BIRD MONITORING IN THE VICINITY OF THE OHAU CHANNEL DIVERSION STRUCTURE AT LAKE ROTOITI - 2009 PROGRESS REPORT

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Prepared for:

ENVIRONMENT BAY OF PLENTY
P.O. BOX 364
WHAKATANE

Wildland CONSULTANTS

WILDLAND CONSULTANTS LTD, 99 SALA STREET, P.O. BOX 7137, TE NGAE, ROTORUA 3042
Ph 07-343-9017, Fax 07-343-9018, email ecology@wildlands.co.nz, www.wildlands.co.nz

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PROJECT TEAM

Chris Bycroft - Field survey, report compilation.
Richard Gillies - Field survey, report compilation.
William Shaw - Technical overview and peer review.
Roger Bawden - GIS mapping.

Reviewed and approved for release by:

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W.B. Shaw
Director/Principal Ecologist
Wildland Consultants Ltd

1. INTRODUCTION

Environment Bay of Plenty has been granted resource consent to build a wall structure in Lake Rotoiti, to stop water from flowing from Lake Rotorua into the main body of Lake Rotoiti, by directing the bulk of the outflow from the connecting Ohau Channel towards the Kaituna River, the main outlet from Lake Rotoiti. One of the consent conditions is to undertake avifauna monitoring and reporting on these results for Lake Rotoiti.

> "The consent holder shall undertake baseline monitoring of waterbird populations on Lake Rotoiti. The monitoring shall comprise monthly counts over the period from May 2005 to a date five years following the construction of the flow diversion wall."
>
> "The consent holder shall, by 30 June each year, report to the Regional Council' on the results of the avifauna monitoring carried out, for the previous annual period, pursuant of Condition 10.7".

Environment Bay of Plenty commissioned Wildland Consultants to undertake monthly bird surveys at Lake Rotoiti and to report on these results to meet the requirements of these resource consent conditions. This report presents a summary of findings from monthly bird counts at the Lake Rotoiti site from June 2008 to May 2009.

2. BACKGROUND

The wall structure is anchored into the floor of Lake Rotoiti and rises to just above water level. The wall is *c.*1,200 metres long, extending from the Ohau Channel outlet to Te Akau Point, *c.*75 m offshore from State Highway 33 (refer to Figure 1). The structure diverts water flowing through the Ohau Channel from Lake Rotorua, and directs it down the Kaituna River.

It is predicted that the diversion will prevent 180 tonnes of nitrogen and 15 tonnes of phosphorus from entering the main body of Lake Rotoiti from Lake Rotorua each year via the Ohau Channel. The diversion is expected to improve water quality in Lake Rotoiti within five years, as research has shown that 70 percent of the nutrients entering Lake Rotoiti come through the Ohau Channel.

Construction of the wall commenced in June 2007, with the first wall sections being put in place along a central section of the wall opposite the end of Te Akau Road. Installation of wall sections then proceeded north and south from this central section. The boat ramp near the Ohau Channel mouth (at the south-western corner of survey area T1 - see Section 4 and Figure 2) functioned as a construction site, and activity occurring there included use of cranes, generators, power tools and welding equipment, and related vehicle and boat movements.

By September 2007, wall sections were in place along most of count area T1, but had not reached T6 (Figure 2). By November 2007 wall sections were starting to be put in

place in area T6, and by December 2007, the crane barge placing the wall sections was adjacent to the Ohau Channel delta, remaining there until May 2008. Major construction activity ceased in July 2008, and completion of the capping rail occurred in September 2008. For the purposes of this study, therefore, the construction phase is defined as being between June 2007 and September 2008.

With this type of development, it is difficult to assess ecological affects with precise accuracy prior to its construction. Monitoring of ecological effects which started in May 2005, including birds, was undertaken for two years before wall construction, which commenced in June 2007. Preliminary results from this period were presented in Wildland Consultants (2007), and for the period 2007-2008 in Wildland Consultants (2008). This report provides results for the period between June 2008 and May 2009.

3. EXISTING INFORMATION

A previous ecological assessment of the diversion wall project area was undertaken by Wildland Consultants (2005). That report provides descriptions of the vegetation and habitats present, lists of species, an assessment of potential ecological effects, and requirements for future monitoring. Follow-up monitoring (bird counts) are reported on in Wildland Consultants (2007) and Wildland Consultants (2008).

Lake Rotoiti was included in a major fauna survey in the early 1980s (Rasch 1989) and was classed as "outstanding wildlife habitat, holding the largest population of New Zealand dabchick in the region". The western end of the lake and the Okere Arm were specifically highlighted as significant habitats for a diverse range of waterbird species.

Waterbirds were surveyed at Lake Rotoiti (and 16 other Rotorua lakes) in 1985, 1991, 1996, and 2001. Results for the first three of these surveys are reported in Innes *et al*. (1999). The waterbird population has been relatively stable in terms of total numbers of all species combined and species composition, although ten of the 19 species counted showed population fluctuations (Innes *et al*. 1999).

There has been other monitoring of dabchick at Lake Rotoiti (Innes *et al*. 2000; Harris 2001) and also research into their ecology (Reynolds 1997, Bright *et al*. 2004). Harris (2001) recorded six dabchick at the Ohau Channel Delta. The effects of structures and boat-pass disturbances on dabchick have also been investigated at Lake Rotoiti, by Montgomery (1991) and Bright *et al*. (2004).

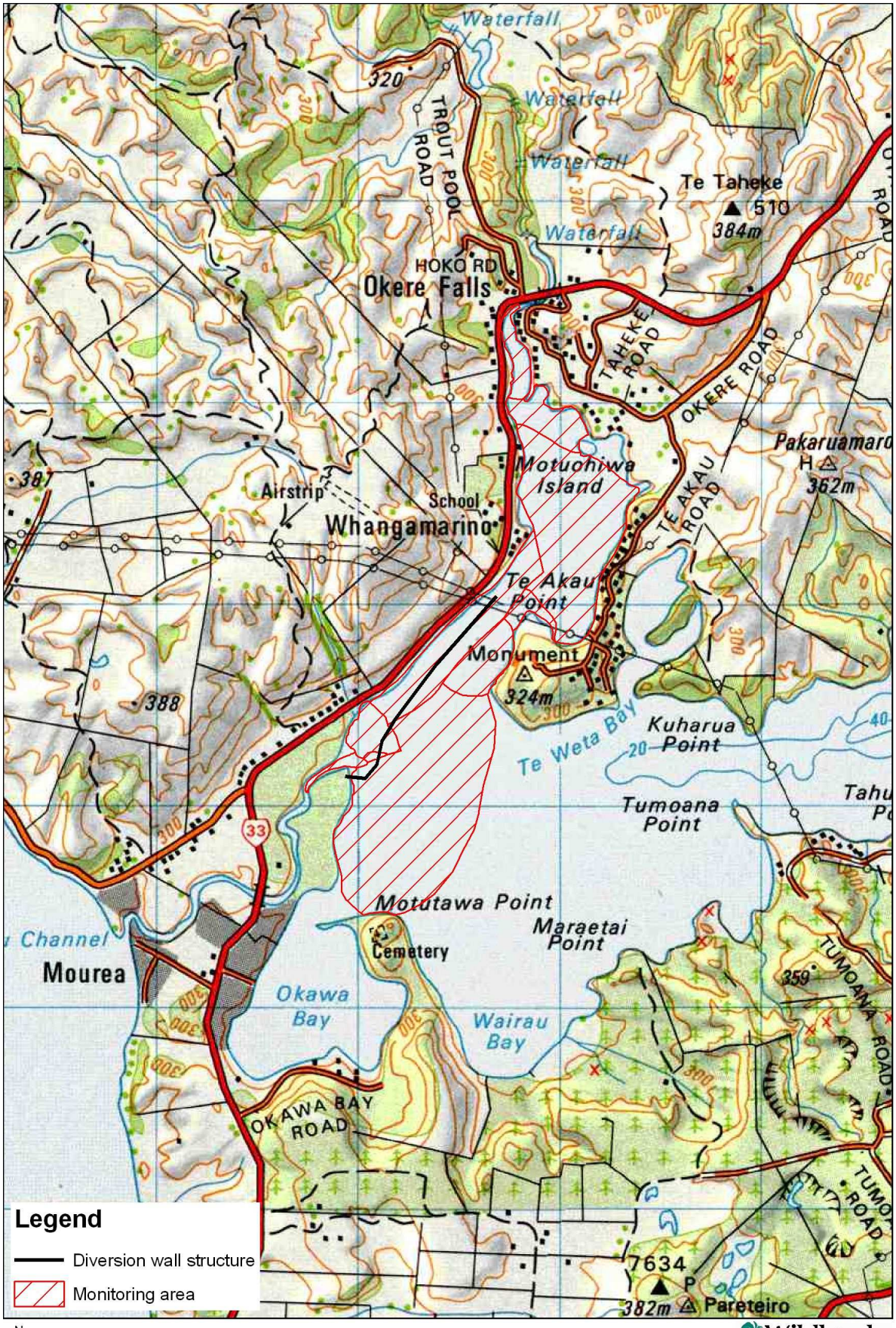


Figure 1. Bird monitoring study area and approximate alignment of diversion wall

4. METHODS

Overview

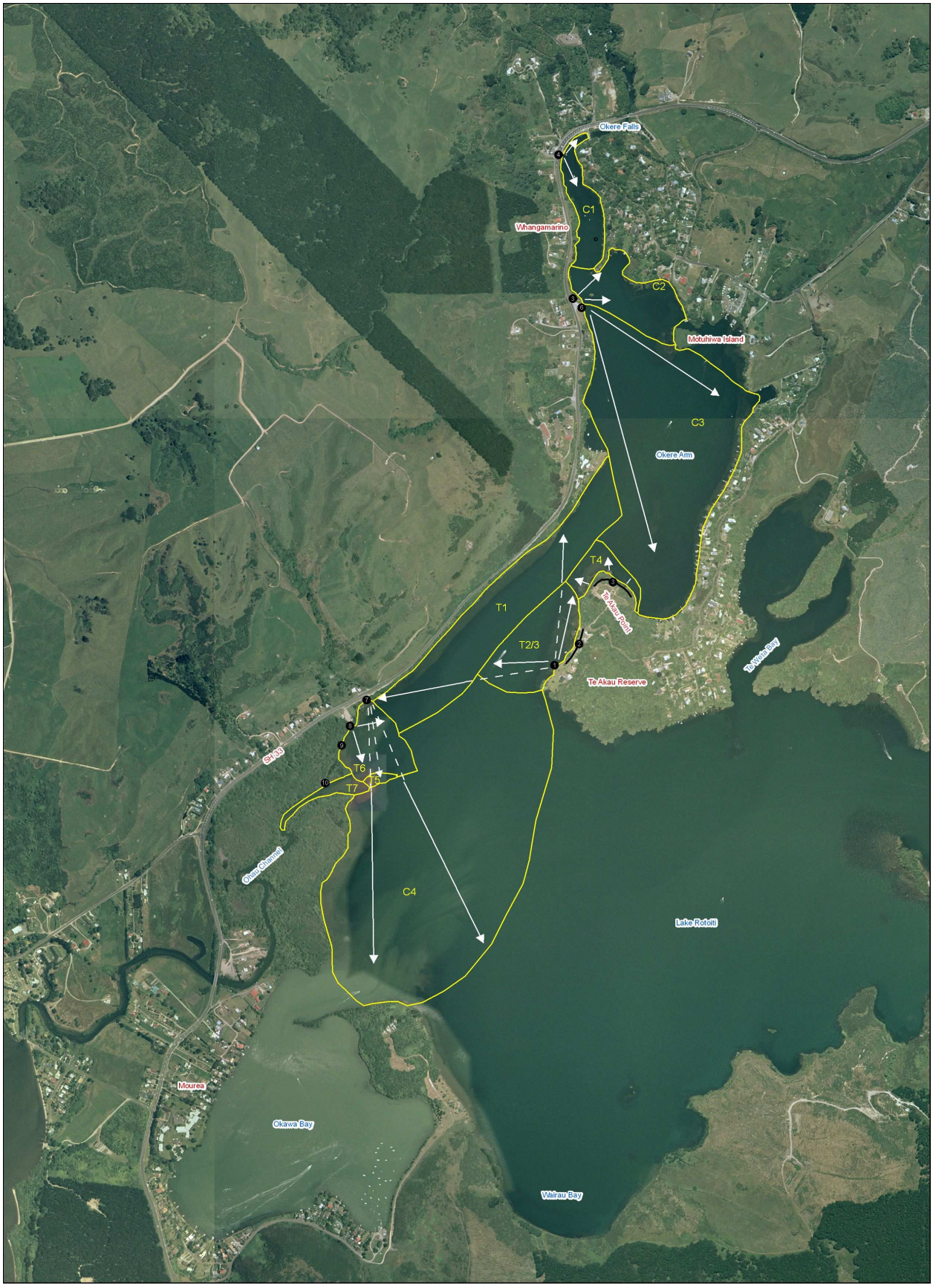
Bird monitoring for this study, involving counts undertaken on one day per month, commenced at Lake Rotoiti in May 2005. Figure 1 shows the location of the study area and the diversion wall at the western end of Lake Rotoiti.

Study Areas

The study area was divided into six pre-construction (i.e. prior to June 2007) treatment areas adjacent to the diversion wall, and four control areas (C1, C2, C3 and C4) away from the proposed location of the diversion wall (see Figure 2 and Table 1). The six treatment areas (T1, T2/3, T4, T5, T6, and T7 monthly) encompass most of the open water habitats adjacent to the diversion wall, and counts were undertaken with each of these. From March 2008, count area T1 has been split into three sub-sites:

- T1 - all birds were recorded on the water that could be seen from the jetty on the eastern side of the survey area (near Te Akau Point) (excluding birds on the wall).
- T1A - all birds roosting on the wall.
- T1B - birds recorded from the western side of the survey area now obscured by the wall.

The four control areas are located in open bodies of water away from the diversion wall. Monitoring of treatment sites began in May 2005, while monitoring of control sites began in July 2005. Comparisons between control and treatment survey areas will enable analyses of major changes to populations of bird species in the vicinity of the diversion wall, taking into account seasonal and yearly differences in bird populations. Bird populations can vary in size at different times of the year and seasons due to both environmental and human-induced events.



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Legend

- Bird survey station
- C1 Bird survey areas

Figure 2. Bird survey stations and survey areas at Lake Rotoiti

0 500 1,000 m

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Wildlands

Scale: 1:12,500
Date: 03/07/07
Cartographer: RPB

Recording

Each water bird seen or heard during the monitoring period at each survey area was identified and recorded. Terrestrial bird species were generally recorded by presence/absence only, although numbers were recorded for five terrestrial species: pheasant, shining cuckoo, tui, bellbird, and magpie. Juvenile birds were recorded separately in three size classes: small, medium, and large. These data were entered into a Microsoft Excel spreadsheet held by Wildland Consultants.

Optical Aids

Most counts were undertaken using a tripod-mounted spotting scope (telescope), with binoculars used for birds close to stations.

Weather

Counts were generally undertaken during settled weather as waves can make accurate counting of waterbirds difficult.

Limitations of Monthly Counts

Monthly surveys of birds, for set periods of time, can show trends in population numbers over time, but do have some limitations in terms of accuracy. Innes *et al.* (1999) outline factors that reduce or increase numbers recorded compared to actual numbers present. These are set out below with some additions relevant to this particular study.

Factors that May Reduce a Count

- Birds may be roosting, moulting and nesting in habitat that will not be viewed by the observer. This effect can be seasonal.

- Birds fleeing observers or other lake users (e.g. boats, canoes on lake, and people fishing on margins).

- Misidentifications (most likely in this survey for birds that are in the distance, particularly differentiating between red-billed gulls and black-billed gulls; Australian coot and New Zealand scaup; and little black shags and juvenile little shags).

- Actively-moving birds.

- Dense populations (e.g. little black shags and little shags on Ohau Channel Delta) where birds can be hidden behind other birds.

- Uncounted birds - birds leaving a count zone and flying to other parts of survey area that have already been counted.

Table 1: Survey areas, site names, count times, approximate sizes of survey areas, list of survey stations, and notes on bird monitoring associated with the Ohau Channel diversion wall at Lake Rotoiti. Refer to Figure 2 for location of survey areas.

Survey Area	Site Name	Count Duration[1]	Approximate Area (ha) of Survey Areas	Station(s) Recorded From	Notes
T1[2], T1A, T1B	North-western side of the proposed diversion wall	10-15 minutes	*c.*17.9 ha	Station 1 - jetty at end of Te Akau Road. Station 11 - walk along SH33 verge, from rest area by Ohau Channel boat ramp north-east to planting site (*c.*0.8 km in length).	Record all birds that can be seen from the jetty between the boat sheds to the west to as far as can be seen to the northeast. Use a boundary of approximately half-way across the lake to split this Survey Area from T2 (see below). From March 2008 Site T1 was split into three sub-sites: • T1 - all birds on the water that can be seen from the jetty on eastern side of survey area (near Te Akau Point) were recorded (excluding birds on the wall); • T1A - includes all birds roosting on the wall, from a line between the jetty at the end of Te Akau Road and the boat ramp on SH 33 adjacent to the Ohau Channel delta, north to the wall's terminus; • T1B - includes birds recorded on the western side of the wall (not visible from the jetty at the end of Te Akau Road), viewed by walking along adjacent SH33.

[1] Count duration is subject to the number of birds present. Low numbers mean that some sites can be counted very quickly, but if high numbers were present then the count duration is as long as it takes to complete the count.

[2] T1-T7 are 'pre-treatment' sites, where the wall is to be constructed.

Survey Area	Site Name	Count Duration[1]	Approximate Area (ha) of Survey Areas	Station(s) Recorded From	Notes
T2/3	South-eastern side of the proposed diversion wall	5-10 minutes (also walk along shoreline for Station 2)	*c.*7.3 ha	Station 1. Station 2 - any additional birds recorded along shoreline while doing a walk through inspection in front of houses at end of Te Akau Road.	Record all birds that can be seen from the jetty to approximately half-way across the lake. Do not record any birds from beyond Namaste Point here. Do not record any birds recorded in Survey Area T1. Walk the shoreline in front of the houses and record any additional birds not previously recorded from Station 1.
T4	Te Akau Reserve and Peninsula	5-10 minutes	*c.* 2.2 ha	Station 3 - walk through survey of shoreline of Te Akau Reserve.	Walk along shoreline boundary in Te Akau Reserve. Record any birds in the vicinity of the proposed flow diversion wall that will not be seen from any of the other stations.
C1[3]	Okere Inlet (north)	5-10 minutes	*c.*3.6 ha	Station 4 - mooring platform opposite Okere Falls Store.	Record any birds seen from the platform (except any that will be better recorded in Area C2).
C2	Okere Inlet (central)	5-10 minutes	*c.*6.5 ha	Station 5 - grassy area on SH33, 0.5 km south of Okere Falls Store, higher part.	Record any birds in the central end of Okere Inlet to approximately the south end of Motuhiwa Island. Do not count any birds that have/will be recorded in Areas C1 or C3.
C3	Okere Inlet (south)	5-10 minutes	*c.*37.2 ha	Station 6 - grassy area on SH33, 0.5 km south of Okere Falls Store, lower part.	Record all birds to the south of the area surveyed in Area C2. Be careful not to record any birds recorded in area T4.
T5	Delta	5-10 minutes	*c.*60.3 ha	Station 7 - rest area picnic table on SH33, adjacent to boat ramp.	Record any birds that are on the delta near the mouth of the Ohau River Channel. If the delta is submerged record any birds in approximate location of delta.

[3] C1-C4 are 'control' sites, outside of the construction zone.

Survey Area	Site Name	Count Duration[1]	Approximate Area (ha) of Survey Areas	Station(s) Recorded From	Notes
C4	Beyond delta	5-10 minutes	*c.*43.7 ha	Station 7.	Record all birds in the body of water beyond the delta. Do not record any birds in Wairau Bay (it is too difficult to identify species over this distance).
T6, T6A	Boat ramp	5 minutes, and any additional birds recorded from Station 9 (quick inspection only)	*c.*4.0 ha	Station 8 - jetty at Ohau Channel boat ramp. Station 9 - shoreline between boat ramp and Ohau Channel mouth.	Record all birds that can be seen from the boat ramp (north of delta) that were not in the survey areas T1, T5 and C4. Record any birds present at Station 9 (that could not be seen from Station 8). From November 2007, wall sections in T6 were recorded as site T6A.
T7	Ohau Channel mouth	5-10 minutes	*c.*1.1 ha	Station 10 - water level stage, Ohau Channel.	Record all birds in Ohau Channel not recorded in areas C4, T5, and T6.

Factors that May Increase a Count

- Birds fleeing observers and other people using the lake and being counted twice (see above).
- Misidentifications (see above).
- Actively-moving birds.
- Counted birds leaving the count zone and reappear in other parts of the lake which have not yet been counted.

This survey has the advantage that most counts have been undertaken by only two people, reducing the bias of survey methods between observers.

5. MONITORING RECORDS 2005-2009

A total of 41 bird species have been recorded during the first four years of monitoring (Table 2). Twenty-seven of these species are indigenous, while 14 species are introduced (including mallard/grey duck hybrids). One additional species, skylark, was recorded in the June 2008 to May 2009 surveys. Seven of the indigenous species are classified as 'Threatened' or 'At Risk' by Miskelly *et al*. (2008). Of the species recorded previously during the surveys, grey teal, greenfinch, and goldfinch were not recorded in the June 2008 to May 2009 period. None of these species were commonly recorded in the monthly surveys in the previous two years before wall construction began.

Table 2: Bird species recorded during surveys at the western end of Lake Rotoiti between May 2005 and May 2009. The threat status of birds as listed in Miskelly 2008 *et al*. are provided.[4].

Common Name	Scientific Name	Threat Classification
Grebes (family name: podicipedidae)		
New Zealand dabchick (weweia)	*Poliocephalus rufopectus*	Threatened, Nationally Vulnerable
Shags (phalacrocoracidae)		
Black shag (kawau)	*Phalacrocorax carbo*	At Risk, Naturally Uncommon
Little black shag	*Phalacrocorax sulcirostris*	At Risk, Naturally Uncommon
Little shag (kawaupaka)	*Phalacrocorax melanoleucos*	At Risk, Naturally Uncommon

[4] Several species have not yet been recorded in the study area during monthly surveys, but are likely to utilise habitats present. These include grey duck (*Anas superciliosa*), morepork (*Ninox novaeseelandiae*).

Common Name	Scientific Name	Threat Classification
Herons, bitterns and egrets (ardeidae)		
White-faced heron	*Ardea novaehollandiae*	Not threatened
Waterfowl (anatidae)		
Black swan	*Cygnus atratus*	Not threatened
Canada goose	*Branta canadensis*	Introduced
Feral goose	*Anser anser*	Introduced
Paradise shelduck (putangitangi)	*Tadorna variegata*	Not threatened
Mallard	*Anas platyrhynchos*	Introduced
Grey teal (tete)	*Anas gracilis*	Not threatened
Australasian shoveler (kuruwhengi)	*Anas rhynchotis*	Not threatened
New Zealand scaup (papango)	*Aythya novaeseelandiae*	Not threatened
Raptors (accipteridae and falconidae)		
Australasian harrier (kahu)	*Circus approximans*	Not threatened
Gamebirds (phasianidae)		
Pheasant	*Phasianus colchicus*	Introduced
Rails, gallinules and coots (rallidae)		
Pukeko	*Porphyrio porphyrio*	Not threatened
Australian coot	*Fulica atra*	
Stilts and avocets (recurvirostridae)		
Pied stilt	*Himantopus himantopus*	At Risk, Declining
Plovers, dotterels and lapwings (charadriidae)		
Spur-winged plover	*Vanellus miles*	Not threatened
Gulls, terns and noddies (laridae)		
Black-backed gull	*Larus dominicanus*	Not threatened
Red-billed gull	*Larus novaehollandiae*	Threatened, Nationally Vulnerable
Black-billed gull	*Larus bulleri*	Threatened, Nationally Endangered
Caspian tern	*Sterna caspia*	Threatened, Nationally Vulnerable
Cuckoos (cuculidae)		
Shining cuckoo	*Chrysococcyx lucidus*	Not threatened
Kingfishers (alcedinidae)		
Sacred kingfisher	*Todiramphus sanctus*	Not threatened
Larks (alaudidae)		
Skylark	*Alauda arvensis*	Introduced
Swallows and Martins (hirundinidae)		
Welcome swallow	*Hirundo tahitica*	Not threatened
Thrushes (muscicapidae)		
Blackbird	*Turdus merula*	Introduced
Song thrush	*Turdus philomelos*	Introduced
Australasian warblers (acanthizidae)		
Riroriro, grey warbler	*Gerygone igata*	Not threatened
Monarch flycatchers (monarchidae)		
Piwakawaka, North Island fantail	*Rhipidura fuliginosa* subsp. *placabilis*	Not threatened
White-eyes (zosteropidae)		
Silvereye	*Zosterops lateralis*	Not threatened
Honeyeaters (meliphagidae)		
Bellbird	*Anthornis melanura*	Not threatened
Tui	*Prosthemadera novaeseelandiae*	Not threatened

Common Name	Scientific Name	Threat Classification
Finches (fringillidae)		
Chaffinch	*Fringilla coelebs*	Introduced
Greenfinch	*Carduelis chloris*	Introduced
Goldfinch	*Carduelis carduelis*	Introduced
Sparrows and Weavers (ploceidae)		
House sparrow	*Passer domesticus*	Introduced
Starlings and Mynas (sturnidae)		
Starling	*Sturnus vulgaris*	Introduced
Indian myna	*Acridotheres tristis*	Introduced
Bell Magpies (cracticidae)		
Australian magpie	*Gymnorhina tibicen*	Introduced

Notes on the local status of birds recorded in the study area, including records of breeding activity, are presented in Table 3.

Table 3: Status of birds in study area during the first four years (May 2005-June 2009) of bird surveys associated with the Ohau Channel diversion wall at Lake Rotoiti.

Bird Species	Status in Vicinity of Proposed Wall	Status at Control Sites	Broods/ Nesting Recorded May 2005-May 2008 Surveys	Broods/ Nesting Recorded June 2008-May 2009	Notes
New Zealand dabchick	Common	Common	✓	✓	Common and have bred throughout study area. Two records only between May 2008 and June 2009, both in control areas.
Black shag	Occasional	Occasional			Recorded several times from open water habitats in 2006 and 2007. Often roosts on lake margins and jetties.
Little black shag	Common	Common			Common throughout open water habitats. Roost on jetties, lake margins and delta.
Little shag	Common	Common			Common throughout. Roost on jetties, lake margins and regularly present at delta.
White-faced heron	Occasional	Occasional			Utilise in shallow water and lake margins.
Black swan	Common	Common	✓	✓	Common in open water habitat and lake margins throughout study area. Broods recorded regularly in control and treatment areas.
Canada goose	Occasional	Occasional			Recorded occasionally, mostly in control areas, but also recorded once at the delta in 2008-2009.
Feral goose	Expected - not recorded	Occasional			
Paradise shelduck	Occasional	Not recorded			Occasionally seen in open water habitat, around the Ohau Channel delta (72 birds at the delta in March 2007), or in the Ohau Channel itself.
Mallard	Occasional	Occasional	✓	✓	Recorded occasionally throughout study area.
Australasian shoveler	Occasional	Not recorded			Recorded occasionally in delta area (east of Ohau Channel).
Grey teal	Occasional	Occasional			Recorded occasionally, throughout study area.
New Zealand scaup	Common	Common	✓	✓	Common throughout open water habitats. One of the most common species present in study area. Broods recorded from control and treatment sites in June 2008 to May 2009 surveys.
Australian harrier	Occasional	Occasional			Recorded occasionally, flying over study area.
Pheasant	Occasional	Occasional			Recorded occasionally, in lake margin habitat.
Pukeko	Common	Common	✓		Common on lake margins and occasionally on open water. No broods recorded in June 2008 to May 2008 surveys, but broods have been recorded in previous years.

Bird Species	Status in Vicinity of Proposed Wall	Status at Control Sites	Broods/ Nesting Recorded May 2005-May 2008 Surveys	Broods/ Nesting Recorded June 2008-May 2009	Notes
Australian coot	Common	Common	✓	✓	Very common in open water habitats of western Lake Rotoiti. Present throughout open water habitats and occasionally on lake margins. Broods commonly present in control and treatment areas.
Spur-winged plover	Common	Common			Commonly recorded on terrestrial habitat surrounding open water habitats and on the delta.
Pied stilt	Occasional	Occasional			Recorded occasionally from Ohau Channel Delta.
Black-backed gull	Usually present	Occasional			Recorded occasionally throughout the study area. Seen regularly at Ohau Channel delta.
Red-billed gull	Common	Common			Common throughout study area. Regularly present at delta.
Black-billed gull	Common	Common			Common throughout the study area. Regularly present on delta.
Caspian tern	Seasonally present (Winter)	Not recorded			Up to 18 birds have been recorded, particularly during winter months, at Ohau Channel delta.
Shining cuckoo	Seasonally common (summer)	Seasonally common (summer)	✓		Common between September and January, in terrestrial margins.
Kingfisher	Common	Common			Common in lake margins habitat of study area.
Skylark	Occasional	Not recorded			Recorded once in open grassland habitat at Te Akau Reserve.
Welcome swallow	Common	Common			Common flying over open water habitat throughout study area.
Silvereye	Common	Common			Common in lake margin terrestrial habitat.
Grey warbler	Common	Common	✓		Common in lake margin terrestrial habitat.
Blackbird	Common	Common			Common in lake margin terrestrial habitat.
Song thrush	Common	Common			Common in lake margin terrestrial habitat.
Fantail	Common	Common			Common in lake margin terrestrial habitat.
Tui	Common	Common			Common in lake margin terrestrial habitat.
Bellbird	Common	Common			Common in lake margin terrestrial habitat.
House sparrow	Common	Common			Common in lake margin terrestrial habitat.
Chaffinch	Common	Common			Common in lake margin terrestrial habitat.
Goldfinch	Common	Common			Common in lake margin terrestrial habitat.
Starling	Common	Common			Common in lake margin terrestrial habitat.
Indian myna	Common	Common			Common in lake margin terrestrial habitat.
Australian magpie	Common	Common			Common in lake margin terrestrial habitat.

6. THREATENED OR AT RISK SPECIES

Threatened and at risk species (as per Miskelly *et al*. 2008, which supersedes Hitchmough *et al.* (comps.) 2007) recorded in the project area are listed below, with comments on their respective New Zealand populations (summarised from Heather and Robertson 2005). The New Zealand threat classification system was reviewed and updated in 2007 (Townsend *et al*. 2008), resulting in several new threat categories, and redefinition of some existing categories. Some previously-used categories are no longer used at all (i.e. 'Serious Decline' and 'Gradual Decline'). Based on this new assessment, the number of threatened waterbird species present has increased from six to seven since the 2007-2008 reporting year (the threat classification of little shag has deteriorated from 'Not Threatened' to 'At Risk'). Threat classifications have deteriorated for three of the six threatened or at risk species listed in the 2007-2008 report, and remained unchanged for the other 3 species.

'Threatened-Nationally Endangered'

Black-billed gull - A New Zealand endemic. *c.*50,000 pairs in New Zealand in 1996. Numbers have crashed in the South Island since the 1970s, for unknown reasons, but black-billed gulls are slowly increasing in numbers and range in the North Island. Threat classification has deteriorated from 'Chronically Threatened-Serious Decline' (Hitchmough *et al.* 2007).

'Threatened-Nationally Vulnerable'

Caspian tern - *c.*3,000 birds in New Zealand. Sizes of colonies vary from year to year, but rarely exceed 100 pairs. An almost cosmopolitan species - breeding in all temperate continental regions except those of South America. No change in threat classification.

Red-billed gull - Widespread and locally common, the three largest colonies each have >5,000 breeding pairs but have shown evidence of population declines in recent years. Threat classification has deteriorated from 'Chronically Threatened-Gradual Decline' (Hitchmough *et al.* 2007).

New Zealand dabchick - A New Zealand endemic. Population of *c.*1,700, all in the North Island, with *c.*500 present in the Volcanic Plateau. Presumed extinct in the South Island. Threat classification has deteriorated from 'At Risk-Sparse' (Hitchmough *et al.* 2007).

'At Risk-Naturally Uncommon'

Little black shag - between 1,000 and 5,000 pairs in New Zealand. More common in the north than south of New Zealand.

Black shag - 5,000-10,000, scattered throughout New Zealand.

Little shag - 5,000-10,000 pairs, more common in the northern North Island. Threat classification has deteriorated from 'Not Threatened' (Hitchmough *et al.* 2007).

7. RESULTS FOR SELECTED OPEN WATER SPECIES

7.1 Overall summary of results

A summary table of key waterbird species for each year of the study is presented in Table 4. Mean monthly count totals for most waterbird species have either remained relatively stable or fluctuated between 2005 and 2009. However, mean monthly counts of New Zealand dabchick within treatment areas has shown a slight, but steady decline since 2005. This may reflect disturbance or displacement by boat movements within the narrow centred waterway formed by the diversion structure, or poor water quality discharging from Lake Rotorua via the Ohau Channel, or it may be simply be part of overall natural year-to-year fluctuations at the western end of Lake Rotoiti (*c.f.* Innes *et al*. 2000).

Table 4: Monthly mean numbers of key open water bird species in the vicinity of the Ohau Channel diversion wall before, during, and after wall construction (C = control area; T = treatment area), June 2005 to May 2009.

Project Phase (approximate)	Pre-construction						Construction Period			Post-construction		
	2005-2006			2006-2007			2007-2008			2008-2009		
Species	C	T	Total	C	T	Total	C	T	Total	C	T	Total
New Zealand dabchick	17.2	18.0	35.2	15.3	15.3	30.5	13.3	13.3	26.6	14.5	10.2	24.6
Black shag	<0.1	0.0	<0.1	0.2	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Little shag	1.5	2.5	4.0	3.0	2.7	5.7	2.6	3.6	6.2	2.4	3.0	5.4
Little black shag	3.3	2.6	5.5	2.8	23.9	26.8	10.3	6.3	16.6	10.6	6.3	16.8
Black swan	24.2	14.3	38.3	19.6	29.6	49.2	31.8	16.5	48.3	24.6	23.8	48.4
New Zealand scaup	55.7	61.9	113.0	99.8	111.7	211.4	142.7	139.3	281.9	115.0	74.4	189.4
Australian coot	93.0	103.8	198.2	104.1	66.1	170.2	129.0	66.5	195.5	73.7	85.0	158.7
Black-backed gull	0.6	6.3	7.5	0.8	4.4	5.2	0.0	3.2	3.2	0.0	1.7	1.7
Red-billed gull	0.3	3.3	3.6	0.8	0.8	1.6	0.1	3.8	3.9	0.2	4.9	5.1
Black-billed gull	0.3	3.3	3.5	1.1	33.3	34.4	0.3	18.2	18.4	0.3	13.3	13.6
All gulls (including unidentified species)	1.2	12.8	14.0	4.3	42.6	46.8	0.5	29.2	29.7	0.6	24.3	24.8
Caspian tern	0.0	2.2	2.2	0.0	3.4	3.4	0.0	1.8	1.8	0.0	4.3	4.3

New Zealand dabchick

Dabchicks have been found scattered throughout the study area, with the most birds observed on larger open areas of water (e.g. Treatment 1 and Control 3 sites - see Table 1 and Figure 2). In the vicinity of the proposed diversion wall in (pre-treatment/treatment survey areas monthly means of 15, 13, and 10 dabchicks were recorded in 2005-2006, 2006-2007, 2007-2008, and 2008-2009 respectively. The maximum number of dabchicks (31) in the pre-treatment area was recorded in April 2007. While there has been a slight downward trend in the number of birds in the treatment area, the changes are generally within the range of the overall standard deviation (see Table 5). More data is required to assess long term trends.

Table 5: Mean and standard deviations of New Zealand dabchicks recorded in monthly surveys in treatment and control areas in the vicinity of the Ohau Channel diversion structure: June 2005 to May 2009.

Year	Control		Treatment	
2005-2006	15.75	(6.08)	18.00	(6.67)
2006-2007	15.25	(6.14)	15.25	(9.25)
2007-2008	13.33	(5.07)	13.25	(5.89)
2008-2009	14.45	(3.50)	10.18	(3.66)

Black shag

Black shags are only recorded occasionally in the study area, with birds being recorded during four surveys of the first 24 months of surveys for this study. A maximum of four birds were recorded in December 2006 and November 2007, with individuals having been recorded in control and treatment (pre-treatment) areas.

Little black shag

Little black shags are common throughout the study area with birds being recorded from each survey area at least once during the first two years of this study. A maximum number of little black shags (194) was recorded in August 2006, with *c.*163 birds present on the Ohau Channel Delta (T5). The number recorded varies greatly between surveys. Survey areas in the vicinity of the proposed diversion wall (pre-treatment/treatment survey areas) had means of 2.6, 23.9, 6.3, and 6.3 birds, recorded in 2005-2006, 2006-2007, 2007-2008, and 2008-2009 respectively. These results show considerable variations in the number of shags between years, rather than any long-term trends.

Little shag

Little shags are common in the study area and have been recorded at least once from each survey area during the first two years of this study. The maximum number of 17 birds was recorded in the vicinity of the proposed diversion wall (pre-treatment/treatment survey area) in May 2008, with means of 2.5, 2.7, 3.6, and 3.0 birds recorded in 2005-2006 and 2006-2007, 2007-2008, and 2008-2009 respectively.

Black swan

Black swan are common in the survey area with a maximum number of swans recorded in February 2009 (167 birds with 86 birds in control survey areas and 81 birds in pre-treatment survey areas). Black swans have been found scattered throughout the study area, with birds having been recorded from all survey areas at least once during the first three years of this study. The highest numbers have been recorded from the largest areas of open water (e.g. Treatment 1 and Control 4). In the pre-treatment (treatment) survey areas, means of 14.3, 29.6, 16.5, and 23.8 black swans were recorded in 2005-2006, 2006-2007, 2007-2008, and 2008-2009 respectively.

New Zealand scaup

New Zealand scaup are very common throughout the study area. Scaup have been recorded from all survey areas during the first three years of this study. A maximum number of 574 scaup were recorded in the study area in October 2008 (with 413 birds in the control survey areas and 161 in treatment survey area). Means of 61.9, 111.7, 139.3, and 74.4 scaup were recorded in the pre-treatment (treatment) survey area during the 2005-2006, 2006-2007, 2007-2008, and 2008-2009 seasons respectively.

Australian coot

Australian coot are very common throughout the study area. A maximum of 426 coot were recorded in the study area in June 2008, with 138 birds present at pre-treatment survey areas and 288 birds at control survey areas. Means of 103.8, 66.1, 66.5, and 85.0 coot were recorded at the pre-treatment (treatment) survey area in 2005-2006, 2006-2007, 2007-2008, and 2008-2009, respectively.

Black-backed gull

Black-backed gulls are occasionally present throughout the study area, although in some surveys particularly large numbers of birds were recorded at the Ohau Channel delta. Larger numbers were present at the delta in April 2006 (51), May 2006 (10), August 2006 (16), December 2006 (15), and September 2007 (13). Means of 6.3, 4.4, 3.2, and 1.7 black-backed gulls were recorded from the pre-treatment (treatment) survey area in 2005-2006, 2006-2007, 2007-2008, and 2008-2009, respectively. Numbers of this species are too low to assess whether changes are significant.

Red-billed gull

Red-billed gulls have been recorded throughout the survey areas, including all survey areas except the Ohau Channel survey area (T7). A maximum of 28 birds was recorded in February 2006. Means of 3.7, 0.8, 3.8, and 4.9 red-billed gulls were recorded from the pre-treatment (treatment) survey areas in 2005-2006, 2006-2007, 2007-2008, and 2008-2009, respectively.

Black-billed gull

Black-billed gulls have been recorded throughout the survey area with all sites except one - Control 1 (the northern section of Okere Arm) - having black-billed gulls present. A maximum of 124 black-billed gulls was recorded in August 2006, with 122 birds present at the Ohau Channel delta. Means of 3.3, 33.3, 18.2, and 13.3 black-billed gulls were recorded from the pre-treatment (treatment) survey areas in 2005-2006, 2006-2007, 2007-2008, and 2008-2009, respectively.

All three gull species combined (including unidentified gulls)

Gulls have been recorded from all sites throughout the survey. A maximum of 143 gulls was recorded in August 2006, with 139 birds at the Ohau Channel delta. Means of 12.8, 39.2, 29.9, and 24.3 gulls were recorded from the pre-treatment (treatment) survey areas in 2005-2006, 2006-2007, 2007-2008, and 2008-2009 respectively.

Caspian tern

All records of Caspian terns have been from the Ohau Channel delta. Caspian terns were present at the delta during June 2005 (12 birds), September 2005 (2), May 2006 (12), June 2006 (14), September 2006 (3), October 2006 (6), May 2007 (18), June 2007 (18), July 2007 (3), October 2007 (1), June 2008 (5), July 2008 (15), August 2008 (6), and October 2008 (26). These results show that this species has continued to utilise habitats before, during, and post-construction of the diversion wall.

8. BREEDING

Juveniles of six water bird species - New Zealand dabchick, black swan, mallard, New Zealand scaup, Australian coot and pukeko - were recorded during monthly surveys from May 2005 to May 2009. Juveniles of all of these species, except for pukeko, were recorded in the 2008-2009 monthly surveys. Pukeko, which are usually found on lake margins, are unlikely to be affected by the construction and presence of the wall.

New Zealand dabchick

- *June 2005 to May 2007*

  Dabchick juveniles were recorded between November and March in the 2005-2006 breeding season[5], and December to March in the 2006-2007 breeding season. Broods have been recorded from both the pre-treatment and control sites. Nine juveniles were recorded during the 2005-2006 breeding season, while 8 juveniles were recorded during the 2006-2007 breeding season.

[5] The breeding season is included within the study year.

- *June 2007 to May 2008*

  Four dabchick young were recorded (all in treatment areas) between December 2007 and April 2008.

- *June 2008 to May 2009*

  Two dabchick young were recorded (both in control area C2) between October 2008 and February 2009. No young were recorded in treatment areas.

Black swan

- *June 2005 to May 2007*

  Only two broods of black swan were recorded during the 2005-2006 breeding season; in October 2005 and May 2006. The May 2006 group of young was probably recorded again in June 2006 - which would usually be recorded in the 2006-2007 breeding season, but was recorded as production from the 2005-2006 breeding season. Broods were common between November 2006 and May 2007 in the 2006-2007 breeding season, in both the control and pre-treatment areas. Eight juveniles were recorded in the study area in the 2005-2006 breeding season, while 18 juveniles were recorded in the 2006-2007 breeding season.

- *June 2007 to May 2008*

  Twenty-six young from *c.*10 broods were recorded between July 2007 and April 2008. Four of the ten broods were in the treatment area.

- *June 2008 to May 2009*

  Eleven young from *c.*4 broods were recorded between November 2008 and February 2009, all of which were recorded from control areas.

Mallard

- *June 2005 to May 2007*

  Only one brood of ten young mallard (or mallard-grey hybrids) was recorded in the study area prior to June 2007.

- *June 2007 to May 2008*

  No records.

- *June 2008 to May 2009*

  One brood of three young mallard (or mallard-grey hybrids) was recorded from a control area in Jan 2009.

New Zealand scaup

- *June 2005 to May 2007*

  New Zealand scaup appear to have the shortest breeding season of these five waterbird species at Lake Rotoiti, and were highly productive during the first two years of this study. In the 2005-2006 breeding season all young (18) were recorded between December and January. In the 2006-2007 breeding season, 72 juveniles were recorded between December and March.

- *June 2007 to May 2008*

  All broods of scaup were recorded between December 2007 and February 2008. During this period, 42 young were recorded in nine broods, with four broods in control areas and five broods in treatment areas.

- *June 2008 to May 2009*

  All broods of scaup were recorded in January and February 2008. During this period 46 young were recorded in control areas, and 17 young were recorded in treatment areas.

Australian coot

- *June 2005 to May 2007*

  Australian coot appears to be amongst the most prolific species breeding at the western end of Lake Rotoiti. In the 2005-2006 breeding season, 47 young were reported between October and March. During the 2006-2007 breeding season, 64 juveniles were reported between December and April.

- *June 2007 to May 2008*

  All broods of coot were recorded between December 2007 and March 2008. During this period, 25 young were recorded in 16 broods, with eight broods in control areas and eight broods in treatment areas.

- *June 2008 to May 2009*

  All broods of coot were recorded between January and May 2009. During this period, 19 young were recorded in control areas and 9 young were recorded in treatment areas.

9. USE OF THE WALL DURING AND AFTER CONSTRUCTION

Shags and gulls regularly roost on the wall, individually or in small groups, as well as occasionally being observed in the water or flying in areas T1 and T6, within which areas the wall lies. Counts of shags and gulls in survey areas T1 and T6 have

increased substantially since construction of the wall, mainly due to the roosting habitat it provides.

Table 6: Mean monthly counts for bird species in survey areas T1 and T6 at the Ohau Channel diversion structure, pre-construction, construction, and post-construction phases.

	Phase		
Species	Pre-construction (May 2005-May 2007)	Construction (June 2007-September 2008)	Post-construction (October 2008-May 2009)
Black-backed gull	0.1	0.4	1.5
Black-billed gull	1.3	5.9	17.1
Little black shag	3.6	3.3	7.6
Little shag	1.0	1.7	3.1
Red-billed gull	0.6	2.7	7.0
Total	6.6	13.9	36.4

10. DISCUSSION

Bird count data collected from May 2005- May 2007 have provided a useful baseline assessment of bird species in the vicinity of the diversion wall prior to its construction. Data collected from June 2007-May 2009 will enable analysis of seasonal and yearly differences in bird populations during the construction and post-construction phases of the Ohau Channel diversion wall.

Key species to be analysed, following completion of wall construction and at least three years of post-construction monitoring, will be records for birds of open water habitat, especially New Zealand dabchick, black shag, little black shag, little shag, black swan, New Zealand scaup, Australian coot, red-billed gull, black-billed gull, and Caspian tern.

Interesting findings to date have included the winter roosting of Caspian tern at the delta and the large fluctuations in numbers of little black shag (also at the delta). The survey area in general provides very good habitat for open water birds, particularly New Zealand dabchick, black swan, New Zealand scaup, and Australian coot.

Preliminary results since the first year since the diversion wall construction are:

- All key bird species of open water habitats continued to utilise the control and treatment habitats within the vicinity of the diversion wall.

- Numbers of New Zealand dabchick (the most important species from a conservation perspective) have shown a slight but steady decline in treatment areas in the vicinity of the wall, however numbers fluctuate quite markedly between surveys and more data is required to assess long term trends for this species.

- Caspian terns have continued to utilise habitats adjacent to the diversion structure prior to, during, and post-construction.

- The diversion wall has become a locally important roosting site for three gull species and two shag species.

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