively limited list of varieties that would not only enhance the lake environment but control weeds. It was also important that the plants could be easily maintained once the first growth had been established.



DIGGING THE SILT TRAPS

The lake fringe was already infested with exotic plants of undesirable varieties. These were to be progressively removed, in particular the grey willow (an insidious weed that invades damp and semi-damp areas of wetlands) and replaced with natives. In the drier areas, this was to be by hand followed by chemical control of the stumps. In the wetter areas, the grey willow was to be underplanted with flax and Kahikatea, then over-sprayed with 24D once the flax had become established. Crack willow was also to be removed progressively but was of lesser priority. Hand removal and basal spraying was seen as feasible, as was aerial spraying with Roundup or Escort.

Blackberry needed vigorous control – primarily by hand then by chemical once the old canes had been cleared and burnt. Other noxious plants were also to be controlled and a programme of ongoing weed control was planned and is currently being implemented.

Water quality restoration

For many years Lake Ngaroto has suffered from the effects of accelerated runoff. Land development and the attendant

development of roads has been the major cause of this. Water quality has gradually deteriorated and silt from the various developmental works has entered the lake. As a result, invasive exotic aquatic vegetation has become established, causing further water quality problems and interfering with the lake's legitimate recreational use.

Controls for silt and nutrients were proposed which involved intercepting the silt and nutrients with ponds and traps as well as vegetative filters before discharge into the lake. Provision was made to allow floodwaters to bypass the nutrient traps so as not to adversely affect adjacent farmland.

The initial proposals were to build silt and nutrient traps on all inlets to the lake. However, it soon became apparent that while the silt traps would work to some degree, the control of nitrogen through nutrient trap ponds was not so certain. Therefore, the decision was made to construct only one nutrient trap on a major inflow and construct only silt traps on all other inlets (mainly farm drains). Even if the nutrient input to the lake could not be completely controlled, some control was considered an essential first step in improving the overall quality of the water in the lake.

In order to obtain the necessary resource consent, considerable study was carried out:

- all inlets (mainly farm drains) were examined and studied
- water flows at low flow times were measured
- eel and minnow traps were set in several of the drains and streams to gauge the diversity of fish life present in the water courses
- catchments of the individual drains were measured off an NZMS 260 topographical map. The areas were then calculated and

used alongside rainfall figures for various months to cross check the size of silt or nutrient traps needed at each stream/drain inlet

- the size of the silt traps was calculated so as to allow a reduction in water velocity during normal water flow (Environment Waikato advised that during storm periods, silts carried by the flood waters would largely be flushed from the lake.)
- the nutrient traps were designed to handle normal flows and allow flood flows to bypass the traps (Note that in the end, only one nutrient trap was constructed to study the likely value of installing more.)

THE RESTORATION PROGRAMME IN ACTION

The restoration programme began in August 1995. Subsidised labour contracted through the local iwi trust began work clearing the blackberry from the areas of the 1980s' plantings. Very little of the original planting had survived apart from flax which, although planted in profusion, was totally overgrown with blackberry. This flax was removed, broken into fans and replanted under the willow fringe not affected by the blackberry.

Planting and refencing

A trial planting of manuka *Leptospermum scoparium* was carried out. Each plant was individually staked so it could be located once the inevitable regrowth of the weeds took place. The stakes were specially purchased and of H3 treated radiata so they would last in the ground and be re-useable.

A start was made on refencing the reserve and legal road around the lake reserve. (Waipa District agreed to close the legal road and add it to the reserve.) Many hectares of land that were being grazed by adjoining landowners were reclaimed and fenced into

the reserve. This land is being progressively planted in native vegetation.

Nurseries were contracted to grow plant material for the following year (this has continued in subsequent years) – primarily manuka grown from seed sourced from another nearby peat lake. The plants were grown to root trainer size in the commercial nursery, then repotted into PB2 pots by the iwi group and Department of Corrections, and finally grown on for another year before planting.

The plantings were reinforced with cabbage trees, *Cordyline australis*, and kahikatea, *Dacrycarpus dacridioides*, with a few coprosma species interspersed.

Initially, the willow invasions were treated by hand clearing and stump spraying. While this was effective, it was very labour intensive and attracted criticism from the duck hunters. It was decided to underplant the larger willow stands with large kahikatea seedlings and allow the seedlings to penetrate the willow canopy before overspraying the willow and allowing the kahikatea to take over. This is a long-term, 10-20 year project.

One area of swamp meadow that was being invaded with grey willow has had chemical control of the willow for two years now but will require one or two more years' work to achieve total control. As long as grey willow remains in other parts of the lake, the threat of re-invasion is very high. The ultimate removal of the grey willow is therefore imperative for the long-term success of the restoration plan.

At the beginning of the year 2001, the planting programme was over halfway round the lake. The lake boundary is now fully fenced with a new seven-wire post and batten fence.

Restoration such as this will not be successful without commitment to ongoing maintenance.



DIGGING THE NUTRIENT TRAP

Restoration such as this will not be successful without commitment to ongoing maintenance.

Silt traps

In March 1999, having obtained the necessary resource consents, the silt traps were constructed on all the inflows to the lake. Essentially these traps are just an enlargement of the drain or water course, both in width and depth, sufficient to allow the water flowing through the channel to slow and allow sediments to settle out. They were calculated to be large enough so that the water entering them would slow sufficiently for the bed load to be deposited in the trap.

The objective was to intercept the heavier silt moving along the floor of the drains, not necessarily the suspended silts, although it was hoped some of these would be trapped. (A prototype of this was built by the Department of Conservation during the early 1990s at Lake "B" north of Hamilton. It was very successful in intercepting a large percentage of the silt moving down the drain, although no scientific study of its effects was ever made. It certainly stopped a large proportion of the bed load of moving sediments which had been forming a delta in the lake at the point of discharge of the drain to the lake).

One nutrient trap only was constructed on the largest inflow to the lake from nearby Lake Ngarotoiti. This had some initial stability problems that had to be rectified but it is now working effectively. Water quality testing results are not yet available.

As part of the resource consent conditions, Environment Waikato agreed to continue to expand the lake-water monitoring

programme they had been operating on the lake for several years. It will be several years before the results of this work will reveal any long-term effects.

The rationale behind limiting the silt and nutrient traps to processing normal flows is that, generally, flood waters flush rapidly from the lake and much of the suspended sediment and nutrients would be flushed out.

In March 2000, the silt traps were cleaned for the first time and an estimate made of the quantity extracted. All the drains had some limited silt removed, although in three cases this could only be described as a "trace". One drain, however, contained a large quantity of silt, and the drain above the trap was likewise filled with silt. The land above this was the only area within the immediate lake catchment where a paddock had been cultivated in the previous 12 months.

Walking track

At the same time that ecological restoration of the lake was beginning, work started on constructing a walking track right around the lake. All drains are now bridged and a major boardwalk over one section has been completed. The track is designed to allow the public to see the work in progress and thus maintain public support for the proposal.

Maintenance of the project

Restoration such as this will not be successful without commitment to ongoing maintenance. As part of its ongoing parks and reserves maintenance programme, Waipa District Council has adopted a 10-year maintenance programme involving plantings and weed control.



THE NGAROTOITI DIVERSION WEIR

key determinants of project success

This project has shown that there are a number of key components that will determine the success of a lake restoration project.

- 1 Long-term support from the controlling authority is needed.
- 2 A strong labour base is required to maintain the impetus of a project that is necessarily long term. Waipa District was fortunate in this, having iwi-based subsidised labour to start and Department of Corrections labour to continue. Some contractual labour is also needed during critical periods, like planting, and for technical work like chemical weed control.
- 3 The acquisition of plants will inevitably be the limiting factor in the progress of any project of this nature. Seed should be sourced from locally growing plants if at all possible. This means that a delay of one to two years at least is necessary for propagating significant quantities of plants from the appropriate source. Over 40,000 manuka have been planted annually since the second year of the project.
- 4 The choice of manuka as the pioneer species conforms with natural regrowth patterns in these areas. Manuka should be planted at no greater than 1.5 metre centres, in a random pattern. Once the manuka is 1.5 to 2 metres high and is shading the ground, weed control is much easier.
- 5 It is better to plant more mature plants than smaller ones. Two-year-old PB2-size plants that have been pruned once or twice are more robust than root-trainer plants. They establish better and grow above the grass more rapidly, so are therefore less demanding in maintenance terms. Staking the plants is particularly important when locating them for releasing purposes.
- 6 Engaging a professional fencing contractor to erect new fences is preferable to relocating and working with old fences.
- 7 Areas of retired and replanted pasture should be grazed right up to the time of planting. Planting is far easier in short grass than in long rank growth. A chemical spray brew is necessary to control the grass regrowth for the first few months. This is applied a few weeks before planting is due to start so that the areas to be planted can be easily identified by the die-back.
- 8 Plants should be released by pushing the grass away from the plant, not by chemical releasing, unless there are weed problems such as blackberry or convolvulus. Manuka can stand the use of 24D, the chemical used to control the convolvulus. It is also reasonably tolerant of Grazon, the chemical of choice for control of blackberry among the manuka plants. Blackberry also invades the remaining flax plants and this can also be controlled with Grazon without significantly affecting the flax.
- 9 In considering silt and nutrient control, it may be better to address the issue of nutrient and silt on the adjoining land with a view to preventing the material entering the watercourses. Silt traps were not as effective as had been anticipated. Some heavy particles of material transported on the streambed are being intercepted, but the monitoring work of Environment Waikato has already indicated that the amount of suspended sediment collected is negligible.

The most challenging issue to address is public perception and understanding of what restoration actually means.



RECREATION LAKE NGAROTO

The future of Lake Ngaroto, and several other lakes in the Waikato Basin, may be determined by two distinct processes – peat oxidation and silt infilling.



SPRAYING GREY WILLOW IN A SWAMP MEADOW

10 The most challenging issue to address is public perception and understanding of what restoration actually means. There has been a definite expectation that a “Climax Forest” will result and be evident in the near future. The long-term nature of the project, ie that it will take 40-50 years before the result will be realistically achieved, is something that must be communicated from the outset.

Waipa District has commissioned an interpretive programme to communicate the goals and ideals of this project to the public and politicians. A programme such as this should be considered at an early stage of any project so that the public can see that the short-term inconveniences and destruction have long-term goals of full restoration of the lake’s ecology.

11 New Zealand Ornithological Society members visiting the lake in the winter of 2000 crossed a boardwalk at the southern end where planting was yet to take place. A marsh crake, an uncommon and secretive wetland species, was observed along with spotless crake. This has caused a major rethink on the revegetation in this sector of the lake. The environment where the birds were seen is raupo and grey willow with swamp meadows abutting it. Marsh crake have only been seen once before in the Waikato in 20 years. Discussions with Department of Conservation staff have resulted in a relatively minor adjustment of the planting programme. This sighting might never have taken place at all if it were not for the construction of the boardwalk. Perhaps it is indicative of the difficulty of monitoring species such as these.

CONSIDERATIONS FOR THE FUTURE

Considering the deterioration of Lake Ngaroto and several other lakes in the Waikato Basin, it would seem that their future may be determined by two distinct processes – peat oxidation and silt infilling.

Peat oxidation

As long as there is peat surrounding the lakes in the Waikato and this peat is being farmed, there will inevitably be conflict with the adjacent farming community about the viability of their land as the peat oxidises and shrinks. This has caused considerable conflict in the Waikato as farmers whose land is next to lakes see their peat lands getting wetter. If farmers take the initiative and lower the outlet of the lake, reducing water levels to what they see as the proper level, the lakes will be drained.

Silt infilling

As land use in the area changes, silt finds its way into the peat lakes of the Waikato.

Conservatively, there may be several metres of silt accumulated in many of the peat lakes. Is it possible to suction-dredge the silts from the lakes and use this material, which is likely to be very high in nutrients, to “cap” the adjacent peat areas? Perhaps a metre of silt from a medium-sized lake could cap the adjacent peat paddocks, thus reducing the oxidation of the peat and providing a high-nutrient soil in its place. Local farmers would likely consider such a scheme if there was access to funding.

The outcome would be twofold. Firstly, the adjacent land would be less likely to flood if it were raised by 30 cm. Secondly, the lake would be restored to near its historic depth and the ecology would improve after an initial deterioration caused by stirring up the sediments. This would also have the added effect of reducing the encroachment of undesirable aquatic and semi-aquatic plants into the lake area.

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about the ministry for the environment

Manatū Mō Te Taiao

Making a difference through environmental leadership.

The Ministry for the Environment Manatū Mō Te Taiao advises the Government on policies, laws, regulations, and other means of improving environmental management in New Zealand. The significant areas of policy for which the Ministry is responsible are: management of natural resources; sustainable land management; air and water quality; management of hazardous substances, waste and contaminated sites; protection of the ozone layer; and responding to the threat of climate change. Advice is also provided on the environmental implications of other Government policies.

The Ministry monitors the state of the New Zealand environment and the operation of environmental legislation so that it can advise the Government on action necessary to protect the environment or improve environmental management.

This case study was prepared for the
Ministry for the Environment by:

JOHN GREENWOOD

Environmental and Recreational Consultant
79 Snell Drive
Hamilton

Phone/fax 07 855 6189

Mobile 025 830 239

email: jgreenwood@wave.co.nz



Ministry for the
Environment
Manatū Mō Te Taiao

HEAD OFFICE

Grand Annexe Building
84 Boulcott Street
PO Box 10362
Wellington, New Zealand
Phone (04) 917 7400
Fax (04) 917 7523
Internet <http://www.mfe.govt.nz>

NORTHERN REGIONS OFFICE

8-10 Whitaker Place
PO Box 8270
Auckland
Phone (09) 913 1640
Fax (09) 913 1649

SOUTH ISLAND OFFICE

Level 3, Westpark Towers
56 Cashel Street,
PO Box 1345
Christchurch
Phone (03) 365 4540
Fax (03) 353 2750