Regional Wetland Inventory and Prioritisation Project

February 2005

Authors
Helmut Janssen, Olivier Ausseil, Alistair Beveridge

Acknowledgments
The authors gratefully acknowledge the contributions of Wanganui District Council,
James Lambie and Melanie Dixon (GWRC),
Colin Ogle and Nick Singers (Department of Conservation),
Anne Gaelle Ausseil and Bev Clarkson (Landcare Research),
Maree Clark, Fleur Maseyk, Malinda Matthewson, Ruth Fleeson, Elaine Iddon,
Joe Martin, Craig Davey, Neil Mickleson, Noel Procter, Grant McLaren,
Campbell Sinclair, Claire Ridler, Aaron Madden, Hilary Webb, and Lindsay Fung
(Horizons Regional Council)

Front Cover Photo
Reed-land and Kahikatea wetland forest -
McPherson Forest and Bird Reserve
Photo: Helmut Janssen

February 2005
ISBN No: 1-877310-63-8
Report No: 2005/EXT/615

For more information contact

Offices:	*Head Office:*	*Depots:*
Taumarunui	**Palmerston North**	**Levin**
34 Maata Street	11-15 Victoria Avenue	11 Bruce Road
Phone 07-895 5209	Phone 06-952 2800	Phone 06-367 8259
Wanganui	**Freephone 0508 446 749**	**Taihape**
6 Bates Street		Torere Rd, Ohotu
Phone 06-345 0705	**help@horizons.govt.nz**	Phone 06-388 0192
Marton	**www.horizons.govt.nz**	**Pahiatua**
Hammond Street		Cnr Huxley & Queen Streets
Phone 06-327 7189	**24 hr Pollution Hotline**	Phone 06-376 7758
	Freephone 0508 476 558	
Dannevirke		**Kairanga**
Weber Road		Cnr Rongotea & Kairanga-Bunnythorpe Roads
Phone 06-374 6700		Phone 06-350 1761

FOREWORD

This report is the culmination of three years of intensive work by Horizons Regional Council to catalogue and prioritise wetlands in the Region in terms of their ecological values.

Horizons Regional Council has responsibilities under the Resource Management Act (1991) with respect to native biodiversity management, and has agreed the highest native biodiversity priority for the Region is wetlands and their effective management.

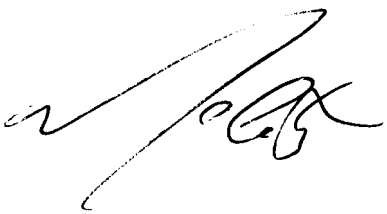
In 2001 a project was started to identify, visit, and assess as many wetlands as possible within the Region. The purpose of this investigation was to determine the location, number, general health and likely threats to our wetlands. Such information is critical for policy development, identifying research needs, and estimating future resource requirements around wetland management.

Over 320 wetlands were visited and recorded. Ninety wetlands were visited and recorded for the first time (many of these were in the Tararua District). Unfortunately, several historically recorded wetlands (recorded in the last 20 years) have either been drained or had their vegetation removed.

Time and resource constraints prevented all wetlands in the region being visited and assessed. There are areas in both central Manawatu and Rangitikei districts that have not been assessed at this stage. It is intended that these areas will be visited, the wetlands added to the inventory, and an updated report produced as resources allow. Staff are confidant that outside of these two areas, the bulk of the regions wetlands have been visited, and that all significant wetlands have been assessed.

The second phase of the project involved ranking wetlands in terms of their ecological value. This information is critical for setting work and resource allocation priorities into the future.

This was a groundbreaking project for the Region, being the first biodiversity asset inventory undertaken by this council. The outputs from this report will be instrumental in setting Horizons' future direction around wetland management.



Michael McCartney
CHIEF EXECUTIVE

CONTENTS

REGIONAL WETLAND INVENTORY

1. Introduction

1.1 Manawatu-Wanganui Region's Native Biodiversity

Until the mid nineteenth century the Manawatu-Wanganui Region was covered almost entirely by podocarp-broadleaf-beech forest. Wetlands and wet floodplain forests covered about 8% of the Region at this time.

Since then approximately 80% of the original native forest cover has been cleared or drained for agriculture and urban development. It has been estimated that 98% of the original wetland habitat cover has been lost, most notably from lowland wetland forests.

Wetland forests and adjacent podocarp-broadleaf forests contain the bulk of New Zealand's biodiversity assets (Brockie, 1992). Almost all of the native species (flowering plants, conifers, invertebrates, amphibians, reptiles and birds) are endemic to New Zealand (Godley *et. al.*, 1985); that is, they occur nowhere else in the world.

1.2 Regulatory Context

The Resource Management Act (1991) gives territorial authorities responsibility for maintaining native biodiversity values outside the Department of Conservation estate. Within the Manawatu-Wanganui Region, Horizons Regional Council has taken a lead role with respect to native biodiversity, even though this role is not stated explicitly in existing Regional Plans (an anomaly that will be addressed through the One Plan development process).

Horizons Regional Council's role around native biodiversity management is supported through the 2004-14 Long-term Community Consultation Plan (LTCCP), via:

- community outcomes – A healthy environment is our gift to future generations.
- organisational vision – The purpose of Horizons Regional Council is to work with communities to enhance our environmental heritage, while fostering economic opportunities and nurturing social and cultural aspirations, for current and future generations of the Manawatu-Wanganui Region.
- organisational goals – protection, enhancement and effective management of the Region's natural environment.
- native biodiversity goal – Enhance the Region's native biodiversity.

1.3 Native Biodiversity Priorities

The Region contains a wide variety of habitat types, ranging from coastal to terrestrial, and marine to wetlands. However, given the extent of historical

wetland loss and the threats still faced by remnants, Horizons Regional Council has identified wetland management and protection as the highest biodiversity priority for the Region. This is consistent with the importance placed on wetland protection at a national level.

1.4 Wetland Inventory and Prioritisation

Before Horizons Regional Council could effectively manage or even begin planning to improve the regional wetland resource, it needed reliable information on the state of the wetland resource. On this basis, a decision was made in 2001 to conduct a regional wetland inventory. The purpose of this inventory was to consolidate existing information on wetlands in the Region and combine this with the results from detailed field assessments.

The inventory would provide information on wetland location, number, general health, and threats. Such information would inform policy, identify research needs, and indicate to Council the future likely resourcing requirements for effective wetland management.

Next, a set of criteria were developed that enabled wetlands to be scored, from which lists were produced ranking wetlands according to their ecological value. These lists will be instrumental in allowing Horizons to set future directions around wetland management, by enabling the setting of work and resource allocation priorities.

The methods used to carry out the inventory and prioritisation processes, and the wetland priority lists, are presented in later sections.

2. Wetlands

2.1 What are Wetlands?

Wetlands are natural transition zones between water and land. They encompass many different types of landform (estuary, lagoon, braided river, swamp, fen, bog). Some are permanently wet; others dry out periodically between tides, rainfall or floods (Buxton, 1991; Johnson & Rogers, 2003). Their most distinctive feature is the plants and animals that are specially adapted to living in wet conditions.

Wetlands are dynamic zones of change, often consisting of a mosaic of habitat types. Many remaining wetlands are covered by few specially adapted plant species that cover large proportions of the sites; others used to be species-rich and/or productive.

Wetland classification systems differentiate wetlands based on their hydrological regimes, geographical location, nutrient levels and plant communities. A wetland's plant community composition depends on local hydrological regimes, nutrient and pH levels, and temperature (Clarkson and Sorrell, 2002).

Bogs predominantly form at higher altitudes or high rainfall zones. Specialised, often rare or distinct plants, adapted to poor nutrient status and acidity cover bogs. The slow decomposition of these plants leads to the build up of peat.

Fens have rainwater input but their association with groundwater seeps accounts for intermediate nutrient availability.

Swamp wetlands are nutrient-rich and associated with river floodplains, natural depressions, or lake margins. Estuaries are wetlands, subject to periodic inundation by salt, brackish and freshwater. Forest swamp and estuary wetland species diversity and natural productivity are high. Such productive wetlands sustain migratory birds and human populations. Historical land use change has placed what little remains of these wetland types amongst the rarest native ecosystem remnants within New Zealand (Stephenson *et. al.*, 1983).

2.2 Why are Wetlands Important?

Although the benefits of draining wetlands to gain productive farmland are well recognised, we remain largely ignorant of the economic, social, and environmental costs of wetland destruction. Many people know that wetlands support wildlife, particularly waterfowl, but few recognise their other values (Table 1).

Table 1: Summary of wetland values.

Biodiversity	Estuaries and lakes are preferred habitats for many migratory and native bird species. Endemic species diversity is highest in wetlands with associated native forests.
Maori	Wetlands provide an important link in the history and culture of many hapu. The plants that grow in wetlands provided clothing, mats, and a source of medicine and dyes. Raupo could be used to thatch the walls and roof of a whare, the underground roots could be eaten and the pollen was used for making bread and porridge. Wetland animals, especially tuna (eels) were a valuable food supply.
Fisheries	A number of commercially harvested fish spend some of their lifecycle in wetlands and estuaries. Wetlands are crucial for maintaining whitebait (inanga) runs in two ways: first, wetlands provide habitat for some adult whitebait species to live. Secondly, coastal wetlands are spawning grounds for inanga.
Recreation	Hunters, fishermen and tourists spend thousands of dollars and hours on active and passive recreation in wetlands annually.
Water Quality	Wetlands are vital to cleansing water, trapping sediment and capturing nutrients from waters that flow through them. In this way, wetlands improve water quality downstream.

Flood protection	By soaking up and storing water, wetlands help prevent flooding. They do this by slowing the flow of water during times of high rainfall so that it can be more easily absorbed into the soil and recharge groundwater reserves. This stored water is released slowly between rainfall events, helping to maintain water flows.
Shoreline Protection	Wetland plants hold soil in place with their roots, absorb the energy of waves, and break up the flow of river currents. It is estimated that an unprotected shoreline erodes four times faster than those that are protected by salt marshes.
Climate Control	Wetlands store carbon within their living material (plants) and preserved (peat) biomass. On a global scale, wetland destruction releases carbon dioxide and adds to the Greenhouse effect.

Of course not all wetlands have all of the values listed above, although many have multiple values. Patterson and Cole (1999) calculated the direct value of wetlands to the national economy as $5,673 million (1994 dollars).

2.3 What are the Threats to Wetlands?

2.3.1 Land use change

The development of land for agricultural and urban purposes has resulted in the widespread drainage and filling of wetlands over the last 150 years. Whilst wholesale wetland conversion has stopped, small wetlands are still being lost, and the size of existing large wetlands is shrinking. These changes continue in response to the demands on farmers to maximise the use of all available land to increase production.

2.3.2 Changes to wetland hydrology

Wetlands are vulnerable to changes in their hydrological regime. That is, changes to water levels and the natural cycle of flooding and drying. Most changes to wetland hydrology result in the wetland either drying up or being permanently flooded. This creates habitats that are similar over larger areas for long periods, reducing diversity.

Changes to a wetland's hydrological regime typically come from activities in the wetlands catchment (that is, where the water that feeds the wetlands comes from) rather than from changes to the wetland itself. Activities that damage wetlands by changing their hydrological regime include:

- drainage, including the deepening of nearby drains, which can lower the water table in wetlands;
- draining one boggy paddock can lower the water table in a nearby wetland if they are connected by groundwater;
- stormwater discharging into a wetland can scour out a channel through the wetland which lowers water levels;
- flood protection works such as stopbanks isolate rivers from their floodplains. Stopbanks stop the regular flooding of floodplain wetlands;

- the over-extraction of groundwater from bores leading to lowered water levels in connected wetlands, and
- the over-extraction of water from streams that feed wetlands.

2.3.3 Plant and animal pests

Non-native plants such as grey willow, alder, tall fescue and other exotic grasses can invade wetlands. Plant pests in wetlands can replace native plants and change water flow and quality. Wetlands degraded by grazing or drainage are more vulnerable to weed invasion, but even healthy wetlands can be invaded and altered by some weed species. The growth and spread of plant pest species can be extremely rapid, altering the natural flow of water, preventing light penetration, and causing oxygen depletion.

Mustelids and other animal pests can greatly reduce wetland bird numbers. Exotic fish have big impacts on lakes eg. koi carp feed on plants growing on the lakebed and stir up the water making it more turbid. On the margins of wetlands, and in wetlands that are dry over summer, possums, hares and rabbits can cause major damage to native vegetation.

2.3.4 Livestock

Livestock can degrade wetlands by eating wetland vegetation, trampling sensitive root systems, and pugging wetland soils. Their dung and urine lead to increased nutrient levels. Wetland margins and wetlands that dry out naturally over summer are particularly vulnerable.

2.3.5 Pollution

Although wetlands can remove water borne pollutants, their capacity to do so can be exceeded. Low nutrient wetland types, such as bogs, are particularly vulnerable to the impact of nutrients. Wetlands that are naturally higher in nutrients are less vulnerable to increased nutrient levels, but even in these areas, excessive nutrients promote aquatic weed invasions and may cause excessive growth of some native species such as raupo, which can replace areas of open water.

Wetlands trap and hold sediment that is washed into them. In areas of high erosion where the water carries a high sediment load, the rate at which the wetland is in-filling (going through a transition to dry land) is increased.

2.3.6 Loss of margins and connections

Animals living in wetlands often require vegetated wetland margins to fulfil key life functions such as nesting and spawning. Vegetated margins also shelter wetlands from wind.

On a larger scale, wetlands need connections to forests along forest corridors to increase available habitat for native flora and fauna, and to increase the ability of these organisms to move between habitats/remnants. Few remaining wetlands have intact vegetated margins and corridors of vegetation linking them with neighbouring wetland/forest remnants.

2.3.7 Road construction

Roads have been built through wetlands because they have been perceived as low value areas. Road effects can include:

- reduction in wetland area;
- sedimentation during construction;
- changing water flows by creating barriers or through drainage;
- contamination via polluted sediments and dirty water; and
- road noise, which may affect sensitive bird species.

3. Methods

3.1 Wetland Inventory

3.1.1 Historical wetland information

A number of agencies have collected information on wetlands over the years. For instance, the Department of Conservation's Protected Natural Areas programme (Myers *et. al.,* 1987; Ravine, 1992; Rogers, 1993) collected vegetation data for national scale reporting from the late 1980s. Further, wetland experts have collected detailed information at key sites for purposes such as identification of threatened species (Cameron *et. al.,* 1995; Ogle & Barkla, 1992).

All historical information that could be linked to sites was entered into Horizons' biodiversity database – ecoBase. Analysis of the historical information revealed there were large areas of the Region with no wetland information. Likewise, some of the historical information was very dated (more than 40 years old).

Accordingly, it was determined all current wetlands needed to be identified and visited, and then reassessed to provide an up-to-date overview of the regional wetland resources.

3.1.2 Wetland identification

A list of potential wetland sites was developed for the Region using a variety of techniques, including the analysis of:

- historical information,
- satellite imagery and datasets such as soil/vegetation maps, aerial photographs, topographic maps, and
- the personal recollections of Horizons and DoC field staff.

Once the potential wetland list was compiled, Horizons staff contacted the appropriate landowners seeking permission to enter the property, conduct an assessment of the wetland(s), and enquire about any other wetlands that may be on the property.

The response from landowners to the project was overwhelming, with almost all landowners allowing staff onto their property.

3.1.3 Rapid Ecological Assessment (REA)

The principle means of ensuring field data was collected consistently was through use of Rapid Ecological Assessment (REA) forms. REA forms can be used to collect data on any biodiversity sites of interest.

Wetland sites were mapped (refer Nicholls, 1976 and Atkinson, 1985 for habitat classification and mapping techniques), and then details about the site were recorded. The type of information recorded included:

- wetland habitats – size, shape and area;
- structural composition – types of ecological communities, and abundance and diversity of species; and
- threats – plant and animal pests, drainage, livestock etc., along with recommendations for future management.

The output from a typical wetland REA is as follows:

Rotokura (Christie's) Lake

Map Ref: S212:956-464 ***Environmental domain:*** B 1.3

Ranking: TOP 40 (Region), TOP 5 (Wanganui District)

Ownership: Private Land ***Protection:*** None

Description of the site
Medium-sized, natural, spring-fed lake located in hill country south of Makirikiri Stream valley. Palustrine areas around the lake and towards the outflow (eastern end of lake). From shore to lake, succession of sedge-rushland, Manuka over *sphagnum* moss and a pure stand of the regionally rare *Eleocharis sphacelata*.

Threats to site
- Lake is unfenced and Palustrine parts are moderately to heavily damaged by stock
- Mustelids and possums

Habitat Types and Size

Habitat type	Native / Exotic	Size (ha)
Lake	Native	4.1
Sedgeland	Native	0.5
Rushland	Native	2.6
Herbaceous Wetland	Native	1.4
Kanuka – Manuka Forest	Native	0.6
Deciduous woodland	Exotic	0.3
Total		**9.4**
Total Native Habitat		**9.1**

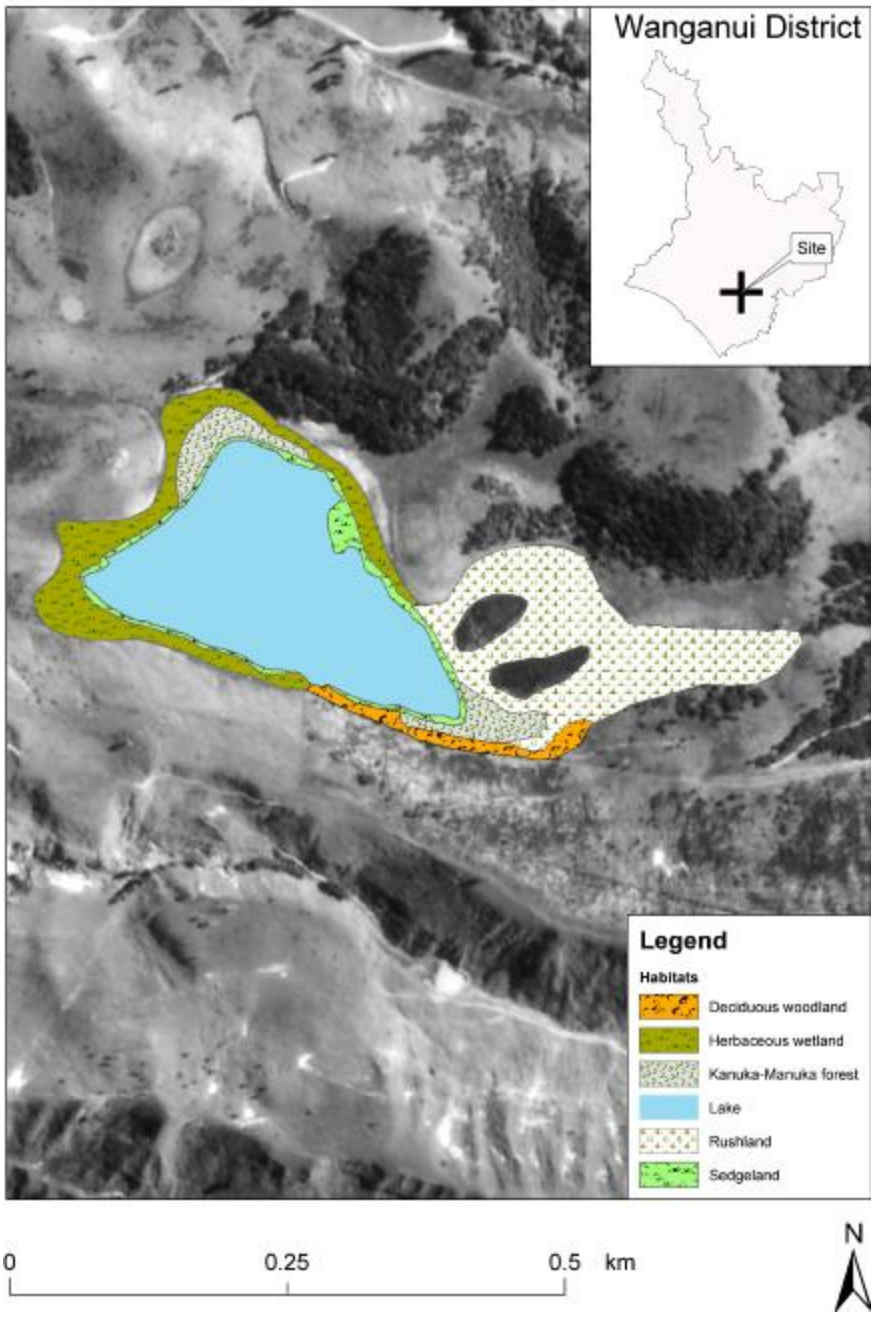


Figure 1: Rotokura (Christie's) Lake: Habitat Map.

Errors
Errors were introduced in two ways:

- gaps in coverage – time and resource constraints prevented visits of all wetlands in the region. Two main areas were not covered as part of the field assessment – central Manawatu and Rangitikei districts.
- field data collection – There was some variability in the quality of data collected, due to different identification skills of various field staff. This situation generally improved over time as staff skills improved; and
- data-entry – errors were introduced as data was transferred from field sheets to ecoBase. A quality assurance system was implemented to minimise such errors.

3.2 Wetland Prioritisation

3.2.1 Overview

A prioritisation method was developed in collaboration with Landcare Research, to rank the wetlands according to their ecological value. This report only describes the main points of the prioritisation method, specifics can be found in the paper: "Rapid mapping and prioritisation of wetland sites in the Manawatu Wanganui Region, New Zealand" (Ausseil *et. al.*, submitted).

The prioritisation method used the following steps:

1. Define a set of indicators relating to the wetland's ecological value. Five indicators were defined;
   - biodiversity
   - size
   - representativeness
   - contribution to remaining wetland area
   - presence of rare / threatened species
2. Assign a score to each wetland for the five indicators,
3. Weight the relative importance of the indicators; and
4. Calculate a final score to define the final rankings.

3.2.2 Indicators of wetland ecological value

Native Biodiversity
A native biodiversity score was allocated to each wetland, on a 1 to 5 scale. It was based on expert knowledge and information gathered using the REA method during the surveys. The biodiversity score accounts for the quality, diversity and potential sustainability of the native habitats, and the native plant and animal communities sustained within the site.

Size
Size is an important indicator of a wetland's ecological value, as it affects the long-term viability of its plant and animal communities. Bigger wetlands are more likely to sustain plant and animal populations, and have better buffer zones against human disturbance and pests (Whaley *et. al.,* 1995). Size is particularly critical for smaller wetlands, up to around 50 ha, beyond which the advantages of bigger size become negligible.

To assign a 1 to 5 score to each wetland, a mathematical function was defined (Table 2). Its curve increases rapidly for the smaller wetlands (where size is most critical), and more slowly for the bigger wetlands (where other factors are more critical). The value of the parameter b has been defined so a wetland of 50 ha, considered "big enough" gets a nearly maximum score (96%) of 4.8.

Where close hydrological and ecological connections between isolated fragments exist, sites were considered as one larger site

Table 2: Value functions, constant estimation and example of calculated scores for different wetland value indicators.

Indicator	Value function	Examples of scores	
		criteria	score
Areal extent (size)	$V = 5^* (1-e^{-bx})$ x being the size of the wetland in hectares b = 0.064377	x = 0.1 ha	0.03
		x = 1 ha	0.3
		x = 5 ha	1.4
		x = 10 ha	2.4
		x = 20 ha	3.6
		x = 50 ha	4.8
		x = 100 ha	5
Representativeness	$V = 5^* e^{-bx}$ x being the percentage of remaining wetlands compared to original extent b = 4	x = 0.2%	5.0
		x = 2%	4.6
		x = 5%	4.1
		x = 10%	3.4
		x = 24%	1.9
Size contribution	$V = 5^* (1-e^{-bx})$ x being the percentage of size contribution b = 7	x = 0.2%	0.1
		x = 10%	2.5
		x = 50%	4.8
		x = 80%	5.0
		x = 100%	5.0

Representativeness
Representativeness compares the remaining extent of an ecosystem or habitat type to its original size. Lands Environments of New Zealand (LENZ) (Leathwick *et al.,* 2003) is currently the most suitable framework to calculate the representativeness of wetlands.

The representativeness score of wetlands in each environmental domain is calculated on a 1 to 5 scale by using an exponential value function, as defined in Table 2.

Contribution to Remaining Wetland Area
This indicator uses the contribution of each wetland site to the total current wetland area within its environmental domain.

As for the size indicator, an increasing value function was used. The value of the constant b has been defined so a wetland contributing 50% of the remaining wetland area within its environmental domain gets a nearly maximum score (96%) of 4.8.

Presence of Rare/Threatened Species

Rare or threatened species information is known only for a few sites. For these sites, a 1 to 3 score has been assigned according to expert advice (*pers comm.* C Ogle and N Singers).

3.2.3 Determining the final ranking

Relative weighting of the indicators by Pairwise Comparison

Obviously, some indicators are more important than others when determining the ecological value of a natural site. For example, the native biodiversity score of a wetland is judged to be more important than its size.

Before the scores can be incorporated into a formula calculating the final ranking, their importance in relation to each other needs to be determined. At this point, judgment calls have to be made. However, comparing one parameter in relation to several others simultaneously was not an easy task. Landcare Research recommended the use of a pairwise comparison protocol (Anselin *et al.,* 1989; Beinat, 1997). This method allows the operator to use intuitive references to compare each parameter with each of the others, one at a time (Table 3). The matrix then calculates the final weights for each parameter. Table 4 presents the results of the process.

Table 3: Pairwise comparison scores and their equivalence in intuitive judgment terms (adapted from Saaty, 1977).

Pairwise Comparison	
1	equal importance
3	weak (somewhat more) important
5	Strong (more) important
7	demonstrated importance
9	absolute importance
2, 4, 6, 8	Intermediate
reciprocal I/j	1/i/j

Table 4: Pairwise comparison for proportional weighting of wetland prioritisation parameters

Level 1	Representativeness	Size	Biodiversity	Size contribution
Representativeness	1	2	0.2	3
Size	0.5	1	0.5	2
Biodiversity	5	2	1	5
Size contribution	0.33	0.5	0.2	1
Sum	6.83	5.5	1.7	11
Geometric Mean	0.88	1	2.66	0.427
Normalised weight	**0.15**	**0.18**	**0.58**	**0.09**

Calculation of the Final Score
The final scores were determined using a weighted sum model that incorporates the different scores and their weights.

The "presence of threatened species" score is known only for a few sites. Therefore it cannot be incorporated directly in the weighted sum. This score was used as a "bonus point" and incorporated into the following model:

$$Score1 = (w_1V_1 + w_2V_2 + w_3V_3 + w_4V_4) + 0.5V_5$$

Where V_1 is the biodiversity value score ($w_1 = 0.58$)
V_2 is the areal extent score ($w_2 = 0.18$)
V_3 is the representativeness score ($w_3 = 0.15$)
V_4 is the size contribution score ($w_4 = 0.09$)
V_5 is the rare species score

4. Results

4.1 Wetland Loss

By comparing maps of soil types that developed under wetlands, it can be estimated that 171,000 ha (7.8%) of the Region was once wetland, mostly on floodplains, hill country plateaus and dune-hollows (Figure 2).

The largest historical wetlands were on the floodplains of the major rivers in the Region – the Manawatu, Oroua, Ohau, Rangitikei, Whangaehu, Turakina, Whanganui, Owahanga, and Akitio rivers. These floodplains comprised shifting mosaics of riverbed, meanders, ox-bows, bogs, swamp forest and scrubland. These wetlands are now almost all gone, with only 2% of the original forest-scrubland wetland habitat remaining. Pests, drainage and loss of river connectivity threaten remaining wetland-forest habitat. Many remnants are in a slow transition to a drier podocarp hardwood forest community.

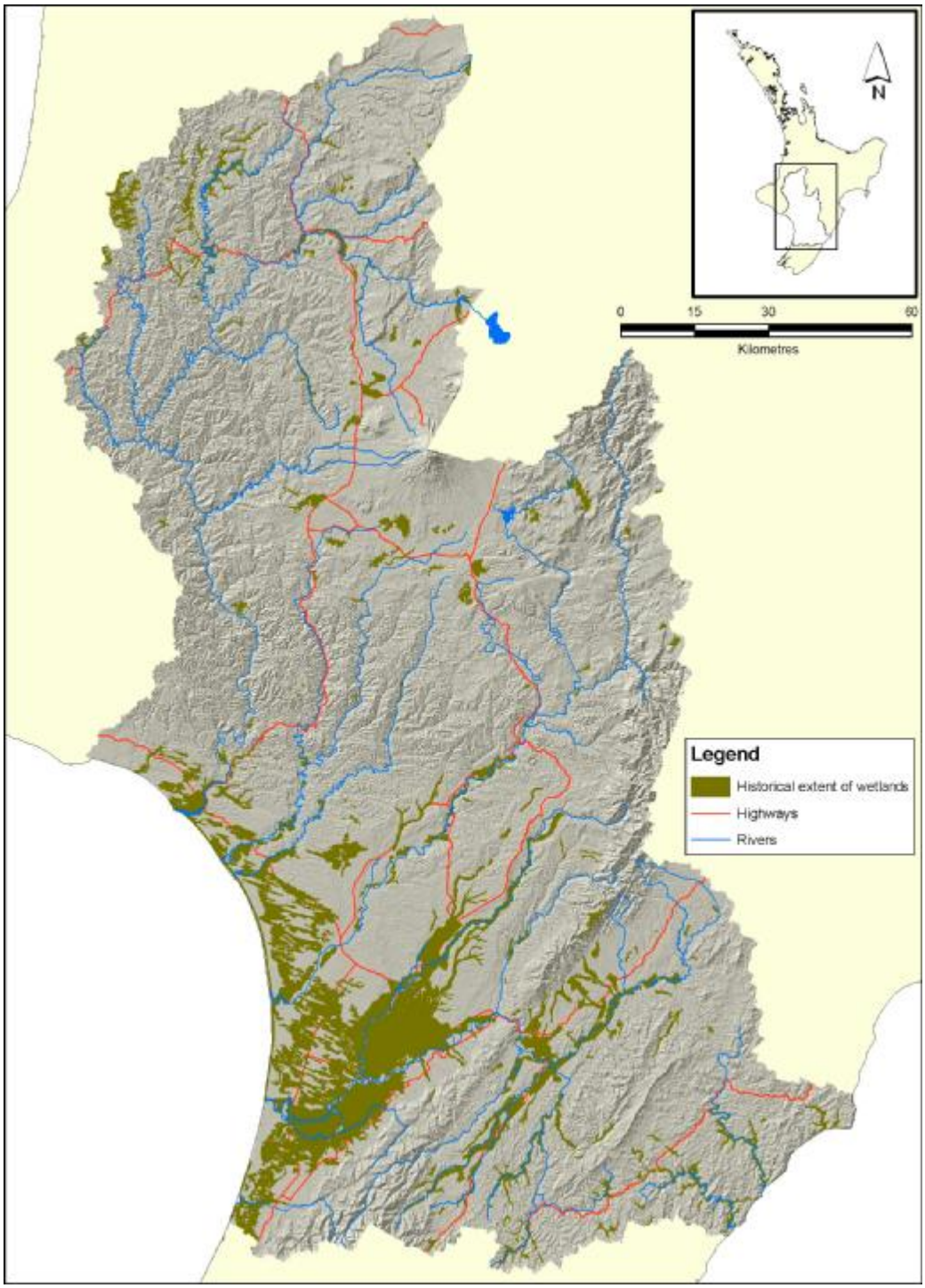


Figure 2: The historic extent of both permanent and ephemeral wetlands based on soils, wetland vegetation and remotely sensed data (Landcare Research).

Nutrient poor bogs have retained better representation in the Region, largely due to their inaccessibility or unsuitability for farming or forestry. Large areas still remain of this wetland type in the upper Rangitikei, Ruapehu and Stratford districts.

Many new wetlands have been created as humans seek to store stockwater in farm ponds, filter effluent, for recreational purposes (duck-ponds) or to construct sediment traps. While the biodiversity value of such artificial wetlands is generally low, they do improve connectivity between isolated natural wetlands.

4.2 Inventory Results

Over 320 sites were assessed as part of the project, with relevant information added to ecoBase. Of these, about 90 new wetland sites were identified and added to the inventory, many of these were located in the Tararua District. Several topographically recorded wetland sites had been drained or had their vegetation removed.
With the exception of central parts of the Manawatu and Rangitikei districts, and few isolated areas Horizons is satisfied all significant wetlands in the Region were surveyed as part of this project. Missed sites will be added over time as resources allow, but these new sites should not alter the rankings of the wetlands outlined in the following section.

Figure 3 shows the location of the wetlands that were visited and assessed as part of this project.

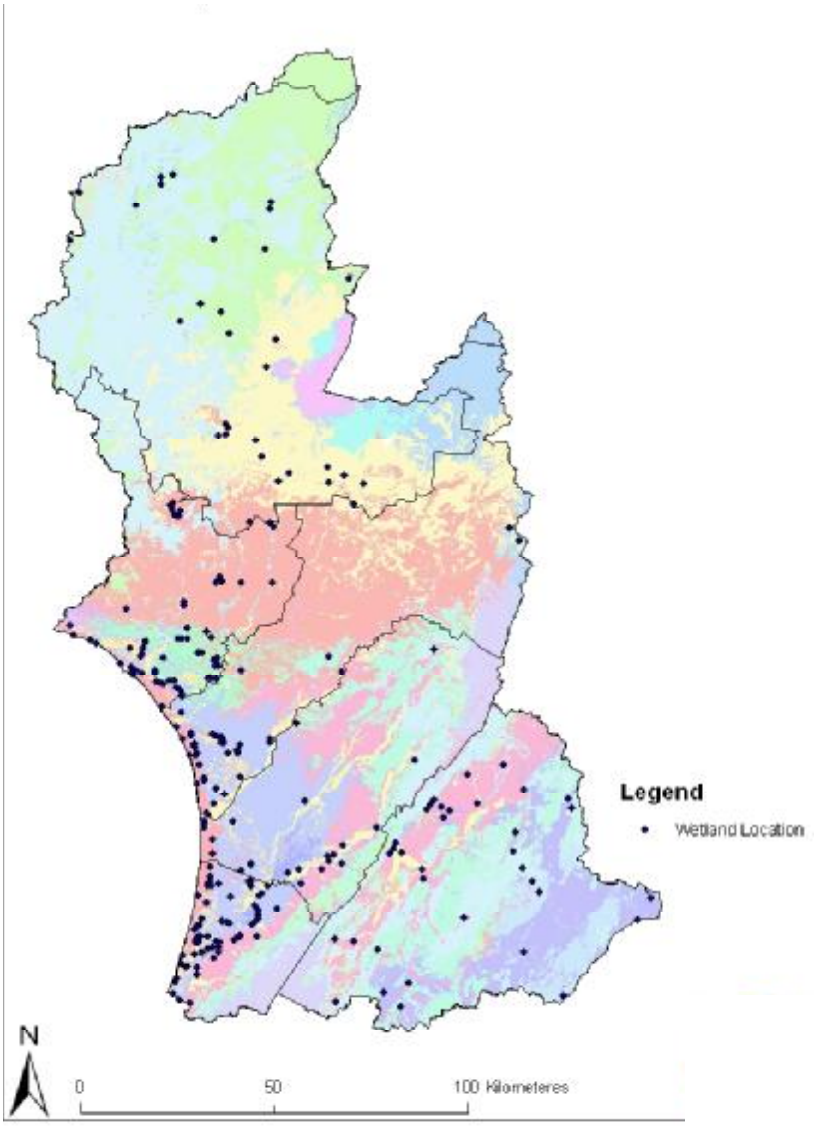


Figure 3: Mapped wetlands in relation to environmental domains and district boundaries.

4.3 Wetland Prioritisation

4.3.1 Manawatu-Wanganui Regions top 100 wetlands

Rank	TLA	Site (DoC reserves in italics)	Easting	Northing	ecoBase ID
	RANGITIKEI DISTRICT	Reporoa bog	2778869	6175423	
	RANGITIKEI DISTRICT	Makirikiri tarns	2781208	6171810	
	WANGANUI DISTRICT	Twin Lakes (Otoko)	2709754	6160717	552
	HOROWHENUA DISTRICT	*Lake Papaitonga*	2698342	6060318	1071
	TARARUA DISTRICT	*Haukopua Scenic Reserve 1*	2756100	6086000	1345
	MANAWATU DISTRICT	Totara Reserve (wetland habitats)	2754489	6114484	1290
	HOROWHENUA DISTRICT	Lake Horowhenua north swamp / Whitiki bush	2701105	6065450	976
	RUAPEHU DISTRICT	Mount Damper Swamp (Stratford district)	2665547	6250240	216
	RANGITIKEI DISTRICT	Simpsons Reserve	2732178	6141634	17755
10	WANGANUI DISTRICT	Whitiau Scientific Reserve	2689200	6128300	16005
	RUAPEHU DISTRICT	Waitaanga North Road Wetland	2667842	6263081	17852
	RUAPEHU DISTRICT	ERUA BOG	2716033	6217257	16141
	HOROWHENUA DISTRICT	*Round Bush Scenic Reserve / Omarupapukau*	2703800	6082500	3017
	TARARUA DISTRICT	Hukanui Source Swamp	2733684	6067959	17856
	RUAPEHU DISTRICT	Irirangi Swamp	2738500	6181500	1124
	PALMERSTON NORTH CITY	Ashhurst Domain	2744498	6096904	1943
	RUAPEHU DISTRICT	Lake Otamangakau	2737333	6240382	1097
	RANGITIKEI DISTRICT	Sarah Pond	2704445	6119037	799
	RANGITIKEI DISTRICT	McPherson	2709503	6137942	
20	TARARUA DISTRICT	Waihi Falls	2786400	6080200	17846
	MANAWATU DISTRICT	Kitchener Park	2726000	6103600	858
	PALMERSTON NORTH CITY	Keeble's and Manderson' s Bush	2730400	6086200	1309
	MANAWATU DISTRICT	*Pukepuke Lagoon/Wildlife Management Reserve*	2702300	6093800	904
	RANGITIKEI DISTRICT	Lake Alice	2708630	6116360	814
	WANGANUI DISTRICT	Higgies Wetland A (QE2)	2702600	6140800	641
	HOROWHENUA DISTRICT	Manawatu Estuary	2698473	6079345	966
	RUAPEHU DISTRICT	Te Paata Wetland	2722006	6189623	17811
	RUAPEHU DISTRICT	Ohakune Lakes Scenic Reserve	2714829	6193843	530
	HOROWHENUA DISTRICT	Lake Koputara / QE2 Willis	2701711	6086821	1937
30	RUAPEHU DISTRICT	Mangaroa Oxbow	2682448	6259460	17842
	TARARUA DISTRICT	Makuri High Country Swamp	2766953	6073551	17838
	HOROWHENUA DISTRICT	Lake Kopureherehere	2693572	6051958	1043
	RANGITIKEI DISTRICT	Lake Herbert	2706300	6116200	805
	WANGANUI DISTRICT	Rotokura Lake (Christie' s Lake)	2695737	6146390	775
	RUAPEHU DISTRICT	Motts wetlands	2736155	6188781	
	RUAPEHU DISTRICT	Nihoniho Swamp Forest	2689000	6267100	17844
	HOROWHENUA DISTRICT	Himatangi Bush Scientific Reserve	2711600	6083000	3018
	TARARUA DISTRICT	WED Site 50 (M Genet)	2761900	6099300	1350
	RUAPEHU DISTRICT	Mathieson Fernbird Wetland	2699115	6234069	3088
40	WANGANUI DISTRICT	Taonui Wetland Complex	2716400	6160500	578
	WANGANUI DISTRICT	Parikino Swamp Forest	2694900	6155045	773
	WANGANUI DISTRICT	Waipakura Lake & Forest	2694044	6146219	767
	RUAPEHU DISTRICT	Dobles Wetland Forest	2713439	6198106	17810
	MANAWATU DISTRICT	Lake Kaikokopu	2702219	6089946	902
	HOROWHENUA DISTRICT	*Koputaroa Scientific (Snail) Reserve*	2768671	6068052	1005
	WANGANUI DISTRICT	Puketarata Wetland Forest	2694000	6179500	622
	WANGANUI DISTRICT	Lake Kaitoke	2687000	6136000	409
	PALMERSTON NORTH CITY	Esplanade Bush	2732000	6089400	1311
	TARARUA DISTRICT	Ballance bridge wetland forest	2749313	6092901	17777
50	RANGITIKEI DISTRICT	Forest Road Wetlands	2702434	6102962	792

Manawatu-Wanganui Regions top 100 wetlands (continued)

	RUAPEHU DISTRICT	Ngamatea			
	MANAWATU DISTRICT	Rangitikei Estuary Saltmarsh A (North)	2700007	6098254	17760
	WANGANUI DISTRICT	Gordon Park Scenic Reserve	2689400	6141400	420
	TARARUA DISTRICT	Ormond Estate Wetland and Bush	2751000	6090400	1338
	HOROWHENUA DISTRICT	Koputara Lakes	2701101	6082207	16756
	WANGANUI DISTRICT	Wickham Open Space Covenant	2694951	6155808	3000
	RANGITIKEI DISTRICT	Cherry Grove Shrubland 1	2696791	6121082	17742
	RANGITIKEI DISTRICT	Lake Bernard	2704909	6118706	800
	RUAPEHU DISTRICT	Raurimu Station Wetlands	2718500	6224300	17824
60	RUAPEHU DISTRICT	Otamataraha Wetland	2732231	6187049	17825
	TARARUA DISTRICT	COWPER ROAD OXBOW	2782627	6106900	16335
	WANGANUI DISTRICT	Te Tui Station Swamp	2711735	6176688	591
	PALMERSTON NORTH CITY	Bledisloe Park	2732300	6088300	1314
	TARARUA DISTRICT	Huraua Wetland Forest	2753004	6056364	17830
	TARARUA DISTRICT	Tree Daisy Wetland	2782500	6064388	17845
	RANGITIKEI DISTRICT	Lakes Vipan & Karamu	2702320	6121275	17735
	WANGANUI DISTRICT	Corliss Island	2684100	6137200	397
	MANAWATU DISTRICT	Rangitikei Estuary Saltmarsh B (South)	2700159	6098539	17761
	HOROWHENUA DISTRICT	Makerua Swamp Wildlife Management Reserve	2719000	6076000	939
70	HOROWHENUA DISTRICT	Okuku Road Bush	2714000	6074000	927
	MANAWATU DISTRICT	Tangimoana Fernbird Area	2700109	6096737	888
	WANGANUI DISTRICT	Morikau Swamp	2691885	6181728	17798
	HOROWHENUA DISTRICT	Perawitis Wetland	2709317	6068794	16035
	WANGANUI DISTRICT	Kaiiwi - Waiinu Cliffs	2666290	6147297	356
	WANGANUI DISTRICT	Titoki Wetland	2681254	6138922	17785
	WANGANUI DISTRICT	Lake Pauri	2689471	6134099	421
	RANGITIKEI DISTRICT	Lake Heaton	2705126	6119404	801
	TARARUA DISTRICT	PED SITE 2	2777344	6113312	1450
	HOROWHENUA DISTRICT	Te Hakari Wetland	2693000	6057600	17781
80	RUAPEHU DISTRICT	Pah Hill 1	2705496	6199833	17807
	TARARUA DISTRICT	Oporae Wetland Complex	2782275	6086448	17855
	RANGITIKEI DISTRICT	Mt Amon / Mt Taylor Wetlands	2703100	6107100	796
	HOROWHENUA DISTRICT	Kai Kai and Oporau Lagoons	2698700	6071200	17667
	WANGANUI DISTRICT	Lake Wiritoa	2688563	6134596	418
	WANGANUI DISTRICT	Matatara Swamp - QE2 (Aim)	2695600	6148900	1901
	HOROWHENUA DISTRICT	Ohau River Dune Lakes	2692600	6056800	17404
	HOROWHENUA DISTRICT	Heatherlea Park Swamp	2703969	6066955	995
	HOROWHENUA DISTRICT	Orouakaitawa Lagoon	2701698	6083085	899
	HOROWHENUA DISTRICT	Nga Kawau Lagoon (Rotomahana)	2698272	6068209	16329
90	HOROWHENUA DISTRICT	Te Whanga Swamp Forest	2703000	6067200	17695
	WANGANUI DISTRICT	Lake Marahau	2665597	6149675	353
	WANGANUI DISTRICT	Whanganui River Mouth Flats	2681916	6136697	387
	RUAPEHU DISTRICT	QE2 Seifert	2705496	6199835	1830
	HOROWHENUA DISTRICT	Tokomaru River Bush	2714000	6073100	926
	TARARUA DISTRICT	Graham Road Swamp	2763200	6101100	17836
	RANGITIKEI DISTRICT	Knottingly Swamp	2698800	6113100	17733
	WANGANUI DISTRICT	Te Tui Swamp and Bush	2717921	6175662	17793
	MANAWATU DISTRICT	Karere Lagoon	2724514	6086095	952
	HOROWHENUA DISTRICT	Lake Horowhenua West Bush	2699400	6064300	1080
100	HOROWHENUA DISTRICT	Himatangi Bush Remnant (Middleton)	2712140	6082840	17821

4.3.2 Ruapehu District wetlands

	RUAPEHU DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Waitaanga North Road Wetland	11	2667842	6263081	216
	Erua Bog	12	2716033	6217257	17852
	Irirangi Swamp	15	2738500	6181500	16141
	Lake Otamangakau	17	2737333	6240382	1124
	Pah Hill 3	20	2719383	6187435	1097
	Te Paata Wetland	28	2722006	6189623	17811
	Ohakune Lakes Scenic Reserve	29	2714829	6193843	530
	Mangaroa Oxbow	31	2682448	6259460	17842
	Motts Wetlands	36	2736155	6188781	
10	Nihoniho Swamp Forest	37	2689000	6267100	17844
	Mathieson Fernbird Wetland	40	2699115	6234069	
	Dobles Wetland Forest	44	2713439	6198106	17810
	Te Paata Wetland 5	45	2722615	6188822	
	Te Paata Wetland 4	47	2723198	6188856	17824
	Te Paata Dam	51	2722736	6190584	17825
	Tohunga Farms	54	2714092	6199783	17807
	Pah Hill 4	55	2718172	6188704	1830
	Ngamatea	57	2740910	6187113	3071
	Raurimu Station Wetlands	65	2718500	6224300	3081
20	Otamataraha Wetland	66	2732231	6187049	17812
	Te Paata Wetland 3	77	2721983	6197814	3067
	Pah Hill 1	88	2705496	6199833	17814
	Olds	101	2716509	6197814	17806
	QE2 Seifert	102	2705496	6199835	17808
	Karakia Swamp	123	2702400	6250600	3066
	Liley Wetland	126	2698900	6233900	3086
	Kairori Flaxland	128	2731779	6190905	3079
	Picket Ridge Wetland	140	2717056	6258811	17813
	Browns Wetland 2	143	2706119	6201527	3060
30	Manson Estate Swamp	150	2703700	6199365	17843
	Pah Hill 2	152	2719083	6187253	3075
	Taringamotu Swamp	155	2717291	6260522	3066
	Sturgeon Wetland	159	2704275	6231661	3086
	Oio Road Wetland	169	2693820	6229344	3079
	Browns Wetland 1	209	2705660	6202581	17813
	Waipapa Stream Wetland	211	2691950	6267779	3060
	Groshinski Swamp	246	2688859	6265241	17843
	Percy Wetland	248	2715942	6248227	3075

4.3.3 Wanganui District wetlands

	WANGANUI DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Twin Lakes (Otoko)	3	2709754	6160717	552
	Whitiau Scientific Reserve	10	2689200	6128300	16005
	Higgies Wetland A (QE2)	26	2702600	6140800	641
	Rotokura Lake (Christie' s Lake)	35	2695737	6146390	775
	Taonui Wetland Complex	41	2716400	6160500	578
	Parikino Swamp Forest	42	2694900	6155045	773
	Waipakura Lake & Forest	43	2694044	6146219	767
	Puketarata Wetland Forest	49	2694000	6179500	622
	Lake Kaitoke	50	2687000	6136000	409
10	Gordon Park Scenic Reserve	59	2689400	6141400	420
	Wickham Open Space Covenant	62	2694951	6155808	3000
	Te Tui Station Swamp	68	2711735	6176688	591
	Corliss Island	74	2684100	6137200	397
	Morikau Swamp	80	2691885	6181728	17798
	Kaiiwi - Waiinu Cliffs	82	2666290	6147297	356
	Titoki Wetland	83	2681254	6138922	17785
	Lake Pauri	84	2689471	6134099	421
	Lake Wiritoa	92	2688563	6134596	418
	Matatara Swamp - QE2 (Aim)	93	2695600	6148900	1901
20	Lake Marahau	99	2665597	6149675	353
	Whanganui River Mouth Flats	100	2681916	6136697	387
	Te Tui Swamp and Bush	106	2717921	6175662	17793
	Riverton Swamp	115	2702883	6139173	643
	McDowall's Swamp	118	2694300	6131200	17728
	Castlecliff Beach Reserve	130	2678463	6139816	378
	Marangai Bush 2	133	2692300	6135300	760
	Higgies Wetland B	135	2703444	6141319	647
	Morikau Twin Ponds	137	2691432	6181113	616
	Craigielea Bush	138	2703200	6135800	645
30	Lake Kohata	139	2687604	6134981	417
	Parihauhau Lakes	141	2704237	6161231	541
	Lake Westmere	145	2681000	6143800	385
	Marangai Bush 1	147	2691200	6135300	758
	Lake Virginia	148	2683800	6141600	396
	Lake Rotokauwau	168	2694008	6132627	769
	Sentry Hill Wetland	170	2701855	6146515	636
	Mokonui Road Wetlands	178	2693023	6178404	17797
	Morikau Ponds	181	2693532	6178478	614
	Hogg Park	184	2685000	6145400	401
40	Balgownie Greenbelt	185	2682425	6137921	17775
	Meehan Dam #2 (Volcano Lake)	187	2701492	6136017	17778
	Trotters Bush	191	2687300	6137200	414
	Okehu Stream	194	2670700	6146000	358
	Kaukatea Road Pond N. 2	199	2699300	6142700	786
	Waipakura Swamp	201	2693144	6146254	17784
	Kaukatea Road Pond N. 1	204	2698393	6142496	783
	Reids Wetland	217	2684388	6143716	17792
	Mowhanau / Kaiwi Stream Saltmarsh	221	2672235	6145080	363

4.3.4 Rangitikei District wetlands

	RANGITIKEI DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Reporoa Bog	1	2778869	6175423	
	Makirikiri Tarns	2	2781208	6171810	
	Simpsons Reserve	9	2732178	6141634	17755
	Sarah Pond	18	2704445	6119037	799
	McPherson	19	2709503	6137942	
	Lake Alice	25	2708630	6116360	814
	Lake Herbert	34	2706300	6116200	805
	Forest Road Wetlands	56	2702434	6102962	792
	Cherry Grove Shrubland 1	63	2696791	6121082	17742
10	Lake Bernard	64	2704909	6118706	800
	Lakes Vipan & Karamu	72	2702320	6121275	17735
	Lake Heaton	85	2705126	6119404	801
	Mt Amon / Mt Taylor Wetlands	90	2703100	6107100	796
	Knottingly Swamp	105	2698800	6113100	17733
	Lake Koitiata	125	2697259	6118473	879
	Westoe C	144	2717022	6119905	17762
	Artillerie Swamp (Waimaroha swamp)	146	2697800	6115700	882
	Scotts Ferry Dune Wetlands	151	2700598	6100664	17841
	Lake Waipu	154	2694055	6126853	873
20	Koitiata Domain Recreation Reserve	158	2692800	6123000	871
	Tunnel Hill Pond	162	2696511	6121712	17732
	Haylock Lake	166	2709171	6110001	17826
	Koitiata Swamp	172	2697733	6117956	17734
	Lake Hickson	177	2708669	6117050	813
	Ngaeho Ponds	183	2708446	6116856	17723
	Inanga Spawning Site 12	189	2700910	610305	
	Neumans Line Pond	193	2709202	6118454	17727
	Blind Lakes	195	2698169	6116396	883
	Fernbird Swamp	206	2696314	6115598	
30	Lake Duddings	213	2704566	6120326	798
	Lake Rhodes	230	2704007	6120452	797
	Inanga Spawning Site 14	231	2698100	6108200	884
	Raumai Road Swamp	234	2700000	6109200	17736
	Raumai Road Gravel Pit 2	237	2700091	6109651	17731
	Flockhouse Pond	242	2705226	6105381	17726
	Westoe 1	243	2716985	6119108	832
	Koitiata Pond	253	2697487	6118937	17724
	Raumai Road Gravel Pit 1	254	2700012	6109861	17729
	Koitiata Stream	259	2694409	6119991	875

4.3.5 Manawatu District and Palmerston North City wetlands

	MANAWATU DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Totara Reserve (wetland habitats)	6	2754489	6114484	1290
	Kitchener Park	22	2726000	6103600	858
	Pukepuke Lagoon/Wildlife Management Reserve	24	2702300	6093800	904
	Lake Kaikokopu	46	2702219	6089946	902
	Rangitikei Estuary Saltmarsh A (North)	58	2700007	6098254	17760
	Rangitikei Estuary Saltmarsh B (South)	75	2700159	6098539	17761
	Tangimoana Fernbird Area	79	2700109	6096737	888
	Karere Lagoon	107	2724514	6086095	952
	Kennerleys Wetland	114	2709571	6085768	17749
10	Sharlee's Bush	117	2712107	6087474	17748
	Legg Estate Bush	132	2711949	6087413	917
	C. L. Pemberton Reserve	149	2759420	6143387	17757
	Voss Lagoon	164	2721816	6084988	946
	Reu Reu Road Swamp Remnants	232	2723800	6124000	852
	Pukemarama Lagoon	235	2707500	6098500	914

	PALMERSTON NORTH CITY	Region Rank	Easting	Northing	ecoBase ID
	Ashhurst Domain	16	2744498	6096904	1943
	Keeble's and Manderson' s Bush	23	2730400	6086200	1309
	Esplanade Bush	52	2732000	6089400	1311
	Bledisloe Park	69	2732300	6088300	1314
	Centennial Lagoon	208	2733300	6089900	1315
	Te Matai Road Oxbow	216	2735732	6092235	17786
	Moonshine Valley	220	2735626	6087681	1939
	Craws Pond	239	2725013	6082490	953

4.3.6 Horowhenua District wetlands

	HOROWHENUA DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Lake Papaitonga	4	2698342	6060318	1071
	Lake Horowhenua north swamp / Whitiki bush	7	2701105	6065450	976
	Round Bush Scenic Reserve / Omarupapukau	13	2703800	6082500	3017
	Manawatu Estuary	27	2698473	6079345	966
	Lake Koputara / QE2 Willis	30	2701711	6086821	1937
	Lake Kopureherehere	33	2693572	6051958	1043
	Himatangi Bush Scientific Reserve	38	2711600	6083000	3018
	Koputaroa Scientific (Snail) Reserve	48	2768671	6068052	1005
	Koputara Lakes	61	2701101	6082207	16756
10	Makerua Swamp Wildlife Management Reserve	76	2719000	6076000	939
	Okuku Road Bush	78	2714000	6074000	927
	Perawitis Wetland	81	2709317	6068794	16035
	Te Hakari Wetland	87	2693000	6057600	17781
	Kai Kai and Oporau Lagoons	91	2698700	6071200	17667
	Ohau River Dune Lakes	94	2692600	6056800	17404
	Heatherlea Park Swamp	95	2703969	6066955	995
	Orouakaitawa Lagoon	96	2701698	6083085	899
	Nga Kawau Lagoon (Rotomahana)	97	2698272	6068209	16329
	Te Whanga Swamp Forest	98	2703000	6067200	17695
20	Tokomaru River Bush	103	2714000	6073100	926
	Lake Horowhenua West Bush	108	2699400	6064300	1080
	Himatangi Bush Remnant (Middleton)	109	2712140	6082840	17821
	Poplar Road Bush	112	2714900	6079900	930
	Barber's Bush Scenic Reserve	113	2712200	6083200	17744
	Moutoa Flax Reserve	116	2705795	6072302	17648
	Muhunoa Coastal Swamp	119	2694052	6061450	17817
	Lake Huritini	120	2692171	6053593	1034
	Wai Ewe Lagoon (Moutere 2)	121	2698000	6067600	1066
	Kemps Lagoon (PNA Survey Area 141B)	124	2716300	6081800	16114
30	White's Bush	129	2706965	6079026	
	Factory Lake	131	2713000	6072300	923
	Muhunoa West Rd Swamp (Franks)	134	2698200	6058500	16103
	Ohita Lagoon (Moutere 3)	142	2698369	6067624	1070
	Ratahi Lagoon (Moutere 1)	156	2698500	6066900	1072
	QE2 (MacIntosh)	160	2696300	6051100	16353
	Ohourangi Lagoon (Moutere 5)	163	2697800	6066900	1065
	Lake Omanu	165	2701047	6081681	892
	Otaneko Lagoon (Oturoa 4)	167	2698200	6071200	17415
	Koputaroa Rail Wetland	173	2709378	6068416	17363
40	Koputaroa Swamp	175	2707800	6067400	1001
	Seymours Oxbow	179	2713000	6076900	922
	Manawatu Estuary Saltmarsh (Hoputara Sandfla	180	2700600	6077400	17789
	Lindsay Road Swamp	186	2702300	6065800	16109
	Koputaroa Swamp 2	188	2708200	6067700	17818
	Kuku Lagoon	190	2698990	6068439	17466
	Blind Island Reserve (Moutoa)	192	2706400	6072000	911
	Okuku Road Lake 2 (Douglas)	196	2713900	6075500	925
	Moutoa Recreation Reserve	197	2764644	6072463	17750

4.3.7 Tararua District wetlands

	TARARUA DISTRICT	Region Rank	Easting	Northing	ecoBase ID
	Haukopua Scenic Reserve 1	5	2756100	6086000	1345
	Hukanui Source Swamp	14	2733684	6067959	17856
	Waihi Falls	21	2786400	6080200	17846
	Makuri High Country Swamp	32	2766953	6073551	17838
	WED Site 50 (M Genet)	39	2761900	6099300	1350
	Ballance bridge wetland forest	53	2749313	6092901	17777
	Ormond Estate Wetland and Bush	60	2751000	6090400	1338
	Cowper Road Oxbow	67	2782627	6106900	16335
	Huraua Wetland Forest	70	2753004	6056364	17830
10	Tree Daisy Wetland	71	2782500	6064388	17845
	Lund oxbow	73	2775156	6103119	215961
	PED Site 2	86	2777344	6113312	1450
	Oporae Wetland Complex	89	2782275	6086448	17855
	Graham Road Swamp	104	2763200	6101100	17836
	Kohinui Road Oxbow	110	2756500	6083700	17840
	Lake Rotoataha	111	2779713	6090700	1502
	Lake Mahangaiti	112	2775649	6101803	1433
	Ballance Cafe Wetland	122	2748800	6091300	17848
	Fault Fen	127	2747900	6090200	17837
20	Loveday Road Wetland	136	2759400	6104100	17833
	PED Site 39	153	2794870	6101753	1473
	PED Site 43	157	2780268	6095600	1504
	Duncan Road Swamp	161	2770400	6103000	17850
	Hukanui Swamp (WED Site 24)	171	2738800	6067200	1372
	Tautane Stream Swamp	174	2815379	6078647	17853
	Pahau Swamp	176	2750700	6050300	17854
	Kearney Road Springfield Wetland	182	2761115	6102263	17831
	Oporae Catchment 1	198	2784569	6083014	17847
	Top Grass Road Dam	200	2758300	6102800	17834
30	Owhango Estuary	205	2792700	6053000	613
	Mt Baker Road Dam	210	2746500	6053800	17396
	Coppermine Swamp	228	2757400	6101500	17839
	Herbertville Beach	236	2811865	6072808	1574
	Te Uri Road Lake	241	2793951	6104362	17849
	Kahurauihea Wetland	244	2744845	6065018	17829
	Laws Road Swamp	249	2767840	6110865	17851

5. Summary

This project consolidated historical information on wetlands, and then built on the existing regional wetland picture through field inspections and assessments. Over 320 wetlands were visited, more than 90 of which were inspected or investigated for the first time. Not all sites in the region were visited and assessed. Gaps remain in the central Manawatu and Rangitikei districts. Wetlands in these areas will be visited and assessed, the information added to the inventory, and priority lists regenerated as resources allow.

Wetland habitat once covered almost 8% of the Region. Today, the regional wetland resource has been reduced by 98%, with lowland wetland-forest habitat being most severely affected. Lowland remnants are still at risk from a host of threats including stock, pests and drainage.

In contrast, upland wetlands and bogs remain largely untouched. The largest areas of wetland left in the Region are of this type - Irirangi, Erua and Reporoa bogs, the Makiri tarns, and the Mount Damper and Waitaanga wetland forests.

Criteria for scoring each wetland were developed which allowed wetlands to be ranked in terms of their ecological value. A regional list, and a separate list for each district were produced. The regional list is significant in that only five of the top 50 wetlands in the Region are within the DoC estate, the remainder being in either district council or private ownership.

These lists will inform and guide future efforts to improve the regional wetland resource and prioritise the allocation of resources.

6. References

Anselin A, Meire PM, Anselin L, 1989. Multicriteria techniques in ecological evaluation: an example using the Analytical Hierarchy Process. Biological Conservation. 49: 215-29.

Atkinson IAE, 1985. Derivation of vegetation mapping units for an ecological survey of Tongariro National Park North Island, New Zealand. NZ. J. Bot. 23: 361-378.

Ausseil AE, Dymond JR and Shepherd J, Submitted to Landscape Ecology. Rapid mapping and prioritisation of wetland sites in the Manawatu/Wanganui Region, New Zealand

Beinat E., 1997. Value functions for Environmental Management. Kluwer Academic Publishers.

Brockie R, 1992. A Living New Zealand Forest, pp. 172. D. Bateman.

Buxton R, 1991. New Zealand Wetlands. A Management Guide. DoC Wellington pp. 102.

Cameron, EK, de Lange PJ, Given DR, Johnson PN, Ogle CC, 1995. Threatened and local plant lists (1995 revision), NZ Bot. Soc. Newsletter 39: 15-28.

Clarkson BR, Sorrell B, 2002. Handbook for monitoring wetland condition. MFE SMF project, pp.74.

Godley *et. al.*, 1985. Research on the Vegetation of New Zealand. Symposium papers. New Zealand Journal of Botany, Vol. 23, (4) DSIR Wellington.

Johnson P, Rogers G. 2003. Ephemeral wetlands and their turfs in New Zealand. Science for Conservation, 230, pp.109.

Leathwick JR, Overton JM, McLeod M, 2003. An Environmental Domain Classification of New Zealand and Its Use as a Tool for Biodiversity Management. Conservation Biology. 17 (6): 1612-23.

LTCCP, 2004. Long-Term Council Community plan, 2004-14. Horizons Regional Council. Vols 1-3.

Myers SC, Park GN, Overmars FB, 1987. A guidebook for the rapid ecological survey of natural areas. Protected Natural areas Programme. NZ Biological Resource Centre publication No. 6. pp. 113.

Nicholls JL, 1976. A revised classification of the North Island Indigenous Forests. NZ Journal of Forestry Vol. 21: 105-121.

Ogle CC, Barkla, JW, 1992. Vascular plants of Ngamatea and Irirangi swamps, Waiouru. Wanganui Plant List No. 41. Department of Conservation Wanganui, pp. 9.

Patterson M, Cole A, 1999. Assessing the Value of New Zealand Biodiversity. Occasional Paper Number 1. Massey University.

Ravine DA, 1992. Foxton Ecological District - survey report for the Protected Natural Areas Programme. No. 19 Department of Conservation Wanganui, pp. 264.

Rogers GM, 1993. Moawhango Ecological Region - survey report for the Protected Natural Areas Programme. No. 27 Department of Conservation Wanganui, pp. 103.

Saaty T, 1977. A scaling method for priorities in hierarchical structures. Journal of Mathematical Psychology. 15: 234-81.

Stephenson GK, *et. al.*, 1983. Wetlands. A diminishing resource, Report to the Minister for the Environment by the Environmental Council of New Zealand.

Whaley KJ, Clarkson BD, Leathwick JR, 1995. Assessment of the criteria used to determine 'significance' of natural areas in relation to section 6(c) of the Resource Management Act (1991). Report No. LC9596/021. Landcare Research