One Tree Reach Wetland

Plan of Management

October 2013

One Tree Reach Wetland

Plan of Management

for

Hornsby Shire Council

By

Waratah Eco Works

Document Control

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For Waratah Eco Works	
Name	Michael Dixon
Position	Director
For Client Name	Hornsby Shire Council
Name	Mark Hood
Position	Project Officer - Biodiversity Planning & Assessment

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Glossary

AMSL – above mean seal level

ANSTO – Australian Nuclear Science and Technology Organisation

Anthropogenic: caused or produced by humans (www.macquarieonline.com.au)

AHD – Australian Height Datum: a common national surface level datum approximately corresponding to mean sea level.

ANZECC – Australian and New Zealand Environment Council

ARI – Average Recurrence Interval: is the average or expected value of the period between exceedances of a give discharge.

ASS - Acid Sulfate Soils

Catchment - an area of land from which all runoff water flows to a low point (river, creek harbour, etc). (www.stormwater.net.au/definitions)

Climate Change - is a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. (Wikipedia accessed 16/05/13).

CPW – Cumberland Plain Woodland

EEC - Endangered Ecological Community – a group of species that occur together in a particular area of the landscape that are listed on Schedule 1 of the NSW Threatened Species Conservation Act 1995

EPI – Environmental Planning Instrument

GPT - gross pollutant traps are used to prevent large items from polluting waterways

Halocline – a well-defined vertical salinity gradient in saline water. In general water with a higher concentration of salinity sinks below water that is less saline (The Free Dictionary accessed 20/06/13)

HSC – Hornsby Shire Council

Hydrology: the science dealing with the occurrence, circulation, distribution, and properties of the waters of the earth and its atmosphere. (www.dictionary.com)

Impervious surfaces that do not allow water to penetrate, such as roof, driveways, paths, paving etc. (adapted from "Stormwater Detention" www.stormwater.net.au/definitions)

LPT - Liverpool-Parramatta Transitway

NHMRC – National Health and Medical Research Council

NWQMS – National Water Quality Monitoring Strategy

OSD – On Site Detention: is the temporary on site storage of stormwater with a controlled release into the drainage system. (adapted from "Stormwater Detention" www.stormwater.net.au/definitions).

PASS – Potential Acid Sulfate Soils

PMP – Probable Maximum Precipitation: the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of year. (BOM, 1994).

PMF – Probable Maximum Flood: is the flood that occurs as a result of the runoff generated by the Probable Maximum Precipitation.

RAMSAR – The international convention on wetlands, an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their wetlands of international importance.

RFEF – River – flat eucalypt forest

SMCMA – Sydney Catchment Management Authority

SOF – Swamp oak floodplain forest

SLR – Sea Level Rise: as oceans warm, they expand and take up more space; therefore, any increase in global temperature will result in sea level rise, which relates specifically to the long term trend in movement of mean sea level.

TWL – Top water level

VMP - vegetation management plan.

WSUD – Water Sensitive Urban Design: the planning and design of urban environments that is 'sensitive' to the issues of water sustainability and environmental protection.

Acknowledgements

The One Tree Reach Wetland Plan of Management (PoM) has been prepared by Waratah Eco Works (WEW) and J Wyndham Prince (JWP) for Hornsby Shire Council (HSC).

Waratah Eco Works and J Wyndham Prince wish to acknowledge the contributions made to the preparation of this PoM by HSC and members of the Laughtondale community who attended the onsite community meeting and Public Hearing and responded to the community newsletter and questionnaire.

EXECUTIVE SUMMARY

The One Tree Reach Wetland is located at Laughtondale on the banks of the Hawkesbury River in the Hornsby Local Government Area, approximately 74 kilometres North West of Sydney and around 9 kilometres south east of Wisemans Ferry. The immediate catchment area of the wetland is small covering around 50 hectares. The catchment is bounded by a steep sandstone escarpment to the west and the Hawkesbury River to the east. Around half the catchment is covered in natural bushland and the remainder is subject to rural land uses.

One Tree Reach Wetland is generally a freshwater wetland with limited saltwater influence. Previous agricultural land uses have seen the wetland drained to less than half its original size. This has resulted in a reduced water level within the wetland producing Acid Sulfate Soils (ASS). The management of PASS and ASS in the wetland has been the subject of studies and monitoring by Hornsby Shire Council and has resulted in the installation of a weir within the drainage channel north of the wetland. The aim of the weir installation is to retain water at a higher level and so potentially reduce the generation of acidity from acid sulfate soils. Ongoing monitoring will be required to ensure the higher water level is controlling ASS and that retained water in the wetland does not become hyper saline.

The wetland represents one of the few intact natural wetlands in the lower Hawkesbury River, exhibiting a natural transition from areas of open water to dense floodplain paperbark scrub to adjoining terrestrial forest communities. It exhibits high conservation values with 5 endangered ecological communities (EECs):

- Swamp Mahogany Forest, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Floodplain Paperbark Scrub, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Floodplain Reedland, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Forest Red Gum River-flat Forest, part of the River-flat Eucalypt Forest on Coastal Floodplains (EEC);
- Swamp Oak Floodplain Forest (EEC);
- Coastal Saltmarsh (EEC) (as per Smith & Smith 2008, 2009);
- Freshwater Wetlands on coastal floodplains EEC (which includes the open water areas of the wetland) occupies the central wetland; and
- Habitat for 11 threatened fauna species including 3 bats.

The wetland is highly valued by the community as a natural wetland and as a recreational area they would like to see used for passive recreation. The proposed boardwalk, picnic tables, forest walk, signage and car park will further enhance the area for passive recreation. The community is particularly concerned about visitor access to the wetland and recommends access via the village of Wisemans Ferry and Singleton Road. The wetland has been the recipient of several grants administered by Hornsby Shire Council to assist in the remediation of the site. Ongoing grant funding will be required to achieve management strategies set out in this plan of management.

1 Introduction

1.1 One Tree Reach Wetland

The One Tree Reach Wetland study area is located at Laughtondale on the banks of the Hawkesbury River approximately 74 kilometres north west of Sydney and around 9 kilometres south east of Wisemans Ferry. The wetland considered in this plan of management (PoM) covers two land parcels, one larger northern lot owned by Hornsby Shire Council and a smaller southern lot that is a crown reserve (See section 2.3).

The wetland has a small catchment which drains directly to the Hawkesbury River. The wetland is generally a freshwater wetland with limited saltwater influence. Previous agricultural land uses have seen the wetland drained to less than half its original size. This has resulted in a reduced water level within the wetland producing Acid Sulfate Soils (ASS).

The wetland represents one of few intact natural wetlands in the lower Hawkesbury River. The wetland has been the recipient of several grants administered by Hornsby Shire Council to assist in the remediation of the site. Remedial works include ongoing weed management, bush regeneration, plantings and the construction of a small weir to maintain water levels in the wetland.

One Tree Reach Wetland is community land as defined by the Local Government Act, 1993 and as such requires a Plan of Management (PoM).

1.2 Plan of management

The Plan of Management (PoM) for One Tree Reach Wetland has been developed to:

"provide a holistic management document for the wetland."

Hornsby Shire Council (2013)

1.3 Objectives

The PoM will guide management and address the objectives identified by Hornsby Shire Council (2013):

- consider the unique ecology of the site;
- incorporate any associated reports and their recommendations and the proposed future uses of the site by Council; and
- form part of Council's long-term strategic plan for the management of natural resources throughout Hornsby Shire.

During preparation of the plan additional objectives became apparent including:

- recognition of the historical extent of the wetland;
- extension of management activities to the broader original wetland area.

The PoM also aims to reflect the community's concerns and aspirations for the wetland and surrounding area.

1.4 Scope of the Plan

The PoM contains a description of the wetland and an examination of its hydrology, environmental and social values. Relevant policies, acts and strategies are also considered. A brief issues analysis is presented along with management strategies to address issues and to enhance values. Management objectives and actions are prioritised and costed and potential funding sources identified.

As indicated the plan aims to recognise the original extent of the wetland, identify management issues and strategies to guide its day to day and long term management. Management strategies and actions have been developed to manage potential and actual acid sulfate soils, improve water quality and monitor the condition of endangered ecological communities and address community concerns about the management of the wetland and surrounds.

The Plan of Management should be reviewed every five years to enable the effectiveness of the recommended management actions to be considered and updated with new information or technology and community concerns. Wetland management actions should be reviewed annually and reported within the framework of HSC's reporting commitments.

1.5 Local Government 1993 Act

The Local Government (LG) Act, 1993 sets out the requirements for plans of management prepared under the Act. They include:

- categorising the land that is the subject of the Plan of Management;
- defining objectives and performance targets;
- stating the means by which objectives and performance targets will be met;
- stating the means by which performance targets will be measured;
- observing the requirements of any threat abatement plans and recovery plans made under the *Threatened Species Conservation Act 1995* and *the Fisheries Management Act 1994*.

Table 1 Local Government Act 1993 Requirements

LG Act Requirement	**Addressed**
Categorise the land	Table 2
Objectives and performance targets of the plan	Section 1.3
Indicate the means of achieving objectives and performance targets	Chapter 9, Appendix D
How Council will measure and assess objectives and targets	Chapter 9
Permitted future uses of the land	Section 2.3.5
Leases licences and other estates that can be granted	None known

2 Site Setting and Context

2.1 Location and Setting

The study area is located on the southern bank of the Hawkesbury River and surrounded by rural residential properties that support a mixture of agriculture, hobby farms and natural areas. One Tree Reach is a freshwater wetland located in the lower estuary of the Hawkesbury River. The wetland exhibits significant natural values with five endangered ecological communities present along with a variety of threatened and migratory species. A waterbird Survey of Hornsby Shire by Smith & Smith (2012) did not identify any migratory birds within the wetland. The wetland also exhibits soils that are strongly potential acid sulfate soils (PASS) and actual acid sulfate soils (ASS).

The management of PASS and ASS in the wetland has been the subject of studies and monitoring by Hornsby Shire Council and has resulted in the installation of a weir within the drainage channel north of the wetland. The aim of the weir installation is to retain water at a higher level and so potentially reduce the generation of acidity from acid sulfate soils.

Figure 1 Study Area Location

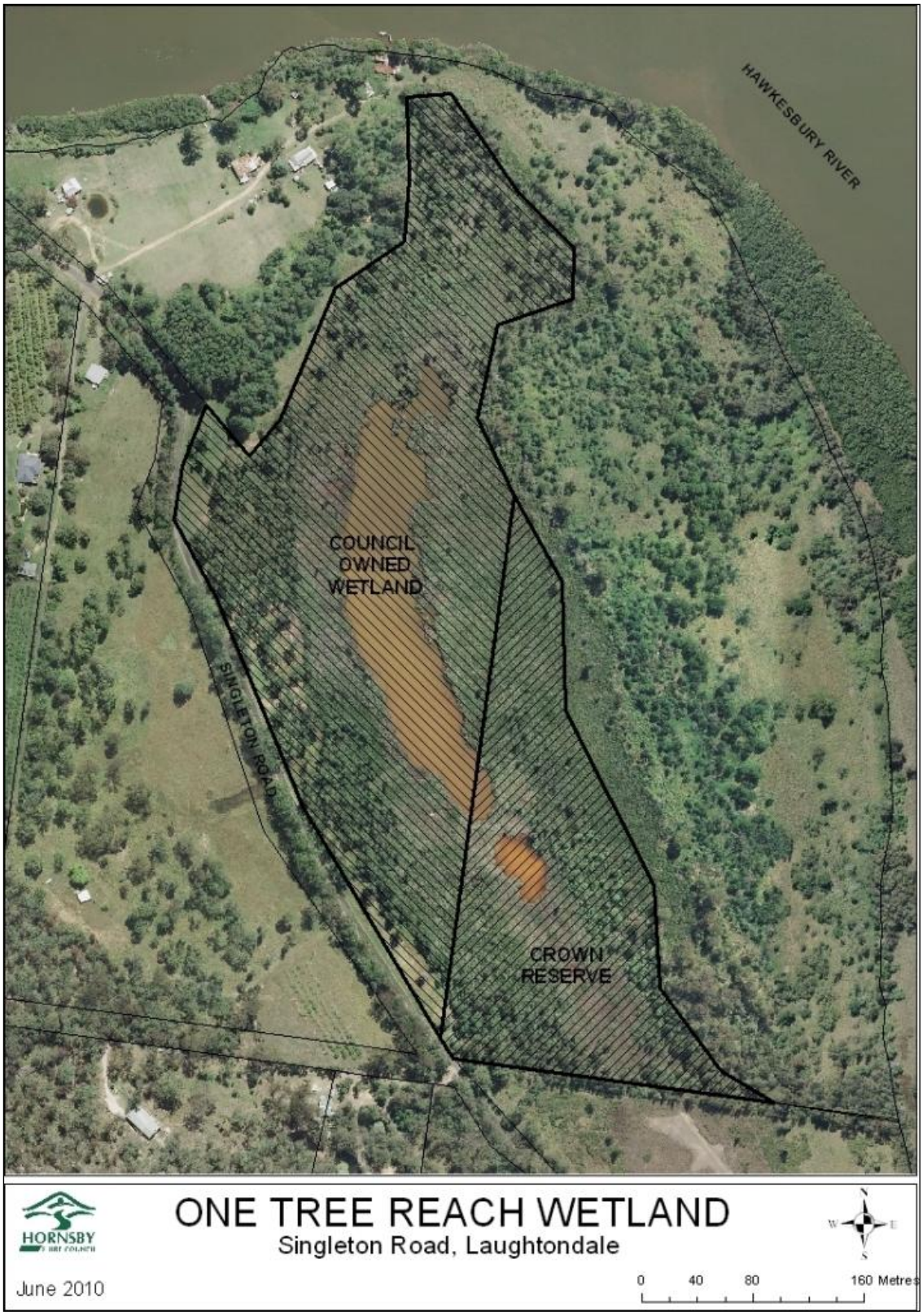

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Figure 2 One Tree Reach Wetland Location

The immediate catchment area of One Tree Reach Wetland is approximately 50 hectares. Approximately half of the catchment is native bushland without stormwater control. The remaining area supports a mix of rural residential properties, agricultural development and native bushland.

2.2 Site History

As part of the Hawkesbury River floodplain much of the broader study region would have been covered with a variety of native vegetation including wetland communities such as Floodplain Paperbark Scrub and Floodplain Reedland, along with Mangroves, Coastal Saltmarsh, Forest Red Gum and Swamp Mahogany River flat forest and Rainforest (Smith and Smith 2008).

The local area was officially settled from 1810 by Europeans. Whilst little is known of what modifications early settlers made to the study area, historical surveys reveal a drain was located between the wetland and the Hawkesbury River from the late 1870s (see survey plans in Appendix A). Anecdotal reports from local residents indicate that clearing and draining of the riverbanks to establish agriculture has occurred in the past.

Historical survey plans contained in Appendix A to this report indicate the current wetland was part of a larger system. The wetland was part of a land grant to William Warner who sold the land to William Browne. Portion 27, shown on the plans, does not contain the wetland but is adjacent to it. Portion 100 shown on the plans contains the wetland. The 1877 survey pans show the owner to be William George Cross. A Certificate of Title was issued to him for the land in 1905. In 1908 - the property was purchased by Ellen Green; later in 1908 by John Kelly; in 1934 by Ada Miller; in 1935 by Percy Charles Miller; in 1981 by George Ashley Miller; then in 1987 by Rod and Victoria Laughton; then in 1989 by Rod Laughton; and finally in 2010 Hornsby Shire Council.

The historical plans show the wetland as situated at One Tree Hill in the Parish of Frederick, Hawkesbury River. The first survey plan held by Hornsby Shire Council is dated 1832. The second dated 1877 clearly shows the “ditch” or drainage line has been cut at the northern end of the wetland to the Hawkesbury River. The third plan dated 1892 refers to the wetland, fringed by Tea Trees to the east and west as a swamp channel about 3 feet deep. The current extent of the wetland represents less than half of its historical extent with the southern half of the historical wetland having been drained by a channel being cut, linking it with Dalgetys Creek (Ward 2012).

2.3 Land tenure, zoning and management

The One Tree Reach Wetland consists of two lots one owned by Hornsby Shire Council and one is Crown Reserve. The legal ownership description and zoning are presented in Table 2.

The land parcels are classified as community land but are currently uncategorised. The categories under the Local Government Act 1993 proposed for the various land parcels are also shown in Table 2.

The applicable community land categories for the One Tree Reach Wetland as defined by the Local Government (General) Amendment (Community Land Management) Regulation 1999 are listed in Table 3, the actual land categories are shown in Figure 5.

The core objectives for each land category are listed in the Local Government Act 1993 and presented in Table 4.

Table 2 Land Ownership and Management One Tree Reach Wetland

Legal Description	Address	Owner	Current Zoning	Proposed Zoning	Classification	Proposed Categorisation
Lot 101/752029	Singleton Road, Laughtondale	Crown Reserve R45642 (Hornsby Shire Council Trustees	Environmental Protection A (wetlands)	Environmental Management E3.	Community Land	Wetland, Watercourse and Bushland
Lot 1/616661	901 Singleton Road, Laughtondale	Hornsby Shire Council	Environmental Protection A (wetlands) Environmental protection B (River Catchment)	Environmental Conservation E2 and Environmental Management E3.	Community Land	Wetland and Bushland

Table 3 Applicable community land categories

Category	Guidelines for Categorisation
Natural area: Bushland	Is the natural vegetation or a remainder of the natural vegetation of the land. Or although not the natural vegetation of the land, is still representative of the structure or floristics, or structure and floristics, of the natural vegetation in the locality. This includes bushland that is mostly undisturbed, or moderately disturbed or, highly disturbed
Natural area: Watercourse	any stream of water, whether perennial or intermittent, flowing in a natural channel, or in a natural channel that has been artificially improved, or in an artificial channel that has changed the course of the stream of water, and any other stream of water into or from which the stream of water flows, and associated riparian land or vegetation, including land that is protected land for the purposes of the Rivers and Foreshores Improvement Act 1948 or State protected land identified in an order under section 7 of the Native Vegetation Conservation Act 1997.
Natural area: Wetland	The land includes marshes. mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands that form a waterbody that is inundated cyclically, intermittently or permanently with fresh, brackish or salt water, whether low moving or stationary.

Source: Local Government (General) Amendment (Community Land Management) Regulation 2005

Table 4 Core objectives for community land management

Category	Core management objectives
Natural area: Bushland	(a) to ensure the ongoing ecological viability of the land by protecting the ecological biodiversity and habitat values of the land, the flora and fauna (including invertebrates, fungi and micro-organisms) of the land and other ecological values of the land, and (b) to protect the aesthetic, heritage, recreational, educational and scientific values of the land, and (c) to promote the management of the land in a manner that protects and enhances the values and quality of the land and facilitates public enjoyment of the land, and to implement measures directed to minimising or mitigating any disturbance caused by human intrusion, and (d) to restore degraded bushland, and (e) to protect existing landforms such as natural drainage lines, watercourses and foreshores, and (f) to retain bushland in parcels of a size and configuration that will enable the existing plant and animal communities to survive in the long term, and (g) to protect bushland as a natural stabiliser of the soil surface.
Natural area: Watercourse	a) to manage watercourses so as to protect the biodiversity and ecological values of the instream environment, particularly in relation to water quality and water flows, and (b) to manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation and habitats and bank stability, and (c) to restore degraded watercourses, and (d) to promote community education, and community access to and use of the watercourse, without compromising the other core objectives of the category.
Natural area: Wetland	(a) to protect the biodiversity and ecological values of wetlands, with particular reference to their hydrological environment (including water quality and water flow), and to the flora, fauna and habitat values of the wetlands, and (b) to restore and regenerate degraded wetlands, and (c) to facilitate community education in relation to wetlands, and the community use of wetlands, without compromising the ecological values of wetlands.

2.3.1 Current Zoning

The One Tree Reach Wetland is currently included in the Hornsby Shire Council Local Environmental Plan (LEP) 1994.The 1994 LEP will be superseded by the Draft Comprehensive Hornsby LEP 2013 (HSC 2013a) which has been adopted by Council and has been forwarded to the NSW Department of Planning and Infrastructure for gazettal.

At the time of writing the study area is zoned Environmental Protection A (wetlands) Zone and Environmental protection B (River Catchment) Zone. The location of the zones is shown in Figure 3.

The objectives of Environmental Protection A (wetlands) Zone are:

(a) to protect the ecological value of wetland areas;
(b) to assist in the maintenance of acceptable water quality in the Hawkesbury River; and
(c) to provide for development that is compatible with the ecology of wetlands.

No works are permitted in the zone without consent.

Development for the purpose of:

Agriculture; aquaculture; intensive animal establishments; intensive horticulture establishments; works for drainage that promote scientific or educational value of wetlands are permitted only with development consent.

The objectives of Environmental Protection B (River Catchment) Zone are:

(a) to protect the natural environment of sensitive areas within the catchment of the Hawkesbury River;
(b) to protect the valleys and escarpments within the catchment of the Hawkesbury River and accommodate land uses, including housing, that recognise environmental sensitivity of the area;
(c) *to protect the scenic quality of visually prominent areas and water quality within the catchment of the Hawkesbury River.*

Development without consent is permitted for the purpose of:

Agriculture; home occupations; special care homes; works which, in the opinion of the Council, are minor and will not cause significant environmental impact.

The following development is permissible only with development consent:

Agricultural structures; aquaculture; attached dwellings; bed and breakfast accommodation; bushfire hazard reduction (except ancillary buildings);communications facilities; dams; demolition; dwelling-houses; gardening; group homes; intensive animal establishments; intensive horticulture; establishments; landscaping; recreation areas; recreation facilities; utility installations.

Subdivision.

2.3.2 Proposed Zoning

One Tree Reach Wetland is included in the Draft Comprehensive Hornsby Local Environmental Plan 2013. The study area is covered by zones Environmental Conservation E2 and Environmental Management E3. The proposed zones are shown in Figure 4.

The objectives of zone E2 are:

(a) *To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values;*
(b) *To prevent development that could destroy, damage or otherwise have an adverse effect on those values.*
(c) *To maintain and improve water quality in the Hawkesbury River*

No works are permitted without consent.

Environmental facilities, Environmental protection Works; and Flood mitigation works are permitted with consent.

The objectives of the E3 zone are:

(a) *To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values. To provide for a limited range of development that does not have an adverse effect on those values.*
(b) *To protect the natural environment of steep lands and floodplains within the catchment of the Hawkesbury River.*

Environmental protection works, Extensive agriculture and Home occupations are permitted with consent in this zone.

The following are permitted with consent:

Aquaculture; Building identification signs; Business identification signs; Dwelling houses; Emergency services facilities; Environmental facilities; Farm buildings; Flood mitigation works; Group homes; Home based childcare; Recreation areas; Recreation facilities (outdoor); Roads; Tourist and visitor accommodation; Water reticulation systems; Water storage facilities.

Figure 3 Current Landuse Zones Hornsby Shire Local Environmental Plan 1994

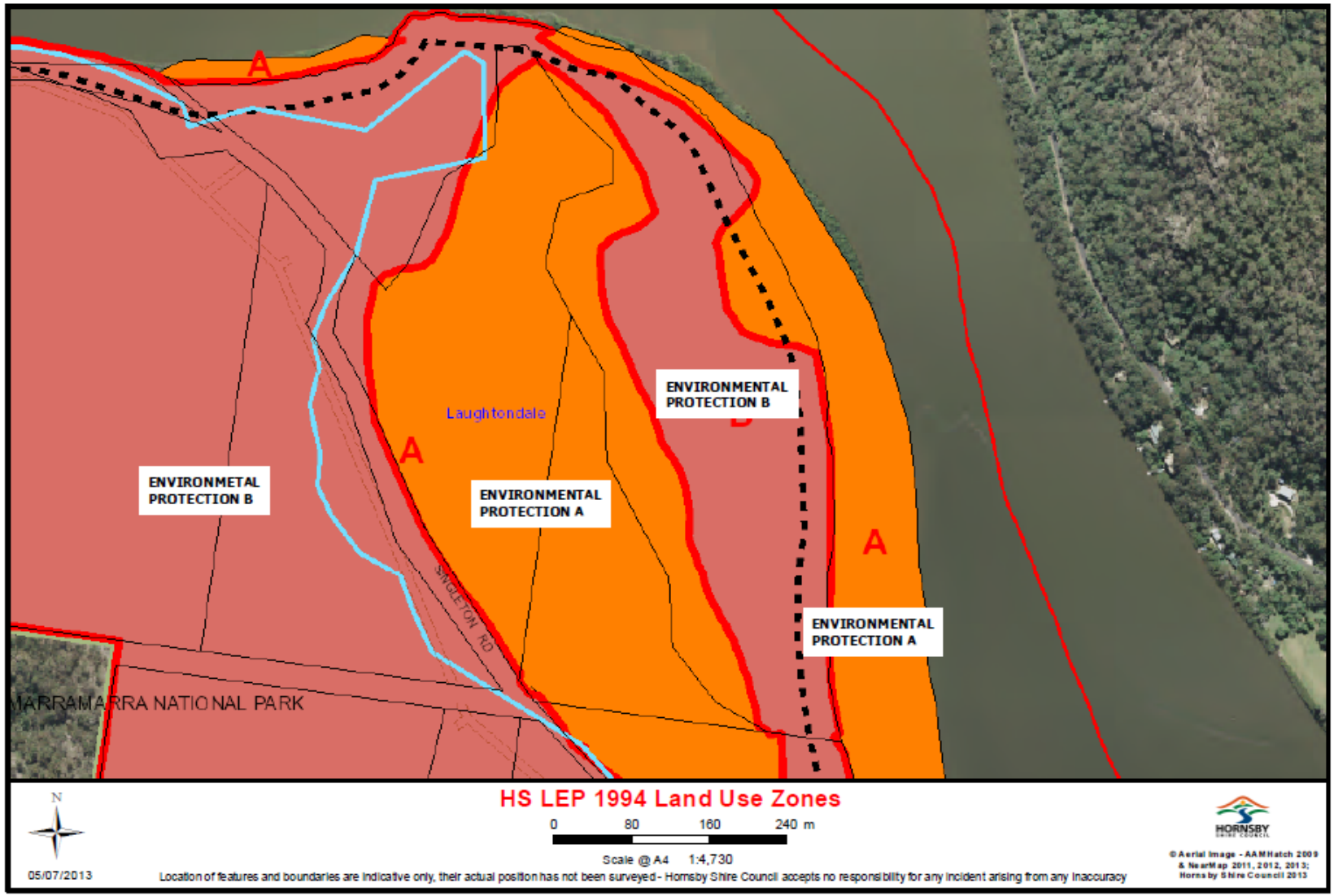

Figure 4 Proposed Landuse Zone Hornsby Shire Council Local Environmental Plan 2013

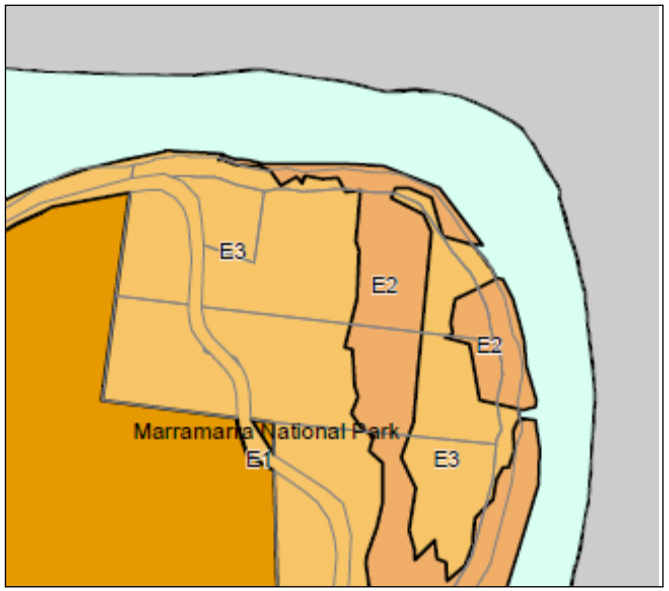

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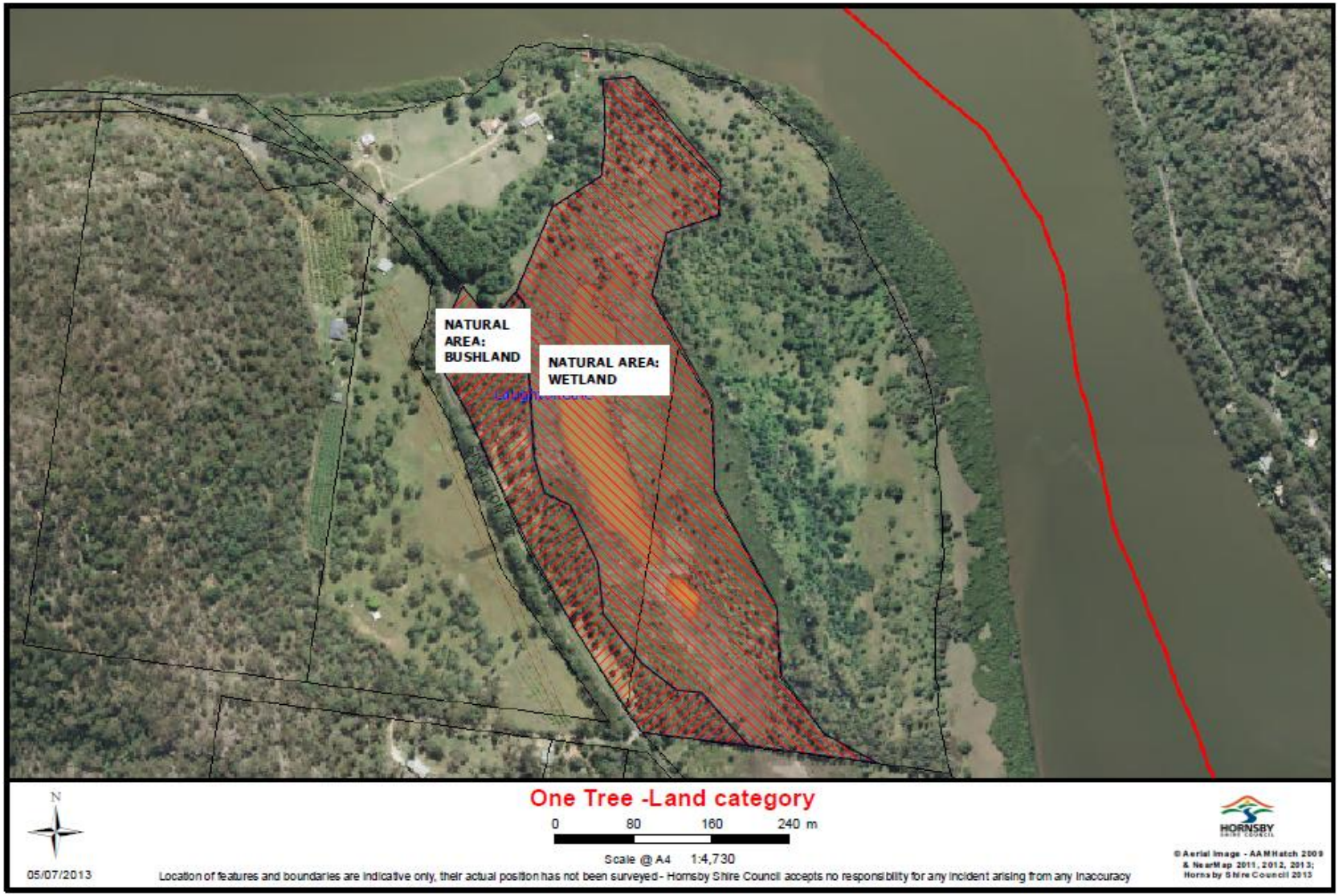
Figure 5 One Tree Reach Wetland land Category Map



2.3.3 Proposed Biodiversity Map

Part of the study area site is mapped as biodiversity on Council's Draft LEP 2013 Biodiversity Map. The objectives of the biodiversity clause is to maintain terrestrial biodiversity through:

(a) protecting native flora and fauna, and
(b) protecting the ecological processes necessary for their continued existence, and
(c) encouraging the conservation and recovery of native flora and fauna and their habitats.

Before determining a development application on land to which this clause applies, the consent authority must:

(a) consider whether there will be any adverse impacts on:

(i) the condition, ecological value and significance of flora and fauna, and
(ii) the importance of the vegetation to the habitat and survival of native fauna, and
(iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition on the land, and
(iv) habitat elements providing connectivity.

(b) be satisfied that:

(i) the development is designed, sited, and will be managed to avoid any potential adverse environmental impact, or
(ii) if that impact cannot be avoided after having taken into consideration feasible alternatives, the development is designed, sited and will be managed to minimise that impact, or
(iii) if that impact cannot be minimised, the development will be managed to mitigate that impact.

2.3.4 Proposed Acid Sulfate Soils Map

The study are is mapped as class 3, 4 and 5 Acid Sulfate Soils on Council's Draft LEP 2013 Acid Sulfate Soils Map.

The objective of this clause is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage.

(2) Development consent is required for the carrying out of works described below to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.

Class of land Works	Works
1	Any works.
2	Works below the natural ground surface. Works by which the water table is likely to be lowered.
3	Works more than 1 metre below the natural ground surface. Works by which the water table is likely to be lowered more than 1 metre below the natural ground surface.
4	Works more than 2 metres below the natural ground surface. Works by which the water table is likely to be lowered more than 2 metres below the natural ground surface.
5	Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the water table is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land. Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority.

(4) Despite subclause (2), development consent is not required under this clause for the carrying out of works if:

(a) a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicates that an acid sulfate soils management plan is not required for the works, and

(b) the preliminary assessment has been provided to the consent authority and the consent authority has confirmed the assessment by notice in writing to the person proposing to carry out the works.

(5) Despite subclause (2), development consent is not required under this clause for the carrying out of any of the following works by a public authority (including ancillary work such as excavation, construction of access ways or the supply of power):

(a) emergency work, being the repair or replacement of the works of the public authority required to be carried out urgently because the works have been damaged, have ceased to function or pose a risk to the environment or to public health and safety, or

(b) routine maintenance work, being the periodic inspection, cleaning, repair or replacement of the works of the public authority (other than work that involves the disturbance of more than 1 tonne of soil), or

(c) minor work, being work that costs less than $20,000 (other than drainage work).

(6) Despite subclause (2), development consent is not required under this clause to carry out any works if:

(a) the works involve the disturbance of less than 1 tonne of soil, such as occurs in carrying out agriculture, the construction or maintenance of drains, extractive

industries, dredging, the construction of artificial water bodies (including canals, dams and detention basins) or foundations or flood mitigation works, or

(b) the works are not likely to lower the water table.

2.3.5 Scale and Intensity of Permitted Uses

The scale and intensity of development within the study area will be guided by the objectives and permissible uses set out for the E2 and E3 zone in the 2013 LEP. Any proposed development will also be required to consider the objectives of the biodiversity clause and the acid sulfate soils clause in the 2013 LEP and will be required to consider the potential impacts on biodiversity values and acid sulfate soils and ensure impacts are mitigated. Any formal development in the study area would be outside the E2 zoning.

2.4 Climate

There are no weather recording stations in close proximity to Laughtondale, the closest Bureau of Meteorology Weather Station is in Richmond approximately 35 kms to the southwest. Consequently the following description of the climate for Laughtondale is based on the information for the Richmond Weather Station (#067021) and is indicative only, due to the distance and variation in topography between the two (2) sites.

For the purposes of this Plan of Management, It may be assumed that Laughtondale's climate is typical of North Western Sydney, with warm to hot summers reaching an average maximum temperature of 23°C. Winter months being cooler with an average maximum temperature of 10°C. The average annual rainfall is approximately 800 mm. January and February are generally the warmest months with the majority of the rainfall between February and March (Bureau of Meteorology, 2011).

Refer to the Bureau of Meteorology graphs Figures 5, 6, and 7, for the relationships between the annual and monthly averages for the Richmond UWS Hawkesbury Bureau of Meteorology weather recording station (# 067021). A more comprehensive set of climate and weather information for Richmond is available at:

http://www.bom.gov.au/climate/averages/tables/cw_067021.shtml

2.5 Physical Geography

Laughtondale is located on the Hawkesbury River Floodplain in the lower Hawkesbury River estuary. The Hawkesbury River occupies a drowned river valley and meanders through steep sandstone ridges (DLWC 1997). The Hawkesbury River, known as the Nepean River upstream of its confluence with the Grose River, drains an area of around 22,000 square kilometres (DLWC 1997). The total catchment is large extending south from the Hunter Valley, east from the Great Dividing Range and north from the Illawarra Range (DLWC 1997). The majority of the northern and western areas of the Hawkesbury River Valley are rugged, mountainous terrain that supports native vegetation (DLWC 1997). The southern part of the catchment is undulating to hilly with a large alluvial plain between Richmond and Windsor (DLWC 1997).

Warragamba Dam is located in the upper Hawkesbury, over 100 km upstream of Laughtondale (DLWC 1997). The dam came into operation in 1960 and has subsequently modified the flood behaviour of the River. The dam controls around 40% of the total Hawkesbury Nepean Catchment and flows reaching the estuary are highly reduced due to the dam and a variety of upstream weirs and reservoirs (HNCMA 2008).

The floodplains of the lower Hawkesbury estuary have been significantly modified by agricultural development, recreation and village developments (HNCMA 2008). They are typically small and narrow and are confined between the river and steep sandstone escarpments (DLWC 1997). The geomorphological processes of the river have created alluvial floodplains where small communities like Laughtondale have been established.

The geology of the study area is Hawkesbury Sandstone. Soils in the wetland are saturated, previous studies and mapping undertaken for the Draft Hornsby Shire LEP 2013 indicate the study area does contain actual and potential acid sulphate soils.

2.6 Adjacent Landuse

The study area has a number of different adjacent land uses. To the north is the Hawkesbury River main channel, to the west rural residential development supporting limited agriculture is present and to the west rural residential land that remains undeveloped. To the south lies the remaining 50% of the active wetland in private ownership that has been subject to drainage works. The wetland lies around 900 metres east of Marramarra National Park.

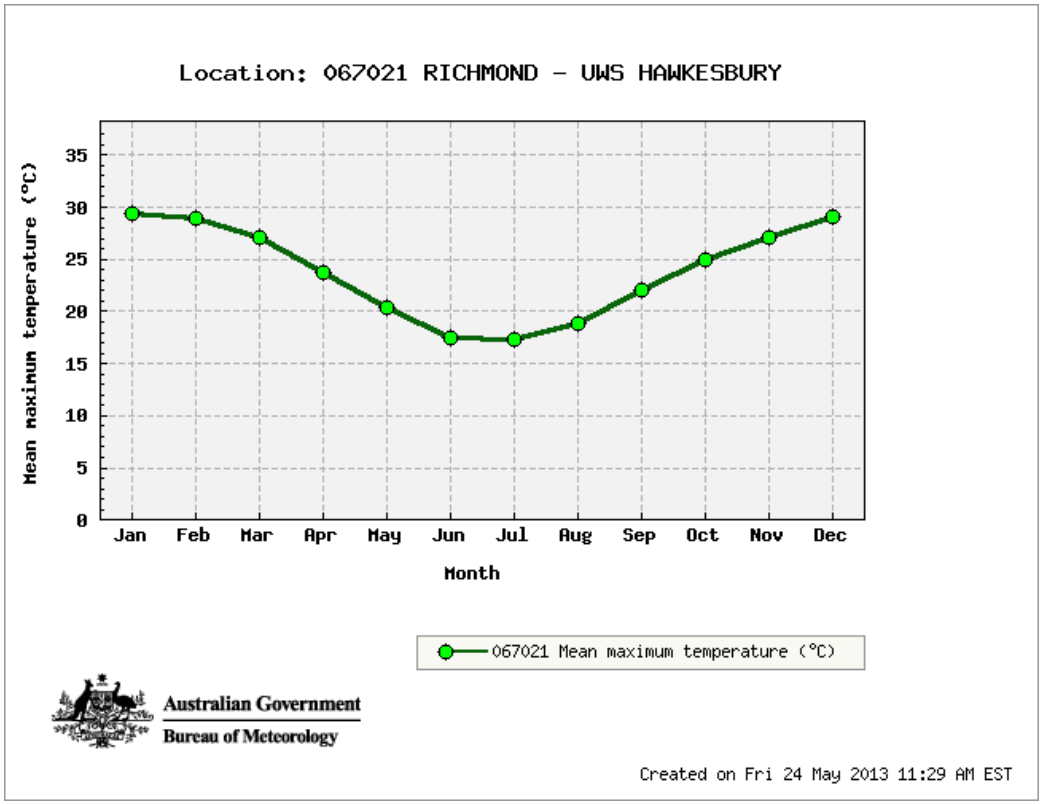


Figure 6 Mean monthly maximum temperatures

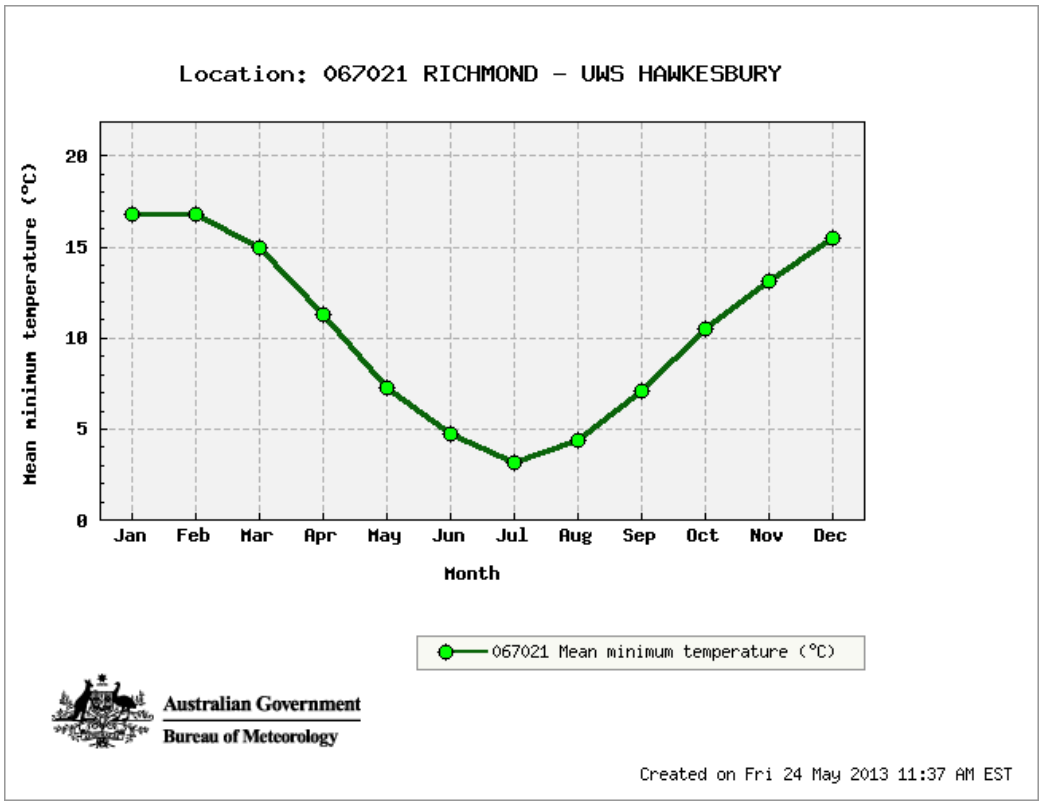


Figure 7 Mean monthly minimum temperatures

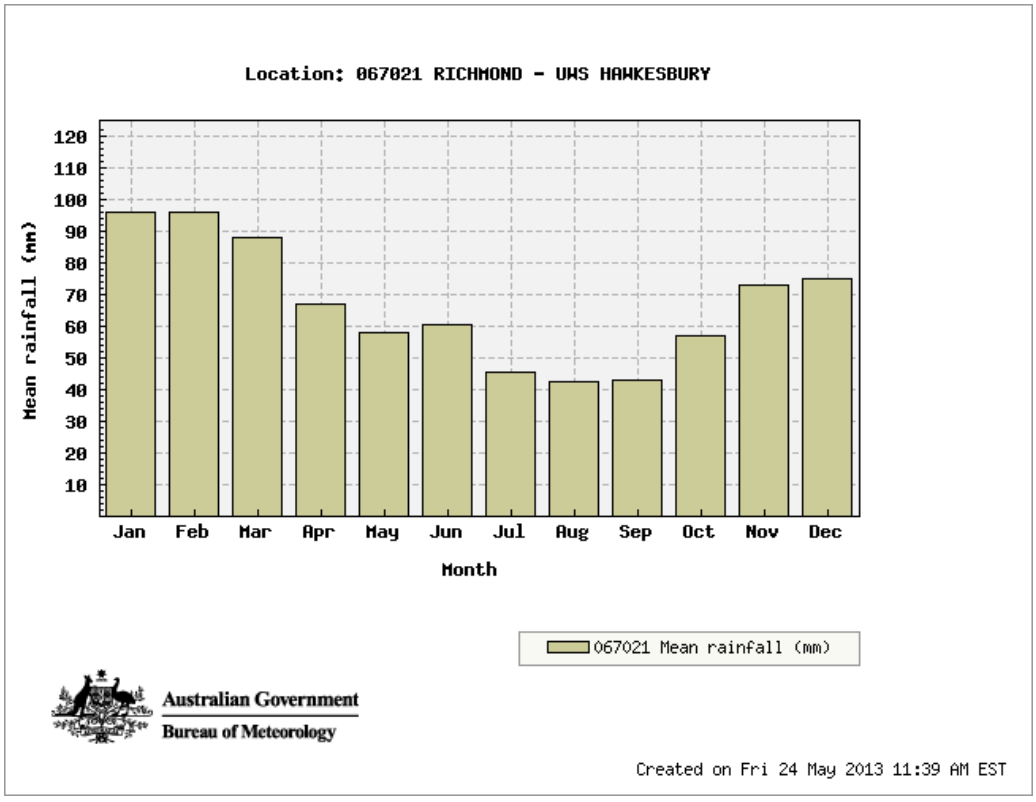


Figure 8 Mean monthly rainfall.

2.7 Wetland Infrastructure

One Tree Reach Wetland is a highly disturbed natural wetland that is subjected to stormwater water runoff from a substantially rural lowland catchment and an open woodland forest on the surrounding sandstone escarpments. The invert of the earth channel connecting the wetland to the Hawkesbury River is at -0.3 AHD, just below, Mean Sea Level (0 AHD). Consequently the northern portions of the wetland are subjected to regular inundation on the rising tide.

Hornsby Shire Council has erected a small Aluminium weir between the wetland and the Hawkesbury River (refer to Figure 8). The top of the weir structure has been set at the natural ground level on either side of the channel, which is approximately equal to mean High Water Springs (0.7 AHD), while the lowest section of the weir is at approximately Mean High Water Neaps (0.3 AHD). Removable "drop boards" in increments of 100 mm are fitted between the lowest section and the top of the weir which makes it possible to artificially control the Top Water Level (TWL) within the wetland between 0.3 and 0.7 Australian Height Datum (AHD).

Figure 9 Wetland Outlet Channel and Tidal Weir Control

The aluminium plate from which the weir is constructed extends 1 metre below the invert of the channel, as a cut off wall, to prevent undercutting and short circuiting of the structure. However scouring of the invert has occurred immediately downstream of the weir and undercut the cut off wall causing a sink hole to form upstream of the weir and low flows to divert beneath rather than through the weir. If left unattended this could develop into a serious "head cut" resulting in the loss of the weir during high flows as well as significant scouring of the channel invert and banks.

Consequently it is recommended that the scour pool, which has developed downstream of the weir, and the sink hole, which has developed upstream of the weir, both be filled in with large rock and the invert and banks of the channel stabilised. Refer to 8.2 Weir Upgrade for remedial actions recommended to control the scouring that is currently occurring at the existing tidal weir control.

3 Planning Context

The following state and local government strategies, policies and pieces of state and national legislation are influential in the management of One Tree Reach Wetland.

3.1 Local Government ACT 1993

Under the *Local Government Act, 1993* Hornsby Shire Council is required to prepare a Plan of Management (PoM) for community land. The Act incorporates legislative requirements, identifies land categories, promotes community participation and active involvement in the decision making process and maintains process transparency. The *Local Government (General) Regulation, 2005* provides the framework for the management of Council owned land.

The PoM has been prepared in accordance with the requirements for specific Plans of Management detailed in Section 36 of the *Local Government Act, 1993* and listed in Section 1.5 in Table 1.

3.2 Environmental Planning and Assessment ACT 1979

The *Environmental Planning and Assessment Act, 1979 (EP&A Act)* establishes the statutory planning framework for environmental and land use planning in NSW. This is achieved through State Environmental Planning Policies (SEPPs), and Local Environmental Plans (LEPs) collectively known as Environmental Planning Instruments (EPIs). The EP&A Act allows EPIs to be made to guide the development process and to regulate competing land uses; it also sets out processes for approving structures and works.

3.3 The NSW Wetlands Management Policy Action Plan 2000/2003

This action plan (Department of Land and Water Conservation 2000) was developed by the State Wetlands Action Group to guide implementation of the NSW Wetlands Management Policy. It recognises that the majority of NSW's 4.5 million hectares of wetlands are located on private property and aims to resource and involve the community in wetland rehabilitation.

The action plan sets out four key strategies and associated actions for the NSW State Wetland Advisory Committee to promote the implementation of the policy. These strategies are:

- development of guidelines for preparing local wetland plans of management;
- development of guidelines for rehabilitation as well as compensatory guidelines for situations where social and economic imperatives require wetlands be destroyed;
- consideration of wetlands in the NSW Water and Vegetation reforms; and
- administration of the NSW Wetland Action Grants Program.

3.4 NSW Invasive Species Plan 2008-2015

The NSW Invasive Species Plan was developed through extensive consultation with a wide range of stakeholders. The NSW Invasive Species Plan aims to prevent new incursions, contain existing populations and adaptively manage widespread species. The plan aims to foster a cooperative culture where all relevant parties contribute with the aim of minimising the impacts of invasive species in NSW (Department of Primary Industries DPI 2008).

The NSW Invasive Species Plan identifies four goals:

- exclude – prevent the establishment of new invasive species;
- eradicate or contain – eliminate, or prevent the spread of new invasive species;
- effectively manage – reduce the impacts of widespread invasive species; and
- capacity building – ensure NSW has the ability and commitment to manage invasive species.

These goals aim to deliver specific measurable outcomes and actions that complement the NSW targets for natural resource management as identified in the NSW State Plan. The Plan's principles address current planning processes, efficacy and ethical issues, and is based on current commitments by the NSW Government and investment by a wide range of other stakeholders (DPI 2008).

3.5 Threatened Species Priority Action Statement

The Threatened Species Priorities Action Statement (PAS) (DECC 2007) outlines the broad strategies and detailed priority actions to be undertaken in NSW to promote the recovery of threatened species, population and ecological communities; and manage key threatening processes.

The primary objectives of the statement are to:

- move as many species as possible from threatened to non-threatened conservation status;
- abate or eliminate the impacts of key threatening processes (KTPs);
- provide a comprehensive and strategic approach to threatened species recovery, by making a list of strategies and prioritised actions;
- involve stakeholders, including managers and decision makers at all levels, in working together to implement PAS actions.

The One Tree Reach Wetland contains a number of biodiversity assets which are listed under the NSW Threatened Species Conservation Act 1995, subject to strategies and actions identified in the PAS. These include Endangered Ecological Communities and habitat suitable for threatened species outlined in Section 5. A variety of weeds present in the corridor have been identified as part of key threatening processes listed under schedule 3 of the TSC Act 1995 that would also be subject to actions identified in the PAS.

3.6 A Wetland Prioritisation Technique for the Sydney Metro Catchment Management Authority (SMCMA) Area

The above report was prepared as part of the Sydney Metropolitan Catchment Management Authority (SMCMA) Wetland Management Strategy (Stage 1) (Schaeper et al 2007). The report:

- compiled existing mapping data to identify the extent of wetlands in the SMCMA region;
- remapped wetlands that are listed in the Directory of Important Wetlands in Australia (DIWA);
- developed a wetland rehabilitation prioritisation technique, and;
- assessed the condition of the eight DIWA wetlands that occur in the SMCMA region.

A desktop wetland prioritisation technique was developed to prioritise wetlands for rehabilitation. The technique considers;

- wetland values and threats;
- the representation of the range of wetland types in Sydney;
- rehabilitation project development matters; and
- consideration of the feasibility of proposed projects.

Wetlands were assessed for their values and threats to produce a ranking of high, medium or low. Although this prioritisation technique is suitable to assess wetland condition, this assessment relied on the existence of information such as exists in a plan of management (PoM). In 2009, there were approximately 30 PoM's for wetlands within the SMCMA area.

It was determined that an alternate but complementary process was required to assess many more of the wetlands in SMCMA'S area of operation using other available GIS data. Therefore a GIS database was developed and completed in 2011 and assessed 226 wetlands using the initial prioritisation method of assessing values and threats to produce a ranking of high, medium or low (Ecological 2011).

The appendices of the initial prioritisation that summarise threats, values and scoring templates, as well as the technical report for the Wetlands GIS Prioritisation, are now available on the SMCMA website.

3.7 Hawkesbury Nepean Catchment Weed Management Strategy 2007-2011

The Weed Management Strategy (DPI 2007) aims to facilitate the most efficient use of available funding and resources, and to enhance the works already undertaken in the catchment through a series of actions. The strategy was designed to inspire and guide actions by weeds officers in councils, state government agencies and authorities with regard to weed management activities across the Hawkesbury Nepean catchment over the life of the plan. The strategy was developed in consultation with the users and practitioners, particularly the regional weed committees through workshop sessions and meetings held in 2006. The strategy presented 3 goals:

- Prevent new weed problems;
- Reduce the impact of existing priority weed problems;
- Enhance our capacity and commitment to solve weed problems.

10 objectives linked to the goals were also identified with a variety of associated actions. The development of effective partnerships, targeted to priorities as promoted by the recommended actions and model projects within the strategy were seen as a means for achieving some successful outcomes given limited resources.

3.8 Hawkesbury Nepean Catchment Action Plan

The Hawkesbury Nepean Catchment Action Plan (CAP) (HNCMA 2008a) is one of thirteen CAPs which are central to the delivery of natural resource management throughout New South Wales. CAPs are developed by Catchment Management Authorities (or CMAs) and are ten-year strategic plans that set targets and direct investment of public and private resources to achieve sustainable natural resource management in line with community expectations. The CAPs are not regulatory plans, but

complement other natural resource management plans, including regional strategies, water sharing plans and regional conservation plans. The targets for the CAP are presented under 4 key themes:

- Community and Partnerships;
- River Health;
- Biodiversity;
- Soil and Land.

Each theme begins with an analysis of the state of the resource and the pressures influencing its state. A series of tables are then presented that indicate the condition target with a specific aim and then a series of management targets which also contain detailed objectives, short term targets, priorities, performance indicators and catchment management authority actions. The CAP also identifies HNCMA programs that deliver on ground actions that contribute to the targets for the CAP. Collaboration and partnerships are also identified to promote the best investment in natural resource management.

3.9 The Hawkesbury Estuary Program

The Hawkesbury Estuary Program (HEP) (HSC 2011) is implemented by both Hornsby Shire and Gosford City councils, encompassing the estuarine reaches of the lower Hawkesbury River from Wisemans Ferry to Broken Bay. Hornsby Shire Councils' HEP provides an integrated and strategic approach to the management of estuarine assets in the lower Hawkesbury. This is achieved through the implementation of strategies contained within the Lower Hawkesbury Estuary Management Plan (2008). This plan was adopted by both Hornsby Shire and Gosford City Councils in 2009 to ensure a consistent local government approach to estuary management within the lower Hawkesbury River.

The annual report acknowledges One Tree Reach Wetland as characterised by the presence of significant vegetation communities of Saltmarsh, Mangrove, Swamp Oak Floodplain Forest (outside the PoM study area) and Swamp Mahogany Forest. Works were undertaken at One Tree Reach as part of the implementation of the program including:

- Bush restoration works which included control of woody weeds across site such as lantana, ochna and senna. Revegetation of indigenous plant species in disturbed areas to establish connectivity with core bushland and vegetation surrounding wetland;
- Total of 450 hours of contract bush regeneration undertaken across site;
- Outputs: 0.01ha of coastal native vegetation enhanced /rehabilitated. 2ha of terrestrial native vegetation enhanced/rehabilitated.

3.10 Hornsby Shire Council LEP 1994

The Hornsby Shire Council Local Environmental Plan (LEP) 1991 is the environmental planning instrument (EPI) through which Council controls development throughout its Local Government Area (LGA). It divides land into different zones and, among other things, details the activities that can be carried out within each zone and those activities which are prohibited. See section 2.3 of this report for zoning details for the subject area.

3.11 Hornsby Shire Council Draft LEP 2013

The Hornsby Shire Council LEP 2013 was endorsed by Council for forwarding to the Department of Planning & Infrastructure for its making subject to the minor amendments identified in the report and submitted the draft Plan for its making. Once gazetted the 2013 LEP will be the EPI through which Council controls development. See section 2.3 of this report for zoning details for the subject area.

4 Site Hydrology and Hydraulics

4.1 Catchment Description

The One Tree Reach Wetland is situated on a small floodplain on the western side of the Hawkesbury River approximately 9 kms southeast of Wisemans Ferry along the Singleton Road. Its immediate catchment of approximately 50 hectares is bounded by a steep sandstone escarpment to the west and the Hawkesbury River to the east. Singleton Road bisects the catchment from north to south with only the land (foothills) between Singleton Road and the escarpment cleared for mainly grazing, agistment and orchards. The remainder of the catchment is covered by: open forest on the escarpment; and a dense floodplain paperbark scrub surrounds the permanent open water areas of the wetland (refer to Figure 9).

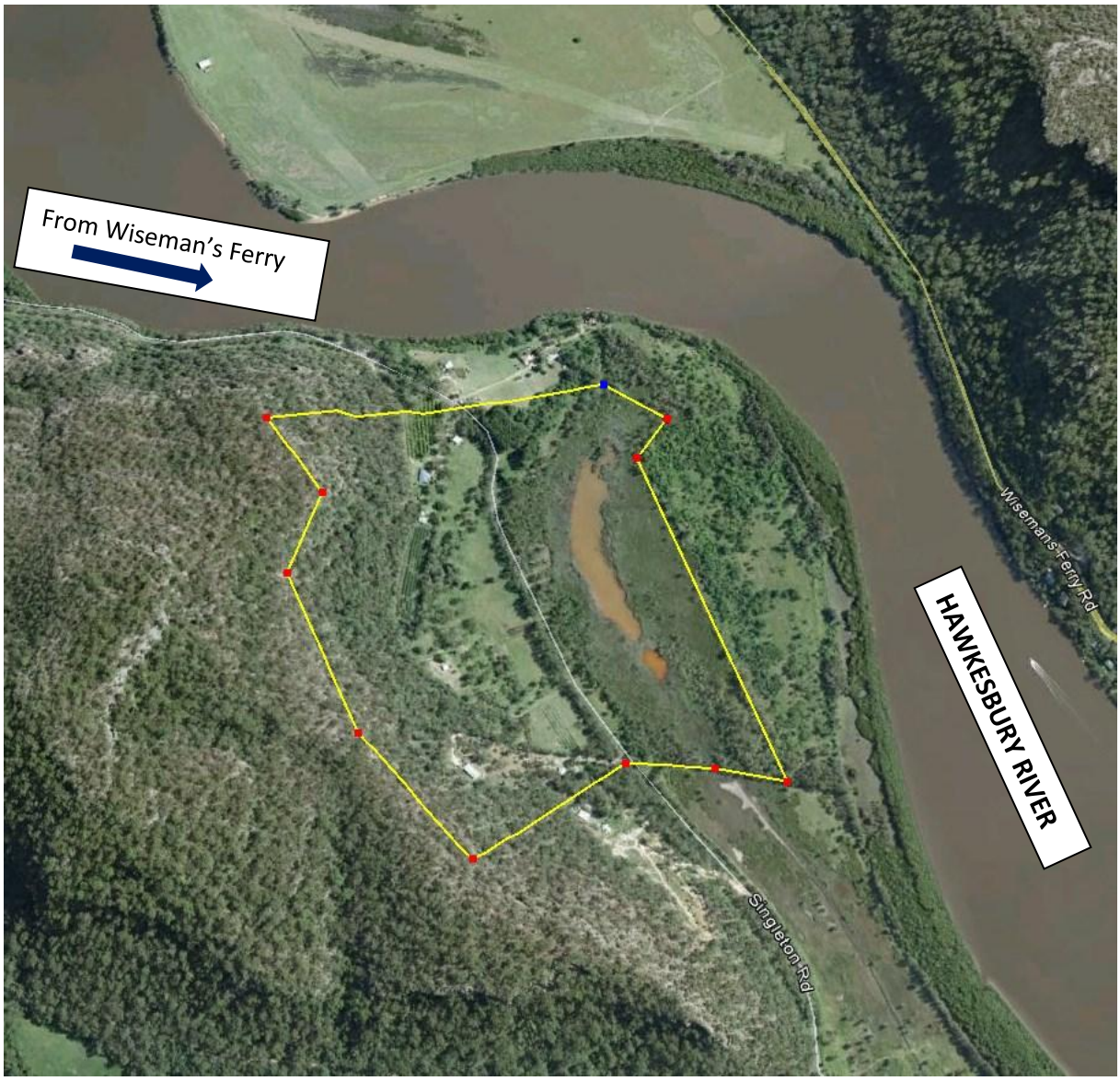


Figure 10 One Tree Reach Wetland Catchment

4.2 Wetland Hydrology

Runoff from the steep topography and shallow sandy soils in the western portion of the catchment responds quickly to rainfall; however this is buffered by the change in grade between the foothills and Singleton Roads and the flat swampy nature of the land between Singleton Road and the wetland.

Consequently runoff from the catchment, in response to local rainfall, could initially be expected to reach the wetland quickly and then taper off over a much longer period as the buffering effect of the flatter grades through the foothills and the detention afforded by the low lying swampy areas takes effect. The water levels in the wetland would fluctuate in response to the freshwater inflows and would initially inundate the surrounding dense scrub and gradually subside as the inflow into the wetland from the catchment becomes less than the discharge capacity of the existing outlet channel and weir.

4.3 Flow Regime

The form of the open water areas within the One Tree Reach Wetland suggests that they were once a subsidiary channel, and possibly part of the main channel, of the Hawkesbury River. The outlet channel is connected to the Hawkesbury River and its invert is only marginally above Mean Sea Level. The weir, once fully operational, will control tidal inundation to only those tides that are in excess of Mean High Water Neaps (0.4 m AHD and 1.3 m Chart Datum approximately) when the weir is fully open, and up to Mean High Water Springs (0.7 m AHD and 1.6 m Chart Datum) when all of the "Drop Boards" are in place. Consequently the top water level within the wetland will vary on almost a daily basis depending on the number of "drop boards" in place within the weir, the height of the tide and the rainfall within the catchment. NOTE: with all of the "Drop Boards" in place the weir may be expected to be over topped by the highest daily tide approximately 10 times per month on average.

Consequently the wetland will always be brackish with the possibility of the formation of a halocline during periods of low rainfall and high tides. Consequently water quality monitoring should concentrate on the salinity levels in the wetland which should then inform the manipulation of the "Drop Boards" to either reduce or increase the tidal inundation, based on the expected tide levels in the area and the extent of flushing by freshwater based on rainfall forecasts. The volume of saltwater intrusion into the wetland during tidal inundation is a complex function of the height of the tide in the Hawkesbury River, the time lag involved in the tide to intrude along the outlet channel, the height at which the "Drop Boards" within the weir are set and time difference between the high and low tides.

Although the wetland is generally less than 1 m in depth (The Ecology Lab, 2008) it is possible that the lower levels of the wetland's water column will become increasingly saline with time and consideration should be given to providing a lower water level control, within the weir, that will allow the wetland to fully drain. Such a modification to the weir will provide greater control over the salinity levels within the wetland and assist in the control of salinity levels, which is especially important for the management of plants that are sensitive to hyper saline conditions.

4.4 Climate Change

4.4.1 General

Projected climate change impacts in the Sydney and Hawkesbury Regions and the associated impact on the One Tree Reach Wetland are related to projected Sea Level Rise estimations (maximums of 0.4 m by 2050 and 0.9 m by 2100) and increases in rainfall intensity (estimated to be approximately 15% by 2030) and runoff volumes in extreme events (estimated to be approximately 25% by 2030). Other factor to consider include projected evaporation increases (maximum of 20%) and changes to wind patterns which are much more difficult to project due to the difficulty in modelling the likelihood and intensity of East Coat Lows. (*"NSW Climate Impact Profile", DECCW June 2010, Publication Reference: 2010/171)*

4.4.2 One Tree Reach Wetland

Based on the projected climate change and sea level rise projections for the Sydney and Hawkesbury Regions (DECCW 2010/171), it is anticipated that low lying estuarine wetlands such as the One Tree Reach Wetland will be subjected to more frequent inundation from higher sea levels and storm surge. It is likely that the water levels within the wetland and its surface area will increase as a consequence of projected increases in sea level. Changes in the structure and form of the vegetation communities is also likely and this will most likely impact on the composition of the estuarine invertebrate communities, which will most likely result in changes to the migratory shorebird populations.

Increases in the water level and surface area of the wetland, as a consequence of projected climate change impacts, may provide greater habitat diversity and encourage a greater diversity in bird species and abundance. Depending on the rate of sea level rise, it is possible that there will be an expansion of mudflats and foraging habitats, due to the flat terrain associated with the fringing Floodplain Paperbark Scrub. However careful monitoring of water levels, and the ability of the weir to artificially manipulate them, will be required if the viability of the wetland as a foraging habitat for shorebirds is to be retained.

4.5 Water Quality

4.5.1 Diffuse Pollution

Diffuse pollution refers to those pollutants that are generated throughout a catchment and do not have one specific point of origin or discharge. These are the pollutants commonly found in concentrated stormwater discharges and generally relate to increases in suspended solids, phosphorus and nitrogen. The stormwater entering One Tree Reach Wetland is not concentrated in a formal drainage network and travels overland as shallow sheet flow and is filtered through the surrounding vegetation. The lack of any new development of land disturbing activities within the catchment make it unlikely that sediment loads would be excessive.

The water quality sampling undertaken by The Ecology Lab in 2008 only measured variables within the wetland itself and no details of background water quality information on stormwater inflows were available. However due to the vegetated nature and the low level of development within the catchment elevated concentrations of suspended solids, phosphorus and nitrogen within stormwater inflows is considered unlikely. The main issues for the wetland appear to be in regard to salinity,

acidity, temperature and dissolved oxygen, none of which could be directly attributable to stormwater.

Although a detailed assessment of catchment runoff has not been undertaken, it is likely that the dense Floodplain Paperbark Scrub, which provides a buffer between the contributing catchment and the wetland, will also filter out much of the suspended solids and nutrients that could be attributed to diffuse pollution from stormwater.

4.5.2 Point Source Pollution

Point Source pollution is generally associated with the release of pollutants from a single source resulting in a concentrated discharge into the receiving environment at a single point. These types of discharges are generally illegal and/or accidental and may be related to a spill incident or illegal connection to the stormwater system.

The land use within the catchment upstream of One Tree Reach Wetland, the light traffic volumes experienced on Singleton Road, and the interest of the local residents in the health of the wetland, makes this form of pollution unlikely.

4.6 Conclusions

For additional details regarding each of the following recommendations refer to Chapter 8.

4.6.1 Monitoring

It is recommended that water quality monitoring throughout the wetland should continue on a monthly basis, until it is possible to develop seasonal trends for the following minimum number of variables:

- Temperature;
- Conductivity;
- Salinity;
- pH;
- Oxidation Reduction Potential;
- Dissolved Oxygen; and
- Turbidity.

These data should then be interrogated by a reputable scientific organisation, experienced in the management of estuarine ecosystems, and their recommendations for the management of the system with respect to achieving the management objectives, undertaken.

Additionally it will be necessary to monitor water levels and the efficiency of the weir at maintaining the water levels at desirable levels and in managing the water quality and salinity levels with the wetland.

4.6.2 Flood Management and Climate Change

These are natural phenomena, both of which are generally outside of control of Hornsby Shire Council, especially in a location as isolated as the One Tree Reach Wetland.

However, some control over water levels and seawater intrusion into the wetland is possible through the prudent use of the "Drop Boards" within the weir. It may be necessary to raise the weir to accommodate future projected sea level rise and still maintain the desired objectives for the wetland.

Flooding from rainfall in the local catchment does not, apart from access to the site, appear to be as big an issue a regional flooding from the Hawkesbury River. If regional floods inundate the wetland then it will be necessary to undertake more detailed monitoring to determine the level of impact and the measures required to overcome the impact. Of particular importance is the introduction of pest species of fish (such as European Carp) and weeds (such as Salvinia, Alligator Weed and Water Hyacinth) following flood events.

4.6.3 Stormwater Treatment Measures

Treatment of stormwater from the existing catchment is not considered an issue of concern for the wetland, and may, if formal measures were constructed in close proximity to the wetland, create more of an impact than if no measures were implemented at all.

However, during construction of the facilities to cater for visitors, boardwalks, viewing platforms, car parking etc, it is recommended that a detailed erosion and sediment control plan be prepared and implemented.

The shallow nature of the groundwater and its high acidity levels is not ideal for the construction of underground stormwater treatment measures. Consequently any controls implemented in the vicinity of car parking facilities are recommended to be above ground vegetated filter strips to act as a buffer between the formal access points and car parks especially, and the wetland. Litter bins should be considered and reinforced with a litter reduction education programme.

4.6.4 Sediment Removal

Sediment loads reaching the wetland, from the immediate catchment, are considered to be no greater than what could be expected from an undeveloped rural/natural catchment. Any development and/or land disturbing activities within the catchment should be conditioned to undertake recognised and approved erosion and sediment control practices and the maintenance of those practices enforced throughout the development until the site is stabilised.

Sediment deposited as a consequence of regional flooding from the Hawkesbury River, should be monitored and advice regarding its impact sought from a specialist experienced in the monitoring and management of sediment in estuarine areas. Due to constraints on access removal of any unwanted sediment should be carefully considered as the impact of the heavy equipment may be greater than the impact of the sediment load on the wetland ecology.

4.6.5 Water Quality

At the present time there are no definitive standard water quality expectations for estuarine wetlands in the lower reaches of the Hawkesbury River. However the ANZECC, 2000 "Trigger Values" for Estuaries in South-east Australia would appear to be the best available guidelines although they are provided on the basis that "a precautionary approach should be adopted when applying default trigger values to these [estuarine] systems". That is the trigger values should not be used as mandatory standards, they are designed to assist land managers to consider if the water quality is good enough for the water resource to be used, in this case as an aquatic ecosystem. If these trigger

values are exceeded then Hornsby Shire Council should look at why they were exceeded and wether this causes an undesirable impact on the objectives for the wetland. Rather than looking at reference sites long distances from One Tree Reach Wetland the site should be monitored over time (at least 12 months) to gain baseline data and then if there is significant change in monitoring results this may trigger management actions.

The following variables have been extracted from the "Trigger Values" in Table 3.3.2 (ANZECC, 2000) with respect to Estuarine Ecosystems in South-east Australia:

Chlorophyll a	4 μ/L
Total Phosphorus	30 μ/L
Filterable Reactive Phosphorus	5 μ/L
Total Nitrogen	300 μ/L
Oxides of Nitrogen	15 μ/L
Ammonium	15 μ/L
Dissolved Oxygen	80% (saturation)
pH	7.0 to 8.5

Whilst these values are not mandatory standards, and are guidelines which if exceeded should trigger additional investigations, they do provide background information with which to compare various variable measurements taken in the field. Consequently it is recommended that the water quality monitoring referred to in 4.6.1 Monitoring be expanded to include the variables listed above.

5 Environmental Values

In order to document the environmental values of One Tree Reach Wetland a desktop study was undertaken which included consideration of existing literature and mapping and interrogation of threatened species databases. A number of reports commissioned by Hornsby Shire Council were included in the desktop study:

- Smith P.J. and Smith J.E. (2008) Native Vegetation Communities of Hornsby Shire 2008 Update report prepared for Hornsby Shire Council;
- The Ecology Lab (2008) One Tree Reach Wetland Aquatic Ecology Assessment report prepared for Hornsby Shire Council;
- Hornsby Shire Council (2011) One Tree Reach Wetland, Laughtondale File Note;
- Ward (2012) *One Tree Reach Wetland Acid Sulfate Soil Restoration Project: Monitoring Protocol* report prepared for Hornsby Shire Council;
- DragonFly Environmental (2011) *One Tree Reach Wetland Acid Sulfate Soils Study* report prepared for Hornsby Shire Council;
- Smith & Smith (2012) A *Waterbird Survey of Hornsby Shire* report prepared for Hornsby Shire Council.

5.1 Native Vegetation

One Tree Reach Wetland has been subject to previous mapping by Smith and Smith (2008). Four vegetation communities were recorded in the study area:

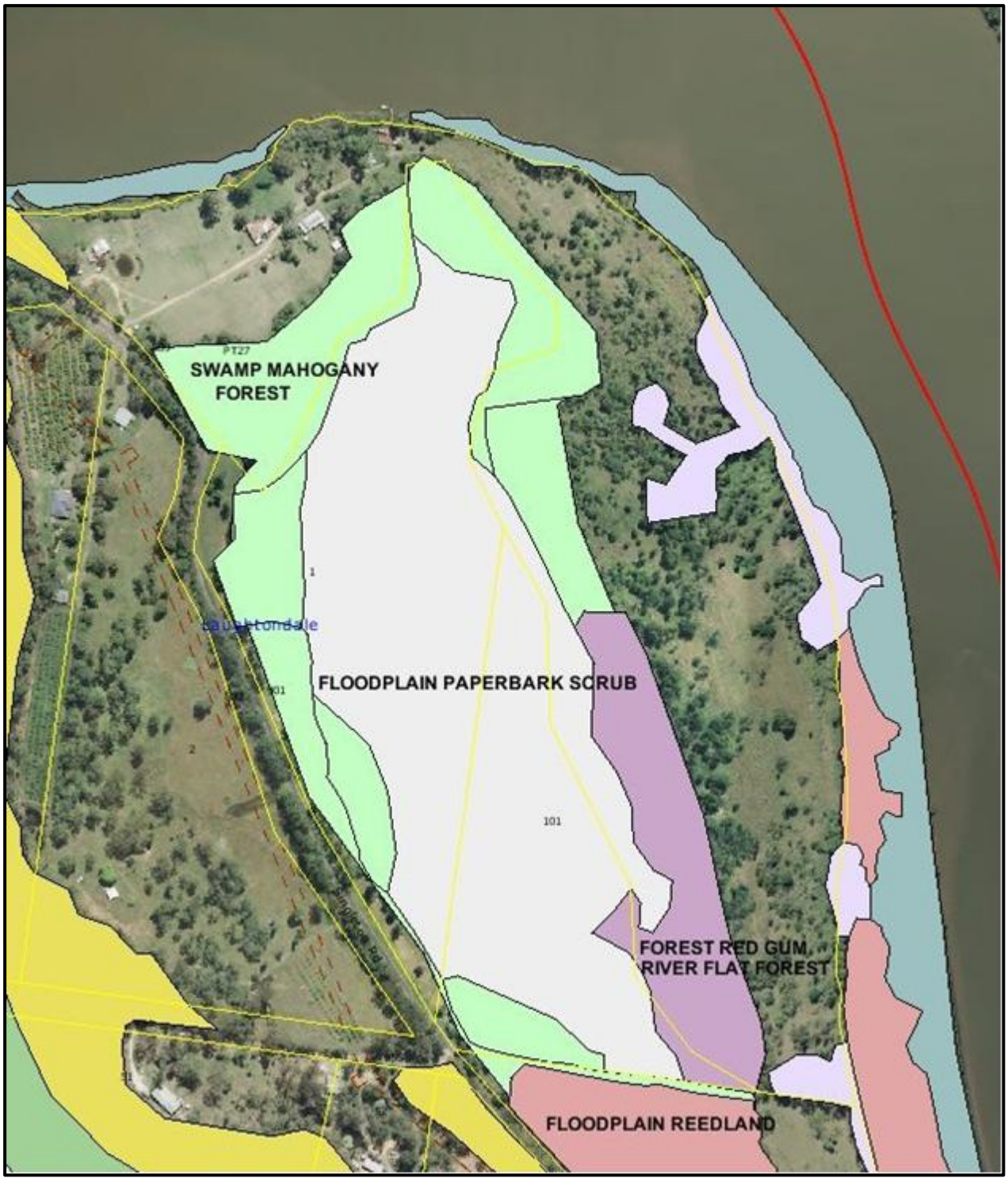
- Swamp Mahogany Forest;
- Floodplain Paperbark Scrub;
- Forest Red Gum River Flat Forest;
- Floodplain Reedland.

Further south, within the wetland that is currently privately owned, 2 additional vegetation communities are present:

- Saltmarsh; and
- Mangroves.

The corresponding endangered ecological communities, dominant species, biometric vegetation types (OEH 2008) and habitat values are presented below in Table 5.

The central area of the wetland shown in white in Figure 9 currently supports an area of open water; this has been included in Table 5.



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Waratah Eco Works (WEW) endeavours to ensure the information provided in this map is correct at the time of publication. WEW does not warrant, guarantee or make representations regarding the currency and Accuracy of information contained in this map

Figure 11 Vegetation communities at One Tree Reach Wetland (source: Smith & Smith 2008)

Table 5 Summary of Vegetation Communities and Fauna Habitat Values

Vegetation Community	*Endangered Ecological Community*	*Dominant Species*	*Biometric Vegetation Type*	*Condition*	*Habitat Values*
Swamp Mahogany Forest	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community (listed in Part 3 of Schedule 1 of the TSC Act)	*Eucalyptus robusta* (Swamp Mahogany)	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin and South East Corner	Good to moderate	High, foraging and shelter habitat for birds and arboreal mammals, shelter resources for migratory birds and reptiles and amphibians and invertebrates
Floodplain Paperbark Scrub	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community (listed in Part 3 of Schedule 1 of the TSC Act)	*Eucalyptus robusta* (Swamp Mahogany) is the dominant tree species or co-dominant with *Melaleuca quinquenervia* (Broad-leaved Paperbark)	Paperbark swamp forest of the coastal lowlands of the North Coast and Sydney Basin	Good to moderate	High, foraging and shelter habitat for birds and arboreal mammals, shelter resources for migratory birds and reptiles and amphibians and invertebrates
Forest Red Gum River Flat Forest	River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community (listed in Part 3 of Schedule 1 of the TSC Act)	*Eucalyptus tereticornis* (Forest Red Gum), low tree layer of *Myoporum acuminatum* (Mangrove Boobialla), *Melaleuca styphelioides* (Prickly-leaved Paperbark) and *Casuarina glauca* (Swamp Oak).	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	moderate	High, foraging and shelter habitat for birds and arboreal mammals, shelter resources for migratory birds and reptiles and amphibians and invertebrates

Floodplain Reedland	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community (listed in Part 3 of Schedule 1 of the TSC Act)	*Phragmites australis* (Common Reed)	*Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin	moderate	High, foraging and shelter habitat for migratory and water birds and reptiles and amphibians and invertebrates
Saltmarsh (outside current PoM study area)	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC(listed in Part 3 of Schedule 1 of the TSC Act)	*Sarcocornia quinqueflora, Samolus repens, Juncus kraussii, Suaeda australis*	Saltmarsh in estuaries of the Sydney Basin and South East Corner	moderate	High, foraging and roosting habitat for shorebirds and foraging habitat for insectivorous bats
Swamp Oak Forest (outside current PoM study area)	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC(listed in Part 3 of Schedule 1 of the TSC Act)	Swamp oak *Casuarina glauca*	Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest on coastal floodplains, Sydney Basin and South East Corner	good	High, foraging and shelter habitat for migratory and water birds and reptiles and amphibians and invertebrates
Mangroves	N/A NSW DPI is responsible for the management of fish and marine vegetation, including mangroves, under the Fisheries Management Act 1994 (FM Act). Any development or activity that may harm mangroves must be referred to NSW DPI for approval.	*Grey Mangrove (Avicennia marina)*	*N/A*	good	High, shelter and foraging habitat for juvenile native fish and shellfish, foraging and shelter habitat for birds and macroinvertebrates
Open Water	Freshwater wetlands on coastal		Freshwater	Moderate to	High, water source for a variety

	floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community (listed in Part 3 of Schedule 1 of the TSC Act)		Wetlands	good	of native and introduced species, foraging resources for migratory birds and some bats, breeding habitat for amphibians, habitat for aquatic species and invertebrates.

TSC Act – NSW Threatened Species Conservation Act 1995 DPI- Department of primary Industries

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

An online search on matters of National Environmental Significance (NES) or other matters protected by the commonwealth EPBC Act was undertaken for a five kilometre radius of the site. The online search revealed 28 species listed on the EPBC Act, including:

- 10 birds;
- 3 fish;
- 5 frogs;
- 1 snake;
- 5 turtles;
- 7 mammals (including 2 bats);
- 11 flora species; and
- 22 migratory bird species.

The species are presented in Table 9, 10 and Table 11 in Appendix B to this report.

5.1.2 Threatened Species Conservation Act 1995

A spatial analysis was undertaken utilising the Office of Environment and Heritage (OEH) NSW Wildlife Atlas of threatened species records in a ten kilometre radius of the site (the locality).

The search revealed a total of 33 fauna species and 16 flora species listed on the TSC Act 1995. The species recorded during the database search are shown in Tables 10 and 11 in Appendix B.

The study area is also known to support five endangered ecological communities:

- Swamp Mahogany Forest, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Floodplain Paperbark Scrub, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Floodplain Reedland, a form of Swamp Sclerophyll Forest on Coastal Floodplains (EEC);
- Forest Red Gum River-flat Forest, part of the River-flat Eucalypt Forest on Coastal Floodplains (EEC);
- Swamp Oak Floodplain Forest (EEC);
- Coastal Saltmarsh (EEC) (as per Smith & Smith 2008, 2009); and
- Freshwater Wetlands on coastal floodplains EEC (which includes the open water areas of the wetland) occupies the central wetland.

5.2 Fauna Habitat Values

Fauna Surveys were undertaken in the wetland by Hornsby Shire Council's biodiversity team in 2008 (Hornsby Shire Council 2008). Targeted surveys included:

- Bird surveys;
- Spotlighting;
- Anabat recording;
- Hair tubing.

Surveys revealed a diversity of native birds using the wetland and surrounding habitats, these are listed in Appendix C. The surveys recorded 34 species of birds (including winter migrants such as the rose robin). The survey indicated it is likely the wetland is used as marginal foraging and potential breeding habitat for migratory wetland birds, however none were observed during the survey period (HSC 2008).

A number of native mammals and reptiles were recorded during the fauna survey of the wetland these are listed in Appendix C and included:

- Long nosed bandicoot;
- Swamp wallaby;
- Bush rat;
- Common brushtail possum;
- Red bellied black snake; and
- Eastern brown snake.

A variety of bats were also recorded through the use of an Anabat CF ultrasonic recording device. Bat species recorded including 3 threatened species:

- Large Footed Myotis (Vulnerable TSC Act 1995);
- Large-eared Pied Bat (Vulnerable TSC act 1995 and EPBC Act 1999);
- Grey-headed Flying Fox (Vulnerable TSC Act 1995 and EPBC Act 1999).

A variety of flora species were also recorded during the fauna surveys, these are presented in Table 15 in Appendix C.

Flora and fauna surveys were undertaken in winter (to target winter flowering eucalypts) and summer. Surveys during spring may reveal a greater diversity of fauna and flora species.

5.3 Aquatic Ecology

An aquatic ecology assessment of the wetland was undertaken in 2008 (The Ecology Lab 2008). The specific aims of the assessment were to:

- Sample aquatic macroinvertebrates and fish utilising a range of standardised and repeatable methodologies;
- Undertake a rapid assessment of wetland health;
- Survey aquatic vegetation, if present;
- Assess the significance of the wetland for conservation and fisheries values;
- Consider threatened species that may be associated with the wetland;
- Provide a report indicating findings and recommendations.

The assessment reviewed a range of existing information including database records and existing vegetation mapping. Field survey was undertaken at six sites for water quality and macroinvertebrate sampling.

The assessment had the following key findings:

- The riparian vegetation associated with the wetland has been preserved in a relatively natural state;

- The majority of riparian and aquatic vegetation is native with little weed invasion;
- Grey mangroves and the common reed *Phragmites australis* both salt tolerant species were found throughout the wetland;
- Water quality sampling indicated both sections of the wetland are brackish;
- Dissolved oxygen reading across the wetland were variable and considered possibly related to the presence of photosynthesizing algae indicating elevated nutrients and eutrophication;
- pH decreased from north to south and was considered likely to relate to freshwater inflows from the Hawkesbury River to the north;
- A very low pH together with orange iron floc, clear water and the presence of dead trees in the small open water section at the southern end of the wetland in the Crown Reserve were considered likely to indicate the presence of acid sulfate soils;
- Macroinvertebrate families observed were considered typical of those found in still or slow moving waters;
- Edge habitats had a variety of macroinvertebrate families and the majority of those surveyed had a low sensitivity to disturbance, except the Libellulid dragon flies which have a mid range sensitivity to disturbance indicating the relatively undisturbed nature of the wetland;
- Abundant macroinvertebrate larvae were considered a good food source for most fish that would be present in the wetland;
- Both native (Blue spot goby and glass goby) and noxious (mosquito fish) were recorded in the wetland;
- Suitable habitat for fish in the wetland is considered limited to areas of higher dissolved oxygen, with pH values approaching a neutral pH of 7;
- The wetland did not appear to support a high diversity or abundance of fish, this was considered possibly due to an absence of adequate habitat (woody debris) and low levels of dissolved oxygen and low pH;
- The wetland was assessed as having a moderate to good conservation value for fish;
- The presence of five native riparian vegetation endangered ecological communities demonstrated the high conservation value of the wetland for native flora;
- The low diversity and low occurrence of introduced vegetation or weeds was noted;
- The distribution of fish and mangroves indicated the northern end of the wetland has greater conservation values, possibly associated with the freshwater inflows at this point;
- The importance of the wetland to birdlife was supported by the presence of breeding waterbirds indicated by numerous nests and eggs;
- The Wetland Health Rapid Assessment indicated that the riparian/floodplain community in the wetland is of very good health, due mainly to the presence of the five EECs and the absence of introduced species. The overall assessment of wetland health was good to very good, the lack of any deep water (> 1.0 m) habitat and a shallow water habitat health assessment of moderate preventing it from attaining a higher rating.

The assessment recommended the following:

- Bush regeneration in the area adjoining the wetland to improve the conservation value of the wetland;
- Care must be taken to avoid any damage to mangroves in the area, which are protected under the Fisheries Management Act;
- Acid sulfate soils if present should not be disturbed;
- an acid sulfate soil study and remediation plan be undertaken to determine the presence and extent of acid sulfate soil exposure on the site and remediation actions for the wetland and surrounding area;
- further data on water quality be obtained to determine the variability indicated, particularly pH and dissolved oxygen;
- Follow-up sampling of nutrients (including total phosphorous, ammonia, nitrate or total nitrogen) should be done If dissolved oxygen levels continue to be highly variable;
- If pH levels continue to be very low, a further assessment of acid soils should be done prior to disturbance of soils or changing of water levels;
- Further ecological survey be done prior to regeneration and at least twice after the regeneration program is complete.

5.4 Introduced Species and Noxious Weeds

The surveys undertaken in the One Tree Reach Wetland indicate a low diversity and occurrence of weeds in the wetland.

A number introduced flora species have been recorded in the wetland, these are listed below in Table 6.

Table 6 Weed Species Recorded from One Tree Reach Wetland (HSC 2008)

Common Name	Scientific Name
Pampas Grass	*Cortaderia* spp.
Acetosa	*Acetosa sagittosa*
Whisky Grass	*Andropogon virginicus*
Blackberry Nightshade	*Solanum nigrum*
Bridal Creeper	*Asparagus asparagoides*
Lantana	*Lantana camara*
Paddy's Lucerne	*Sida rhombifolia*
Moth Vine	*Arauja sericea*
Fire Weed	*Senecio madagascarensis*
Wild Aster	*Aster subulatus*
Bamboo	*Phyllostachys spp.*
Scotch Thistle	*Onopordum acanthium* spp. *acanthium*
Pine Tree	*Pinus radiata*
Passionfruit Vine	*Passiflora* spp.

A number of weeds identified as Weeds of National Significance (WONS) and listed as noxious weeds by Hornsby Shire Council have been recorded from the wetland. These weeds are listed below in Table 7.

Table 7 Weeds of National Significance and Noxious Weeds

Species	Common Name	Status
Asparagus asparagoides	Asparagus fern/Bridal creeper	WON Class 4 noxious weed HSC
Cortaderia spp.	Pampas Grass	Class 3 noxious weed HSC
Lantana camara	Lantana	WON Class 4 noxious weed HSC

Legally noxious weeds must be controlled or removed under the Noxious Weeds Act 1993. Weeds are declared noxious if they pose a significant problem to human health, the environment, livestock or the agricultural industry. In NSW, local Councils are responsible for controlling weeds in urban and rural areas under their responsibility.

Relevant controls for noxious weeds listed in Table 6 are:

Class 3 - the plant must be fully and continuously suppressed and destroyed;

Class 4 - the growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed.

5.4.1 Past Weed Control Programs

Bush Regeneration has been undertaken in One Tree Reach Wetland in the Crown section since 2008 and since its purchase by Council in 2009. Bush restoration works have included control of woody weeds across site such as lantana, ochna and senna. Revegetation with locally endemic native plant species has been undertaken in disturbed areas to establish connectivity with core bushland and vegetation surrounding the wetland.

Bridal creeper rust was introduced to the wetland in 2008 as a biocontrol method for this invasive weed of national significance. The rust spread and was effective in spreading (assisted by ideal weather conditions) and controlling bridal creeper on the eastern boundary of the site. The rust will continue to spread and provide a long term management solution for Bridal Creeper (HSC 2008).

5.5 Key Threatening Processes

Schedule 3 of the TSC Act lists Key threatening processes (KTPs). A threatening process is something that threatens, or could potentially threaten, the survival or evolutionary development of a species, population or ecological community. A threat can be listed under the TSC Act as a 'Key Threatening Process' if it adversely affects threatened species, populations or ecological communities or if it could cause species, populations or ecological communities that are not threatened to become threatened.

Given the presence of EECs and the potential presence of a variety of threatened species listed on the TSC Act a number of KTPs are currently impacting on the One Tree Reach Wetland. These include:

- Predation by *Gambusia holbrooki* Girard, 1859 (plague minnow or mosquito fish);

- Invasion of native plant communities by exotic perennial grasses;
- Invasion, establishment and spread of *Lantana camara.*

The Threatened Species Priorities Action Statement (PAS) (DECC 2007) outlines the broad strategies and detailed priority actions to be undertaken in NSW to:

- promote the recovery of threatened species, population and ecological communities; and
- manage key threatening processes.

The PAS is based around 34 recovery and threat abatement strategies. A number are relevant to the One Tree Reach Wetland including:

- habitat protection;
- habitat management: feral animal control;
- habitat management: weed control;
- habitat rehabilitation: restoration and rehabilitation; and
- community and landholder liaison, awareness and education.

6 Buffer Zone and Connectivity

6.1 Connectivity

The One Tree Reach Wetland is located on the floodplain of the Hawkesbury River. It is directly linked to the mangrove community fringing the river to the east and to terrestrial native vegetation that extends west from the wetland into Marramarra National Park. Singleton Road presents an impediment to wildlife movement in an east west direction. Anecdotal evidence from locals regarding road kills indicates that wildlife crossing (in particular swamp wallabies) is concentrated in an area near the southern boundary of the Crown Reserve. Examination of aerial photography indicates this area is the beginning of an approximately 500 metre stretch where native vegetation occurs on either side of Singleton Road.

6.2 Buffer Zone

Buffers of natural vegetation and grassy filter strips can contribute to water quality in wetlands and creeks. Natural vegetation and grassy filter strips can trap around 90 per cent of sediment moving from upslope (DEC 2005), and buffer strips can also control levels of bacteria in run off (DEC 2005).

Currently the One Tree Reach Wetland supports 4 endangered ecological communities that are linked to riparian vegetation along the Hawkesbury River. A grassy buffer occurs to the wetland on the north west and western edge between the EECS and Singleton Road and associated rural and agricultural development. The grassy buffer has not been subject to mowing since 2009 and regeneration of native species has occurred in the southern section of the western buffer. The northern buffer is subject to higher levels of introduced species including whisky grass.

6.3 Fish Passage Assessment

The aquatic ecology assessment of the wetland (The Ecology Lab 2008) revealed the presence of native (Blue spot goby and glass goby) and noxious (mosquito fish) in the wetland. All these species are small less than 100mm in length. The presence of larger fish in the wetland was not confirmed, however Hornsby Shire Council Officers report observing eels and small fish (not Gambusia) within the channel leading to the wetland from the Hawkesbury River and larger fish (likely freshwater mullet) (at least 200mm long) within the northern most part of the wetland. Hornsby Shire Council installed a weir in in 2012 to reduce variation in water level in the wetland and reduce exposure of potential and actual acid sulfate soils.

The weir was developed in consultation with NSW Fisheries who did not consider fish passage an issue, primarily due to over 70% of high tides exceeding the 0.4m AHD level. As the tide recedes from the wetland the water level will eventually lower to the top of the board, which would then present a barrier to fish passage, however this impedance is only temporary.

The proposed construction of a formal stilling pond on the downstream side of the weir may provide larger fish species with deeper water downstream of the vertical face of the weir and allow them to launch themselves through the opening during periods of low flow through the weir, subsequently improving fish passage.

7 Social Values

One Tree Reach Wetland is located in Laughtondale near Wisemans Ferry in the Hornsby local government area (LGA) in the north west of Sydney. The Hawkesbury River Estuary has extremely high social and economic values including high recreational usage and commercial fishing (HNCMA 2008). The Hawkesbury River estuary supports the second largest commercial coastal fishery of estuary prawns, oysters (prior to the outbreak of Pacific Oyster Mortality Syndrome in 2013 and the QX disease) and fish in NSW with a wholesale value of approximately $6.3 million annually (HNCMA 2008). Community based environment awareness and activity is very high (HNCMA 2008).

Wisemans Ferry in the lower Hawkesbury River estuary was settled by Europeans in 1810 when Giles William Moore was granted ninety acres of land at the mouth of Webbs Creek (Ferry Facts undated). The Hawkesbury River was one of the major transportation routes for transporting food from the surrounding area to Sydney during the 1800s. Wisemans Ferry was named for Solomon Wiseman an ex-convict and early settler in the district (Ferry Facts undated).

Laughtondale is located south east of Wisemans Ferry and supports a population of 262 at the 2006 census with 2.3% or 6 people of the population identifying as indigenous Australians. Members of the Laughton family still reside in Laughtondale. One Tree Reach Wetland is adjacent to the Hawkesbury River and to rural residential properties that are utilised for agriculture. Few formal recreational facilities are located in the immediate area; however an area where the river can be accessed south of the wetland is used by visitors to the area as a fishing spot. The wetland is on the route used by visitors to access “pick your own fruit” farms that are becoming increasingly popular with visitors to the area.

7.1 Existing and Potential User groups

One Tree Reach Wetland is used primarily by bird watchers who are aware of the presence of the wetland. No formal recreational facilities are present at the wetland and no signage is currently present to indicate the area is public land.

The area is also known to experience limited anti-social behaviour associated with vehicle movements.

7.2 Value of One Tree Reach Wetland to the Community

The value of One Tree Reach Wetland to the community has been gauged by the responses to an onsite meeting held on the 15th of March 2013. A total of 8 community members attended the meeting.

In summary the park is highly valued by the community as:

- a natural wetland area;
- a recreational area they would like to see used for passive recreation.

7.3 Community Consultation

7.3.1 Approach

A community consultation program was undertaken as part of this Plan of Management. The objectives of the program were to:

- identify values of One Tree Reach Wetland to the community;
- gain an understanding of community attitudes towards the wetland; their likes and dislikes; and

- provide an opportunity for community members to offer suggestions on how the wetland could be improved.

Involving the community in the preparation of the Plan of Management ensures the plan reflects the needs and concerns of those who have an interest in the future of One Tree Reach Wetland.

A number of techniques were used to facilitate communication between the community and the study team during the preparation of the Plan of Management. These included:

- distribution of a letter inviting local residents to an onsite meeting at the start of the plan of management process;
- an onsite meeting at One Tree Reach Wetland held on the 15th March 2013;
- distribution of a newsletter and questionnaire to the residents of the surrounding residential area of Laughtondale;
- day to day contact through the provision of a contact name and email address; and
- a public hearing while the draft plan of management is on exhibition.

The public hearing will be held after the preparation of the draft Plan of Management to provide the community with an opportunity to comment on the draft document.

7.3.2 Results

A total of 147 invitations were distributed to properties and non-resident landowners around the study area.

A total of 8 community members attended the onsite meeting. As indicated above residents were generally in favour of the wetland remaining in a natural state and valued the area and hoped it would be used for recreation.

Residents also had ideas on how the wetland and surrounding area could be improved, specifically:

- The issue of safe access to the wetland needed to be addressed residents would prefer visitors to access the wetland via Old Northern Road and Singleton Road, not Laughtondale Gully Road;
- The need for some open areas to manage fore risk;
- The need to control carp following flood events;
- Provision of access to the river for kayaks;
- Provision of rubbish bins in areas where visitors will be;
- The need for weed control, especially *Lantana camara;*
- The need for some mowing adjacent to Singleton Road
- The need for careful design of any car park so cars can still pass on the narrow road and that antisocial behaviour in cars is discouraged (e.g. limited room for “donuts”);
- Fauna crossing signs to be erected on Singleton Road to warn traffic;
- Document the history of Laughtondale and the wetland;
- Provide a boardwalk and seats;
- In the long term provision of additional educational signage adjacent to the proposed boardwalk.

A total of 46 newsletters were distributed to residents around the wetland. At the time of writing four written responses and one phone response had been received. By far the greatest concern to

residents is how visitors will access the wetland and in particular the hazard presented by Laughton Gully Road and the preference for visitors to use Old Northern Road and Singleton Road via Wisemans Ferry as it is a safer route and would encourage people to visit Wisemans Ferry and offer potential associated economic benefits to the local economy. Another concern was the maintenance of existing zoning so that current land uses can be maintained.

7.3.3 Public Hearing

A Public Hearing was undertaken on the 25th of September 2013 at Wisemans Ferry under Section 40A of the *Local Government Act 1993.* The Public Hearing was attended by Council Officers, the Consultants who prepared the Plan of Management and two community members. A report on the submissions made in relation to the public hearing was produced (Parkland Planners 2013). In summary the report indicated:

- No written submissions were received during the public exhibition period of the Draft Plan of Management;
- The community members who attended the Public Hearing asked two questions regarding the categorisation of land at One Tree Reach Wetland and were satisfied that the proposed catergorisation (see section 2.3) as Natural Area-Wetland and Natural Area-Bushland is appropriate.

7.4 Indigenous Heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) reveals that no Aboriginal sites or places are recorded in or near One Tree Reach Wetland. The extent and history of agricultural development in the wetland do reduce the potential for indigenous cultural heritage values to occur, however no detailed Aboriginal Heritage Assessment has been undertaken of the wetland.

The Aboriginal people inhabited the Hawkesbury region long before European settlement. The Darug people were known to have occupied the area for more than 40,000 years (Hawkesbury City Council undated). Before 1788 up to 3000 Darug people were known to live in the Hawkesbury River Valley. The Darug People of the Hawkesbury, the Marramarra Clan, resided around the rich and diverse Hawkesbury River, known as the Deerubbin. The Hawkesbury River played a significant role in the Darug People's day to day subsistence and ceremonies and many Aboriginal heritage sites occur in the Hawkesbury River Valley (Hawkesbury City Council undated).

7.5 European Heritage

A search of Hornsby Shire Council's heritage register Masterview and a review of the Hornsby Shire Heritage Development Control Plan revealed the following items (listed in Table 8) of heritage significance along Singleton Road. Of the items listed in Table 8 only the chimney is located in close proximity to One Tree Reach Wetland on the western side of Singleton Road.

Table 8 List of European Heritage Items in along Singleton Road

Address	Property Description	Item	Significance
Singleton Road	Lot 2, DP 506876	"White Rock" House	L
Singleton Road	Lot 40, DP 752029	Fords Farm	L
Singleton Road	Lot 26, DP 59266	Mill Creek Mill ruins	L
Singleton Road	Ms.1526 Sy. G.G. 22/8/1900	Wisemans Ferry Cemetery	S
Singleton Road	Lots 15 and 44, DP 752029, Lot 17, DP 752029	Singleton's Mill	S
Singleton Road	Lot 8, DP 752029	House ruins	L
Singleton Road	Lot 50, DP 752029	Chimney	L
Singleton Road	Lot 301, DP 629539	The Lodge	L
80 Singleton Road	Lot 20, DP 856306	Sandstone well/soak	L

L= local significance S = State Significance

8 Issue Analysis

A list of preliminary management issues are presented below:

- Acid sulfate soil management;
- Weir upgrade;
- Ecological management;
- Open space maintenance;
- Recreational facilities;
- Historical context;
- Community engagement, education and capacity building; and
- Funding and management.

8.1 Acid Sulfate Soil Management

Previous studies indicate One Tree Reach Wetland contains actual acid sulfate soils (ASS) and soils that are strongly potential acid sulfate soils (PASS) (Dragonfly Environmental 2011; Ward 2012). The management of PASS and ASS for the wetland has been the subject of studies and monitoring and has resulted in a proposal which recommended the installation of a weir within the outlet drainage channel on the northern end of the wetland. The aim being to retain water within the wetland at a higher level, thereby keeping the areas identified as potentially acid sulphate soil submerged and reducing the opportunity for them to form acid sulfate soil.

Ward (2012) indicates the installation of the weir and subsequent rise in water level to 0.4 metres may initially flush more acidity into the wetland. However water quality was expected to gradually improve with time as greater inundation reduced further sulfide oxidation and soil reduction processes consume any additional acidity. Ward (2012) also considered it likely that water quality may become less spatially variable as a result of greater mixing of the surface waters.

However increased inundation may also result in additional sulfide formation in the newly inundated surface soils. Ward (2012) indicated that if it is not possible to maintain the water level within the wetland at approximately 0.4 m, a reduction in water level may lead to further acidification as a consequence of the oxidation of any newly formed sulfides.

The existing studies have not considered the likely extent of the inundation caused by the increased water levels within the wetland and the likelihood of this increase in producing additional PASS and or ASS. This is identified as a data gap and consideration should be given to further studies and or modelling and ongoing monitoring that may provide information on the likely future production of ASS and PASS in the wetland particularly in light of the projected sea level rises in the order of 400 mm by 2050 and 900 mm by 2100 (*"NSW Climate Impact Profile", DECCW June 2010, Publication Reference: 2010/171)*, as a result of climate change.

However, the DECCW anticipates that ASS will remain a problem in tidal foreshore areas but this will ameliorate over time. Initial rises in sea level are likely to cause saline water to inundate some areas with ASS, leading to a structural decline of the soil. Over time, the interaction of a continuing rise in

sea level and catchment-driven flooding are likely to lead to more freshwater inundation on floodplains, resulting in an improvement in ASS." (*"NSW Climate Impact Profile", DECCW June 2010, Publication Reference: 2010/171)*

8.1.1 Recommendations

- continue to implement the water quality and soil monitoring protocol developed by Ward (2012) to measure the impacts of the weir based remediation strategy.
- ensure the weir continues to function effectively;
- select appropriate construction materials for the boardwalk given the presence of acid sulfate soils.

8.2 Weir Upgrade

The existing weir is designed to control the influx of saltwater from the Hawkesbury River and maintain a water level at least 300 mm higher than the existing invert level of the outlet channel. Turbulence, created by water discharging through the lowest level of the weir, has created a scour pool approximately 1 m deep and 2 m long downstream of the weir, which has undercut the weir's cut-off wall and created a sink hole upstream of the weir, which allows water to pass under the weir and prevents it from maintaining a deeper water level throughout the wetland.

Figure 12 Existing Tidal Weir Control and Associated Scour Pool

Consequently, for the weir to fulfil its desired purpose of maintaining a water level of between 300 mm and 700 mm higher within the wetland the existing scour pool and sink hole must be filled in and stabilised.

The preferred treatment, for stabilising the invert of the outlet channel, is the use of large durable loose rocks, which are resistant to high levels of salinity and acidity, packed tightly together in what is generally referred to as a "Rip Rap Stilling Basin and Apron". There are a number of technical publications which allow the dimensions for these structures, as well as the size of the rock used, to be calculated. The sizing and design procedures provided in *"Chapter 5, Culvert Manual No1 Ministry of Works & Development NZ, 1978"* were determined to be appropriate for this location with the final dimensions of the proposed stilling basin checked against those of the existing scour pool. A number of assumptions (such as the peak flow rate (0.33 m^3/s) and its velocity (2.2 m/s) as it passes over the weir, and the duration (60 minutes) of the peak flow) had to be made in order for these procedures to be used in this situation.

Based on the values adopted in the afore mentioned assumptions, and the use of the procedures referred to above, the recommended dimension for the rock rip rap protection downstream of the existing weir is:

Total length of rock rip rap protection:	6 m;
Length of the stilling basin:	5.3 m;
Width of the stilling basin:	3 m;
Depth of the stilling basin:	0.6 m;
Median rock size (d50):	0.5 m;
15% (d15) rock size:	0.25 m;
Minimum rock size (d10)	0.125 m;
Depth of the rip rap rock protection:	0.75 m;
Geotextile underlay:	Bidim A44 or equivalent.

These details are reflected in the concept sketches following.

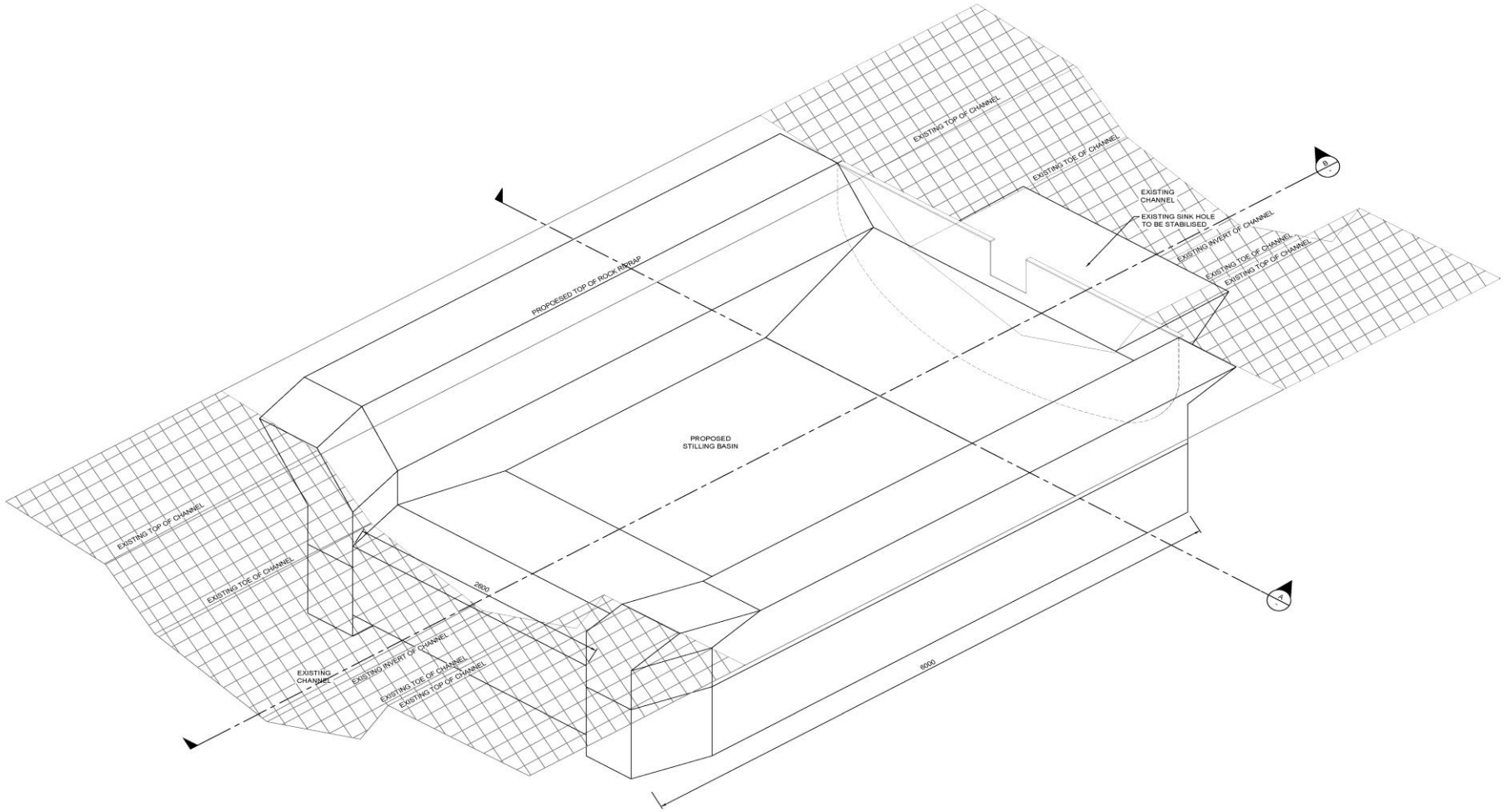

Figure 13 Concept Sketch Isometric View

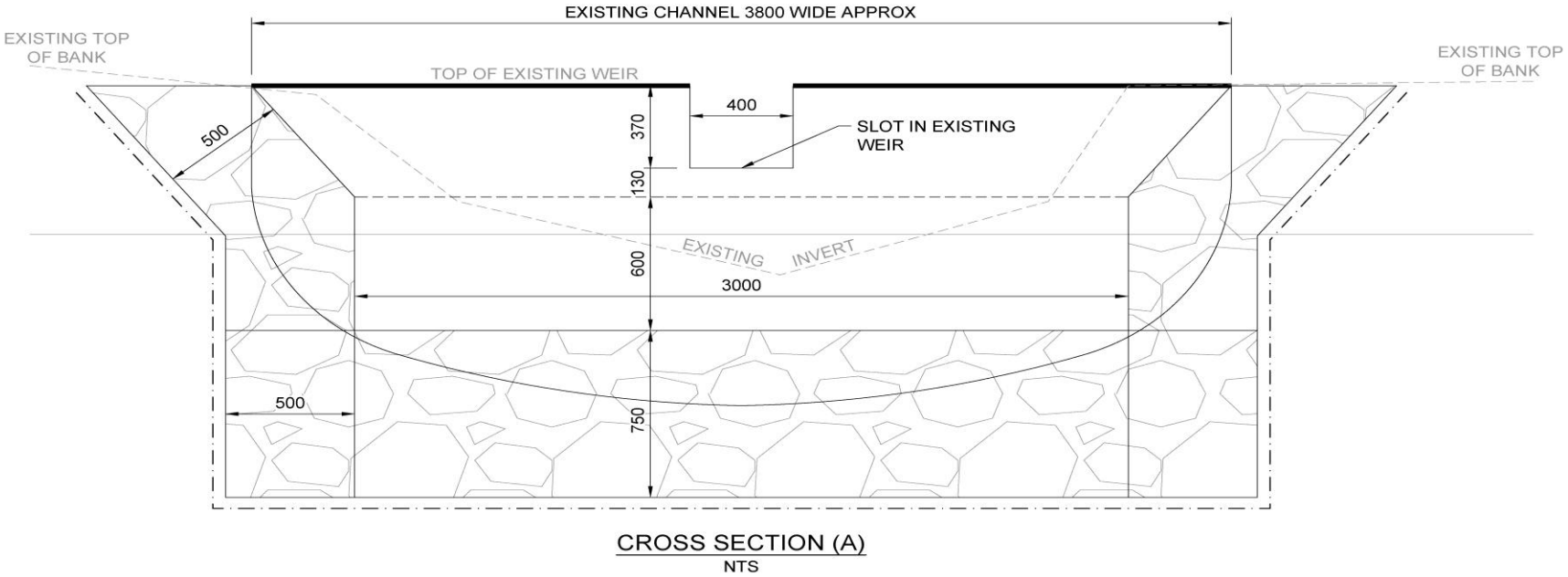

Figure 14 Concept Sketch Longitudinal Section

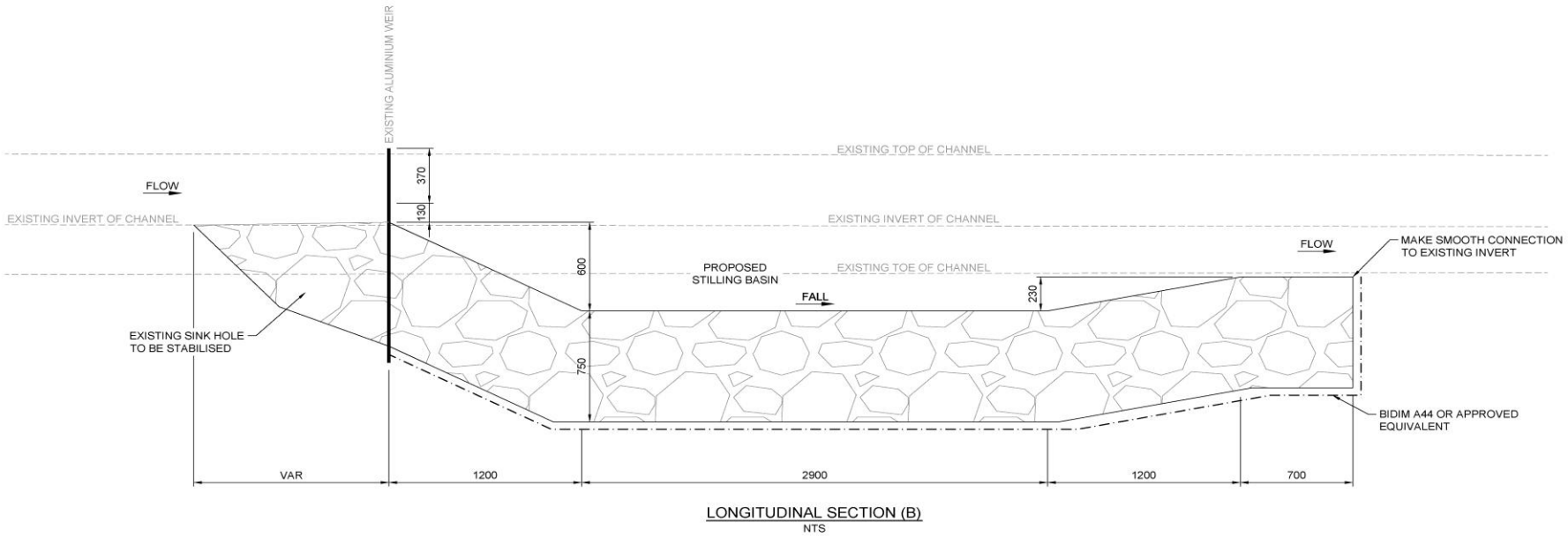

Figure 15 Concept Sketch Cross Section

In addition to the recommended downstream rock rip rap protection it is necessary to re-instate the integrity of the channel invert upstream of the weir, and this can be undertaken using the same loose rock rip rap approach, proposed downstream, to fill in the existing sink hole that has developed upstream. The rock rip rap protection should extend at least to the top of the exiting channel on both sides of the weir to protect the channel sides during period when water levels in the wetland exceed the height of the weir and outflows are concentrated "funnelled" into the channel as the downstream water level falls.

The recommended remediation strategy referred to above is not thought to adversely impact on fish passage through the weir. Further, the construction of a formal stilling pond on the downstream side of the weir may provide the larger fish species with deeper water downstream of the vertical face of the weir and allow them to launch themselves through the opening during periods of low flow through the weir.

During periods of low rainfall and high tides there is potential for the development of a halocline in the standing water in the wetland. This if left unmanaged could result in hyper saline conditions in the wetland and resulting negative impacts on aquatic life and vegetation. Consideration should be given to providing a lower water level control, within the weir, that will allow the wetland to fully drain prior to forecast rainfall events that would then "refill" the wetland. Ongoing monitoring of salinity levels in the wetland will be required to ensure that draining events are undertaken at appropriate times to reduce the potential for hyper saline conditions to develop.

8.3 Ecological Management

The current extent of One Tree Reach Wetland supports 3 endangered ecological communities (EECs). The original extent would have supported 5 EECs but only three have been mapped in its current extent. The wetland is considered primarily as a freshwater wetland with limited saltwater influence. Vegetation within and around the wetland indicate a strong reliance on fresh groundwater (Ward 2012). The installation of the weir and subsequent increased water level do not appear to have had any short term impacts on the EECs present in the wetland but with no baseline survey data for quadrats within vegetation communities in the wetland changes in vegetation community composition and or density cannot be assessed.

The presence of mangroves in One Tree Reach Wetland has been document by Dragonfly Environmental (2011). Saltmarsh loss to mangrove encroachment has been occurring since the 1940s across all east coast bioregions and a range of geomorphic settings (Saintilan et al 2009). A variety of hypotheses have been presented by authors to explain the trend of landward mangrove encroachment including higher rainfall freshening the intertidal environment promoting landward migration of mangroves, the interaction of nutrients and sediments, estuary opening and relative sea level rise. Without baseline mapping of the extent of mangroves across the wetland including adjacent to the saltmarsh EEC no monitoring can be undertaken to determine if landward mangrove migration may be a management issue for One Tree Reach Wetland.

Ongoing bush regeneration involving the control of weeds with a focus on noxious weeds and weeds of national significance will contribute to the maintenance of the conservation values of the EECs present on the subject site. Consideration of the need to revegetate areas with locally endemic native species should be based on the results of bush regeneration activities.

Fauna surveys and database records indicate that a variety of threatened fauna species may utilise the wetland as part of their home ranges. Survey undertaken by Hornsby Shire Council concentrated in the winter and summer months. Annual spring based survey in the wetland may reveal a greater diversity of fauna species utilising habitats in the wetland. There is evidence of habitat enhancement for the Eastern Pygmy Possum in the wetland through the introduction of suitable nest boxes. Consideration should be given to the introduction of nest boxes suitable for microchiropteran bats, forest owls, parrots, gliders and possums.

Bushfire hazard was acknowledged by local residents as a key issue of concern. Hornsby Shire Council in conjunction with the Rural Fire Service implements a program of hazard reduction burning and bushfire fuel management in the rural areas of Hornsby Shire.

8.3.1 Recommendations

- Continue bush regeneration and planting with locally endemic native plant species;
- Baseline vegetation Surveys to determine the species composition and abundance within the vegetation communities in the wetland;
- Baseline mapping of the distribution of mangroves in and around the wetland and including adjacent to the saltmarsh EEC on the eastern boundary of the southern privately owned portion of the wetland;
- Additional fauna survey during spring;
- Installation of nest boxes for microchiropteran bats, forest owls, parrots gliders and possums.
- Provide further information to residents on the Bushfire hazard reduction program implemented by Hornsby Shire Council and the Rural Fire Service.

8.4 Open Space Maintenance

Currently a grassy buffer is present between Singleton Road and the wetland and between the Council owned wetland and the adjoining private property to the north. Grassy filter strips can contribute to water quality in wetlands (DEC2005). The current management strategy has been to cease mowing of the grassy buffer, this has resulted in:

- Regeneration of native plant species;
- Increased wildlife movements (particularly by wallabies, possibly for grazing) across Singleton Road on the southern boundary of the wetland and subsequent road kills;
- Increased antisocial behaviour by people in vehicles along the grassy buffer possibly due to the sense of an unmanaged and so unoccupied area indicated by the long grass;
- High density of whisky grass on the northern edge of the council owned wetland lot.

A balance is required between the no mow regime and the need to encourage native plant regeneration and to ensure vehicular safety along the edge of Singleton Road adjoining the wetland.

A temporary fence has been left around some regenerating vegetation on the south west edge of the wetland. The fence has since fallen into disrepair and is no longer protecting vegetation from grazing wildlife.

8.4.1 Recommendations

- Instigate a regular mowing regime on the grassy verge immediately adjoining Singleton Road of approximately 2 metres. This area should be mowed regularly (at least every season);
- Mowing around existing signage to increase visibility
- Consider the installation of a low boundary (possibly a rustic log barrier) to delineate the no mow boundary to the wetland;
- Ongoing cooperation with adjoining landholders to promote the treatment of weeds on the boundaries of the wetland.
- Remove temporary fencing that is no longer required.

8.5 Recreational Facilities

Hornsby Shire Council proposes to install a variety of infrastructure and recreational amenities in the wetland. They include:

- A raised boardwalk along the western edge of the wetland. The route would begin at the northern end of the proposed car park off Singleton Road and extend north along the western edge of the wetland ending in a viewing area overlooking the open water;
- A formalised car parking area that could accommodate small groups of cars and allow school or tourists buses to pull off Singleton Road;
- A series of small picnic tables and chairs made from rustic logs are also proposed on the south western edge of the wetland near the entrance to the forest walk and on the western edge of the Swamp Mahogany Forest;
- A forest walk through the Forest Red Gum River Flat Forest. This walk would require the installation of an onground track and relevant signage.

The design and potential route of the boardwalk have been developed by Hornsby Shire Council and are shown in Figure in Appendix D.

Further consideration of the proposed car park is required to ensure any design can accommodate small numbers of cars and permit off street bus parking without promoting inappropriate use of the area by vehicles.

8.6 Historical Context

The original One Tree Reach Wetland was once a much larger system than that considered in this PoM. It extended north to the Hawkesbury River and south to Dalgety's Creek. As indicated the wetland was part of a land grant with records that date back to 1832. The wetland was drained for agricultural purposes and as a result habitat features were lost, drainage conditions altered and the water level reduced. The reduced water level exposed acid sulfate soils which resulted in highly acidic water and sediment deposition in the wetland.

Ultimately the management of One Tree Reach Wetland as an entire system regardless of land ownership would contribute to the natural and conservation values of the wetland and assist with the management of water levels to control acid sulfate soils.

The local community expressed high levels of enthusiasm regarding the European history of the wetland and acknowledged that descendants of original settlers are still living and some remain in the local area. These people may have memories of the past management of the wetland that the local community would like to see documented and the disturbance history of the wetland may inform current management.

One Tree Reach Wetland lies on the route utilised for the Hawkesbury Harvest Farm Gate Trail to a local farm established in 1901 that enables visitors to pick their own produce. There is an opportunity to link the wetland with its long history of European settlement to the existing farm gate trail or for it to form part of a Heritage Trail for the area that incorporates other local European and Aboriginal heritage sites.

8.6.1 Recommendations

- Formally document the historical full extent of the One Tree Reach Wetland System;
- Consider the potential for Hornsby Shire Council to begin negotiations with adjoining private landholders with an aim to develop a memorandum of understanding (MoU) that the entire wetland be managed as a whole regardless of land ownership;
- Consider the implementation of Council's rural land incentives program to contribute toward management of the wetland by the adjoining private landholders;
- Consider the collection and documentation of a verbal history of the management of the wetland from descendants of original settlers;
- Consider the incorporation of the wetland into existing or new heritage or farm gate trails that attract visitors to the area;
- Consider the timing of attracting visitors to the wetland with a view to the provision of recreational infrastructure prior to attracting visitors.

8.7 Community engagement, education and capacity building

The local community place high levels of value on the wetland for its natural amenity and they aspire to the area being used by visitors and locals alike. This was made clear at the community meeting held at the beginning of this plan of management and in responses to the newsletter and questionnaire distributed during preparation of this plan of management.

The provision of recreational facilities including the proposed boardwalk, picnic tables and chairs, additional signage and car parking areas will assist in attracting visitors to the wetland. This approach acknowledges that the area has a limited carrying capacity and the volume of visitation will be limited by the facilities available.

A key concern for local residents that emerged during preparation of the PoM was how visitors would access the wetland. This was based on responses to a newsletter that is a draft brochure for the wetland. Following feedback from residents it is clear the brochure should be revised to encourage access to the wetland via Wisemans Ferry and Singleton Road. This would have the dual benefits of offering a safer route and encouraging visitation to the village of Wisemans Ferry.

Bush regeneration in the wetland has been undertaken by both volunteer Bushcare groups and contractors engage by HSC. It is recommended that existing Bushcare efforts are supported along with a number of supplementary measures.

Hornsby Shire Council has a strong Bushcare community that takes an active role in the management of local bushland reserves, including reserves to the north at Wisemans Ferry. Over 100 Bushcare groups with pver 800 volunteers as well as Landcare groups throughout the Hornsby Shire have become part of the Landcare Community. A recent initiative Floating Landcare is organised by the Hawkesbury-Nepean Catchment Management Authority, funded by the NSW Environmental Trust and run in partnership with Pittwater Council, Hornsby Council, Gosford Council and National Parks and Wildlife Service. This organisation facilitates volunteers caring for bushland in locations that can only be reached by boat along the Hawkesbury River.

Support for community involvement in the ongoing care and management of One Tree Reach Wetland will require effort and funding to be successful. It is recommended that existing Bushcare and Landcare efforts are supported with a number of supplementary measures.

- A launch of this wetland plan of management at the wetland once it is to be implemented, this could coincide with the beginning of construction of the boardwalk and culminate in a grand opening of the boardwalk.
- Increase in the flow of information from Council to residents and visa versa (for example the collection and documentation of verbal histories of the wetland and the provision of information on bushfire hazard management).
- Keep the community informed of the program for open space maintenance and recreational facility installation at the wetland.
- Revise the draft One Tree Reach Wetland Brochure to suggest access via Wisemans Ferry and Singleton Road.
- Develop links to local schools primary and secondary through the provision of information to teachers on the wetland and once recreational facilities are available encourage the wetland to be used as a field classroom for various curriculum elements.
- Develop links with local businesses to provide information on the history and values of the wetland and encourage the development of partnerships to develop a local stewardship program that could engage businesses based in the Hornsby Shire in care, management and funding of works in the wetland.
- Engage and inform local conservation groups about the conservation values of the wetland and encourage groups to visit the wetland.
- Engage with and inform the local community about the conservation values and history of the wetland for example through local press including the Living Heritage and Galston and Glenorie Community News.
- Develop links to the local Aboriginal groups including the Darug Tribal Corporation and the Darug Custodian Aboriginal Corporation.

8.8 Funding and management

The One Tree Reach Wetland requires significant ongoing works to ensure the core objectives detailed in the LG Act 1993 for the management of the various land categories it currently supports can be met. These include:

- Bushland;
- Wetlands; and
- Water courses.

Hornsby Shire Council provides for maintenance of the study area in its annual budget. The budget allocation is aimed at achieving satisfactory levels for maintenance and facility provision in community land areas.

The current funding allocation for management and provision of recreational facilities in the wetland is supplemented by grant moneys obtained and administered by Council from State and Commonwealth Government Agencies. The annual budget allocation will require supplementary funding from grants to meet core objectives for management and to provide recreational facilities and to achieve some of the actions proposed in this plan of management. Particularly in relation to the collection of baseline ecological data, community engagement and heritage initiatives.

The incorporation of One Tree Reach Wetland onto a natural assets register that details the current condition of environmental assets in the LGA and the costs associated with their management and restoration may assist in predicting the required levels of ongoing financial support.

Ongoing examination of potential funding sources including rate levies, state and federal grants, developer contributions and volunteer resources along with specific funding sources identified in this plan of management will be required to ensure adequate and ongoing funds are available for management of the wetland.

9 Management Strategies

A variety of management strategies and actions have been developed to take into account the issues analysis and to provide clear and specific management objectives. Strategies include:

- Acid sulfate soil management;
- Weir upgrade;
- Ecological management;
- Open space maintenance;
- Recreational facilities;
- Historical context;
- Community engagement, education and capacity building; and
- Funding and management.

The management actions and priorities have been summarised and are presented in Table 16 in Appendix E.

9.1 Acid Sulfate Soil Management

9.1.1 Objectives

To monitor water quality and soil for indications of the impacts of the weir based remediation strategy on acid sulfate soils.

9.1.2 Actions

- implement the water quality and soil monitoring protocol developed by Ward (2012);
- monitor the ongoing function of the weir to ensure it is achieving its design objectives;
- practice adaptive management.

9.1.3 Performance Targets

Routine water quality monitoring undertaken regularly at a number of sites, with four selected sites to be monitored in greater detail (see Ward 2012);

Soil properties be monitored at selected sites (see Ward 2012).

9.1.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

Fisheries grants; and Estuary Management grants.

9.2 Weir Upgrade

9.2.1 Objectives

To increase the water level in the wetland by a minimum of 300 mm and provide approximately 400 mm of water level control in 100 mm increments over and above the 300 mm increase and reduce the opportunity for potentially acid sulphate soils surrounding the wetland to acidify.

To manage salinity in the open water areas of the wetland to avoid the development of hyper saline conditions.

9.2.2 Actions

- Retain the existing weir structure in its present location;
- Stabilise the outlet channel invert and banks downstream and upstream of the existing weir;
- Construct a rock rip rap stilling pond and apron downstream of the existing weir.
- Install a lower water level control, within the weir, that will allow the wetland to fully drain prior to forecasted rainfall events.

9.2.3 Performance Targets

Routine inspections to ensure that further erosion of the channel invert and banks are not eroding and that the integrity of the existing weir structure is maintained. If the weir is observed to be impeding fish passage then a small fish ladder could be constructed on the downstream face of the weir, and integrated into the rock rip rap stilling pond. Installation of a lower water level control in the existing weir, no occurrence of hyper saline conditions in the wetland.

9.2.4 Funding Sources

Hornsby Shire Council annual operations budget;

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000. http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.3 Ecological Management

9.3.1 Objectives

To gather baseline data on the endangered ecological communities and faunal assemblages present in the wetland so they can be monitored and managed for their conservation values.

9.3.2 Actions

- Continue bush regeneration and planting with locally endemic native plant species;
- Baseline vegetation Surveys to determine the species composition and abundance within the vegetation communities in the wetland;
- Baseline mapping of the distribution of mangroves in and around the wetland and including adjacent to the saltmarsh EEC on the eastern boundary of the southern privately owned portion of the wetland;
- Additional fauna survey during spring;

- Installation of nest boxes for microchiropteran bats, forest owls, parrots gliders and possums;
- Provide further information to residents on the Bushfire hazard reduction program implemented by Hornsby Shire Council and the Rural Fire Service.

9.3.3 Performance Targets

Baseline flora surveys undertaken;

Fauna surveys undertaken during spring;

Baseline mapping of the distribution and abundance of mangroves;

Number of nest boxes installed;

Information provided to residents.

9.3.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000. http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.4 Open Space Maintenance

9.4.1 Objectives

To undertake a satisfactory level of maintenance of open space areas in a manner that is sympathetic to the wetland's ecological values.

9.4.2 Actions

- Instigate a regular mowing regime on the grassy verge immediately adjoining Singleton Road of approximately 2 metres. This area should be mowed regularly (at least every season);
- Mowing around existing signage to increase visibility;
- Consider the installation of a low boundary (possibly a rustic log barrier) to delineate the no mow boundary to the wetland;
- Ongoing cooperation with adjoining landholders to promote the treatment of weeds on the boundaries of the wetland;
- Remove temporary fencing that is no longer required.

9.4.3 Performance Targets

Regular mowing of mow areas;

Establishment of boundaries to no mow areas;

Extent of natural regeneration of indigenous vegetation species;

Evidence of ongoing engagement with adjoining landholders to address weed invasion issues;

Successful reduction of weed density in open space areas.

9.4.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants
http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000.
http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.5 Recreational facilities

9.5.1 Objectives

To provide the timely and appropriate delivery of recreational facilities to the wetland that will promote its sustainable use by the local community and visitors.

9.5.2 Actions

- Install a sign that identifies the wetland from Singleton Road as an area of public land;
- Install a raised boardwalk along the western edge of the wetland. The route would begin at the northern end of the proposed car park off Singleton Road and extend north along the western edge of the wetland ending in a viewing area overlooking the open water (see detailed plans in appendix D);
- Consider the installation of a raised viewing platform within the boardwalk design to enable additional views of the open water habitat;
- Install a formalised car parking area that could accommodate small groups of cars and allow school or tourists buses to pull off Singleton Road;
- Install a series of small picnic tables and chairs made from rustic logs are also proposed on the south western edge of the wetland near the entrance to the forest walk and on the western edge of the Swamp Mahogany Forest;
- Install a forest walking track through the Forest Red Gum River Flat Forest;
- Install relevant educational signage on the boardwalk and forest walk.

9.5.3 Performance Targets

Detailed design and installation of recreational facilities listed above

9.5.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants
http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000. http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.6 Historical Context

9.6.1 Objectives

Recognise and the historical extent of the wetland and manage the system as a whole, promote the heritage values of the wetland to local heritage tourism.

9.6.2 Actions

- Formally document the full historical extent of the One Tree Reach Wetland System;
- Consider the potential for Hornsby Shire Council to begin negotiations with adjoining private landholders with an aim to develop a memorandum of understanding (MoU) that the entire wetland be managed as a whole regardless of land ownership;
- Consider the implementation of Council's rural land incentives program to contribute toward management of the wetland by the adjoining private landholders;
- Consider the collection and documentation of a verbal history of the management of the wetland from descendants of original settlers;
- Consider the incorporation of the wetland into existing or new heritage or farm gate trails that attract visitors to the area;
- Consider the timing of attracting visitors to the wetland with a view to the provision of recreational infrastructure prior to attracting visitors.

9.6.3 Performance Targets

Formal documentation and recording of the original extent of the wetland, initiation and ongoing liaison with adjoining landholders regarding the overall management of the wetland system, development of a verbal history project for the wetland, incorporation or promotion of the wetland as part of a local heritage trail.

9.6.4 Funding Sources

Hornsby Shire Council annual budget .

Community Heritage grants from the NSW Office of Environment and Heritage.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000. http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.7 Community Engagement, Education and Capacity Building

9.7.1 Objectives

To engage the local community and users of the wetland to undertake measures that will contribute to the long term management of the wetland.

9.7.2 Actions

- Identify and engage with local community user groups;
- A launch of this wetland plan of management at the wetland once it is to be implemented, this could coincide with the beginning of construction of the boardwalk and culminate in a grand opening of the boardwalk;
- Increase in the flow of information from Council to residents and visa versa (for example the collection and documentation of verbal histories of the wetland and the provision of information on bushfire hazard management);
- Keep the community informed of the program for open space maintenance and recreational facility installation at the wetland;
- Revise the draft One Tree Reach Wetland Brochure to suggest access via Wisemans Ferry and Singleton Road.
- Develop links to local schools primary and secondary through the provision of information to teachers on the wetland and once recreational facilities are available encourage the wetland to be used as a field classroom for various curriculum elements;
- Develop links with local businesses to provide information on the history and values of the wetlands and encourage the development of partnerships to develop a local stewardship program that could engage businesses based in the Hornsby Shire in care, management and funding of works in the wetland;
- Engage and inform local conservation groups about the conservation values of the wetland and encourage groups to visit the wetland;
- Engage with and inform the local community about the conservation values and history of the wetland for example through local press including the Living Heritage and Galston and Glenorie Community News;
- Develop links to the local Aboriginal groups including the Darug Tribal Corporation and the Darug Custodian Aboriginal Corporation;
- Provide information to local groups, residents and the community in how they can become involved in management and monitoring in the wetland, for example birds in backyards surveys and world wetlands day; and
- Develop incentives for the local community to utilise the riparian corridor for educational and recreational purposes.

9.7.3 Performance Targets

Encourage formation of a Bushcare group at One Tree Reach Wetland;

Increased community use of the wetland for passive recreation;

Engagement of local and broader community groups in programs that contribute to management and monitoring in the wetland;

Visitor access to the wetland via Wisemans Ferry and Singleton Road.

9.7.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants
http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000.
http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

9.8 Funding and management

9.8.1 Objectives

To ensure ongoing adequate and sustained funding is available to undertake management in the wetland.

9.8.2 Actions

- Explore the inclusion of One Tree Reach Wetland on the natural assets register for Hornsby Shire Council;
- Continue Hornsby Shire Council Officers involvement in regional environmental and catchment initiatives;
- Ensure adequate staff resources are available for ongoing examination of potential funding sources including rate levies, state and federal grants, developer contributions and volunteer resources.

9.8.3 Performance Targets

Allocation by Hornsby Shire Council of adequate and ongoing resources to undertake management measures detailed in this PoM.

9.8.4 Funding Sources

Hornsby Shire Council annual budget.

Environmental Trust Grant administered by the NSW Office of Environment and Heritage Environmental Restoration and Rehabilitation Grants
http://www.environment.nsw.gov.au/grants/restoration.htm

Hawkesbury Nepean Catchment Management Authority Funding for Landholders and Community Groups http://www.hn.cma.nsw.gov.au/funding/

NSW DPI Fisheries Habitat Action Grants 2014-2015 large grant maximum $40,000.
http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program#Habitat-Action-Grants-2012-2013

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Appendices

Appendix A Historical Survey Plans

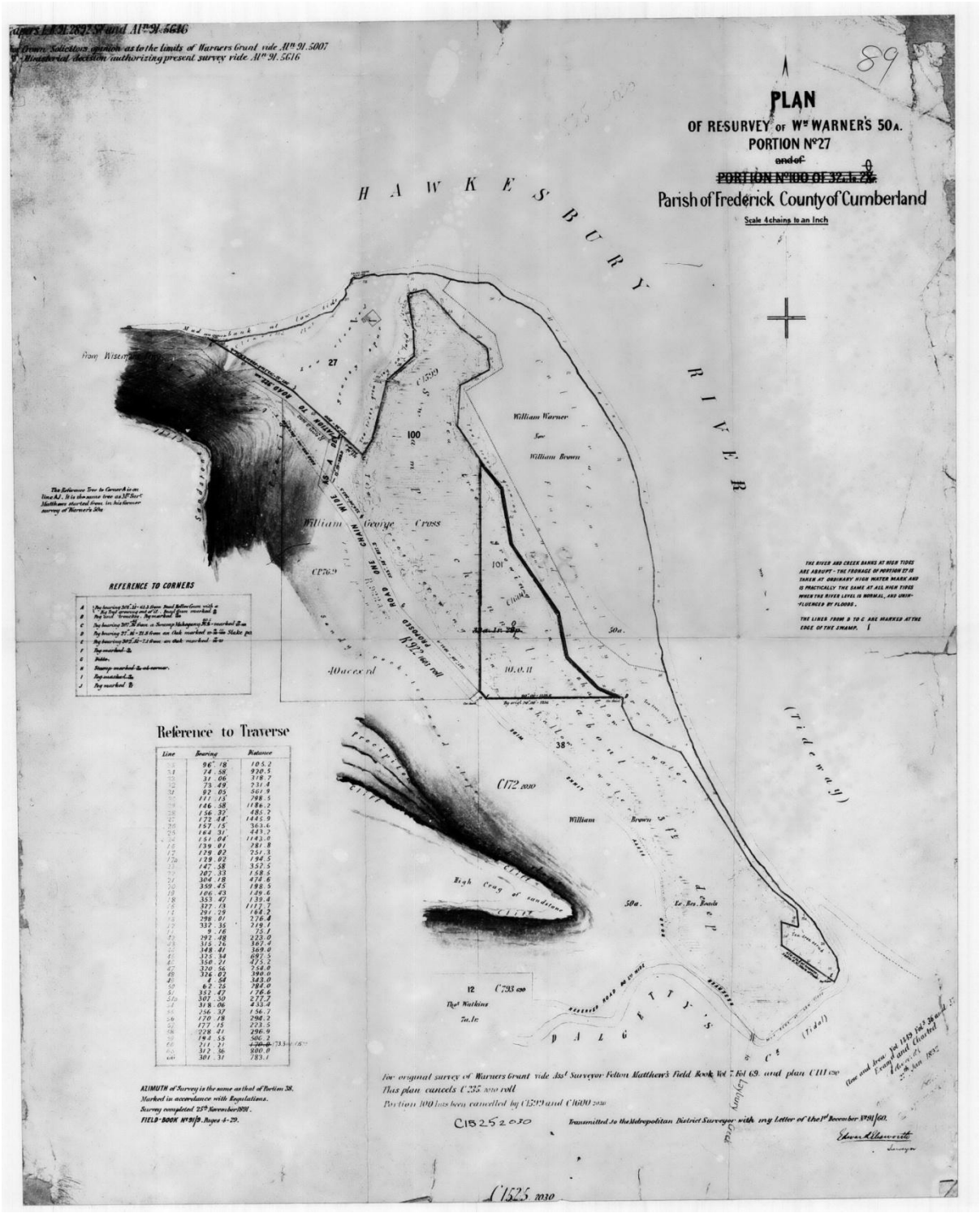

Figure 16 1832 Survey Plan

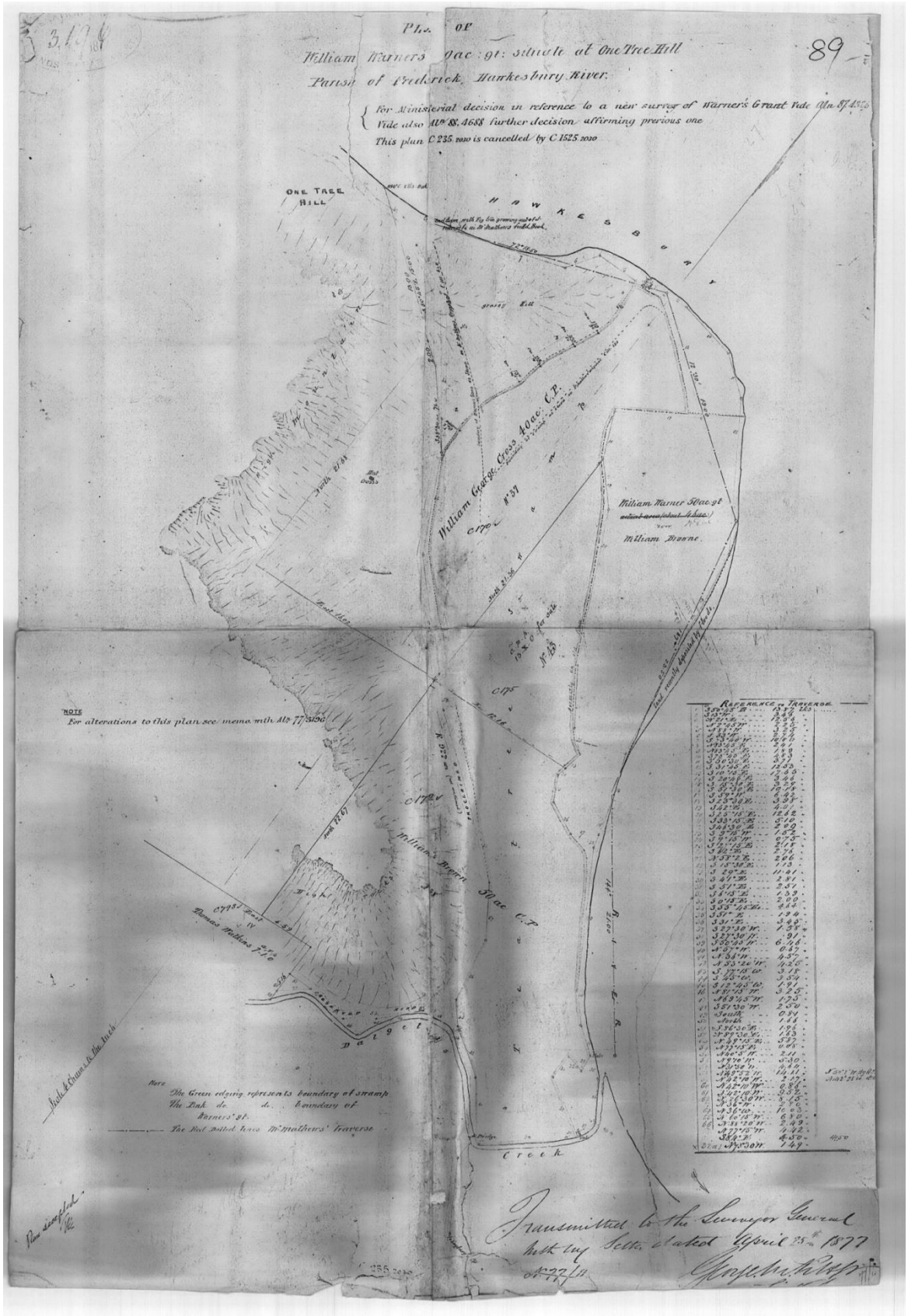

Figure 17 1877 Survey Plan

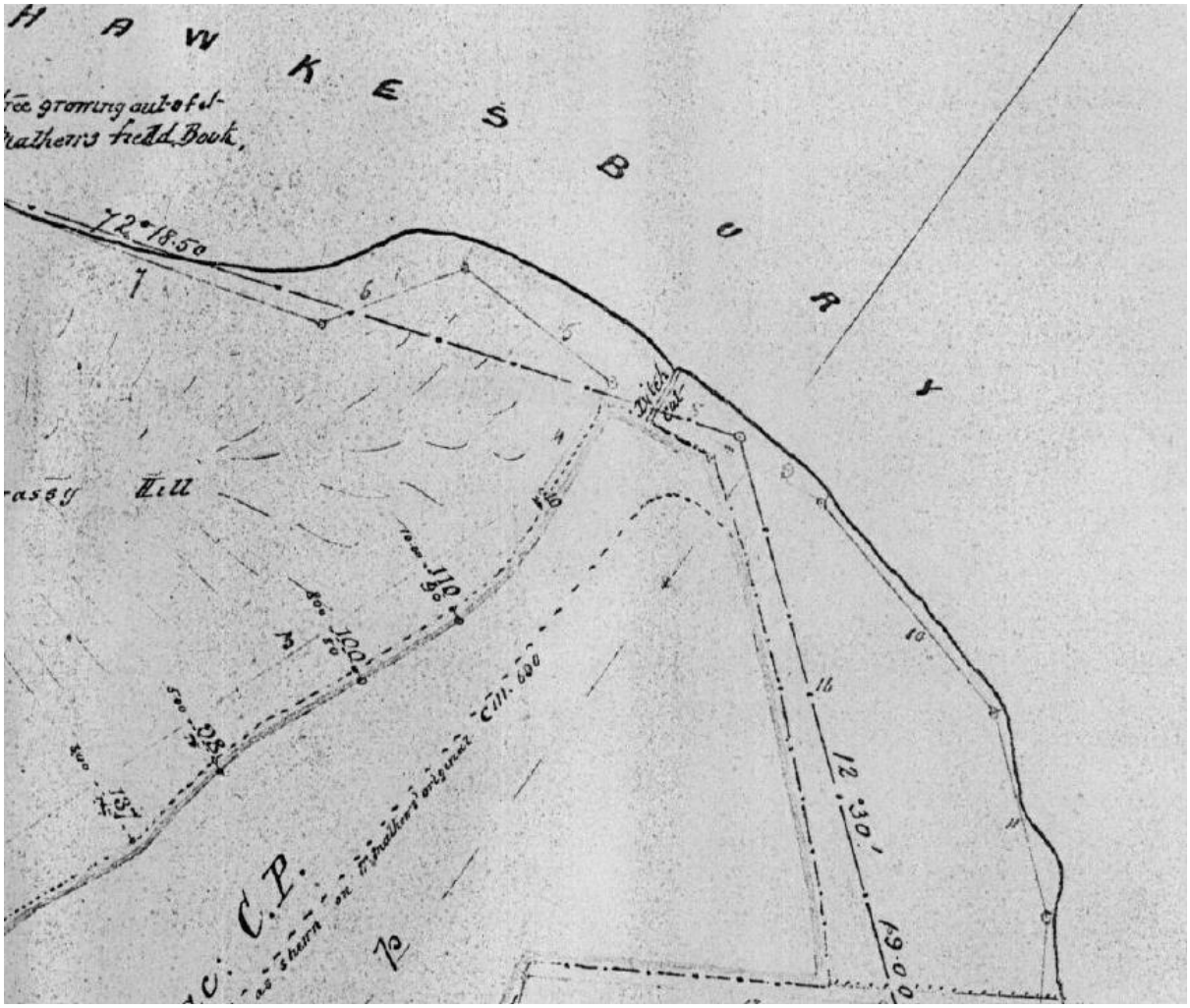

Figure 18 snapshot of 1877 plan showing ditch cut notation

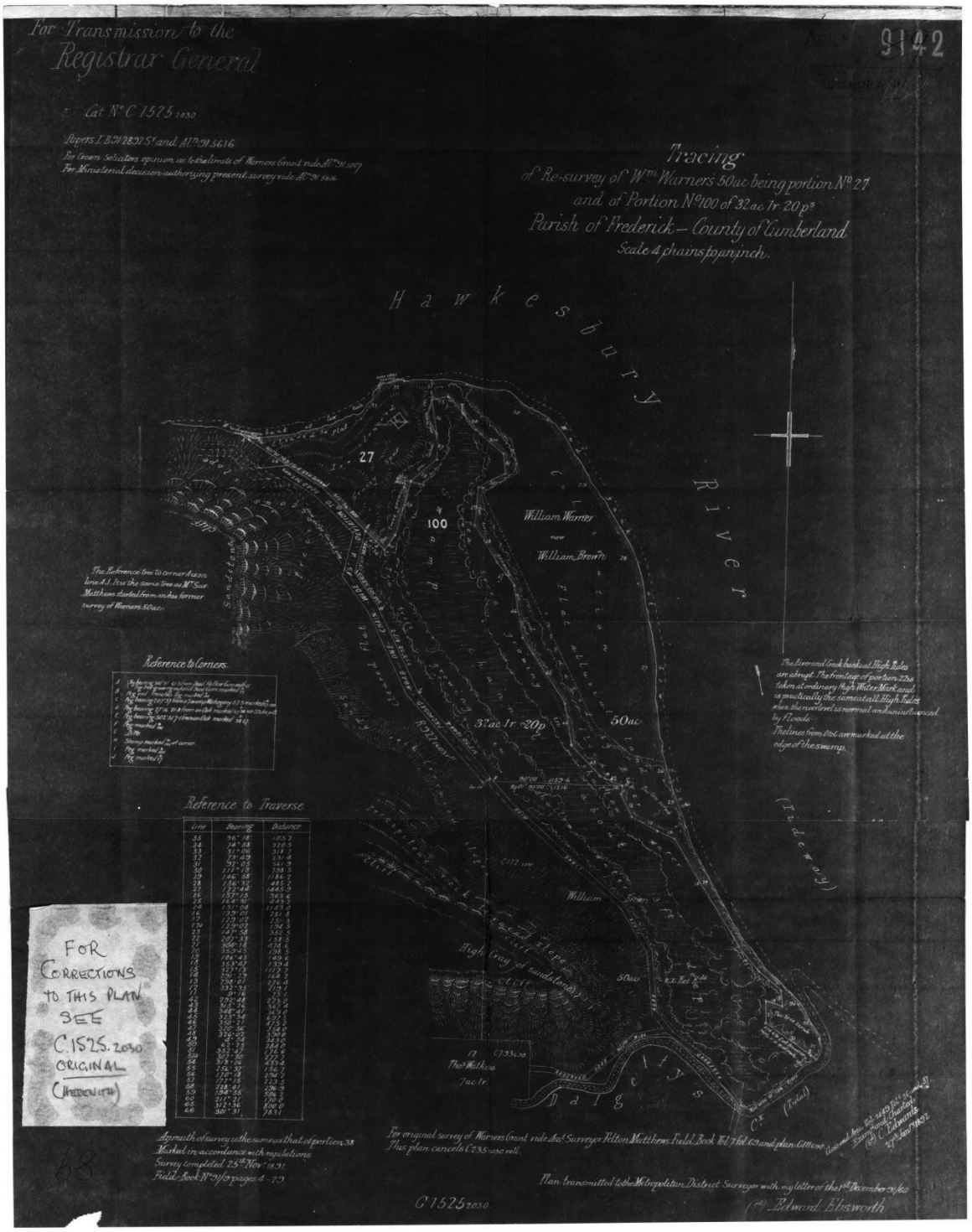

Figure 19 1891 Survey Plan

Appendix B Threatened Flora and Fauna Species Lists

Table 9 Nationally Listed Threatened Species Recorded within a 10km radius of One Tree Reach Wetland

Scientific Name	Common Name	Conservation Status (EPBC Act)
Birds		
Anthochaera phrygia	Regent Honeyeater	Endangered
Botaurus poiciloptilus	Australasian Bittern	Endangered
Dasyornis brachypterus	Eastern Bristlebird	Endangered
Diomedea exulans antipodensis	Antipodean Albatross	Vulnerable
Diomedea exulans exulans	Tristan Albatross	Endangered
Diomedea exulans gibsoni	Gibson's Albatross	Vulnerable
Diomedea exulans (sensu lato)	Wandering Albatross	Vulnerable
Erythrotriorchis radiatus	Red Goshawk	Vulnerable
Lathamus discolour	Swift Parrot	Endangered
	Australian Painted Snipe	Vulnerable
Fish		
Epinephelus daemelii	Black Rockcod	Vulnerable
Macquaria australascia	Macquarie Perch	Endangered
Prototroctes maraena	Australian Grayling	Vulnerable
Frogs		
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable
Litoria aurea	Green and Golden Bell Frog	Vulnerable
Litoria littlejohni	Littlejohn's Tree Frog	Vulnerable
Mixophyes balbus	Southern barred Frog	Vulnerable
Mixophyes iteratus	Giant Barred Frog	Endangered
Mammals		
Large-eared Pied Bat	Chalinolobus dwyeri	Vulnerable
Dasyurus maculatus SE mainland population	Spotted tailed quoll	Endangered
Petrogale penicillata	Brush-tailed Rock-wallaby	Vulnerable
Phascolarctos cinereus combined populationsQld, NSW Act	Koala	Vulnerable
Potorous tridactylus tridactylus SE mainland	Long-nosed potoroo	Vulnerable
Pseudomys novaehollandiae	New Holland Mouse	Vulnerable
Pteropus poliocephalua	Grey-headed Flying -fox	Vulnerable
Plants		
Allocasuarina glareicola		Endangered
Asterolasia elegans		Endangered
Cryptosylis hunteriana	Leafless Tongue Orchid	Vulnerable

Kunzea rupestris		Vulnerable
Leptospermum deanei	Deane's paperbark	Vulnerable
Micromyrtus blakelyi		Vulnerable
Pelargonium sp. Striatellum		Endangered
Pimerlea curviflora var. curviflora		Vulnerable
Rhizanthella slateri	Eastern Underground Orchid	Endangered
Streblus pendulinus	Siah's backbone	Endangered
Tetratheca glandulosa	Glandular pink bell	Vulnerable
Reptiles		
Caretta caretta	Loggerhead Turtle	Endangered
Chelonia mydas	Green Turtle	Vulnerable
Dermochelys coriacea	Leatherback Turtle	Endangered
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable
Hoplocephalus bungaroides	Broad-headed Snake	Vulnerable
Natator depressus	Flatback Turtle	Vulnerable

Table 10 Threatened Flora Species Recorded in a 10km Radius of One Tree Reach Wetland (source: NSW Wildlife Atlas)

Scientific Name	**Common Name**	**NSW status**	**Comm. status**
Olearia cordata		V,P	V
Tetratheca glandulosa		*V,P*	*V*
Amperea xiphoclada var. pedicellata		E4,P	X
Acacia bynoeana	Bynoe's Wattle	E1,P	V
Grammitis stenophylla	Narrow-leaf Finger Fern	E1,P,3	
Pilularia novae-hollandiae	Austral Pillwort	E1,P,3	
Darwinia biflora		V,P	V
Darwinia fascicularis subsp. oligantha	Darwinia fascicularis subsp. oligantha population in the Baulkham Hills and Hornsby Local Government Areas	E2	
Kunzea rupestris		V,P	V

Micromyrtus blakelyi		V,P	V
Syzygium paniculatum	Magenta Lilly Pilly	E1,P	V
Rhizanthella slateri	Eastern Australian Underground Orchid	V,P,2	E
Ancistrachne maidenii		V,P	
Grevillea parviflora subsp. supplicans		E1,P	
Asterolasia elegans		E1,P	E
Zieria involucrata		E1,P	V
Lasiopetalum joyceae		V,P	V
Pimelea curviflora var. curviflora		V,P	V

*For conservation status codes see table 12

Table 11 Threatened Fauna Species Recorded from a 10km Radius of One Tree Reach Wetland (source: NSW Wildlife Atlas)

Scientific Name	Common Name	NSW status	Comm. status
Pseudophryne australis	Red-crowned Toadlet	V,P	
Varanus rosenbergi	Rosenberg's Goanna	V,P	
Hoplocephalus bungaroides	Broad-headed Snake	E1,P,2	V
Pterodroma leucoptera leucoptera	Gould's Petrel	V,P	E
Botaurus poiciloptilus	Australasian Bittern	E1,P	E
Ixobrychus flavicollis	Black Bittern	V,P	
Hieraaetus morphnoides	Little Eagle	V,P	
Pandion cristatus	Eastern Osprey	V,P,3	
Burhinus grallarius	Bush Stone-curlew	E1,P	
Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3	
Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P,2	
Glossopsitta pusilla	Little Lorikeet	V,P	
Neophema pulchella	Turquoise Parrot	V,P,3	
Ninox strenua	Powerful Owl	V,P,3	
Tyto novaehollandiae	Masked Owl	V,P,3	

Tyto tenebricosa	Sooty Owl	V,P,3	
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V,P	
Chthonicola sagittata	Speckled Warbler	V,P	
Daphoenositta chrysoptera	Varied Sittella	V,P	
Petroica boodang	Scarlet Robin	V,P	
Petroica phoenicea	Flame Robin	V,P	
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E
Phascogale tapoatafa	Brush-tailed Phascogale	V,P	
Phascolarctos cinereus	Koala	V,P	V
Petaurus australis	Yellow-bellied Glider	V,P	
Petaurus norfolcensis	Squirrel Glider	V,P	
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P	
Mormopterus norfolkensis	Eastern Freetail-bat	V,P	
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V,P	
Myotis macropus	Southern Myotis	V,P	
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P	

*For conservation status codes see table 12

Table 12 Conservation Status Codes

Code	Description	Definition under the TSC Act 1995,
		Refers to fauna not listed in Schedule 11 of the NPW Act 1974.
P	Protected	
P 13	Protected Native Plants	Refers to flora listed in Schedule 13 of the NPW Act 1974.
V	Vulnerable	Refers to fauna and flora species that are likely to become endangered unless the circumstances & factors threatening its survival or evolutionary development cease to operate (Schedule 2, TSC Act 1995).
E1	Endangered	Refers to fauna and flora species that are likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary developments cease to operate; or, its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction; or, it might already be extinct, but it is not presumed extinct (Schedule 1, part 1, TSC Act 1995).
E2	Endangered Population	Refers to a population where, in the opinion of the Scientific Committee, its numbers have been reduced to such a critical level, or its habitat has been so drastically reduced, that it is in immediate danger of extinction and it is not a population of a species already listed in Schedule 1, and: (a) it is disjunct and at or near the limit of its geographic range, or (b) it is or is likely to be genetically distinct, or (c) it is otherwise of significant conservation value. (Schedule 1, part 2, TSC Act 1995).
E4	Extinct	Refers to fauna and flora species that have not been located in nature during the preceding 50 years despite searching of known and likely habitats of that period (Schedule 1, part 4, TSC Act 1995).
E4A	Critically Endangered Species	Refers to a species that is eligible to be listed as a critically endangered species if, in the opinion of the Scientific Committee, it is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with criteria prescribed by the regulations. (Schedule 1a, part 1, TSC Act 1995).

Appendix C Flora and Fauna Species Lists

Table 13 Bird Species Recorded in One Tree Reach Wetland (HSC 2008)

Common Name	Scientific Name
Golden-headed Cisticola	*Cisticola exilis*
Golden Whistler	*Pachycephala pectoralis*
Welcome Swallow	*Hirundo neoxena*
Australian Wood Duck	*Chenonetta jubata*
Chestnut Teal	*Anas castanea*
Brown Thornbill	*Acanthiza pusilla*
Satin Bowerbird	*Ptilonorhynchus violaceus*
Australian King Parrot	*Alisterus scapularis*
Australian Magpie	*Gymnorhina tibicen*
Eastern Rosella	*Platycercus adscitus eximius*
Noisy Miner	*Manorina melanocephala*
Laughing Kookaburra	*Dacelo novaeguineae*
Mistletoe Bird	*Dicaeum hirundinaceum*
Eastern Yellow Robin	*Eopsaltria australis*
White-eared Honeyeater	*Lichenostomus leucotis*
Wonga Pigeon	*Leucosarcia melanoleuca*
Rainbow Lorikeet	*Trichoglossus haematodus*
Spotted Pardalote	*Pardalotus punctatus*
Olive-backed Oriole	*Oriolus sagittatus*
Yellow-faced Honeyeater	*Lichenostomus chrysops*
Scarlet Honeyeater	*Myzomela sanguinolenta*
Silvereye	*Zosterops lateralis*
Eastern Spinebill	*Acanthorhynchus tenuirostris*
Grey Butcherbird	*Cracticus torquatus*
White-faced Heron	*Egretta novaehollandiae*
Noisy Friarbird	*Philemon corniculatus*
Eastern Whip Bird	*Psophodes olivaceus*
Superb Fairy Wren	*Malurus cyaneus*
Red Whiskered Bulbul	*Pycnontus jocosus*
Rose Robin	*Petroica rosea*
Lewin's Honeyeater	*Meliphaga lewinii*
Little Wattlebird	*Anthochaera chrysoptera*
Striated Thornbill	*Acanthiza lineata*
Australian Raven	*Corvus coronoides*
Grey Fantail	*Rhipidura albiscapa*
Sulphur Crested Cockatoo	*Cacatua galerita*
Brown Cuckoo-Dove	*Macropygia amboinensis*
Channel-billed Cuckoo	*Scythrops novaehollandiae*
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*
Bell Miner	*Manorina melanophrys*
Yellow-tufted Honeyeater	*Lichenostomus melanops*
White-cheeked Honeyeater	*Phylidonyris niger*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Grey Fantail	*Rhipidura albiscapa*
Black Cormorant	*Phalacrocorax sulcirostris*
Swamp Harrier	*Circus approximans*
Brown Goshawk	*Accipiter fasciatus*

Buff-banded Rail	*Gallirallus philippensis*
Sacred Kingfisher	*Todiramphus sanctus*
Southern Emu-wren	*Stipiturus malachurus*
White-browed	*Scrubwren Sericornis frontalis*
White-throated	*Gerygone Gerygone olivacea*
Cicadabird	*Coracina tenuirostris*
Rufous Whistfler	*Pachycephala rufiventris*
Leaden Flycatcher	*Myiagra rubecula*

Table 14 Mammals and reptiles recorded from One Tree Reach Wetland (HSC 2008)

Common Name	Scientific Name
Long-nosed Bandicoot	*Perameles nasuta*
Swamp Wallaby	*Wallabia bicolor*
Bush Rat	*Rattus fuscipes*
House Mouse	*Mus musculus*
Common Brushtail Possum	*Trichosurus vulpecula*
Dog (domestic or feral)	*Canis lupus familiaris*
Swamp Rat	*Rattus lutreolus*
Large Footed Myotis (Threatened species)	*Myotis adversus*
Large-eared Pied Bat (Threatened species)	*Chalinolobus dwyeri*
Chocolate Wattled Bat	*Chalinolobus morio*
Little Forest Bat	*Vespadelus vulturnus*
White-striped Freetail Bat	*Tadarida australis*
Eastern Broad-nosed Bat	*Scotorepens orion*
Grey-headed Flying Fox (Threatened species)	*Pteropus poliocephalus*
Red-bellied Black Snake	*Pseudechis porphyriacus*
Eastern Brown Snake	*Pseudonaja textilis*

Table 15 Native plants recorded at One Tree Reach Wetland (HSC 2008)

Common Name	Scientific Name
Eucalyptus robusta	Swamp Mahogany
Eucalyptus tereticornis	Forest Red Gum
Melaleuca styphelioides	Prickly Leaved Paperbark
Melaleuca linearifolia	Snow in Summer
Melaleuca ericifolia	Swamp Paperbark
Duboisia myoporoides	Corkwood
Casuarina glauca	Swamp She-Oak
Phragmites australis	Native Reed
Goodenia ovate	Hop Goodenia
Sarcocornia quinqueflora ssp. quinqueflora	Glasswort
Tetragonia tetragoides	New Zealand Spinach
Paspalidium spp.	
Alternanthera denticulate	Lesser Joyweed
Stellaria flaccida	Native Chickweed
Myoporum acuminatum	Mangrove Boobialla

Table 16 Native plants recorded at One Tree Reach Wetland (HSC 2012)

Family	Species
FERNS AND FERN ALLIES	
Blechnnaceae	*Blechnum indicum*
Dennstaedtiaceae	*Pteridium esculentum*
MONOCOTS	
Anthericaceae	*Caesia parviflora var. vittata*
Cyperaceae	*Baumea articulata*
Cyperaceae	*Cyperus difformis*
Cyperaceae	*Cyperus polystachyos*
Cyperaceae	*Fimbristylis velata*
Cyperaceae	*Gahnia clarkei*
Cyperaceae	*Isolepis inundata*
Juncaceae	*Juncus bufonius*
Juncaceae	*Juncus continuus*
Juncaceae	*Juncus kraussii subsp. australiensis*
Juncaceae	*Juncus prismatocarpus*
Juncaceae	*Juncus usitatis*
Juncaginaceae	*Triglochin striata*
Lomandraceae	*Lomandra longifolia*
Philydraceae	*Philydrum lanuginosum*
Phormiaceae	*Dianella ceurulea var. producta*
Phormiaceae	*Dianella longifolia var. longifolia*
Poaceae	*Dichelachne crinata*
Poaceae	*Dichelachne micrantha*
Poaceae	*Digitaria parviflora*
Poaceae	*Echinopogon caespitosa*
Poaceae	*Entolasia marginata*
Poaceae	*Hemarthria uncinata var. uncinata*
Poaceae	*Imperata cylindrica*
Poaceae	*Lachnagrostis filiformis*
Poaceae	*Microlaena stipoides var. stipoides*
Poaceae	*Oplismenus aemulus*
Poaceae	*Oplismenus imbecillis*
Poaceae	*Paspalidium distans*
Poaceae	*Phragmites australis*
Poaceae	*Themeda australis*
DICOTS	
Acanthaceae	*Avicennia marina subsp. australasica*
Aizoaceae	*Tetragonia tetragonioides*
Amaranthaceae	*Alternanthera denticulata*
Apiaceae	*Centella asiatica*
Apiaceae	*Hydrocotyle laxiflora*
Apocynaceae	*Parsonsia straminea*
Araliaceae	*Polyscias sambucifolia subsp. sambucifolia*
Asteraceae	*Epaltes australis*
Asteraceae	*Leptinella longipes*
Asteraceae	*Ozothamnus diosmifolius*

Asteraceae	*Senecio bipinnatisectus*
Asteraceae	*Senecio hispidulus var. hispidulus*
Asteraceae	*Senecio minimus*
Campanulaceae	*Wahlenbergia gracilis*
Caryophyllaceae	*Stellaria flaccida*
Casuarinaceae	*Casuarina glauca*
Chenopodiaceae	*Einadia hastata*
Chenopodiaceae	*Einadia nutans subsp. nutans*
Chenopodiaceae	*Sarcocornia quinqueflora*
Euphorbiaceae	*Phyllanthus hirtellus*
Fabaceae	*Desmodium brachypodum*
Fabaceae	*Desmodium rhytidophyllum*
Fabaceae	*Glycine clandestina*
Fabaceae	*Kennedia rubicunda*
Geraniaceae	*Geranium homeanum*
Goodeniaceae	*Goodenia paniculata*
Goodeniaceae	*Goodenia ovata*
Haloragaceae	*Gonocarpus chinensis subsp. verrucosus*
Haloragaceae	*Gonocarpus teucrioides*
Lobeliaceae	*Lobelia anceps*
Lobeliaceae	*Pratia purpurescens*
Menispermaceae	*Stephania japonica*
Mimosaceae	*Acacia implexa*
Mimosaceae	*Acacia longifolia*
Mimosaceae	*Acacia parramattensis*
Myoporaceae	*Myoporum acuminatum*
Myrtaceae	*Angophora floribunda*
Myrtaceae	*Eucalyptus robusta*
Myrtaceae	*Eucalyptus tereticornis*
Myrtaceae	*Melaleuca ericifolia*
Myrtaceae	*Melaleuca linearifolia*
Myrtaceae	*Melaleucastyphelioides*
Oxalidaceae	*Oxalis exilis*
Oxalidaceae	*Oxalis rubens*
Phyllanthaceae	*Breynia oblongifolia*
Phyllanthaceae	*Glochidion ferdinandi var. ferdinandi*
Phyllanthaceae	*Poranthera microphylla*
Polygonaceae	*Muehlenbeckia gracillima*
Ranunculaceae	*Clematis glycinoides var. glycinoides*
Rosaceae	*Rubus parvifolius*
Scrophulariaceae	*Veronica plebeia*
Solanaceae	*Solanum prinophyllum*
Violaceae	*Viola hederacea*

Appendix D Boardwalk Design and Location

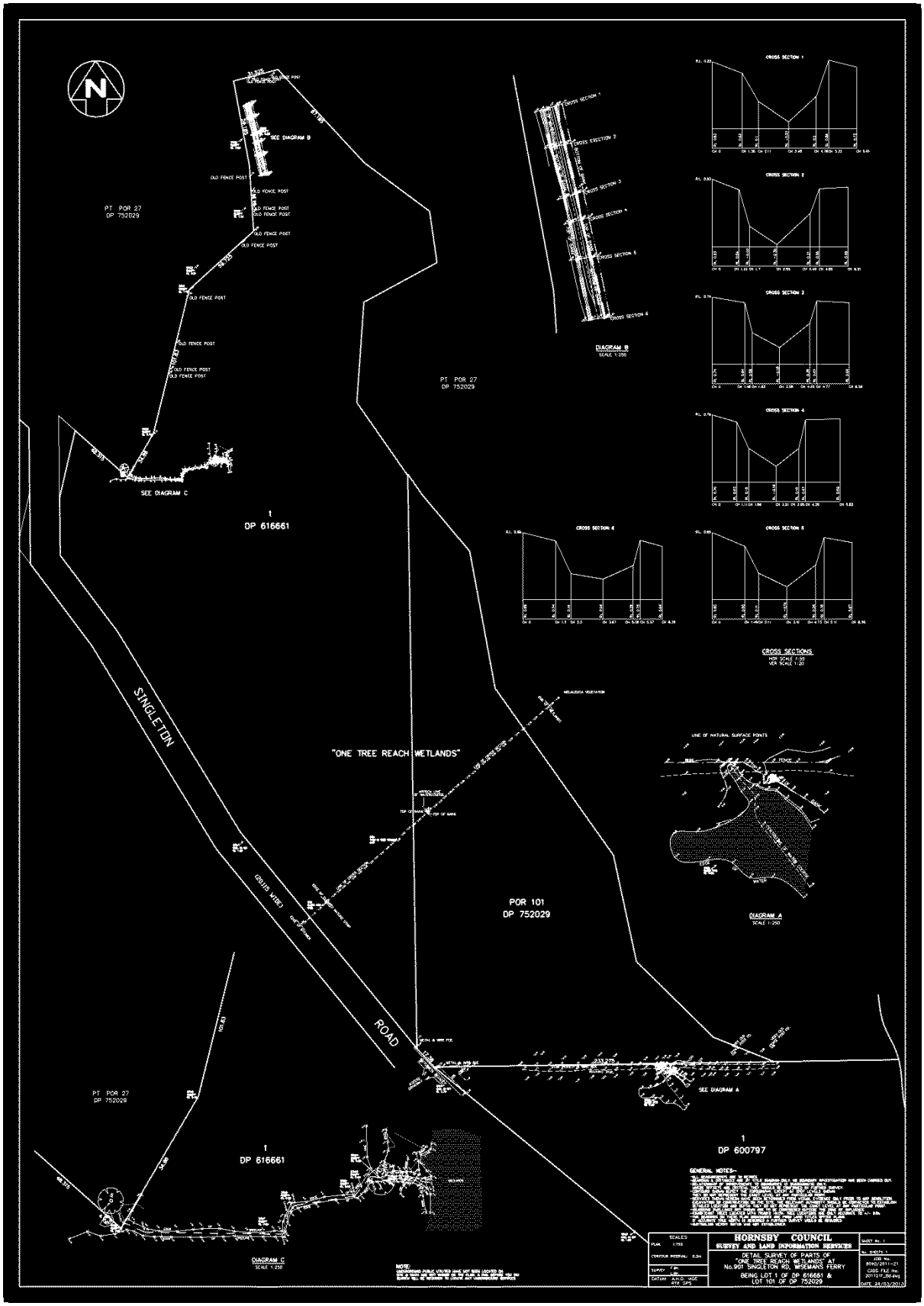

Figure 20 Boardwalk Design and Location

Appendix E Costings and Priorities

Table 17 Costings and Priorities

Management Strategy	*Action*	*Cost*	*Priority*
Acid Sulfate Soil Management	implement the water quality and soil monitoring protocol developed by Ward (2012)	Combined Cost: Council ongoing costs equivalent to $5000 annually	High
	monitor the ongoing function of the weir to ensure it is achieving its design objectives		High
	practice adaptive management		Moderate
Weir Upgrade	Retain the existing weir structure in its present location		High
	Stabilise the outlet channel invert and banks downstream and upstream of the existing weir	$2000	High
	Construct a rock rip rap stilling pond and apron downstream of the existing weir	$20,000 (based on difficult access)	High
	Install a lower water level control, within the weir, that will allow the wetland to fully drain prior to forecasted rainfall events- Pipe through weir with controls	$2000	High
Ecological Management	Continue bush regeneration and planting with locally endemic native plant species	$4000 annually	Moderate
	Baseline vegetation Surveys to determine the species composition and abundance within the vegetation communities in the wetland	Initially Council: $2000 Ongoing annual cost of $1000	Moderate

	Baseline mapping of the distribution of mangroves in and around the wetland and including adjacent to the saltmarsh EEC on the eastern boundary of the southern privately owned portion of the wetland	Council: $1000 annual cost	Moderate
	Additional fauna survey during spring	Council: $1000 annual cost	Moderate
	Installation of nest boxes for microchiropteran bats, forest owls, parrots gliders and possums	$500	Moderate
	Provide further information to residents on the Bushfire hazard reduction program implemented by Hornsby Shire Council and the Rural Fire Service	$250	High
Open Space Maintenance	Instigate a regular mowing regime on the grassy verge immediately adjoining Singleton Road of approximately 2 metres. This area should be mowed regularly (at least every season)	Council's annual Parks Budget	Moderate
	Mowing around signage to increase visibility	Council: $500 annual cost	Moderate
	Ongoing cooperation with adjoining landholders to promote the treatment of weeds on the boundaries of the wetland	Council: $500 annual cost	Moderate
	Remove temporary fencing that is no longer required.	Council: $500 annual cost	High
Recreational Facilities Delivery	Install a sign that identifies the wetland from Singleton Road as an area of public land	$600	On completion of boardwalk
	Install a raised boardwalk along the western edge of the wetland. The route would begin at the northern end of the proposed car park off Singleton Road and extend north along the western edge of the wetland ending in a water viewing area	$100,000	High

	Consider the installation of a raised viewing platform within the boardwalk design to enable additional views of the open water habitat	$10,000	Moderate
	Install a formalised car parking area that could accommodate small groups of cars and allow school or tourists buses to pull off Singleton Road	$5000	High
	Install a series of small picnic tables and chairs made from rustic logs are also proposed on the south western edge of the wetland near the entrance to the forest walk and on the western edge of the Swamp Mahogany Forest	$2500	High
	Install a forest walking track through the Forest Red Gum River Flat Forest	$3000, then $500 annual cost	Moderate
	Install relevant educational signage on the boardwalk and forest walk	$3000	High
Historical Context	Formally document the historical full extent of the One Tree Reach Wetland System	At market rates	Moderate
	Consider the potential for Hornsby Shire Council to begin negotiations with adjoining private landholders with an aim to develop a memorandum of understanding (MoU) that the entire wetland be managed as a whole regardless of land ownership	$4000	Moderate
	Consider the implementation of Council's rural land incentives program to contribute toward management of the wetland by the adjoining private landholders	At Council's cost	High

	Consider the collection and documentation of a verbal history of the management of the wetland from descendants of original settlers	At market rates	Moderate
	Consider the incorporation of the wetland into existing or new heritage or farm gate trails that attract visitors to the area	At market rates	Moderate
	Consider the timing of attracting visitors to the wetland with a view to the provision of recreational infrastructure prior to attracting visitors.		Moderate
Community Engagement, Education and Capacity Building	Identify and engage with local community user groups	$3000	High
	A launch of this wetland plan of management at the wetland once it is to be implemented, this could coincide with the beginning of construction of the boardwalk and culminate in a grand opening of the boardwalk	$2500	High
	Revise the draft One Tree Reach Wetland Brochure to suggest access via Wisemans Ferry and Singleton Road.	$2500	High
	Increase in the flow of information from Council to residents and visa versa the collection and documentation of verbal histories of the wetland is one example, the provision of information on bushfire hazard management is another.	$2500	Moderate
	Keep community informed of the program for open space maintenance and recreational facility installation at the wetland	$500 annual cost	High
	Develop links to local schools primary and secondary through	$2500	Moderate

	the provision of information to teachers on the wetland and once recreational facilities are available encourage the wetland to be used as a field classroom for various curriculum elements		
	Develop links with local businesses to provide information on the history and values of the wetlands and encourage the development of partnerships to develop a local stewardship program that could engage businesses based in the Hornsby Shire in care, management and funding of works in the wetland	$2500	Moderate
	Engage and inform local conservation groups about the conservation values of the wetland and encourage groups to visit the wetland;	$2500	Moderate
	Engage with and inform the local community about the conservation values and history of the wetland for example through local press including the Living Heritage and Galston and Glenorie Community News;	$1500	Moderate
	Develop links to the local Aboriginal groups including the Darug Tribal Corporation and the Darug Custodian Aboriginal Corporation	$1500	Moderate
	Provide information to local groups, residents and the community in how they can become involved in management and monitoring in the wetland, for example birds in backyards surveys, world wetlands day	$2500 annual cost	Moderate
	Develop incentives for the local community to utilise the riparian corridor for educational and recreational purposes	$5000	Moderate

Funding and Management	Explore the inclusion of One Tree Reach Wetland on a natural assets register for Hornsby Shire Council	At Council's cost	High
	Explore opportunities for Hornsby Shire Council Officers to be involved in regional environmental and catchment initiatives	$2500 annual cost	High
	Ensure adequate staff resources are available for ongoing examination of potential funding sources including rate levies, state and federal grants, developer contributions and volunteer resources.	At Council's cost	High
Total implementation costs over 5 years $			
NB All costs are approximate only and subject to detailed design and estimate of costs they have been prepared as a guide to inform Council's budget and grant applications.			