

# **Outcomes of aerial pest plant control operations for alder and willow infestations at Wairarapa Moana**



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## Executive summary

The aim of this study was to determine the outcomes of the aerial herbicide spray operations completed annually to control alder and willow infestations at Wairarapa Moana since 2008. The goal of these pest plant control operations changed over time, with the initial aim being to halt the spread of alder on the eastern shore of Lake Wairarapa. This was to protect the wading bird habitat of the eastern lakeshore. A change of direction was made to site-focussed pest plant control in 2012 as part of the Fresh Start for Freshwater programme. Willow and alder were then controlled in selected wetlands for restoration purposes. There were two aims of removing these species in the Wairarapa Moana wetlands; initially to reinstate the original functional plant community types by removing woody vegetation and secondly to enable a shift from exotic to indigenous communities.

Vegetation communities along the eastern shore of Lake Wairarapa had been mapped in 2006. Areas that had been sprayed since 2008 were re-surveyed in March 2016 to determine the composition of the vegetation present and the effectiveness of the aerial spray operations over time. It was found that the early spray operations had halted the spread of alder along the eastern lake shore and that lower stature vegetation had become the dominant functional vegetation type. The effectiveness of aerial control of willow and alder in terms of the removal of these pest plant species depended however on a number of factors including the density of the original infestation and whether or not follow-up spray operations occurred. Reinvading alder and willow need to be kept under control to ensure that gains that have been made are not lost over time.

In terms of the shift from exotic to indigenous community types, the most successful aerial control operations were completed at sites where there were abundant native species in the understorey. Where the willow or alder infestations were dense with little native understory present, exotic species were found to dominate the plant community following the control operations. It may be possible that it will take some time for native species to re-establish in these areas. A strategy for how to shift these communities to native dominated systems should be developed. It would be useful to repeat the monitoring in five years' time to record any further changes in the vegetation communities.

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## 1. Introduction

Alder and willow have been identified as high priority pest plant species at Wairarapa Moana since 2000 (Airey et al 2000). Alder had replaced most of the wetland vegetation adjacent to the Wairio lakeshore over the past 30 years and was invading the lakebed turf fields. Alder had originally been planted as a shelter-belt tree on nearby farming properties. The *Carex* sedgeland and allied communities had been suppressed under the dense alder forest, while a combination of alder and tall fescue posed a threat to the lake turf fields, an important habitat for wading birds, including many migratory species. An analysis of changes in vegetation on the eastern shoreline from 1985 to 2007 showed that reedland was being lost to tall fescue and alder infestations (Wildland Consultants 2007a). The majority of the lake-edge wetlands were dominated by willow and lagoons (even of large size) were shrinking as a result of the willow invasion).

The vegetation communities on the northern and eastern sides of Lake Wairarapa were mapped in the summer of 2006/2007 and a restoration strategy completed (Wildland Consultants 2007b and c). A control programme to halt the expansion of alder infestations on the northern and eastern edges of Lake Wairarapa was initiated in late 2007, while a trial using two different chemicals for aerial spray alder and willow control operations was completed in 2008. A report was provided to the Wairarapa Moana Wetlands Group in 2011 (Crisp 2011) outlining the progress of the alder control programme, which was successfully controlling the alder invasion on the lake shoreline.

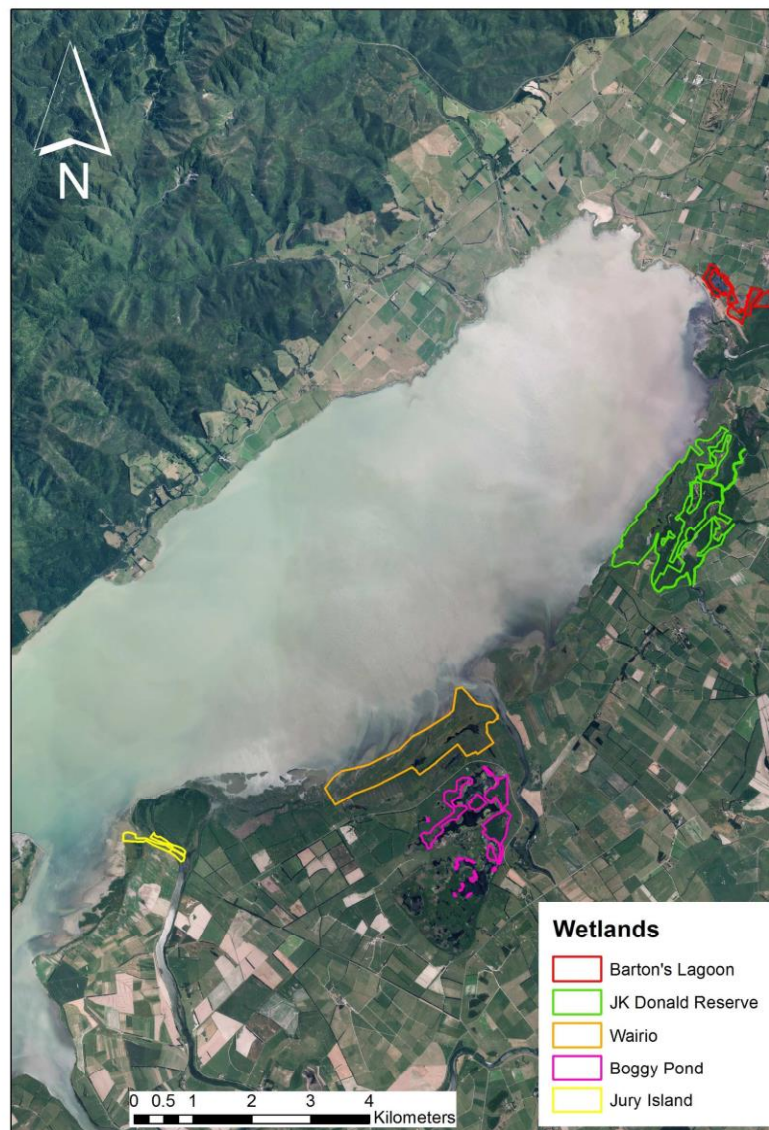
In 2012, funding for restoring Wairarapa Moana was received from the Ministry of the Environment as part of the FreshStart for Freshwater programme. The aim of that project was to restore six wetland sites on the side of Lake Wairarapa; Barton's Lagoon, JK Donald Reserve, Boggy Pond, Matthew's Lagoon and the Wairio Wetland. The focus of the Wairarapa Moana pest plant control programme changed to site-based willow and alder control with the aim of enabling a shift in the composition of the vegetation communities from those dominated by exotic species to those dominated by indigenous species. While it was recognised that this would take some time to eventuate, a short-term objective was to remove the trees to return the community to small stature vegetation to improve the capacity of the wetland to remove nutrients. It was considered that willows would be less effective in removing nutrients than perennial vegetation such as grasses and native vegetation. This is because willows are deciduous and stop growing during the winter months. Reconnecting lagoons by clearing willow choked waterways was intended to maximise contact (both in terms of space and time) between water and plants to improve nutrient removal.

A re-survey of the plant communities at the control sites has been completed in early 2016 by two Greater Wellington botanists (employed as casual staff). The aim of this re-survey was two-fold: firstly to assess the long-term effectiveness of the willow or alder control and secondly to record the changes in plant communities at those sites following the spray operations.

## 2. Methodology

Five areas at Wairarapa Moana (each containing a number of sites) were visited during March 2016; Barton's Lagoon (and Simmond's Lagoon), JK Donald Reserve, Boggy Pond/Matthews Lagoon, Wairio Wetland and Jury Island. The locations of these areas are shown in Map 1. An assessment of the effectiveness of the spray operation was made at each site by noting the pest plant kill rate and by recording the amount of re-sprouting seen. The plant community was then classified according to the vegetation classes used by Wildland Consultants 2007b, e.g. wetland pasture or exotic herbfield, with notes made of native and exotic species present.

**Map 1: Location of pest plant aerial control sites at Wairarapa Moana**





### 3. Results

A summary of the results recorded is shown in Table 1. Maps showing the areas referred to are shown in the field notes in the Appendix (Maps 2, 3, 4, 5 and 6). In general, good kills were recorded, but there is now abundant resprouting and seedling growth at the alder control sites at Simmonds Lagoon and Jury Island (aerial control of alder and willow completed in 2008). It should be noted that the areas of greatest pest plant re-sprouting were those that were treated the most years ago and where re-spraying did not occur. Alder infestations have shown the greatest degree of regrowth. Control was effective at the sites where pest plant densities were low, e.g. where the infestations were in the early stages of invading the indigenous plant communities (Wairio wetland Area 4, JK Donald Reserve Area 1 and Barton's/Simmond's Lagoon Area 4).

Of the 18 re-survey sites that were classified as willow or alder infestations in 2006:

- 5 sites (28%) have remained in exotic vegetation, i.e. are now exotic herbfield/wetland pasture
- 7 sites (39%) are now classified as native vegetation, and
- 6 sites (33%) are a mix of native and exotic species (but largely exoticdominated).

The type of plant communities present at sites where pest plant control had been completed was found to be dependent on the original communities present. The areas where there was originally a dominance of native undergrowth have regenerated in native species, but in the majority of cases (over 70% of sites), the undergrowth was either exotic pasture originally or was completely shaded out by the willow or alder tree infestation. Native regeneration was greatest in areas where the pest plant density was lower, e.g. Barton's/Simmond's Lagoon Area 4 or JK Donald Reserve Area 1. In contrast, where the pest plants were present as a thicket, e.g. JK Donald Area 3, very little native vegetation is regenerating.

As an aside, but worth noting is an area that was controlled using ground control in 2008 (but is not included in this aerial control analysis). The area was planted in 2008, but has had top-up plantings completed by the community since that time. Some species from the original plantings are now over two metres in height. Flax, ribbonwood, toetoe, manuka and some *Carex* species appear to have been the most successful species that have established at this site. It is also worth noting that a change to the water management at Boggy Pond has led to willow being replaced by open water or water/raupo, especially at the northern end.

**Table 1: Summary of changes in plant communities at aerially controlled alder/willow infestations (areas identified are shown in the Appendix)**

Site	Area	Original classification	Current classification	Effectiveness of control	Control Year	Herbicide
Barton's Lagoon	1	Alder forest	Exotic herbfield/wetland pasture	Good kill Re-sprout 1 tree in 50	2013 2015	Glyphosate
Barton's Lagoon	2	Willow/alder forest	Exotic herbfield/wetland pasture	Good kill Occasional resprout	2013 2015	Glyphosate
Barton's Lagoon	3	Alder forest	Regenerating native shrubs	Good kill Re-sprout 1 tree in 100	2015	Glyphosate
Barton's Lagoon (Simmonds Lagoon)	4	Alder/willow over Isolepis herbfield	<i>Isolepis</i> herbfield	Good kill Re-sprout 1 tree in 50	2013 2015	Glyphosate
Barton's Lagoon (Simmonds Lagoon)	5	Alder forest	<i>Carex germinata</i> dominant, but flax, toetoe, cabbage tree	Immediate kill good but major re-sprouting now	2008	Garlon
Barton's Lagoon (Simmonds Lagoon)	6	Alder forest	Alder with gorse, blackberry and some flax and cabbage trees	Immediate kill good, but less so than with Garlon Numerous alder trees and abundant resprout	2008	Glyphosate
JK Donald Reserve	1	Willow forest	Mixed indigenousexotic rushland and herbfield	Good kill No re-sprouts	2014 2015	Glyphosate
JK Donald Reserve	2	Willow forest/raupo	Raupo, indigenous shrubland	Good kill No re-sprouts	2015	Glyphosate
JK Donald reserve	3	Willow forest	Exotic herbfield/wetland pasture	Good kill No re-sprouts	2015	Glyphosate
JK Donald Reserve	4	Willow forest	Exotic herbfield/wetland pasture	Good kill No re-sprouts	2015	Glyphosate
Boggy Pond	1	Willow forest	Exotic herbfield, but some native plants establishing	Good kill 1 re-sprout seen	2014 2015	Glyphosate
Boggy Pond (Matthews)	2	Willow forest	Beggar's ticks, some native	Good kill Section of regrowth on western edge of path	2015	Glyphosate
Boggy Pond	3	Willow forest	Sparse native plants	Good kill No re-sprouts	2014 2015	Glyphosate
Boggy Pond (Matthews)	4	Willow forest	Sparse native plants	Good kill No re-sprouts	2016	Glyphosate
Wairio Wetland	1	Willow forest	Exotic herbfield/wetland pasture	Good kill No re-sprouts	2013 2015 2016	Garlon and glyphosate

Wairio Wetland	2	Alder/ <i>Isolepis</i>	<i>Isolepis</i> herbfield	Good kill No re-sprouts	2008 2011 2012 2014	Garlon
Jury Island	2	Alder forest	Beggar's ticks, <i>Cordyline</i> and other natives	Regrowth occurring	2008	Glyphosate
Jury Island	3	Alder forest	<i>Carex</i> , <i>Isolepis</i> , <i>Austroderia</i>	Regrowth occurring	2008	Garlon

#### 4. Discussion

The effectiveness of alder and willow control depended on a number of factors including the density of the original infestation and whether or not the infestation was re-sprayed as part of a follow-up programme. The alder and willow spraying at Simmonds Lagoon and Jury Island appeared to be effective at the time of control, but those infestations were not re-sprayed when the focus changed from species-focussed to site-based pest plant control (as part of FreshStart for Freshwater) in 2012. The previous goal of halting the range expansion of alder was achieved by the removal of the infestations of this pest plant species on the eastern shoreline of the lake (Wairio Area 2 and JK Donald Area 1) and between Barton's and Simmond's Lagoons (Simmond's Area 4). The control of the expansion of willow (as opposed to alder) was also successful on the lake edge (Wairio Wetland Area 2 and JK Donald Area 1). The functional low stature plant communities are now dominant in these areas. In both cases the undergrowth that was previously present (*Isolepis* or mixed exotic/indigenous herbfields) has benefited from the control. –These areas will remain at risk of reinvasion however and vigilance is required to keep alder and willow seedlings from re-establishing.

The alder control in Simmond's Lagoon and at Jury Island was part of a herbicide trial, using Garlon and Glyphosate on willow and alder infestations. While the results were initially promising, follow-up control was needed to contain those infestations. This site has yet to shift to operational maintenance in the control programme. The successive aerial pest control operations at Barton's Lagoon have been effective, but there will be a need to check for resprouting (e.g. Area 1 is showing some signs of regrowth). A greater degree of re-growth was recorded in alder (as opposed to willow), which may be an indication of the greater degree of difficulty in controlling this pest plant species.

Recent willow control at Boggy Pond (and Matthews Lagoon) and in JK Donald Reserve appears to have been very effective and has been successful in removing the woody species. The collapse of dead willow at Boggy Pond has occurred about five years after spraying. There is less evidence that there has been a successful shift from exotic to native-dominated plant communities where there were high densities of pest plants present. While it may be that it will take some time for native regeneration to occur in these areas, there is concern that it is will be difficult for native species to re-establish where exotic species dominate. Huge, old *Carex* plants can be seen in parts of Matthew's

Lagoon where willows had not invaded, but the re-establishment of species such as these into willow-controlled areas will be slow. A strategy for how to shift these communities to native dominated systems should be developed.

## **5. Recommendations**

While the original approach to pest plant control at Wairarapa Moana was successful in halting the invasion of alder and willow, it is now worthwhile to approach the control of the large pest plant infestations in a more finely tuned site-based fashion. The goal is to continue pest plant control in a manner that allows the habitat to adapt slowly to the removal of the exotic species present, with smaller areas being targeted. This approach is being taken by the Wairarapa Moana Ecological Management Programme managed by the Department of Conservation. Vigilance for any expanding infestations needs to be ongoing (e.g. at the invasion fronts on the lake edge) and continuing control of already controlled infestations should remain a priority. Given that the best regeneration is seen in areas where there is existing native vegetation, consideration should be given to controlling those areas as the next priority. A strategy needs to be developed to shift the exotic-dominated communities within the wetland complex to native-dominated communities following pest plant control. Monitoring should be repeated in five years' time to record any further changes in the vegetation communities.

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## Appendix - Botanist field notes

### A1 Barton's Lagoon

#### Map 2: Operational areas at Barton's and Simmond's Lagoon



#### Area 1 (Barton's Lagoon)

- Spray appears to have been very effective
- Approx. 1:50 show sign of young regrowth
- The surrounding fence line just above the shallow wetlands there are approx. 1 seedling per 5m<sup>2</sup> (alder) Seedlings are no older than 2 years
- The area is now wetland pasture/ exotic herbfield
- The wetlands are a combination of mostly raupo and *Bidens* (Beggars ticks)
- Hard to visualise recruitment within the dead alder wetland, but probably <5 per 5m<sup>2</sup>

- Worthwhile spraying the gorse that is currently a small infestation near the plantings on the lake side of the lagoon.

#### **Area 2 (Barton's Lagoon)**

- 99% of the targeted willow and alder have been killed. 2-3 willow and 2-3 alder are re sprouting in entire site. Water too deep to access, so visual assessment with binoculars
- Wetland pasture/ exotic herb field.

#### **Area 3 (Barton's Lagoon)**

- Alder is 99% dead (maybe 1 re shoots per 100 trees)
- Some mahoe regeneration. There are 3 well established plants
- Just outside the target area is blackberry and gorse beginning to establish.

#### **Area 4 (Simmond's Lagoon)**

- A dense area of alder and willow has been significantly targeted and killed. The willow has been far more effectively killed from visual assessment with binoculars
- A number of mature alder have survived approx. 5-10 trees
- Approx. 1:50 significantly spray damaged alder are re shooting
- There is an established population of willow and some mature fruiting alders in a long strip on the southern side of the track south of (4) that should possibly be targeted in the future.

#### **Area 5 (Simmond's Lagoon)**

- The area controlled with Garlon has had obvious immediate results, but there is much young regrowth from the alder. Too numerous to effectively count
- The very dead trees in this site are probably willow. There appears to be a lot of common native plants establishing in this site. Especially flax, cabbage trees, toe toe and mahoe. *Carex geminata* is dominant wetland cover
- Blackberry and gorse are also present. There are a number of defoliated but not dead willows along western boundary.

#### **Area 6 (Simmond's Lagoon)**

- The immediate success of control at this site is also evident, but apparently not so successful as Garlon (5). Possibly this area was far more dense with mature alder trees and few willows to begin with
- Numerous 2-5m tall alder and abundant re shoot on the majority of plants. Flax and cabbage are present, but much of the area is being overrun with gorse and blackberry
- Another spray should certainly be considered.



**Photo 1: Simmonds Lagoon Area 5 – alder re-shoot, defoliated willow and *Carex geminata* understory**

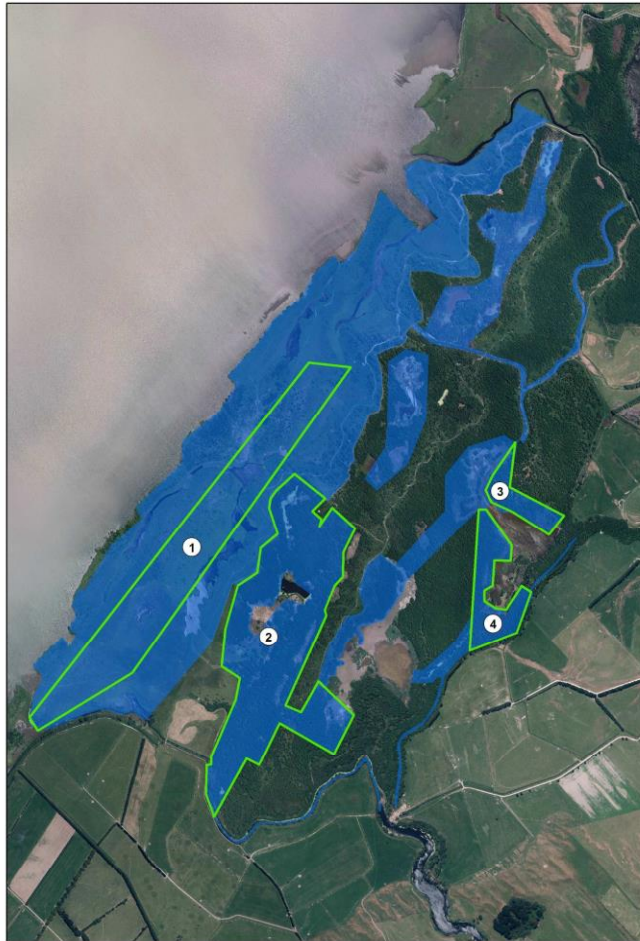


**Photo 2: Simmond's Lagoon Area 6 – alder re-shoot, blackberry and defoliated willow in background**



## A2 JK Donald Reserve

Map 3: Operational areas at JK Donald Reserve



### Area 1

- The area can be classified (i) turfs and mudflats and (ii) mixed indigenous exotic rushland and (iii) exotic herbfield and grassland
- Willow control has been very successful. No regrowth seen in 100 plants counted
- <10 % of flora is native. *Apodasmia similis*, *Cordyline australis* and *Coprosma propinqua*
- Mostly exotic herbs. *Rumex obtusifolius*, *Cirsium sp*, *Persicaria hydropiper*
- Large areas of *Schedonorus arundinaceus* (tall fescue) and on wetland peripheries *Paspalum distichum* (Mercer grass)
- The area is currently being heavily grazed by cattle
- The lake edge has a narrow strip of healthy willow trees that were obviously not targeted during control.

## Area 2

- The area can be classified (i) wet pasture with pockets of (ii) indigenous shrub and (iii) Raupo
- Willow control has been very effective. 0 regrowth seen in 100 plants counted.
- On exiting southern part of site, some very young regrowth visible on mostly dead mature trees.
- A small grove of willow hasn't been targeted on the south west corner of this area
- There are some very healthy populations of raupo within this area, and raupo appears to be establishing in open low wetland areas throughout
- There are pockets of *Coprosma propinqua*, *Phormium tenax* and *Cordyline australis*. Also a number of maturing *Dacrycarpus dacrydioides* (kahikatea) within wetland.
- The northern part of the site has numerous *Coprosma propinqua*, *Parsonsia heterophylla*, *Melicytus ramiflorus*, *Muehlenbeckia complexa* and *Cordyline australis*.

## Area 3

- Wetland pasture. (Temporary wetland). It is proposed that the land manager will open weirs in this area and drain. This area is probably re classified exotic herbfield
- Willow control has been very effective. No regrowth in 100 plants counted
- *Persicaria hydropiper* is dominant
- Very little native vegetation
- Area is currently at least foot deep water.

## Area 4

- Wetland pasture. Similar to site (3).
- Willow very effectively controlled
- Only visual assessment from a distance with binoculars. Site in deep water (again, this is a temporary wetland).

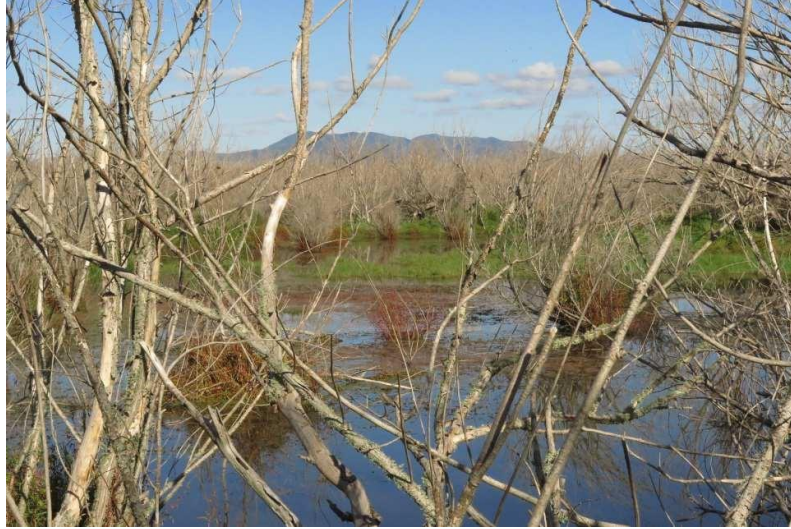
**Photo 3: JK Donald Reserve Area 1- dead willow and tall fescue**



**Photo 4: JK Donald Reserve Area 2 -Dead willow and dense raupo**



**Photo 5: JK Donald Reserve Area 3 looking at Area 4 – dead willows**



### A3 Boggy Pond and Matthews Lagoon

Map 4: Operational areas at Boggy Pond and Matthews Lagoon



#### Area 1 (Boggy Pond)

- Wetland pasture/ exotic herbfield
- Willow has been significantly controlled. Only 1 sign of regrowth in total target area
- Older mature trees on the periphery of Boggy Pond, parallel to road have not been affected. Assumed that these trees were purposefully not targeted
- The surrounding wetlands are raupo reedland dominant, raupo seems to be coming up in small patches within the remnant willow forest
- Very lush exotic herbfield within wetland, beneath dead willow. *Ranunculus sp.*, *Solanum nigrum*, *Sonchus sp.*, *Calystegia silvatica* are abundant
- *Bidens frondosa* is prolific on the edges of wetland
- Some native plants are establishing within area. *Cyperus ustulatus*, *Solanum lacciniatum*, *Cordyline australis*, *Juncus sp.*, *Carex sp.* and *Phormium tenax*.

### **Area 2 (Matthew's Lagoon)**

- Mixed exotic herbfield (80%), indigenous shrub land (20%)
- Willow significantly killed off. However, the western edge of the path has Willow regrowth on approx. 10 plants per 50m.
- Area is higher, and drier ground compared to Boggy Pond border
- Underneath dead willow, *Bidens frondosa* is prominent and tall. *Persicaria hydropiper* and *Conzuya* are also present.
- Native plants include *Solanum lacciniatum*, *Melicytus ramiflorus*, *Carex secta* and *Cordyline australis*.
- A large area on eastern side of the main path has obviously been sprayed this season and is showing signs of decline

### **Areas 3 (Boggy Pond) and 4 (Matthew's Lagoon)**

- A long strip of previous willow forest and various small islands of willow trees were mostly inaccessible due to deep water. Visual with binoculars from where possible showed willow control to be very successful, no visible regrowth. Vegetation types now very similar to the other sites in Boggy Pond, with the usual native plants as already listed present, but sparse.

### **Photo 6: Boggy Pond Area 1 - dead willow and lush exotic herbfield, mostly *Ranunculus sp***



**Photo 7: Boggy Pond Area 2 - dead willow and dense, tall beggars ticks**



**A4 Wairio wetland**

**Map 5: Operation areas in Wairio wetland**





### Area 1

- The area was originally classified as alder. The strip of trees were once willow, but have been effectively killed. No sign of regrowth or recruitment - The site should now be classified exotic herbfield and grassland (pasture) - Mostly *Rumex obtusifolius*, *Schedonorus arundinaceus*, *Bidens frondosa*.

### Area 2

- South west of the area are various alder trees that have been effectively killed with no apparent sign of regrowth. This area was not allocated as part of the main Wairio willow control zone 2014.

## A5 Jury Island

### Map 6: Operational areas at Jury Island



### General area

- Alder and willow still appears to be a problem at Jury Island

- It is obvious where the alder (and some willow) has been targeted (1) and (2) on map
- Regrowth is evident on old trees and recent recruitment present. There are numerous alder in the vicinity that are fruiting.

#### **Area 1**

- Glyphosate has shown the most success, but 17 trees were showing strong regrowth.

#### **Area 2**

- Garlon has been less effective. Over 75 alder still alive within target area. These are all new regrowth on previously poisoned trees
- Within areas (1) and (2) there are many *Cordyline australis* growing well with new recruitment present. There are patches of raupo, *Carex geminata* and *Carex secta*. *Austroderia sp.*, and *Isolepis prolifera*
- The seasonal wetland/ inlet that divides the two target areas is predominantly mercer grass (*Paspalum distichum*), beggars ticks (*Bidens frondosa*) and tall fescue (*Schedonorus arundinaceus*).

**Photo 8: Jury Island - divide of healthy alder between pasture and target area, spray damage obvious on tree tops**



**Photo 9: Jury Island – looking towards Area 1 from seasonal wetland full of beggar’s ticks, with healthy strip of native vegetation and uncontrolled alder in background**

