Lake Okareka Hornwort Management Plan 2013

Bay of Plenty Regional Council
Operations Publication 2015/03

5 Quay Street
PO Box 364
Whakatāne 3158
NEW ZEALAND

ISSN: 1176-5550 (Print)
ISSN: 1179-9587 (Online)

BAY OF PLENTY REGIONAL COUNCIL
TOI MOANA

Lake Ōkāreka Hornwort Management Plan 2013

Operations Publication 2015/03
ISSN: 1176-5550 (Print)
ISSN: 1179-9587 (Online)

July 2015

Bay of Plenty Regional Council
5 Quay Street
PO Box 364
Whakatane 3158
NEW ZEALAND

Prepared by Stephanie Bathgate, Land Management Officer (Rotorua)

Cover Photo: Lake Okareka
Photographer: R Cook

Contents

Part 1: Introduction

Hornwort (*Ceratophyllum demersum*) fragments were found in Lake Ōkāreka by a local tourism operator in April 2012 who reported the finding to the Bay of Plenty Regional Council (BOPRC). Surveillance was then undertaken by BOPRC divers and National Institute of Water and Atmosphere (NIWA) scientists to assess the full extent of the incursion. Fragments were found within the weed cordon in Acacia Bay and plants were found adjacent to Steep Street Reserve and throughout the north western bays from Boyes Beach to the Department of Conservation (DOC) campsite.

Hornwort is classified as a containment pest under the Regional Pest Management Plan for the Bay of Plenty 2011-2016 (RPMP). Containment pests are pests we want to minimise the effects of and prevent their further spread. Rule D (3) of the RPMP applies to this pest:

"D (3): Landowners and Occupiers must destroy *Egeria densa, Lagarosiphon major* and hornwort in all areas defined in Figure 3 (of the Plan)".

Figure 3 defines Lake Ōkāreka as an area where rule D (3) applies for hornwort.

Responsibility for aquatic weed control within the Te Arawa Lakes is complicated and not clear cut for several reasons, including:

- Rule D (3) of the Regional Pest Management Plan applies to hornwort within Lake Ōkāreka which states that land "owners" and "occupiers" must destroy hornwort.

- While Te Arawa is clearly the "owner" of the lakebeds, they have disclaimed responsibility for controlling aquatic weeds that are attached to the lakebed, which has been confirmed in settlement legislation[1].

- Historically, Land Information New Zealand (LINZ), acting for the Crown, has taken voluntary responsibility for managing aquatic pest plants in the lakes.

- Recent amendments to the Biosecurity Act have signalled a change which could hold the Crown legally responsible for managing pests named in Regional Pest Management Plans on Crown Land; however, these amendments are not yet in force.

- While the Crown could be considered to be the "occupier" of the lakebed, they are currently immune from any costs or obligations under the RPMP as it cannot currently impose costs or obligations on the Crown.

However, advice notes in our RPMP provide some further guidance:

"The Crown is responsible for managing aquatic pests in the Rotorua Lakes, through the Te Arawa Lakes Deed of Settlement. In the event of a new incursion, an incursion response plan will be developed by Council in consultation with Te Arawa Lakes Trust and LINZ."

Land Information New Zealand agrees, in principal, to the intent of the Plan and have agreed to work with us to develop annual work programmes to implement the Plan based on available funding and other biosecurity priorities. Annual work programmes will need to also consider the views of Te Arawa and other key stakeholders.

[1] Refer to section 26, Te Arawa Lakes Settlement Act 2006.

1.1 Background

Lake Ōkāreka is a volcanic lake approximately 3.34 km² with an average depth of 20 m. It is considered a mesotrophic lake due to its moderate levels of algal productivity and reasonably clean water. It drains to Lake Tarawera via Waitangi Springs and an artificial surface channel. In the past, water quality has been affected by excessive nutrient inputs; however, current water quality is showing a stable trend.

The lake has been infested with *Lagarosiphon major, Elodea canadensis* and *Egeria densa* for a number of years; these pest plants are listed in BOPRC's Regional Pest Management Plan 2011-16 (RPMP). The introduction of hornwort is likely to further affect the lake's health. This impact will be measured by Lake Submerged Plant Indicators (LakeSPI) which is a system that uses the composition of native and invasive submerged aquatic plants to characterise the lakes ecological condition (Clayton & Edwards 2006).

The submerged aquatic plants give an indication as to the water quality and impacts from catchments areas. However, the most important feature of LakeSPI in relevance to this report, is that it assesses aquatic pest plant invasion. Of all the Rotorua lakes, Ōkāreka was ranked sixth with an overall condition of 'Moderate' (Table 1).

Table 1 Summary of current LakeSPI indices for 12 Rotorua lakes in order of their overall lake condition, using the most recent data collected (2011). Scores are the average of five baseline sites

Lake	LakeSPI Index (%)	Native Condition Index (%)	Invasive Condition Index (%)	Lake condition
Rotomā	51	58	52	High
Rotomahana	50	53	47	Moderate
Okataina	44	47	63	
Tikitapu	41	33	48	
Rerewhakaaitu	36	52	78	
Okareka	**35**	**43**	**76**	
Rotokakahi	31	26	75	
Okaro	27	19	69	Poor
Tarawera	24	26	88	
Rotoiti	20	25	91	
Rotorua	20	20	81	
Rotoehu	17	24	90	

Surveillance, monitoring, and control efforts are currently undertaken throughout the Rotorua lakes which are ranked in terms of priority. Table 2 below shows the prioritisation fields considered when determining "intactness" and values for the lakes. Lake Ōkāreka was ranked fourth for surveillance priorities and third for control work priorities. These rankings are primarily due to the lakes' high recreational values and the threat posed if additional aquatic pests managed to establish.

Table 2 Bay of Plenty Regional Council lakes priority spreadsheets (surveillance and control work priorities)

Surveillance priorities						
Lake	**Risk of pest entry**	**Recreational use**	**Intactness (LakeSPI)**	**Reduced risk of spread**	**Ability to detect new incursions**	**Score (max 25)**
Rotomā	5	4	4	5	5	23
Ōkataina	5	4	4	5	5	23
Tikitapu	4	5	2	4	4	19
Okareka	**3**	**4**	**2**	**3**	**3**	**15**
Rotokakahi	3	3	3	3	2	14
Okaro	4	2	3	3	2	14
Rerewhakaaitu	3	3	2	3	2	13
Rotomahana	2	2	5	2	2	13
Tarawera	1	4	3	2	2	12
Rotoiti	1	4	2	1	1	9
Rotoehu	1	2	1	1	1	6
Rotorua	1	3	1	0	0	5

Control work priorities						
Lake	**Reduced risk of pest exit**	**Improve surveillance ability**	**Improve recreation amenities**	**Improve biodiversity values**	**Reduce weed biomass**	**Score (max 25)**
Rotoiti	5	2	4	2	3	16
Rotoehu	4	2	3	2	4	15
Okareka	**4**	**2**	**3**	**3**	**2**	**14**
Rerewhakaaitu	3	3	2	3	3	14
Rotorua	5	1	3	1	4	14
Tarawera	4	2	3	2	2	13
Rotomā	1	4	2	3	2	12
Ōkataina	1	4	2	3	2	12
Tikitapu	2	2	2	2	2	10
Rotokakahi	1	2	2	3	2	10
Rotomahana	2	2	2	2	2	10
Okaro	1	2	1	3	2	9

In terms of the biodiversity values in Lake Okareka, native charophyte beds dominate the deeper depth bands (seven to twelve metres) with *L. major* appearing between two and seven metres and *E. densa* at eight to nine metres. Currently, the charophyte beds are known to be free of aquatic pests due to the fact that *L. major* and *E. densa* are pressure sensitive and do not typically inhabit these depths.

However, hornwort can grow to depths of ten to twelve metres and therefore pose a real threat to colonising these native plant beds. Targeted spray programmes will minimise the potential impacts on these beds and protect these native charophyte assemblages.

Part 2: Lake Ōkāreka – Aquatic pest surveillance and management

2.1 2011 Weed cordon installation

A weed cordon designed to prevent the spread of invasive aquatic weeds was installed at the Acacia Road boat ramp on 22 November 2011. At the time of weed cordon installation, Lake Ōkāreka was known to contain three aquatic pest plant species; *L. major, E. canadensis* and *E. densa*. The cordon installation was done with the intention of reducing the risk of any hornwort incursions along with managing the vectoring of *E. canadensis, E. densa* and *L. major* from the lake.

2.2 2012 incursion

Hornwort fragments were detected and reported to BOPRC in April 2012 by Rotorua Duck Tours, a local tourism operator that uses an amphibious vehicle within three (Tikitapu, Ōkāreka and Tarawera) of the 12 Rotorua lakes.

The report was followed up with surveillance by BOPRC divers and NIWA scientists.

Several fragments were found; one within the weed cordon in the emergent raupo, one in front of the Steep Street Reserve and scattered plants and fragments throughout the north-western bays from Boyes Beach along to the Department of Conservation (DOC) campsite.

In order to ensure that best efforts were taken at locating fragments and plants, further surveillance was planned for the summer months of 2012-2013; the warmer months promote new growth resulting in larger plants and tips of fragments displaying a light, fluorescent green colour. This results in plants and fragments being more noticeable to divers, especially in low visibility conditions.

2.3 2013 Delimitation Survey

Surveillance was undertaken over a three day period by BOPRC divers in March 2013 using a variety of dive techniques including; manta boarding, spot diving, snorkelling and underwater scooter. During the surveillance period, conditions were considered moderate with underwater visibility being recorded between two to five metres. Two of the three days were overcast, further decreasing visibility underwater and the ability to detect plants. In order to combat low visibility areas, surveillance was done via underwater scooter, rather than manta board, which allowed greater diver control over visual limitations.

Results of the surveillance revealed two additional hornwort infestation areas to those detected in 2012 (Figure 1).

The majority of the new infestations occupied the northern end of the lake and ranged from scattered plants (5-10 m^2) to established beds approximately 50 m^2 in size, plants were found in depths ranging from two to eight metres. The entire Boyes Beach area has been classed as one site as it contained scattered plants, some up to 50 m^2 in size.

Two plants were found at the southern reach of the lake; one small plant at the outlet that connects to Lake Tarawera, and one small plant within the bay to the eastern side of Acacia Road Point. Plants here were found in depths ranging from four to eight metres.

Figure 1 *Lake Ōkāreka with areas marked where hornwort was located during the 2012 and 2013 surveillance period*

2.4 Actions to date

In the event of an incursion, NIWA recommend the following steps:

1 Confirm identification.

2 Carry out intensive delimitation surveys.

3 Contain the incursion.

4 Evaluate options for management.

5 Carry out eradication programme (if deemed feasible).

6 If eradication is not feasible, investigate other control methods, or protect un-impacted high-value areas of the lake.

7 If eradication is deemed feasible, continue intensive surveillance for outlier sites and evaluate effectiveness of control.

8 Once all pest plants are removed, continue regular surveillance of the treated areas for at least two years. Any new plants detected re-set the programme.

To date we have completed steps 1 to 2, and LINZ have completed the initial control work to contain the current infestation (step 3). Management options have been evaluated and presented to Council recommending a “Containment” approach (step 4).

2.5 Discussion

The initial introduction of hornwort to Lake Okareka probably occurred with fragments being transported from another lake via a vessel. With the hornwort infestation being greatest in mass along Boyes Beach, there is reason to believe that the incursion initially established at this point.

The current delimited estimation of hornwort presence within Lake Ōkāreka is 17.5 ha. Broken down, this equates to:

- Boyes Beach - 9 ha, medium density.
- Department of Conservation campsite - 4 ha, medium density.
- Combined remaining sites – 4.5 ha, low density.

Established populations of *L. major* and *E. densa* minimise the ability to detect low density infestations. Lake Okareka also has relatively low visibility compared to some other lakes, due to natural characteristics and human influences. This reduces our confidence that all known infestations have been located and impacts on the likelihood of eradication attempts being successful.

The potential habitat for hornwort in Lake Ōkāreka is considered to be 102 ha. Calculations suggest hornwort currently inhabits 17% of the potential habitat, therefore, is already reasonably well established. This has been a major consideration when identifying management options and the efficient use of resources.

The northern bays have beds of *L. major* growing within depth bands of five to seven metres, shallower depth bands (two to five metres) are still primarily dominated by native charophytes. Hornwort plants were found on the shallower margins, fringing *L. major* beds, and fragments were discovered in the shallows within the exterior margins of raupo. The exception to the above was the location of one large infestation which has colonised a 50 m² area. This infestation leads into the Boyes Beach area where hornwort is establishing in scattered plants of varying sizes. Due to the sizes and patterns of the scattered plants, this particular area can be recognised as one large infestation.

The lake bed within the southern bays of the lake is heavily infested by surface reaching *L. major*, particularly the bay, encompassing the outlet to Lake Tarawera. Here, *L. major* and *E. densa* are well established and easily dominate the plant community. Stands here are dense, tall, and surface reaching in depths of approximately 10 m. As discussed previously, this makes eradication difficult as it makes locating individual plants or low density infestations problematic; this has been a major consideration when identifying the appropriate management option.

Part 3: Management approach

3.1 Overview

It is probable that any decision not to actively manage hornwort at Lake Okareka will be strongly opposed by the community. The popularity of the lake means leaving hornwort to further establish increases vector risks to surrounding lakes (particularly Lake Tikitapu) which would further impact negatively on the overall invasive weed status' of Rotorua's lakes. Furthermore, if hornwort is left uncontrolled throughout the lake, the recreational, cultural and economic implications are likely to be significant.

At this stage, the option of eradication is not seen as viable due to:

- High level of current infestation.
- High recreational use of the lake which increases the likelihood of re-infestation both inter and intra lake.
- Limitations around visual ability for dive surveillance to locate every fragment and plant.

Given this, an approach that manages and reduces the impacts of hornwort within the lake will be implemented. This means focusing control programmes on areas with high amenity and recreational values and also areas that pose a vectoring risk. It is worth keeping in mind that current control methods of herbicide spray may be superseded by improved management options in the future and may allow for this approach to be reviewed.

It is acknowledged however, that this approach will still result in reduced biodiversity and LakeSPI values within the lake.

The areas of concern when taking into account amenity and recreational values, are the northern bays, particularly Boyes Beach and DOC campsite, where hornwort is established and located in shallower depth bands. The high recreational use of these areas highlights the need for control here in terms of vector risks with lake vessels.

Due to the dense, surface-reaching *L. major* and *E. densa* beds present in the southern bays of the lake, it is likely hornwort will initially establish along the bare substrate fringes, rather than within the charophyte beds in the shallower depth bands, this is due to the natural buffers provided by *L. major* and *E. densa*, as discussed earlier, this limits our ability to eradicate hornwort from these sites.

Pre and post control monitoring will be required to track and gauge the success of herbicide control. Annual monitoring will be completed over a three year period to evaluate the effectiveness of control programmes and assist with management decisions on timing of additional control.

3.2 Management plan

This Management Plan will be carried out in partnership with LINZ. Land Information New Zealand agrees, in principal, with the intent of this management approach. Work programmes and budgets will be agreed between Council and LINZ, following consultation with Te Arawa and key stakeholders, this consultation will be done on an annual basis. Work programmes will be dependent on available funding and other regional biosecurity priorities.

An “adaptive management” approach will be followed while implementing this plan. This will allow the programme to be modified quickly if new information or techniques are obtained, which indicate a change in approach is needed.

This management plan has three parts:

1 Containment of known hornwort infestations.

2 Monitoring of control programme effectiveness.

3 Increased public awareness programmes aimed at Lake Ōkāreka users.

3.2.1 Containment of hornwort infestations

Control, using appropriate herbicides, will be implemented annually during March/April, the time when hornwort is in full growth. These control operations will target areas of high amenity and recreational value and areas that pose a high risk for vectoring the pest. If monitoring reveals good control has been achieved, return times for repeat spray applications will be reviewed and reduced accordingly in an effort to minimise the use of herbicides.

The current control method for hornwort in the Rotorua Lakes is applications of the herbicide “diquat”. However, BOPRC is currently preparing a resource consent application for “endothall” which is showing strong potential for controlling hornwort, to support management of aquatic plant pest incursions.

Sites that will be targeted for control include (see Appendix 2 for maps):

- Department of Conservation campsite (amenity, biodiversity and vector point).
- Boyes Beach (amenity, biodiversity and high-risk vector point).
- Acacia Road boat ramp and weed cordon (high-risk vector point).
- Bay east of Acacia Road Point (amenity – homeowners on the point).
- Southern outlet (recreational – ski lanes).

All control programmes using herbicides will be carried out in accordance with all resource consent conditions.

3.2.2 Monitoring of control programmes

Pre and post spray monitoring would need to be undertaken to determine the size of the weed bed (pre) and the result of the spray operation (post). This information will then be analysed to determine the effects of the spray programme and provide information for management decisions on further control operations.

3.2.3 Increased public awareness programmes

A comprehensive communication strategy specifically aimed at Lake Ōkāreka users’ will be developed with the local community, lake users and Te Arawa Lakes Trust, to highlight the threats of aquatic pests and the measures lake users can take to prevent the vectoring of hornwort (and other pests) to other lakes. It will also aim to reduce barriers to herbicide use by ensuring stakeholders and local community are adequately informed about control programmes.

Areas of public awareness that will be considered include:

- Communications on risks with vector points.
- Timely information on the herbicide being applied and control methods. It will also be important to cover aspects of how the herbicide and application techniques impact on lake health and recreational users of the lake (i.e. restrictions on the lake while herbicides are being applied).

3.2.4 **Costs** (see Appendix 1 for itemised costs)

During 2012/13, BOPRC spent approximately $21,740 undertaking active aquatic pest surveillance in Lake Okareka. As hornwort, *L. major*, *E. densa*, and *E. canadensis* are now all present in the lake, this money will be diverted to the management options identified in this plan.

Annual costs to implement this Management Plan are estimated to be $31,620 and are summarised in the table below:

Plan Component	**Dollars (includes staff time)**
Control Programme	$24,500
Pre and Post monitoring	$7,120
Communications	$5,000
Total (annual)	**$36,620**
Total cost for 3 years	**$109,860**
Total cost for 10 years	**$366,200**

Considering the previous expenditure on surveillance in Lake Okareka, and the cost of the proposed management activities outlined in this plan, it is estimated that BOPRC will spend an additional $14,880 per annum specifically in Lake Okareka to implement this management plan.

Appendices

Appendix 1 – Cost Tables

Annual work programmes and budgets to implement the Plan will be jointly developed with LINZ and based on available funding and other biosecurity priorities. Annual work programmes will also need to consider the views of Te Arawa and other key stakeholders.

Itemised Cost Table

Component	Per day
Boat charge	$360
Divers (x 5, includes skipper)	$3,200
Control Programme	$1,400/ha (+ GST)

Cost Table for Containment Option

Site	Method	Area (ha)	Dollars
Boyes Beach	Boat and boom	9	$12,600
DOC campsite	Boat and boom	4	$5,600
Southern Outlet	Boat and boom	2.5	$3,500
Acacia Point Bay	Boat and boom	1.5	$2,100
Acacia Bay boat ramp	Boat and boom	0.5	$700
TOTAL		**17.5**	**$24,250**

Total Containment Option Costs

Plan Component	Dollars (includes staff time)
Control Programme*[1]	$24,500
Pre and Post monitoring*[2]	$7,120
Communications	$5,000
Total (annual)	**$36,620**
Total cost for 3 years	**$109,860**
Total cost for 10 years	**$366,200**

*[1]This cost does not include the LINZ contribution of 50% towards the annual spray programme.

*[2]Pre and Post monitoring is dive monitoring that is completed before and after herbicide spray. Monitoring determines the health of the plants pre and post spray efforts. It has been estimated to take divers two days annually.

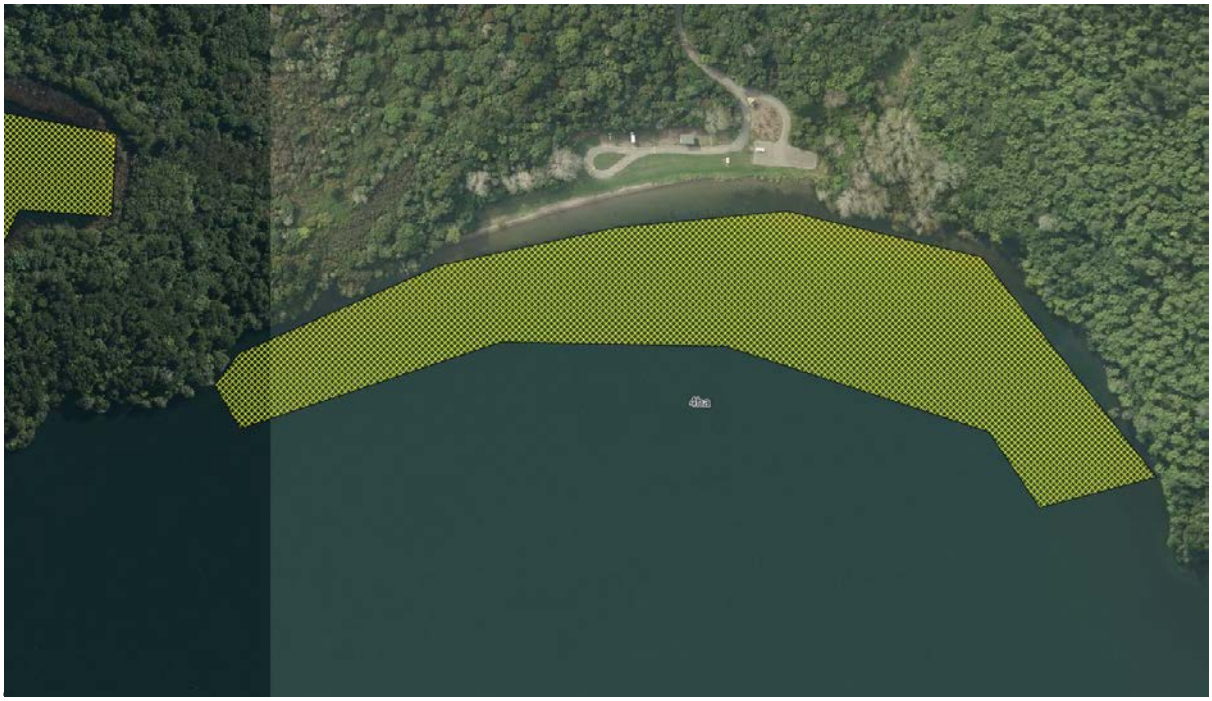
Appendix 2 – Maps

Boyes Beach –proposed area for spraying (9 ha)

Bay east of Acacia Point Road – proposed area for spraying (1.5 ha)

Southern Outlet – proposed area for spraying (2.5 ha)

Department of Conservation Campsite – proposed area for spraying (4 ha)



Weed Cordon and boat ramp (0.5 ha) – proposed area for spraying