Little Waterhouse Lake Ramsar Site

Ecological Character Description

Final

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by

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Contents

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Cover Photo: Little Waterhouse Lake looking south-easterly from the dam wall, November 2009 (Lance Lloyd)

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LIST OF ABBREVIATIONS

ANSTO	Australian Nuclear Science and Technology Organisation
AUSRIVAS	**Aus**tralian **Riv**er **A**ssessment **S**ystem
ANZECC	Australia and New Zealand Environment and Conservation Council
CAMBA	China-Australia Migratory Birds Agreement
CEPA	Community Education and Public Awareness
CPS	Components, Processes and Services
DEH	Department for Environment and Heritage (South Australia)
DEWHA	Department of the Environment, Water, Heritage and the Arts (Commonwealth)
DPIPWE	Department of Primary Industries, Parks Water and Environment
DPIW	Department of Primary Industries and Water (former name for DPIPWE)
DPIWE	Department of Primary Industries, Water and Environment (former name for DPIPWE)
DTAE	Department of Tourism, Arts and the Environment
ECD	Ecological Character Description
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (a Commonwealth Act)
JAMBA	Japan-Australia Migratory Birds Agreement
NCSSA	Nature Conservation Society of South Australia
NWC	National Water Commission
RIS	Ramsar Information Sheet
ROKAMBA	Republic of Korea-Australia Migratory Birds Agreement
SAMDB NRM Board	South Australian Murray Darling Basin Natural Resource Management Board
SIGNAL	Stream Invertebrate Grade Number – Average Level

ECD DISCLAIMER

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government or the Minister for Environment Protection, Heritage & the Arts or the Minister for Climate Change, Energy Efficiency and Water or the Administrative Authority for Ramsar in Australia.

While reasonable efforts have been made to ensure the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication. Guidance on the development of Ecological Character Descriptions, including Limits of Acceptable Change, are areas of active policy development. Accordingly there may be differences in the type of information contained in this Ecological Character Description, to those of other Ramsar wetlands.

This information does not create a policy position to be applied in statutory decision making. Further it does not provide assessment of any particular action within the meaning of the EPBC Act, nor replace the role of the Minister or his delegate in making an informed decision on any action.

This report is not a substitute for professional advice rather it is intended to inform professional opinion by providing the authors' assessment of available evidence on change in ecological character. This information is provided without prejudice to any final decision by the Administrative Authority for Ramsar in Australia on change in ecological character in accordance with the requirements of Article 3.2 of the Ramsar Convention. Users should obtain any appropriate professional advice relevant to their particular circumstances.

EXECUTIVE SUMMARY

This *Ecological Character Description* (ECD) has been developed following the National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands (DEWHA 2008) and contains information on the Little Waterhouse Lake Ramsar Site (referred to as 'the site'). This information includes: geographic and administrative details; the site's ecological character (including components, processes, benefits and services) at the time of Ramsar listing (1982) and currently; gaps in knowledge of the site and issues for management; actual or potential threats; changes that have occurred since listing; site monitoring needs and triggers for management action; and communication, education and public messages to facilitate management and planning.

The Site

Little Waterhouse Lake is an elongate coastal freshwater lagoon of approximately 10 hectares, running in an east-west direction on the coastal sand plains of north-east Tasmania. The lake has clear, circum-neutral water, a well developed macrophyte flora and a substantial area of open water, approximately 700 metres long and 100 metres wide. The lake is located in an interdunal depression between parabolic dunes of the Waterhouse transgressive dunefield. The lake was formed when seaward drainage of a small creek was blocked by mobile coastal dunes. Quaternary sands and clays found in this area are strongly mottled with a layer of impermeable coffee rock at a depth of 1.5 metres. The lake is dammed by a small human-built wall, with lake water seeping through and under the dam wall – and overflowing during significant events – to form a marshy area downstream of the wall. The lake receives its water from local catchment runoff and also from a small drain (formerly a creek) known as Tobacco Creek. Tobacco Creek drains agricultural pasture land.

The water of the lake ranges from fresh to slightly brackish and has dense aquatic plant growth and high species richness. To the east an open scrub covers most of the area with silver banksia (*Banksia marginata*) and grass trees (*Xanthorroea australis*) dominating. West of the site introduced marram grass (*Ammophila arenaria*) occurs on the foredunes with coastal wattle (*Acacia longifolia subsp. sophorae*), silver banksia and prickly moses (*Acacia verticillata*). Downstream of the dam wall there is a pool surrounded by a thick (approximately 5 metres) ring of cumbungi (*Typha latifolia*), situated on a marshy plain. Most of the plain has a cover of aquatic and semi-aquatic herbs with occasional clumps of rushes. The marsh contains a network of springs and rivulets running through and underneath it.

The Ramsar site encompasses the Little Waterhouse Lake and its adjacent floodplain to the south, as well as the marshland which extends approximately 400 metres downstream (west) of the dam wall. An area of sand dunes to the south of the lake is also included within the Ramsar site boundary, as is a strip of native vegetation to the north and to the east of the lake. The whole site is located within the Waterhouse Conservation Area, which provides a much-used recreational area for people within the region and beyond.

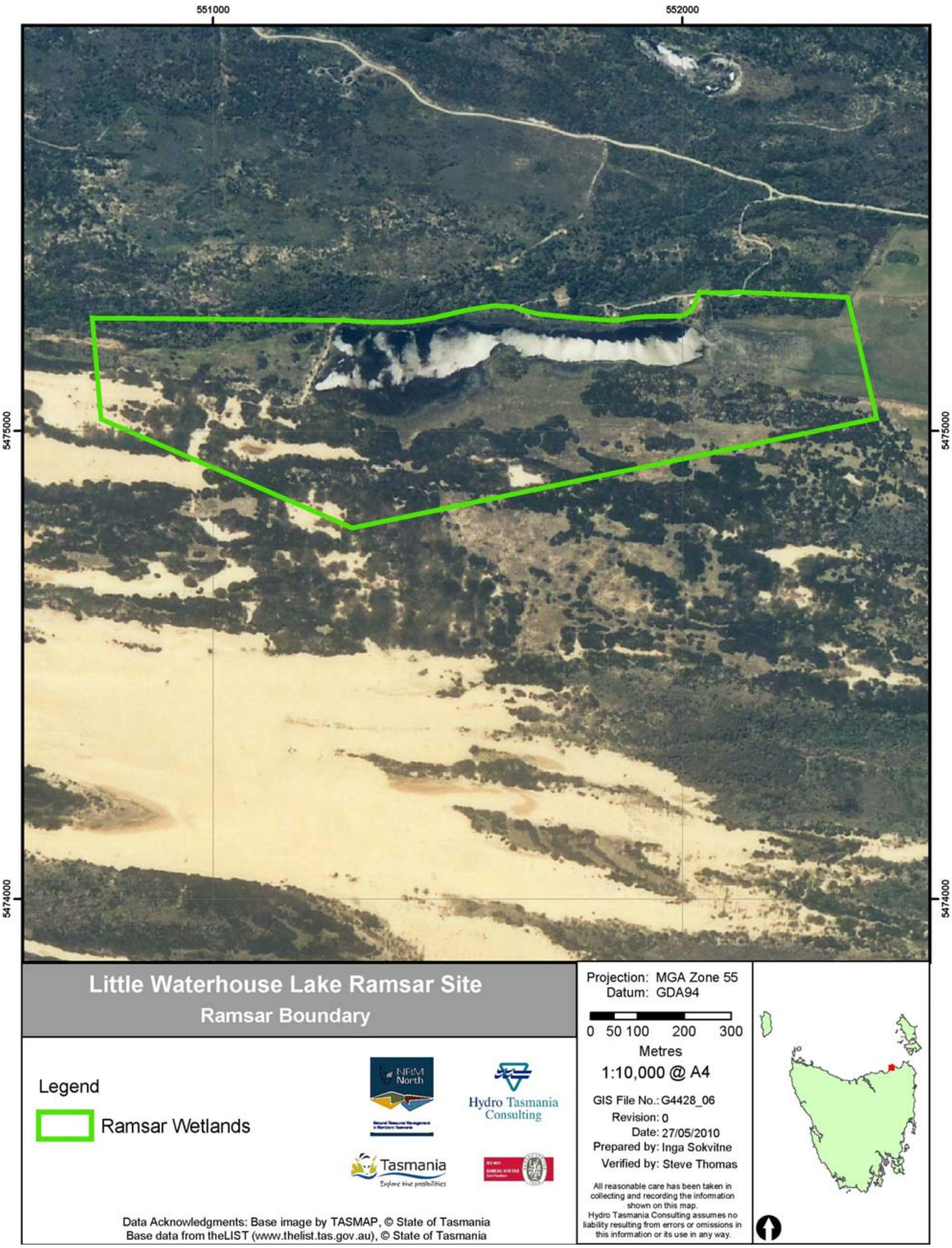

Figure E1: Map of Little Waterhouse Lake Ramsar Site

The northern site boundary is restricted to the Little Waterhouse Lake and its immediate surrounds (Figure E1), including a four-wheel drive access track to the site and a thin strip of open scrub. To the south of the lake, the southern site boundary includes an area of occasionally inundated floodplain adjacent to the lake, and extends into sand dunes and scrub further south of the wetland habitat (Figure E1). Similar to the site's southern boundary, the eastern boundary includes part of the Lake that will be inundated during periods of high inflows. The western boundary extends beyond the Lake's dam wall and includes a pool downstream of the dam wall, as well a marshland largely covered with lacustrine herbfield and rush tussocks. Although dependent on seepage flow from Little Waterhouse Lake, the pool and marshland below the dam can be considered as separate entities from Little Waterhouse Lake itself.

Ramsar Listing Criteria

At the time of writing this document, Little Waterhouse Ramsar Site is listed under Criteria one and three. As a result of preparing this ECD and its accompanying RIS, the site will also be listed under Criterion two.

Criterion one (representative/rare/unique wetland type in appropriate biogeographic region)

Within Australia, Ramsar terrestrial biogeographic regions are delineated on the basis of major drainage divisions. Little Waterhouse Lake is located in the Tasmanian Drainage Division (Commonwealth of Australia 2009), which consists of the whole of Tasmania and is situated near the Bass Strait IMCRA Province (Commonwealth of Australia, 2006). The site is a high quality example of a wetland with Ramsar wetland types K, N, M, O, Tp, Ts and U within the Tasmania Drainage Division. Its high floristic diversity, high biological productivity and near-natural condition contribute to it being considered a representative example of these types of wetland within the drainage division.

The site met this criterion at time of designation and continues to meet it.

Criterion two (supports vulnerable, endangered, or critically endangered species or threatened ecological communities)

The site supports the green and gold frog (*Litoria raniformis*) and the dwarf galaxias (*Galaxiella pusilla*) (both vulnerable, EPBC and vulnerable, TSPA). The green and gold frog was recorded within the Waterhouse Conservation Area (Brereton 1995, Brown 1995) and has been observed at the Little Waterhouse Lake Ramsar Site (D. Wilson, personal communication to Stewart Blackhall, DPIPWE). Although this species had not been recorded at the site at the time of listing, its current presence at the site makes it very likely that it was also present at the time of listing. This is particularly likely as the species was recorded from nearby Blackmans Lagoon around the time of listing. The species was noted as being present in large numbers and also as being heard at other locations within the Waterhouse Conservation Area (Brown 1995).

Criterion three (supports populations of plant and/or animals important for regional biodiversity)

This criterion includes consideration of biodiversity within a regional context. It is reasonable to include the dinoflagellate, *Prorocentrum foveolata*, within this context. Little Waterhouse Lake is one of two lakes in the region that were found to support *P. foveolata* (the other being Blackmans Lagoon).

Criterion three also includes species and communities listed at the State level, particularly since the State forms the Drainage Division and therefore the bioregion. The site has been observed to support a local pair of white-bellied sea eagles *(Haliaeetus leucogaster*, vulnerable, TSPA). The site is a key location for two plant species listed under Tasmania's TSPA 1995: river clubsedge (*Schoenoplectus tabernaemontani*), Rare. Little Waterhouse Lake is one of only two known sites within reserves for the species in Tasmania (DPIPWE 2010); and, sea clubsedge (*Bolboschoenus caldwellii*), Rare. Little Waterhouse Lake is one of seven known sites within reserves for the species in Tasmania (DPIPWE 2010).

The site has high floristic diversity containing over 40 species of aquatic and semi-aquatic plants, it has high productivity, and high habitat diversity. Personal observations at the site indicated high macroinvertebrate abundances and diversity, as well as substantial numbers of fish. The site has also been noted to support a significant population of the freshwater planktonic dinoflagellate, *Prorocentrum foveolata*, a recently described species classified in a taxonomic group that was previously considered entirely marine (Croome and Tyler 1987).

Wetlands Types

At the site, the variety of wetland habitat types is readily recognisable as a critical component of its character (Figure E2).

Wetland habitat types K - Coastal freshwater lagoon and O – Permanent freshwater lake: These wetland habitat types describe the body of Little Waterhouse Lake, which covers 6 hectares. The lake contains many submerged and emergent macrophytes covering a variety of species. These include rushes (eg. species of *Eleocharis*, *Isolepis*, and *Juncus*) and sedges (species of *Carex*, *Baumea* and *Lepidosperma*) among the emergents, and ribbon weed (*Triglochin* spp.), pondweeds (*Potamogeton* spp.) and milfoil (*Myriophyllum* spp.) among the submerged plants. The lake water's clarity (as described 3.2.4) enables good light penetration for photosynthesis through the lake and its naturally high nutrient content would contribute to the lake's rich plant growth.

Wetland habitat type Ts: Seasonal/intermittent freshwater marshes/pools (includes seasonally flooded meadows, sedge marshes) The majority of this wetland type is the large floodplain to the south of the lake and is the largest wetland type in the site at 9.3ha. This is the area that became inundated following the large rainfall event just prior to the site inspection in November 2009 and would be expected to contribute a substantial amount of nutrients to the lake during flood periods. Downstream of the dam wall there are also some areas of the marshland that may also be intermittent/seasonal, although the majority of this area is likely to be permanent freshwater marsh and/or peatland.

Wetland habitat type Tp - Permanent freshwater marshes/pools; Type U – Non-forested peatlands and Type M – Permanent creeks: These wetland types are intermingled and overlap in the area downstream of the dam wall and cover 2.6ha. The wet herbfield growing around and within the marshland and includes the species *Lilaeopsis polyantha* (with long and narrow leaves), *Hydrocotyle hirta* (roundish leaf), *Selliera radicans* (Spathulate leaf, white flower), and also the sedge *Schoenus nitens* and the rush *Juncus planifolius*. The area here is very wet underfoot, with a dark brown to black soil and and many rivulets running through the marsh. The rivulets were typically around 10 to 20 centimetres wide; some were readily visible while others were covered by vegetation growth. At times, these miniature creeks disappeared underground into the peat, re-emerging some metres away.

A significant feature of this area is the large pool which is ringed by the introduced cumbungi (*Typha latifolia*) and due to the height of the cumbungi and the width of the ring it formed around the pool; it was not possible to get a clear view of the pool waters or its macrophyte flora. As described earlier, the pool and marshland appear to be an artefact of the dam. However they now provide a wetland area with several wetland types that add considerably to the site.

Wetland type N – Seasonal/irregular creek: The creek that drains into Little Waterhouse Lake (Tobacco Creek) is an intermittent drain that carries the runoff from surrounding grazed lands. It is now considered a drain rather than a natural waterway, it only measures 0.2ha in size.

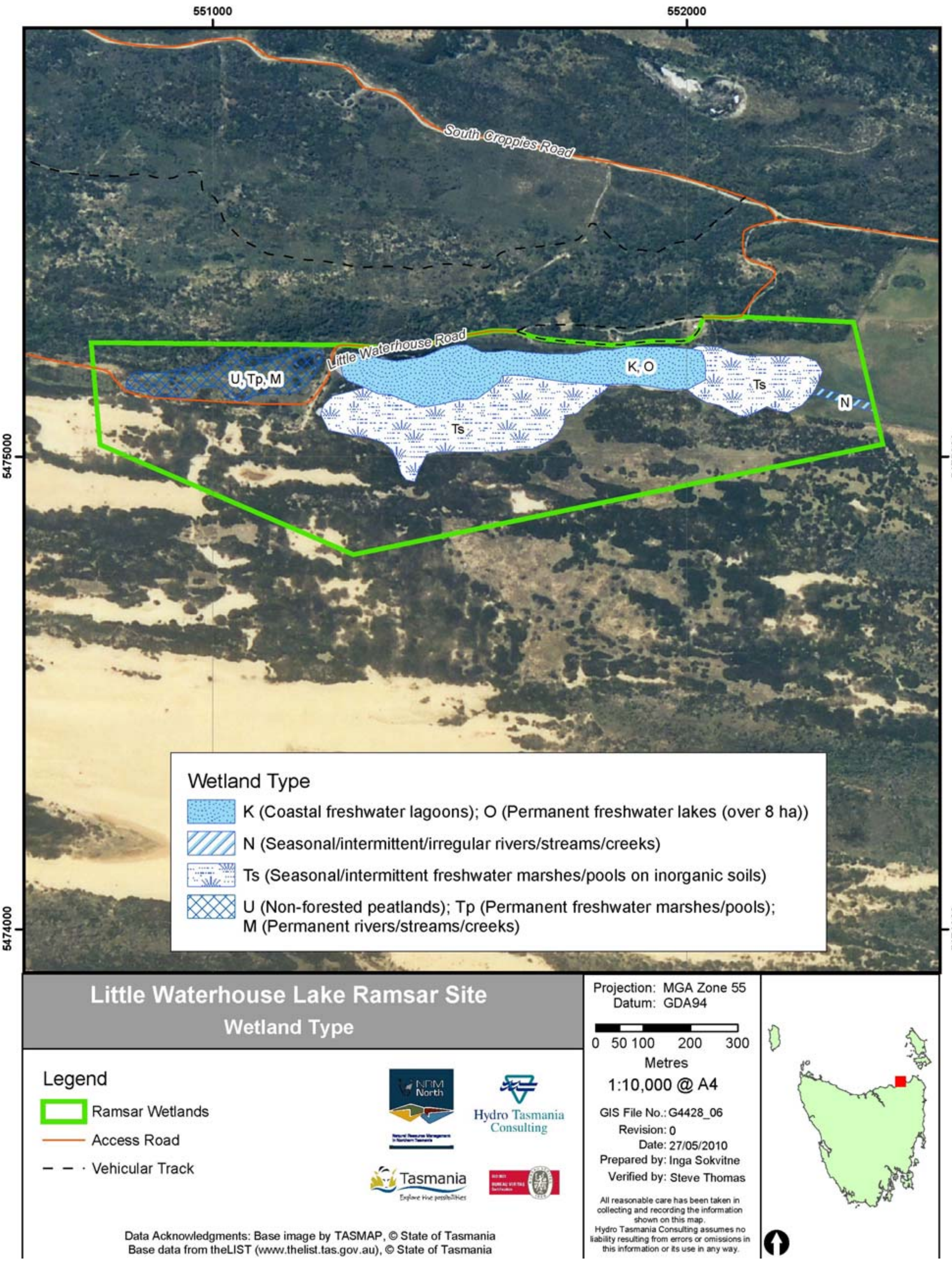

Figure E2: Ramsar wetland types at Little Waterhouse Lake Ramsar Site

Conceptual Model

A landscape conceptual model of the Little Waterhouse Lake Ramsar Site is in Figure E3. The macrophyte flora of the Little Waterhouse Lake is not only a critical component of the site's ecological character, it is also a key indicator of the ecological condition of the lake. The floristic and structural diversity, as well as the presence of listed species provide a strong basis of the site's listing, as well as its ecological character.

The importance of ecosystem components to the aquatic flora include the quality of the lake water with excesses in salinity potentially leading to changes in macrophyte species or dominance of halophytic (salt-loving) algae. Similarly, the existing nutrient concentatrations contribute to the macrophyte richness of the lake. However, increases in nutrient concentrations of the water could lead to phytoplankton (free-floating algae) increasing in the water column. Excessive concentrations of phytoplankton can lead to these algae shading out the submerged macrophytes that grow beneath the water surface, and changing the ecology of the lake from macrophyte dominated to phytoplankton dominated. Aquatic macrophytes are critical to providing habitat to fish and invertebrates which breed, feed and shelter in aquatic vegetation beds.

The water clarity is subject to change as the turbidity of the water could increase through poor land use in the catchment upstream of the lake, leading to the input of fine silts and clays to Tobacco Creek, which runs into Little Waterhouse Lake. Turbidity of the lake's water could also be increased through the growth of the phytoplankton, which themselves contribute to the 'muddiness' of the water. Similarly, poor land use in the catchment could contribute to elevated inputs of nutrients, leading to phytoplankton blooms as described above.

The hydrologic regime of the lake clearly influences the floristic make-up of the site, through the coverage, depth, timing and rate of delivery of water to the system. Inputs of groundwater and surface water (through local catchment runoff and also through the inputs of Tobacco Creek), maintain the water volumes and variations that contribute to the ranges and variability in depths and habitat zones that characterise the site. Changes to the hydrologic regime through climate change (e.g. less rainfall and more evaporation), groundwater abstraction or damming of surface water up-catchment may lead to less water being delivered to the site. This has the potential to increase concentrations of salt and nutrients, as well as reduce the areal extent and depth of the lake, leading to a lower quantity and a lower quality aquatic habitat.

The natural damming of the site, which was washed away by heavy rains and subsequently rebuilt by the local fishing club in 1955, is also a vital aspect of the site's hydrology, providing a barrier (albeit permeable) to flow from the lake. Through the leaking of water, either through or under the reconstructed dam and occasional overflow events, the site also contains a swampy marshland downstream of the dam wall, with green herbfields and wet soils with high organic matter content. This area also contains a small network of rivulets, fed by the throughflow from the dam, sometimes under the peaty soils, sometimes forming small springs and sometimes expressed as small channels within the marshland. This habitat, mixed with tussock grassland and with scrubland nearby, provides high quality potential habitat for the green and gold frog (Figure E3).

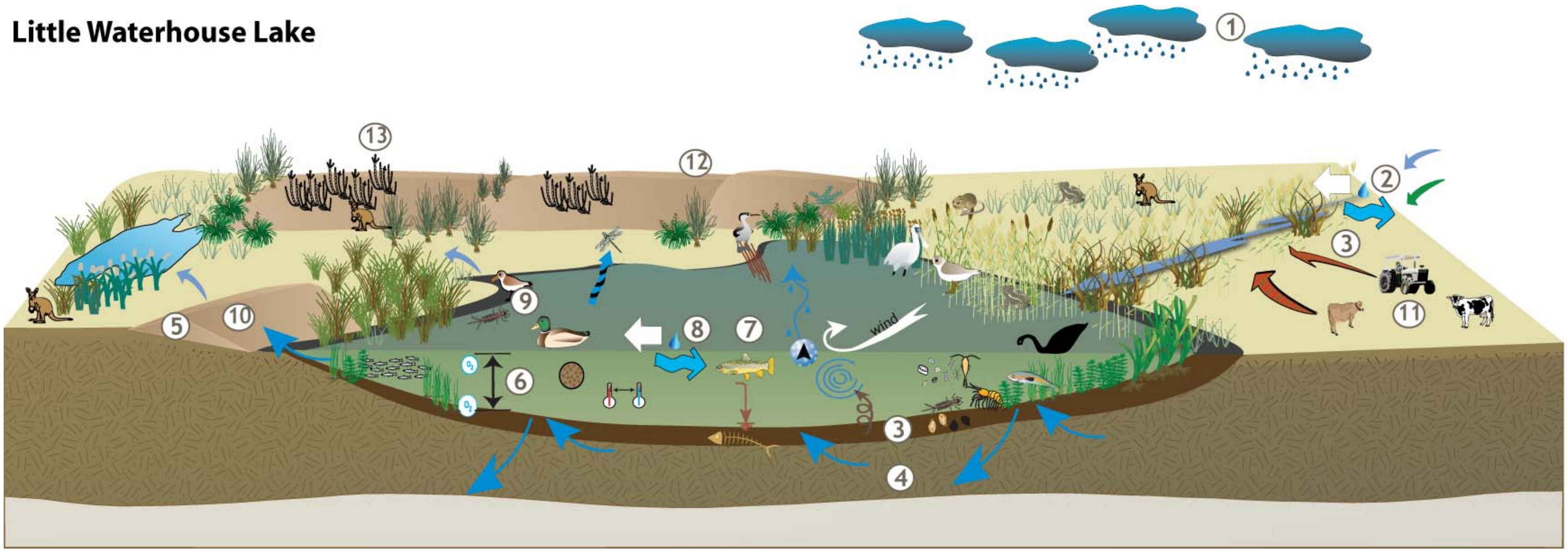

Figure E3: Little Waterhouse Lake Ramsar Site Conceptual Model showing components and processes

Physical & Water Quality Components

(1) Climate is an essential element in supporting the site's ecological character. Rainfall is across a small catchment and there some evidence is that this is changing.

(2) Tobacco Creek is a major source of water for the system. The hydrology has been changed due to climate change and also upstream landuse change such as clearing and forestry practices. (7) The Lake's water regime is also altered (8) via a dam (5) wall.

(3) The lake's sediment is a peaty loam organic soil with poor drainage.

(4) The subsoil is an inorganic layer called "coffee rock" and this layer underlies the sediment on the bed of Little Waterhouse Lake.

(12) Coastal dunes are present around the Lake from current dune processes.

(6) Water depth ranges from shallow to deep (>2 m) depending on Inundation level and it fluctuates widely over time.

Dissolved oxygen concentrations are temporally and spatially variable, low dissolved oxygen may be experienced near the sediment-water interface due to organic matter.

Water temperature also varies temporally and spatially within the Lake.

Lake water is fresh to slightly brackish. Groundwater is unknown. Salinity increases as the Lake dries out.

Turbidity levels are variable - high on initial fill but reducing to very low but wind can contribute to re-suspension of sediments in open waters.

Processes

Inputs from inflowing creeks are the most important inputs of water to the Site. Seepage though the dam wall sustains the Pool and Marshland habitat. Water outflows under extreme inflows around the dam wall into an outlet creek.

Biota may disperse into the Site from the inflowing Tobacco Creek.

Seed and egg banks in the Lake's sediments replenish the aquatic communities following refilling.

Wind results in mixing, causing resuspension of sediments and evaporation of water from the lake.

Mixing increases turbidity but also ensure oxygen is also distributed through the water column.

Sediment resuspension raises turbidity and can result in nutrients being released into the water column.

Evaporation increases with mixing and wind and is a vital process which causes drying and exposure of sediments for mudflats (9), which are important for waders.

Decomposition of biota is an important process for nutrient cycling in the Lake.

Sediment and nutrient run-off from the surrounding landscape is an important source of nutrients which may cause impacts if native vegetation is cleared and landuse is agricultural.

Nutrients and carbon exported to the surrounding terrestrial fauna through export and predation of aerial stages of aquatic invertebrates.

Biota

Aquatic Invertebrates are important source of food for fish, birds and other fauna. Initially, these colonise by invertebrates that emerge from egg banks and resting stages. Other invertebrates colonise the lake via aerial (wind & bird) and aquatic dispersal.

Submerged and floating macrophytes are very important in their own right as well as habitat for macroinvertebrates, substrates for epiphytes, breeding sites and shelter for fish and their role in physico-chemical processes in settling sediment and uptake of nutrients.

Fringing vegetation: around the lake margins and floodplain is vital foraging and nesting habitat and also stabilises the edge and controls erosion. The reeds, rushes and sedges provide vital habitat for cryptic bird species such as snipes and crakes and rare frog species such as green and gold frog

The surrounding lands are largely cleared but parts have remnants of the open woodlands, shrublands, grasslands and herblands. which are important to species such as green and gold frog for feeding and habitat for terrestrial fauna such as small mammals and macropods.

Coastal scrub and tussocks are present on moving sand dunes but blow-outs occur (12) which has resulted in the planting of the invasive species marram grass which binds the dunes but displaces native species. The marram grass is an effective agent in dune stablisation (13) but changes the local geomorphology and is a poor habitat compared to native species.

Herbivores and ducks prefer the deeper water with submerged aquatic vegetation or open water but shelter in marginal vegetation or trees.

Shorebirds and the larger waders prefer the mud flats and shallows.

Piscivores prefer the open water where they can hunt and capture fish or large crustaceans and utlise rare woody debris to perch and rest upon.

Fish are present on site and utilised as food. The extensive aquatic vegetation beds and are excellent habitats for the listed species , dwarf galaxias, which are recorded as present (NVA 2011). Trout have been regularly stocked into the Lake.

Key Threats

Agriculture and land clearance (10) provide a local threat to the Lake through run-off (11) of sediments, nutrients, and possibly toxicants. These impacts can be managed through better on-farm practices and catchment works.

Recreational access to the site impacts by cutting new tracks and clearing vegetation for access. Shacks and recreation on site impacts through himan waste, litter, etc.

The invasive species marram grass which binds the dune, changes the local geomorphology, displaces native species and is poor habitat compared to native species.

Trout are regarded as a threat to both dwarf galaxias and green and gold frog, both EPBC Act listed species and critical components of the site's ecological charcater.

Key Actual or Potential Threats to the Site

The key threats identified for Little Waterhouse Lake Ramsar Site are long standing and most of these threats would have been occurring prior to the time of listing. These threats include:

- changes to the lake's water quality through inappropriate land use in the Tobacco Creek catchment, upstream of the site;
- changes to the site's hydrology through groundwater extractions elsewhere within the aquifer;
- change to the site's hydrology through breaching of the dam wall;
- alien fish stocking;
- vegetation clearance on-site and in surrounding areas;
- vehicle and Recreational use at the site;
- weeds;
- duck hunting; and,
- climate change.

Limits of Acceptable Change

The components and the services largely overlap, leaving the list of components, processes and services that require limits of acceptable change as:

- wetland habitat types;
- rare plant species;
- diverse macrophyte flora; and
- Supporting a significant proportion of two faunal species – the green and gold frog and the dwarf galaxiid.

Limits of Acceptable Change have been derived for these 4 components. Baseline information, justification and comments are also provided in Table E1.

LAC are a tool by which ecological change can be measured and do not constitute a management regime for the Ramsar site.

Exceeding or not meeting LACs does not necessarily indicate that there has been a change in ecological character within the meaning of the Ramsar Convention. However, exceeding or not meeting LACs may require further investigation to determine whether there has been a change in ecological character.

Table E1: Limits of Acceptable Change for Little Waterhouse Lake Ramsar Site.

Critical component, process or service	Baseline information	Limit of acceptable change	Justification and Comments	Confidence
Wetland habitat types	The baseline information used in this assessment is the vegetation map produced as part of this ECD (Figure 13).	The limits of acceptable change for the wetland are: • No more than ten percent reduction in wetland types **K** (coastal freshwater lagoon) and **Ts** (sedgeland floodplain) Areas for **K** and **Ts** are 6 and 9.3 hectares, respectively. • No more than ten percent loss in the combined area of wetland habitat types **Tp** (Permanent freshwater marshes/pools), type **U** (Non-forested peatlands) and type **M** (Permanent creeks). These wetland types overlap and together have a combined area of 2.6 hectares.	There are no data on the variability of the wetland habitat types and, until this ECD, there was no mapping of the wetland types. These limits have been set as a common sense approach to defining a significant loss in wetland types. The second limit recognises the overlap of the three wetland types and the virtually impossible task of separating them. As the wetland habitat map was made without proper field surveying, it will need verification.	Low-medium
Rare plant species	The only baseline information available is that two rare species were recorded as being at the site at the time of designation.	Presence of: • *Bolboschoenus caldwellii* (sea clubsedge) and • *Schoenoplectus tabernaemontani* (river clubsedge)	There is very little quantitative information on either of these species within the site. Both species were allocated a percentage cover of between 0 and 5 percent, recorded as part of a survey described as subjective. Therefore quantitative limits of acceptable change cannot be set and a qualitative LAC based on presence / absence of these five species is provided.	Low
Macrophyte diversity	Two surveys of wetland habitats at the site have been undertaken: Kirkpatrick and Harwood (1981) and Blackhall	**At least 36 species of wetland dependent/indicative native plants** in the semi-aquatic and aquatic zones of the	At least forty-five native wetland dependent or indicative species were present in the combined surveys by Kirkpatrick and	Medium-High

Critical component, process or service	Baseline information	Limit of acceptable change	Justification and Comments	Confidence
	(1995). Together these have established at least 45 species of wetland dependent or wetland indicative native plant species present together with some indicative information on the percent cover of key species.	wetland.	Harwood (1981) and Blackhall (1995). An 80th percentile of the average of this figure results in an estimate of 36 species for the LAC.	
Supporting populations of rare/threatened species (green and gold frog, dwarf galaxias)	The baseline information for the presence of the green and gold frog is the qualitative recording and subsequent personal communication of a DPIPWE field officer. The baseline information for the presence of the dwarf galaxias is a published recording of 92 individuals. Subsequent fish surveys of Little Waterhouse Lake did not record any of this fish species.	Presence of the green and gold frog (*Litoria raniformis*). Presence of the dwarf galaxias (*Galaxiella pusilla*).	Similar to the rare plant species, there is no quantitative information on *Litoria raniformis* at the site. Therefore quantitative limits of acceptable change cannot be set and a qualitative LAC based on presence / absence of the species is provided. Similarly, a single sampling event identified 92 individuals of the dwarf galaxias. This provides no information on the variability of the species at the site. Therefore and a qualitative LAC based on presence / absence of the species is provided.	Low

Changes in Ecological Character since listing

There have been no substantial changes to the site since listing, apart from low water levels during the last decade of drought. Recent rains (during November 2009), however, have given the site a much needed reinjection of water, organic matter and significant biological activity, indicating the site is still meeting its ecological character at the time of listing.

Knowledge Gaps

Highest priority for filling of knowledge gaps is given to the components most critical to the site's listing and ecological character and to components and processes that pose greatest risk to this ecological character. These are presented below, along with lower priority knowledge gaps. Despite the almost complete lack of quantitative data for the site, the high priority knowledge gaps are relatively few.

Baseline data should be gathered using standard methods that allow a derivation of a 'point in time' baseline that can be compared to future monitoring programs. Therefore, an initial sampling strategy should be designed in a way that is cognisant of repeatability (see section 8, below). This is particularly the case for the biota (e.g. vegetation, amphibians and fish) and water quality. The data should also be gathered using methods that allow comparison with other Tasmanian data sets to allow assessment of rare/threatened status.

The following knowledge gaps were assessed as high priority:

- Baseline quantitative vegetation data of the lake and the rest of site, especially focusing upon macrophyte diversity;
- Extent of listed vegetation species;
- Surveys for the current presence and extent green and gold frog;
- Surveys for the current presence and extent dwarf galaxias;
- Water quality data for the site, including quality of inflowing surface and groundwater;
- Surveying of weed communities, particularly cumbungi, in conjunction with assessing ecological impacts; and,
- Stability of the dam wall and the extent to which it affects depth, duration of inundation and area of lake must be determined.

Key Site Monitoring Needs

The monitoring needs of the site focus upon the:

- Identified knowledge gaps;
- Limits of Acceptable Change for the maintenance of the site's ecological character; and
- Major threats to the site.

The high priority monitoring needs mirror the knowledge gaps very closely with ongoing monitoring required for hydrology; macrophyte distribution and diversity; fish and frog populations; and water quality of the site.

Communication, Education and Public Awareness (CEPA) Messages

The primary message that needs to be communicated to relevant stakeholders is:

"An ECD which reflects the ecological character of the Little Waterhouse Lake Ramsar Site at the time of listing in 1982 is complete. The site is listed against three Ramsar Criteria:

- Criterion one (representative/rare/unique wetland type in appropriate biogeographic region);
- Criterion two (vulnerable/endangered/critically endangered species or ecological communities);
- Criterion three (supports populations of plant and/or animals important for regional biodiversity)

This site is a coastal freshwater lagoon which provides habitat for important nationally and state threatened species. The ECD documents past and current conditions, determines approaches to assess changes in condition and identifies potential threats to the wetland's character. The ECD also identifies appropriate management considerations for future management planning and critical information gaps for management. Without active management intervention the ecological character of the site is under threat."

The other CEPA messages are:

- Little Waterhouse Lake is an internationally important wetland;
- The site is a zone of high biodiversity;
- The site contains several national and state threatened species;
- The site provides many important services and benefits to the region;
- An understanding of the ecology of the site will enhance future management of the site;
- Past and present management practices provide some threats to the site's values such as human use, alterations to the hydrologic regime, grazing, vegetation clearance and introduction of pest plants and animals;
- The ECD project has summarized the available information on the site which describes its ecological character; and,
- Landholders, managers and users should promote the wise use of wetlands.

1. INTRODUCTION

This document is an Ecological Character Description (ECD) for the Little Waterhouse Lake Ramsar Site (hereinafter referred to as 'the site'). It contains information about:

- Geographic and administrative details;
- the site's ecological character (including components, processes, benefits and services) at the time of Ramsar listing (1982) and currently;
- gaps in knowledge of the site and issues for management;
- actual or potential threats;
- changes that have occurred since 1982 or are currently occurring;
- site monitoring needs ; and,
- communication, education and public messages to facilitate management and planning.

1.1. Purpose

Ecological Character Descriptions are critical in understanding the ecological character of a Ramsar site through the description of ecosystem components, processes, benefits and services. They form the benchmark for management action, including site monitoring to detect negative impacts, thus ensuring the site maintains its ecological character. It is imperative that the limits of acceptable change are documented as managers need to know how extensively ecosystem components, processes, benefits and services can vary without the ecological character changing. Information on the benchmarks or limits of acceptable change indicates when the ecological character has changed or is likely to change. The *Environment Protection and Biodiversity Conservation Act, 1999* (the EPBC Act) provides the legal framework for ensuring the ecological character of all Australian Ramsar sites is preserved (DEWHA 2008).

The objectives of this ECD are (McGrath, 2006):

1. To assist in implementing Australia's obligations under the Ramsar Convention, as stated in Schedule 6 (Managing wetlands of international importance) of the *Environment Protection and Biodiversity Conservation Regulations* 2000 (Commonwealth of Australia):
    a) to describe and maintain the ecological character of declared Ramsar wetlands in Australia; and
    b) to formulate and implement planning that promotes:
        i) conservation of the wetland; and
        ii) wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.
2. To assist in fulfilling Australia's obligation under the Ramsar Convention to arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the Ramsar List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference.

3. To supplement the description of the ecological character contained in the Ramsar Information Sheet submitted under the Ramsar Convention for each listed wetland and, collectively, form an official record of the ecological character of the site.
4. To assist the administration of the EPBC Act, particularly:
   a) to determine whether an action has, will have or is likely to have a significant impact on a declared Ramsar wetland in contravention of sections 16 and 17B of the EPBC Act; or
   b) to assess the impacts that actions referred to the Minister under Part 7 of the EPBC Act have had, will have or are likely to have on a declared Ramsar wetland.
5. To assist any person considering taking an action that may impact on a declared Ramsar wetland whether to refer the action to the Minister under Part 7 of the EPBC Act for assessment and approval.
6. To inform members of the public who are interested generally in declared Ramsar wetlands to understand and value the wetlands.

The preparation of an ECD also forms the basis of understanding and management of the listed wetland site, including the information required for:

- providing a baseline description of the site as a benchmark for assessing any changes in ecological character
- identifying potential threats and impacts, and evaluating risks to the site
- identifying critical gaps in knowledge and approaches/methods for addressing these gaps
- determining methods and approaches for assessing changes to its condition
- designing programs for monitoring its condition
- devising efficient and appropriate management plans for the ongoing protection of the wetland

The process for preparing an ECD should also engage the relevant stakeholders, thereby laying the foundations for alignment of goals and agreed management outcomes.

1.2. Site Details

Introductory details are presented in Table 1.

The Ramsar site was designated in November 1982, and in 2005 (RIS 2005) was listed under the following revised criteria:

- o Criterion one - A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate bioregion; and
- o Criterion three - it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Table 1: Introduction to the Little Waterhouse Lake Ramsar Site

Ramsar Site	Little Waterhouse Lake
General Location	Little Waterhouse Lake Ramsar site is located 7 km south-west of Waterhouse Point which lies between the towns of Bridport and Tomahawk, on the north-east coast of Tasmania.
Geographical Coordinates	40 degrees 52'30"S, 147 degrees 36' 40"E
Area	56.35 ha
Date of Listing	16/11/1982
Baseline Year Used for Description	1982
Original Description Date	August 2010
Status of Description	First description, following site visit and consultation with stakeholders and land managers.
Compiler's Name	Lance Lloyd (Lloyd Environmental Pty Ltd) & Peter Newall (Independent Ecological Consultant) on behalf of DEWHA. Enquiries to: Lance Lloyd (Lloyd Environmental Pty Ltd) lance@lloydenviro.com.au
Ramsar Information Sheet	Ramsar Information Sheet: Little Waterhouse Lake. Last updated 2005. Ramsar sites information service, Ramsar sites database: http://www.wetlands.org/rsis/ Ramsar Site No.: 260 Wetlands International Site Reference No.: 5AU012.
Management Plan	Management Plan for the Waterhouse Conservation Area: Parks and Wildlife Service (2003). Waterhouse Conservation Area Management Plan. Department of Tourism, Parks, Heritage and the Arts, Hobart, Tasmania.
Responsible Management Authority	Director of National Parks and Wildlife, GPO Box 1751, HOBART, Tasmania 7001.

1.3. Date of Description

This ecological character description has been prepared in August 2010, 28 years after the Little Waterhouse Lake Ramsar Site was listed in November 1982. It is a Ramsar Convention requirement that the ecological character description reflects the conditions at the time of listing. Consequently, this document is focused on the 1982 condition of the site.

This ECD utilises relevant studies and reports on the wetland system undertaken since listing, interpreted to infer the conditions at the time of listing as accurately as possible. Changes to the site’s ecological character are identified and described in Section 4 of this report.

1.4. Relevant Treaties, Legislation or Regulations

This section describes treaties, legislation and regulations relevant to the protection of the site, although most were enacted subsequent to 1982.

1.4.1 International treaties and strategies

Ramsar Convention

The *Convention on Wetlands of International Importance* (Ramsar, Iran, 1971), known as the Ramsar Convention, is an inter-governmental treaty dedicated to the conservation and sustainable use of wetlands (Environment Australia 2001). Australia was one of the first 18 countries to sign the Convention in 1971, and its obligations to protect and maintain the ecological character of its Ramsar sites are recognised in the Commonwealth EPBC Act, described in Section 1.4.2.

The Ramsar Secretariat maintains a *List of Wetlands of International Importance* that includes 65 Australian sites as at September 2007 (c. 7.5 million hectares). Criteria to determine international importance are set out by the Ramsar Secretariat at http://www.ramsar.org/key_guide_list2006_e.htm#V. They include considerations of representative, rare or unique wetland type, the presence of vulnerable, rare or threatened species or ecological communities, diversity of particular biogeographic regions, supporting critical life stages of plant or animal species, the support of large waterbird populations, significance to native fish populations and support for 1% or more of wetland dependent organisms.

Ramsar wetlands and the EPBC Act

Under the EPBC Act, a person is required to obtain an approval for any action that has, is likely to, or will have a significant impact on a matter of National Environmental Significance, which includes the ecological character of a wetland. Actions that would affect the ecological character of wetlands include:

- areas of wetland being destroyed or substantially modified;
- a substantial and measurable change in the hydrological regime (for example, a change to ground-water, or to the volume, timing, duration and frequency of surface-water flows);
- any change that might affect the habitat or life cycle of native species dependent on the wetland;

- a substantial and measurable change in the physico-chemical status of the wetland (for example, a change in salinity, pollutants, nutrients or water temperature which may affect biodiversity, ecological integrity, social amenity or human health); and,
- an invasive species potentially harmful to the wetland community.

The EPBC Act also sets standards for managing Ramsar wetlands through the *Australian Ramsar Management Principles*, established as regulations under the Act (Environment Australia 2001).

International conventions on migratory species

Australia is a signatory to four international conventions on migratory species:

- The Japan-Australia Migratory Birds Agreement (JAMBA);
- The China-Australia Migratory Birds Agreement (CAMBA);
- The Republic of Korea-Australia Migratory Birds Agreement (ROKAMBA); and,
- The Bonn Convention on Migratory Species (CMS).

JAMBA and CAMBA are bilateral agreements between the governments of Japan and Australia and China and Australia, seeking to protect migratory birds in the East Asian – Australasian Flyway. The two agreements list terrestrial, water and shorebird species (most are shorebirds) that migrate between Australia and the respective countries. They require parties to protect migratory birds from 'take or trade', except under limited circumstances, to protect and conserve habitats, exchange information and build cooperative relationships. The JAMBA agreement also includes specific provisions for conservation of threatened birds (DEH 2005).

ROKAMBA, signed in Feb 2006, is a bilateral agreement similar to JAMBA and CAMBA. The agreement obliges its Parties to protect bird species which regularly migrate between Australia and the Republic of Korea, and their environment. An annex to ROKAMBA contains a list of species or subspecies of birds for which there is reliable evidence of migration between the two countries.

The Bonn CMS adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the migratory species are birds.

1.4.2 Commonwealth Legislation and Policy

The principal Commonwealth environmental legislation that relates to wetland conservation is the EPBC Act. Under the Act, any actions that have, or are likely to have, a significant impact on a matter of National Environmental Significance requires approval from the Commonwealth Environment Minister.

Seven matters of national environmental significance are identified in the Act:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (Ramsar wetlands);
- Threatened species and ecological communities;

- Migratory species;
- Commonwealth marine areas; and,
- Nuclear actions (including uranium mining).

The matters relevant to the Little Waterhouse Lake Ramsar Site are Ramsar listing, nationally-threatened species and ecological communities and migratory species.

EPBC Act and protection of species listed under international conventions

The species that are the subject of the agreements or conventions are listed as 'migratory species', a matter of National Environmental Significance under the EPBC Act. Any action that may affect these species requires the Commonwealth Minister for the Environment to decide whether the action will, or is likely to, have a significant impact on the listed species, and whether the action will require approval under the EPBC Act. If this approval is required, an environmental assessment is carried out. The Minister decides then whether to approve the action, and what conditions (if any) to impose.

1.4.3 State Legislation

Tasmanian legislation of most relevance to the site includes the:

- *Threatened Species Protection Act* 1995;
- *Nature Conservation Act* 2002;
- *Forest Practices Act* 1985;
- *Inland Fisheries Act* 1995;
- *Crown Lands Act* 1976;
- *Weed Management Act* 1999; and
- *National Parks and Reserves Management Act* 2002.

The *Threatened Species Protection Act* establishes a Scientific Advisory Committee and enables the development of threatened species lists, strategies, threat abatement and recovery plans. The *Act* also enables the imposition of interim protection orders and facilitates the development of land-management plans.

Threatened vegetation communities at the site and elsewhere in Tasmania are protected through amendments to the *Nature Conservation Act* and the *Forest Practices Act*:

- *Nature Conservation Amendment (Threatened Native Vegetation Communities) Act 2006*; and
- *Forest Practices Amendment (Threatened Native Vegetation Communities) Act 2006.*

The new legislation establishes a list of threatened communities under the *Nature Conservation Act*, and provides measures to protect these communities from clearance and conversion under the *Forest Practices Act*.

The *Inland Fisheries Act* details fishing regulations and licence requirements, as well as prohibited actions in relation to impacts on fish in waterways, which are relevant to the site.

The *National Parks and Reserves Management Act 2002* provides a management framework for the conservation area.Schedule 1 of the *Act* lists the management objectives for conservation areas as:

- to conserve natural biological diversity;
- to conserve geological diversity;
- to preserve the quality of water and protect catchments;
- to conserve sites or areas of cultural significance;
- to provide for the controlled use of natural resources including as an adjunct to utilisation of marine resources;
- to provide for exploration activities and utilisation of mineral resources;
- to provide for the taking, on an ecologically sustainable basis, of designated game species for commercial or private purposes, or both;
- to provide for other commercial or industrial uses of coastal areas;
- to encourage education based on the purposes of reservation and the natural or cultural values of the conservation area, or both;
- to encourage research, particularly that which furthers the purposes of reservation;
- to protect the conservation area against, and rehabilitate the conservation area following, adverse impacts such as those of fire, introduced species, diseases and soil erosion on the conservation area's natural and cultural values and on assets within and adjacent to the conservation area;
- to encourage appropriate tourism, recreational use and enjoyment (including private uses) consistent with the conservation of the conservation area's natural and cultural values;
- to encourage cooperative management programs with Aboriginal people in areas of significance to them in a manner consistent with the purposes of reservation and the other management objectives.

2. GENERAL DESCRIPTION OF THE SITE

2.1 Setting

Little Waterhouse Lake is an elongate coastal freshwater lagoon of approximately 10 hectares situated in the Waterhouse Conservation Area (north-east coast of Tasmania) about two kilometres from the Bass Strait coast (Figure 1). It is approximately 700 metres long and 100 metres wide with clear, circum-neutral water, a well developed macrophyte flora and a substantial area of open water (Figure 2). The lake receives its water from local catchment runoff and also from a small drain (formerly a creek) known as Tobacco Creek which drains agricultural pasture. The lake's level fluctuates with rainfall and outflow and its maximum depth measures between two and four metres.

Little Waterhouse Lake runs in an east-west direction on coastal sand plains. It is located in a depression between parabolic dunes of the Waterhouse transgressive dunefield. Quaternary sands and clays found in this area are strongly mottled with a layer of impermeable coffee rock at a depth of 1.5 metres. The lake has an outlet flow which is dammed. The dam and lake were initially formed naturally, when seaward drainage of a small creek was blocked by mobile coastal dunes. The present dam wall is small and human-built in 1955, following washing away of the natural dam during a high rainfall event. Lake water seeps through and under the dam wall, resurfacing as small soaks and trickle springs to form a marshy area immediately downstream (west) (Figure 3). During periods of high inflow, water may also flow around the dam wall, across the track alongside the Lake and possibly via a floodplain to the south, into the pool and marsh area and then into the outlet creek to the sea.

The water of the lake ranges from fresh to slightly brackish and has dense aquatic plant growth and high species richness. To the east an open scrub covers most of the area with silver banksia (*Banksia marginata*) and grass trees (*Xanthorroea australis*) dominating. West of the site introduced marram grass (*Ammophila arenaria*) occurs on the foredunes with coastal wattle (*Acacia longifolia subsp. sophorae*), silver banksia and prickly moses (*Acacia verticillata*). Downstream of the dam wall there is a pool surrounded by a thick (approximately five metres) ring of cumbungi, situated on a marshy plain. Most of the plain has a cover of aquatic and semi-aquatic herbs with occasional clumps of rushes. The marsh contains a network of springs and rivulets running through and underneath it.

The Ramsar site encompasses the Little Waterhouse Lake and its adjacent floodplain to the south, as well as the marshland which extends approximately 400 metres downstream of the dam wall. An area of sand dunes to the south of the lake is also included within the Ramsar site boundary, as is a strip of native vegetation to the north and to the east of the lake. The whole site is located within the Waterhouse Conservation Area, which provides a much-used recreational area for people within the region and beyond.

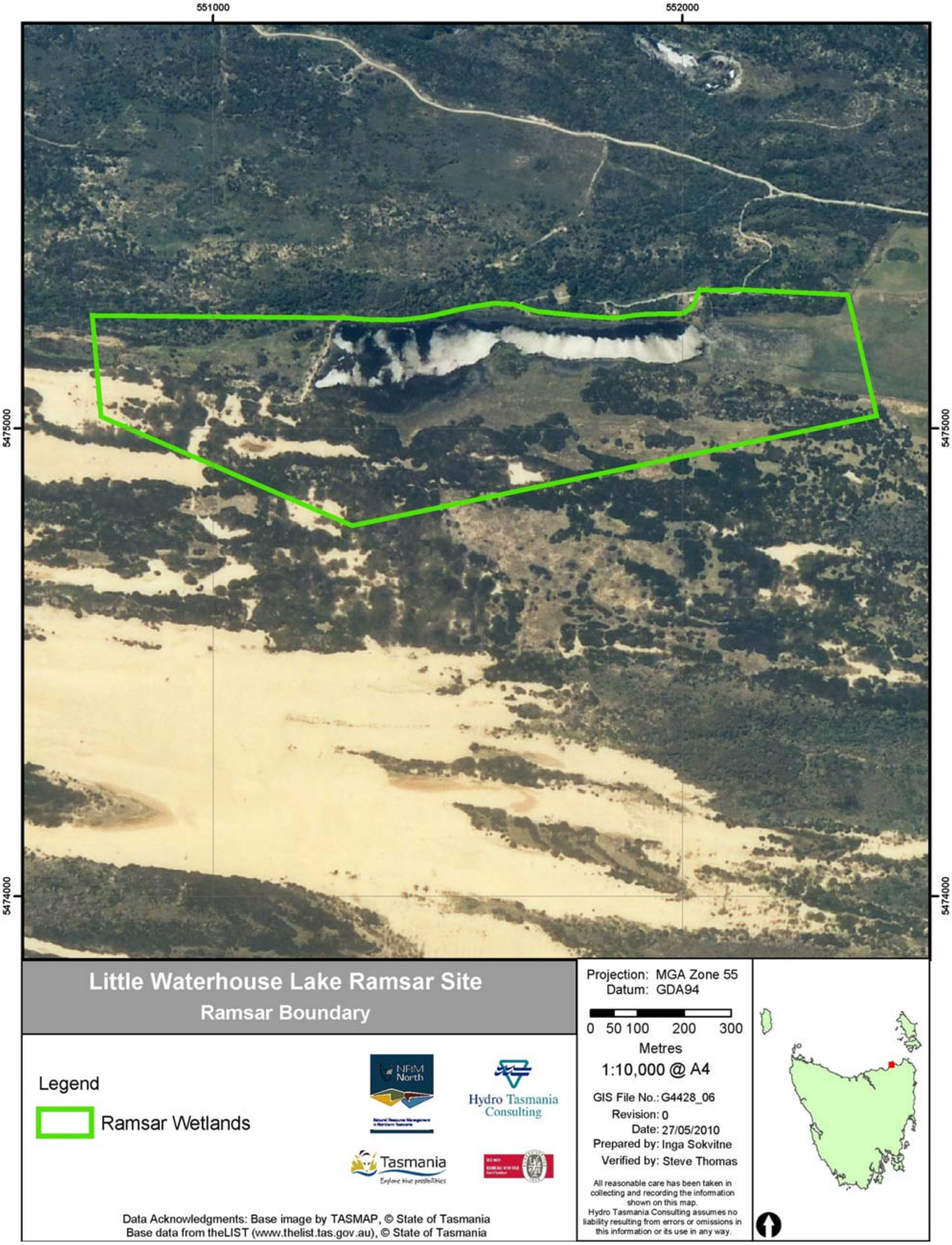

Figure 1: Map of Little Waterhouse Lake Ramsar Site

Figure 2: Photographs of Little Waterhouse Lake, showing habitat diversity (photographs by Peter Newall, 2008)

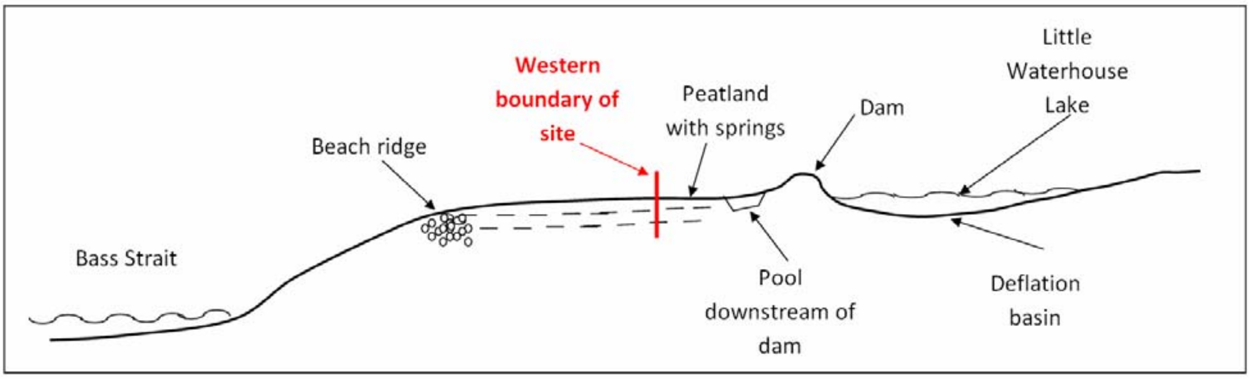

Figure 3: Schematic cross-section of Little Waterhouse Lake in its local setting (drawn from discussions with Ian Houshold, 2008)

2.2 Areas of the Site

The northern site boundary is restricted to the Little Waterhouse Lake and its immediate surrounds (Figure 1), including a four-wheel drive access track to the site and a thin strip of open scrub. To the south of the lake, the southern site boundary includes an area of occasionally inundated floodplain adjacent to the lake, and extends into sand dunes and scrub further south of the wetland habitat (Figure 1). Similar to the site's southern boundary, the eastern boundary includes part of the Lake that will be inundated during periods of high inflows.

The western boundary extends beyond the Lake's dam wall and includes a pool downstream of the dam wall shown in Figure 3, as well a marshland largely covered with lacustrine herbfield and rush tussocks. Although dependent on seepage flow from Little Waterhouse Lake, the pool and marshland below the dam can be considered as separate entities from Little Waterhouse Lake itself.

2.2.1 Little Waterhouse Lake and Adjacent Floodplain

Little Waterhouse Lake is formed in an interdunal deflation basin, receiving water from local runoff. Although originally formed through natural dune encroachment blocking a drainage line, the lake is now maintained by a dam across its western end. Anecdotal evidence indicates that Little Waterhouse Lake broke through to the sea following a winter of very high rainfall in the 1950s and subsequently almost emptied (Parks and Wildlife Service, 2003). The local fishing club reportedly brought in a bulldozer in 1955 (French 2002) and built the earthen wall that can be currently seen damming the lake (Parks and Wildlife Service, 2003).

The areal extent of the lake changes markedly, being reliant on inputs from the local catchment. Photographs taken in December 2008 (Figure 4) show a grassy floodplain adjacent to the southern bank of the Lake. This floodplain was totally inundated following heavy rainfalls in September 2009 (Figure 5).

Figure 4: Floodplain adjacent to southern edge of Little Waterhouse Lake, December 2008. Top photo looking south across lagoon; bottom looking north across lagoon (Photographs by Peter Newall, 2008).

Figure 5: Floodplain adjacent to southern edge of Little Waterhouse Lake. Top photo from western end looking across inundated southern floodplain; bottom photo from northwestern corner (inundated floodplain at top right of photos) (Photographs by Peter Newall, 2009).

Little Waterhouse Lake, like many of the surrounding wetlands, is known to have naturally high nutrient levels and to be a very productive lake, supporting a high diversity of species. Species of conservation significance include: *Wolffia australis*, the smallest flowering plant in the world and a species considered uncommon in Tasmania (Parks and Wildlife Service, 2003), though not currently listed as threatened; the dwarf galaxias, *Galaxiella pusilla*, listed as Vulnerable under the EPBC Act has been reported as possibly occurring in the Lake, however a recent inspection (Lloyd personal observation) did not find any evidence of that species but another Galaxiid species (probably *Galaxias maculatus*) was observed in large numbers in November 2009.

2.2.2 Little Waterhouse Pool and Marshland

The pool and marshland downstream of the dam wall are formed within the same interdunal deflation basin as Little Waterhouse Lake. A site inspection in September 2008 indicated that the majority of the water in the pool and marshland was derived from seepage through, or under, the dam wall. During a site inspection in December 2008, the pool was approximately 20 metres in diameter and was surrounded by an introduced species of bulrush, commonly called 'cumbungi' (*Typha latifolia*) (Figure 6, top). Cumbungi grows in fresh or slightly brackish water in lakes, dams, irrigation channels, marshes and along the banks of rivers. It prefers nutrient rich waters and may not be able to establish until required concentrations of nutrients are available (DPIPWE 2008).

Although the pool and marshland were most likely a part of Little Waterhouse Lake prior to the dam construction, they now comprise an individual ecosystem. Beyond the pool and its surrounding cumbungi, the marshland contains intermingling patches of grassy tussocks containing shiny bogsedge (*Schoenus nitens*) and broadleaf rush (*Juncus planifolius*) and wet herbfields (Figure 6, lower left). The wet herbfields contain a lush green layer of semi-aquatic herbs (Figure 6, lower right), including hairy pennywort (*Hydrocotyle hirta*), Australian lilaeopsis (*Lilaeopsis polyantha*) and swampweed (*Selliera radicans*) as the dominant species. The soil/sediment of the marshland was a dark colour, waterlogged in most areas and had many springs and rivulets running through it.

Figure 6: Pool and marshland downstream of Little Waterhouse Lake. Top photo showing pool with surrounding cumbungi; lower left photo showing patches of rush and herbfield; lower right photo showing herbfield vegetation (Photographs by Peter Newall, 2009).

2.2.3 Little Waterhouse Lake Ramsar Site Wetland Types

The 2005 RIS listed the Ramsar wetland types at the site as:

- K - **Coastal freshwater lagoons**; and
- N - **Seasonal/intermittent/irregular rivers/stream/creek**.

During site visits undertaken as part of this ECD, other wetland types were identified at the site. These were:

- O - **Permanent freshwater lakes**;
- M - **Permanent rivers/stream/creek**
- Tp - **Permanent freshwater marshes/pools**;
- Ts - **Seasonal/intermittent freshwater marshes/pools**; and
- U - **Non-forested peatlands**.

These wetland types are listed in Table 2, along with their areas and locations within the site. The lake itself has two wetland type classifications: K, as it is a coastal freshwater lagoon; and O, as it is a permanent freshwater lake over 8 hectares. Similarly, the 'pools and marshland' area downstream of the dam wall (Figure 6) contains wetland types Tp, Ts and U. Although the type Tp is distinct, types Ts and U largely overlap. A map of wetland types across Little Waterhouse Lake is presented in Figure 7.

Table 2: Wetland types, areas, associated landforms and examples within the site

Code	Wetland Types	AREA (ha)	Examples within site
Ts	Seasonal/intermittent freshwater marshes/pools on inorganic soils	9.3	Little Waterhouse Lake floodplain; marshland downstream of dam
K	Coastal freshwater lagoon	6	Little Waterhouse Lake
O	Permanent freshwater lakes		Little Waterhouse Lake
M	Permanent rivers/stream/creek	2.6	Creek system downstream of dam
Tp	Permanent freshwater marshes/pools		Little Waterhouse pools and marshland
U	Non-forested peatlands		Peatlands surrounding Little Waterhouse pools
N	Seasonal/intermittent/irregular rivers/stream/creek	0.2	Tobacco Ck

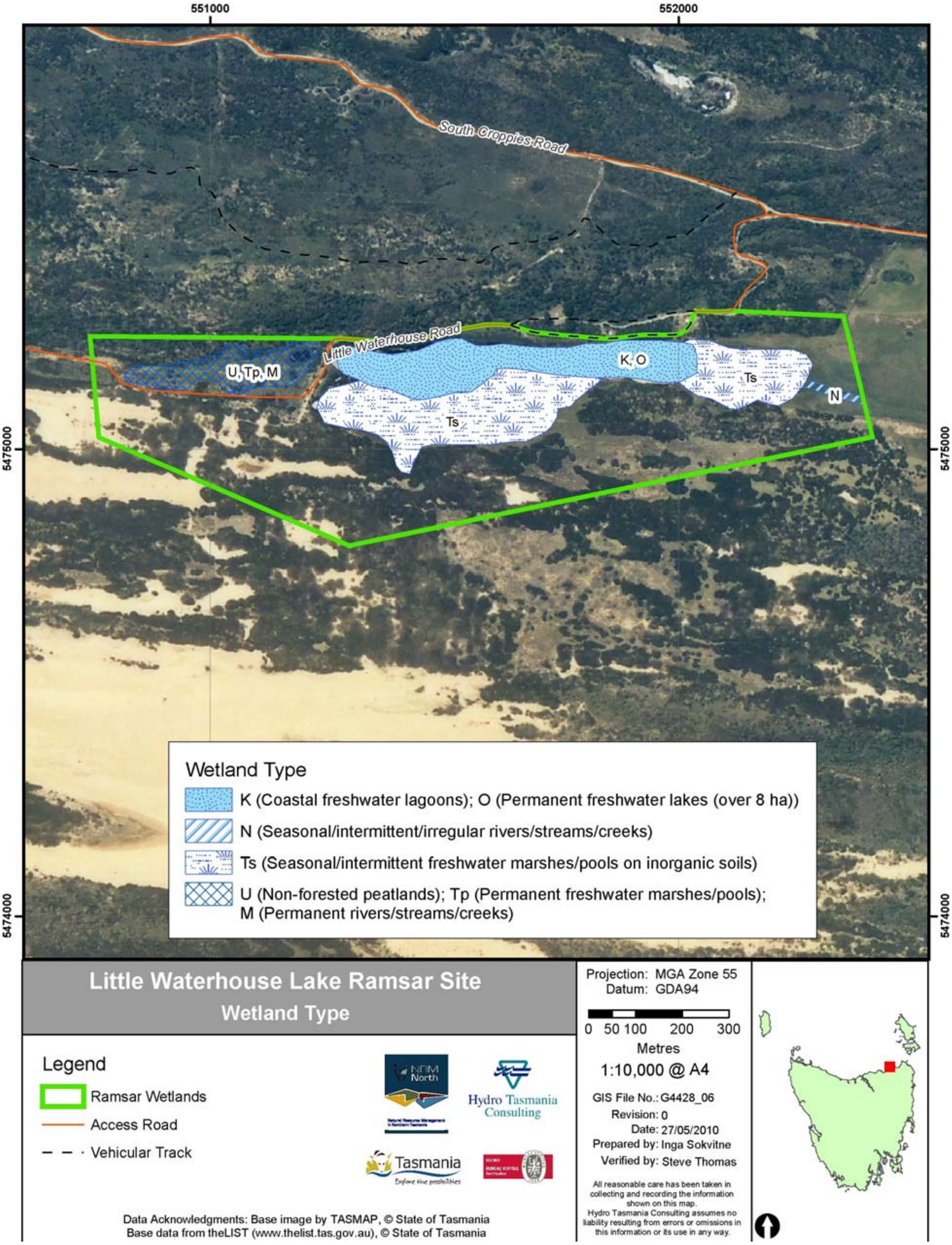

Figure 7: Ramsar wetland types across Little Waterhouse Lake Ramsar Site (Source: NRM North).

2.3 Ramsar Listing

2.3.1 Criteria under which the site is designated

The Ramsar site was designated in November 1982. In the 1998 RIS it was recorded as meeting the (then) criteria 1b and 2b as follows:

A wetland should be considered internationally important if:

> **1b-** it is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region
>
> **2b** - it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.

In 1999 the Ramsar criteria were revised and expanded. The Little Waterhouse Ramsar Site is now listed under Criteria one and three (Table 3)

Table 3: Ramsar Criteria under which the Little Waterhouse Lake Ramsar Site is Listed.

Group A: Sites containing representative, rare or unique wetland types	
Criterion one:	A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate bioregion.
Group B: Sites of international importance for conserving biological diversity	
Criteria based on species and ecological communities	
Criterion three:	A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion one (representative/rare/unique wetland type in appropriate biogeographic region)

Within Australia, Ramsar terrestrial biogeographic regions are delineated on the basis of major drainage divisions. Little Waterhouse Lake is located in the Tasmanian Drainage Division (Commonwealth of Australia 2009), which consists of the whole of Tasmania and is situated near the Bass Strait IMCRA Province (Commonwealth of Australia, 2006). The site is a high quality example of a wetland with Ramsar wetland types K, N, M, O, Tp, Ts and U within the Tasmania Drainage Division. Its high floristic diversity, high biological productivity and near-natural condition contribute to it being considered a representative example of these types of wetland within the drainage division.

The site met this criterion at time of designation and continues to meet it.

Criterion three (supports populations of plant and/or animals important for regional biodiversity)

This criterion includes consideration of biodiversity within a regional context. It is reasonable to include the dinoflagellate, *Prorocentrum foveolata*, within this context. Little Waterhouse Lake is one of two lakes in the region that were found to support *P. foveolata* (the other being Blackmans Lagoon).

Criterion three also includes species and communities listed at the State level, particularly since the State forms the Drainage Division and therefore the bioregion. The site has been observed to support a local pair of white-bellied sea eagles *(Haliaeetus leucogaster*, vulnerable, TSPA). The site also contains two plant species listed under Tasmania's TSPA 1995. These are:

- river clubsedge (*Schoenoplectus tabernaemontani*), Rare. Little Waterhouse Lake is considered a key site for the species, and the Waterhouse Conservation Area is one of only two known reserves for the species in Tasmania (DPIPWE 2010);
- sea clubsedge (*Bolboschoenus caldwellii*), Rare. Little Waterhouse Lake is considered a key site for the species, and the Waterhouse Conservation Area is one of seven known reserves for the species in Tasmania (DPIPWE 2010); and,
- river reed (*Schoenoplectus pungens*) is also listed as present in a previous RIS and as Rare (TSPA). It is no longer listed as threatened but is present at the site (Blackhall 1995).

The site contains over 40 species of aquatic and semi-aquatic plants, and the photographs presented in Figure 2 are indicative of the high floristic diversity and productivity noted above, as well as high habitat diversity. Personal observations at the site indicated high macroinvertebrate abundances and diversity, as well as substantial numbers of fish.

The site has also been noted to support a significant population of the freshwater planktonic dinoflagellate, *Prorocentrum foveolata*, a recently described species classified in a taxonomic group that was previously considered entirely marine (Croome and Tyler 1987). Although several lakes in the region were surveyed (Croome and Tyler 1987) national listing of an algal species would be difficult without sufficient evidence that similar habitats had not been surveyed for the species.

2.3.2 Assessment against the remaining designation criteria

Criterion two (supports vulnerable, endangered, or critically endangered species or threatened ecological communities)

This criterion is focused on species and communities listed at the Commonwealth level, principally through the EPBC Act. The site supports the green and gold frog (*Litoria raniformis*) (Vulnerable, EPBC and vulnerable, TSPA). The green and gold frog was recorded within the Waterhouse Conservation Area (Brereton 1995, Brown 1995) and has been observed at the Little Waterhouse Lake Ramsar Site (D. Wilson, personal communication to Stewart Blackhall, DPIPWE). Although this species had not been recorded at the site at the time of listing, its current presence at the site makes it very likely that it was also present at the time of listing. This is particularly likely as the species was recorded from nearby Blackmans Lagoon around the time of listing. The species was noted as being present in large numbers and also as being heard at other locations within the Waterhouse Conservation Area (Brown 1995).

The site also supports the dwarf galaxias (*Galaxiella pusilla*, Vulnerable, EPBC and vulnerable, TSPA). Similar to the green and gold frog, the dwarf galaxias was recorded at the site after listing (Chilcott and Humphries 1996; 92 individuals were recorded NVA 2011) and it is reasonable to assume that it was therefore present at the site at time of listing.

The site currently meets this criterion and very likely met it at the time of listing.

Criterion five: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

There are no data on waterbird numbers at the site. However given the size of the lake it is reasonable to assume that the site could not support 20,000 waterbirds (currently or at time of listing).

Criterion six: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

There are no data on waterbird numbers at the site and therefore no data to support the site meeting this criterion currently or at time of listing.

Criterion seven: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

There are insufficient data on the fish fauna of the site. It is unlikely that the site would have a high degree of endemism or biodisparity in its fish communities, but this cannot be assessed.

Accordingly, there is no data to support the site meeting this criterion at time of listing or currently.

Criterion eight: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

There are insufficient data on the fish fauna of the site. However, given the size of the lagoon and its landlocked setting, it is reasonable to assume that the site could not meet this criterion, currently or at time of listing.

Criterion nine: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

There are no estimates of the total population of non-avian wetland dependent animal species or sub-species at the site. Accordingly, there is no data to support the site meeting this criterion at time of listing or currently.

2.4 Land Use and Tenure

The site is reserved within the Waterhouse Conservation Area (Figure 8), which was proclaimed a Conservation Area in December 1996 under the *Nature Conservation Act 2002*. The term Conservation Area is applied to an area of land predominantly in a natural state but mining, and in some cases, hunting may be permitted (Department of Primary Industries, Parks, Water and Environment, 2008).

The site is used for recreational purposes, with approximately 80 anglers visiting the area in summer. Other recreational activities include nature observation, walking, boating, recreational vehicle use and hunting.

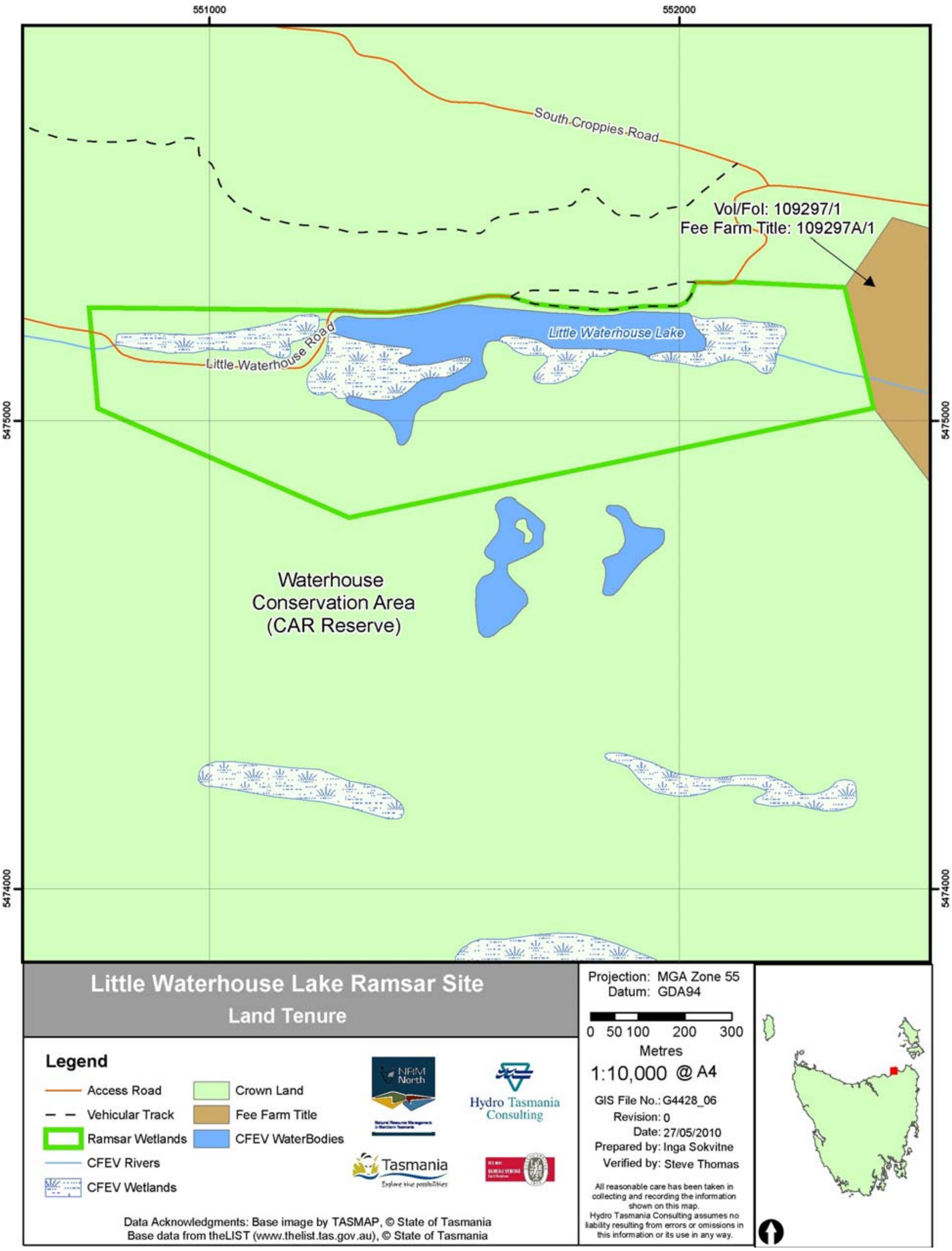

Figure 8: Land Tenure within Little Waterhouse Lake Ramsar Site (Source: NRM North).

3. COMPONENTS, PROCESSES, BENEFITS AND SERVICES OF LITTLE WATERHOUSE LAKE RAMSAR SITE

Ecosystem components include the physical, chemical and biological parts of a wetland (Millennium Ecosystem Assessment 2005). Ecosystem processes are dynamic forces and include all those processes that occur between organisms and within and between populations and communities. This includes interactions with the non-living environment that result in existing ecosystems and bring about changes in ecosystems over time (Australian Heritage Commission 2002). They may be physical, chemical or biological.

In practice, many components can also be processes. For example, climate, hydrology and geomorphology can each be viewed as static parts (components) of the sites as well as dynamic forces (processes) that bring about change to the wetland. In this ECD they are considered together.

3.1 Critical Components and Processes and Essential Elements

The production of an ECD requires the identification, description and where possible, quantification of the critical components, processes, benefits and services that characterise the site. As a minimum, DEWHA (2008) recommends the selection of critical components, processes, benefits and services as those:

1. that are important determinants of the site's unique character;
2. that are important for supporting the Ramsar criteria under which the site was listed;
3. for which change is reasonably likely to occur over short to medium time scales (<100 years); and
4. that will cause significant negative consequences if change occurs.

Identification of the critical components and processes, also lead to identification of components and processes that may not be critical to the site, but are important in supporting the critical components, processes, benefits and services. These have been termed 'essential elements' by DEWHA and may act as early warning indicators of a potential change in character and therefore should be considered in management planning for the site (Hale 2010). Using the approach of Hale (2010), a simple conceptual model has been developed that displays the essential elements for the site, the critical components and processes, the benefits and services and the listing criteria (Figure 9). The model also shows the links between these features.

Four critical components and processes were identified for Little Waterhouse Lake Ramsar site:

- wetland habitat types;
- rare plant species;
- macrophyte diversity; and
- the dwarf galaxias population and the green and gold frog population.

All of these meet the four criteria provided by DEWHA (2008): they are central to the character of the site; they are directly linked to the Ramsar criteria for site listing; they could potentially change in the next 100 years; and their change would result in a negative change in the ecological character of the site.

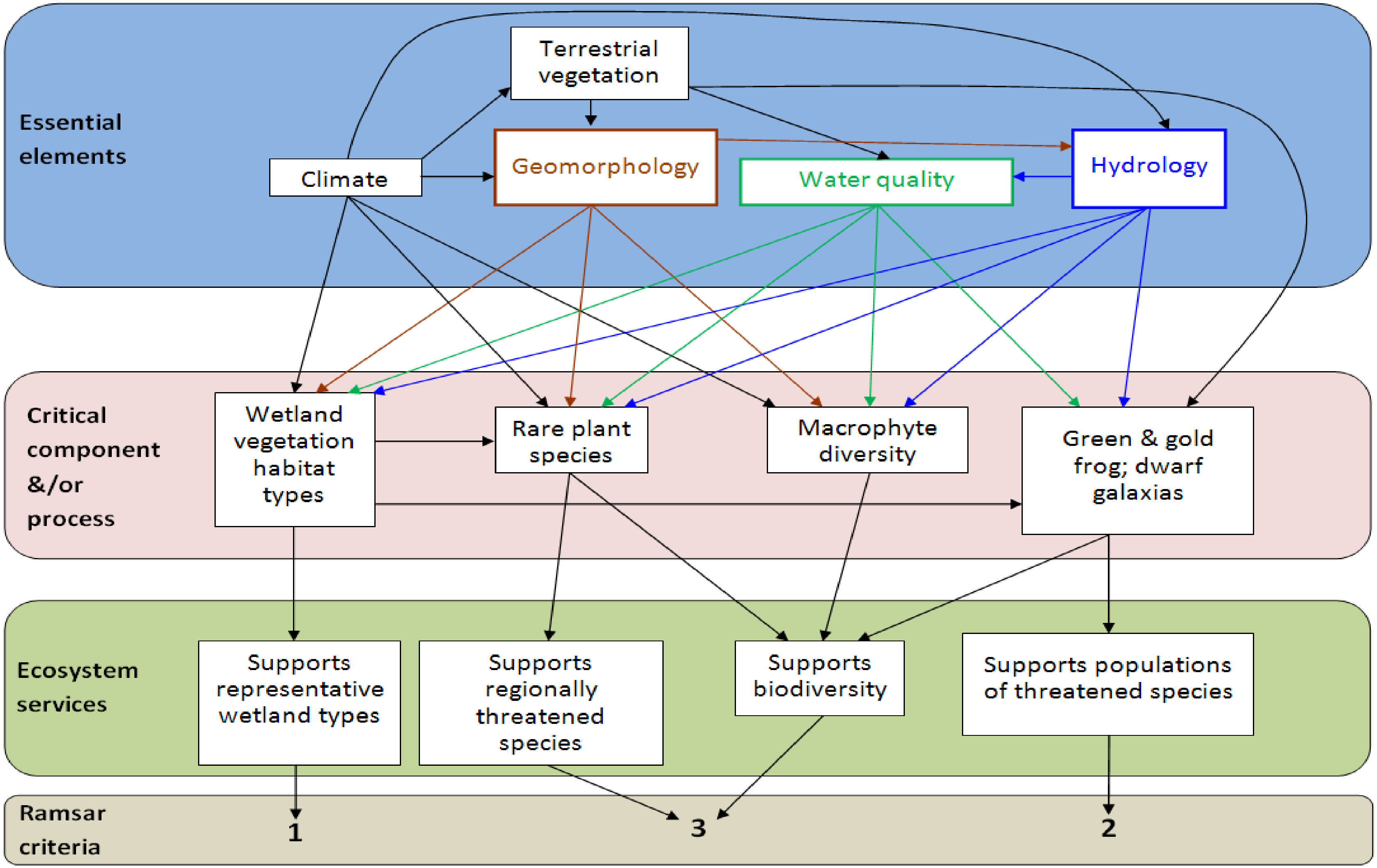

Figure 9: Conceptual model of the components, processes and services of the site, and their links to the Ramsar criteria

The identified essential elements for the site are:

- climate;
- geomorphology;
- hydrology;
- water quality; and
- terrestrial vegetation.

3.2 Essential elements of the site

3.2.1 Climate

Little Waterhouse Lake experiences a cool to mild maritime climate. Bridport, located approximately 15 kilometres south west of Little Waterhouse Lake, experiences average summer temperature minima and maxima of 12.4°C and 21.4°C and average winter temperature minima and maxima of 5.8°C and 13.6°C (Figure 10) (Bureau of Meteorology, 2009).

The area receives an average annual rainfall of 718.9 millimetres. Rainfall is variable, with recorded annual extremes of 394.5 millimetres and 917.2 millimetres (Bureau of Meteorology, 2009). The 10th and 90th percentiles for rainfall for each month are displayed in Figure 11. Prevailing winds vary from northwest to southwest, with north-easterlies common during the summer months (Parks and Wildlife Service, 2003).

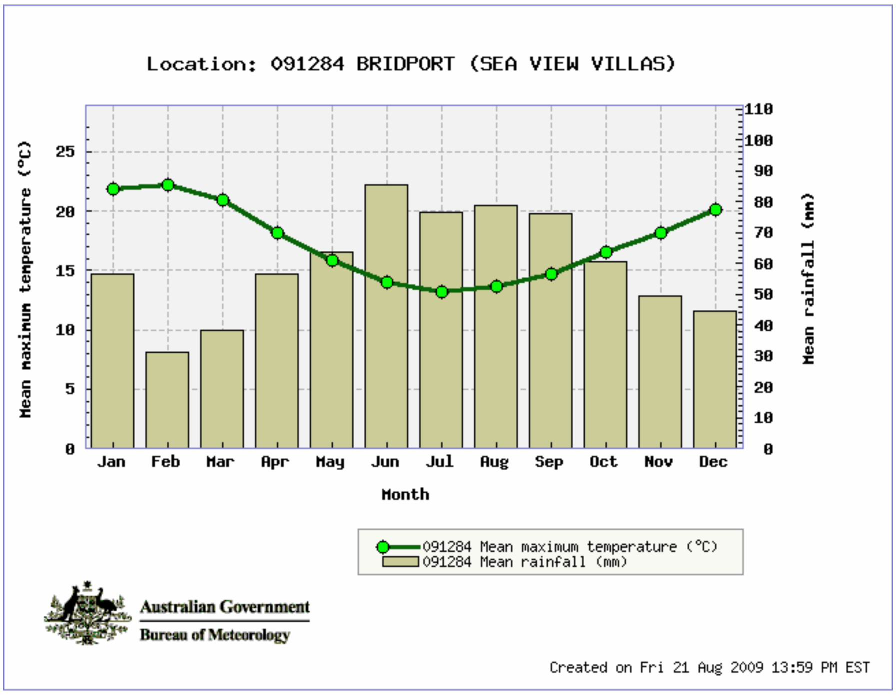

Figure 10: Climograph for Bridport; temperature (1994-2009) and rainfall (1994-2009) (Source: Bureau of Meteorology, 2009).

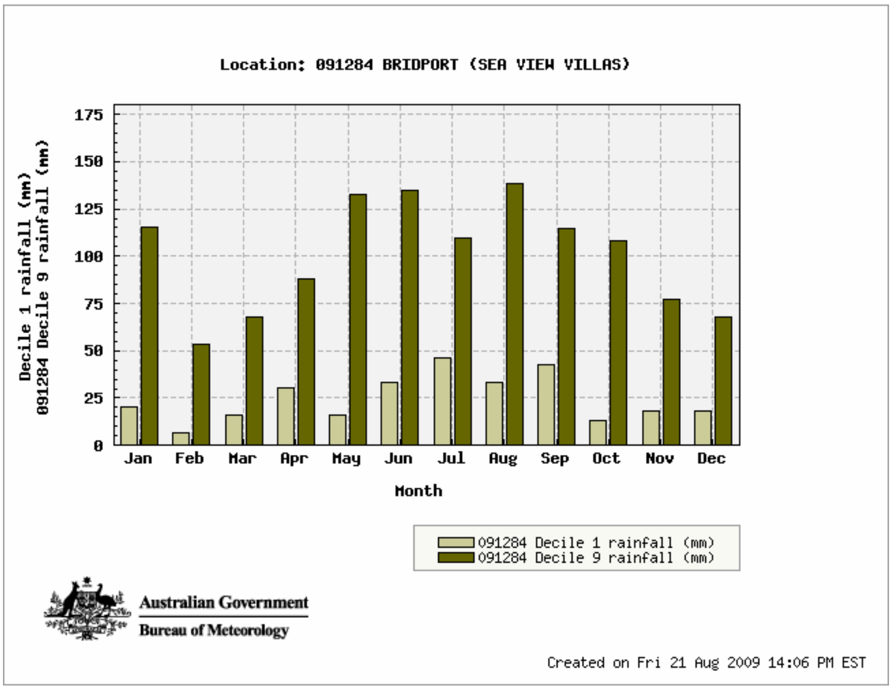

Figure 11: The 10th percentile (Decile 1) and 90th percentile (Decile 9) of Bridport rainfall, 1994-2009 (Source: Bureau of Meteorology, 2009).

3.2.2 Geomorphology

In this section, geomorphology is treated as a component (i.e. in terms of landforms) rather than a process, although both roles apply.

North-east Tasmania contains a diverse geology, with deposits and formations from the Quaternary back to the Ordovician (Cronin 1997). The north-east coast is largely formed of, or underlain by, extensive folded and metamorphosed sandstones and slates deposited during the Ordovician and Silurian periods DTAE (2007), giving rise to the characteristic rounded sandstone outcrops found along the shores of this region. Since the middle Tertiary (approximately 36 million years ago) and especially during the last 2 million years, the geomorphology of the site has been dominated by alternating glacial and interglacial phases, with glacial phases characterised by colder, drier conditions and lower sea levels than the interglacials. During glacial periods, Bass Strait was a broad sandy plain and it is thought that sands blown from what is now the bed of Bass Strait during glacial phases provided source material for the extensive sandy shores and coastal dune complexes along the north east coast of Tasmania, particularly in the Waterhouse area (DTAE 2007). The period of sea level rise following the last glaciation ended about 6,500 years ago when sea level reached roughly its present level (Thom & Roy 1985 in DTAE 2007), allowing the development of the extensive coastal beaches and dune fields found today in the Waterhouse area (DTAE 2007). Some of these Pleistocene aeolian landforms are preserved as a longitudinal dune complex to the east of the site.

The extensive sand deposits that overlie the bedrock granites in most of the Waterhouse Conservation Area formed from the processes described above and today consist of undulating sand plains traversed by relic east-west dune formations (PWS 2003) that extend for up to four kilometres inland (Cronin 1997). Little Waterhouse Lake itself is located within this dune belt, formed within an interdunal deflation blowout (Ian Houshold, personal communication).

The Waterhouse dunefields contain transgressive (mobile) dunes that may migrate across existing features such as parabolic dunes, blowouts, deflation basins and lagoons. Similarly, the transgressive dunefields may contain this suite of landforms, leading to a high level of landscape diversity (DTAE 2007). This is the case with the Waterhouse dunefields, to the north of the Ramsar site, which were listed as a site of geoconservation significance (TGD 2009).

Although generally stabilised by vegetation cover, the transgressive dunes may still migrate, particularly if the vegetation cover is removed or impacted. Vegetation has been severely impacted in parts of the Waterhouse area, leading to erosion and dune movement. Management actions have been undertaken to stabilise these dunes (Parks and Wildlife Service, 2003).

3.2.3 Hydrology

There are no known studies on any aspect of the hydrology of the site, or even qualitative information other than its description as a permanent water resource in an otherwise sandy coastal environment (Parks and Wildlife Service, 2003). It is part of a wetland complex at Waterhouse Point that includes many temporary and permanent wetlands, the largest of which are Big Waterhouse Lake, Blackmans Lagoon and Little Waterhouse Lake.

The water level of the lake fluctuates with rainfall and dune/stream movement and the maximum lake depth measures between two and four metres (Blackhall *et al.* 2003). Drainage patterns are dynamic due to the movement of sand dunes and/or use of water for agriculture. Little Waterhouse Lake broke its banks during spring floods in 1952. Local fishermen, concerned about erosion of the retaining dunes and subsequent loss of fish to the ocean, attempted to dam the outflow. The original structure consisting of sand, soil and brush was inadequate, so donations were called for in 1954, to construct an enlarged wall and spillway. Sufficient funds to complete a dam were granted in 1955 and work finished in July that year (French 2002). As described in Section 2.1, water from the lake seeps below and through the dam wall, feeding the marshland beyond the dam wall (also part of the site) resurfacing as springs and rivulets.

During periods of high inflow, water may also flow around the dam wall, across the track alongside the Lake and into the pool and marsh area and into the outlet creek to the sea. A period of high inflow was observed in December 2009 following a 10 year drought (compare Figure 4 and Figure 5). There were indications that the water had flowed around the southern part of the dam wall and also that water had flowed onto the road along the northern side of the lake. As well as the higher water levels, there were large numbers of young fish (species of Galaxias) and a diverse and abundant macroinvertebrate fauna. The fish and invertebrates were far more evident following the high inflow event.

High inflow events are particularly important for the floodplain habitat of the site and also for inputs of floodplain nutrients to the lake. Connection of waterbodies to their floodplains via floodwaters is recognised as an important process that contributes nutrients – including dissolved organic carbon – along with plant matter to the waterbodies (Baldwyn and Mitchell 2000). The plant matter and dissolved carbon provide the nutrient requirements for the base of the food chain. The paucity of faunal life observed in the lake at the end of a very prolonged drought, compared with the abundant aquatic life observed following the lake's reconnection with its floodplain, support the importance of the hydrological regime as an essential element of the site.

3.2.4 Water Quality

The water of Little Waterhouse Lake is typically fresh but can become slightly brackish. It is very clear (low turbidity) although with some tannin colouring, neutral to high pH and high nutrient concentrations. Very little information about water quality for the site was found. The information that was found is presented in Table 4.

The brackish nature of the water reflects the site's proximity to the sea (with salt spray expected to be blown into the lake's catchment) and also the evaporation of surface water, tending to concentrate dissolved material, particularly during drier periods. This concentration will be greatest during the warmer, drier summer months, with higher inflows diluting the salt concentrations during winter (Figure 12).

Little Waterhouse Lake is known to have naturally high nutrient levels, similar to surrounding wetlands (Parks and Wildlife Service, 2003). Nutrient levels were sampled by Horwitz in 1992, with both oxidised nitrogen and total phosphorous measuring 0.03mg/L. These recordings were both above the ANZECC trigger values for freshwater lakes in southeastern Australia (0.01mg/L for both) (ANZECC & ARMCANZ 2000). However, the ANZECC default trigger values are set at a broad scale, ranging from south-east Queensland to Tasmania and cannot be applied to all freshwater lakes within that area. Further, the trigger values are set for freshwater lakes and reservoirs but not for wetlands, due to a lack of data. Therefore, the baseline water quality at listing is the condition represented by the data in Table 4, and this condition naturally exceeds ANZECC guidelines.

Although high nutrient concentrations may be close to natural, the major inflow to Little Waterhouse Lake is a drain from agricultural land, and there is no information as to what impacts this could be having on nutrient or salt concentrations. Chlorophyll a measured 2.80µg/L, which is within the ANZECC standard of 5µg/L (ANZECC & ARMCANZ 2000). This indicates that although the nutrient concentrations are high, there is no evidence of algal blooms occurring in the lake.

Table 4: Water quality data for Little Waterhouse Lake

Data Source	Year of Sampling	EC (μScm^{-1})	pH	Turbidity (NTU)	Oxidised Nitrogen (mg/L)	Total Phosphorus (mg/L)
Croome and Tyler 1987		1250 to 1400	7.1 to 7.9			
Horwitz 1992		1990 to 2500	7.1 to 8.86	0.55	0.03	0.03
NWMT 2005	2005	2,060 to 4,240	-	-	-	-
NWMT 2008a	2006	2,940 to 4,280	-	-	-	-
NWMT 2008b	2007	2570 to 5630	-	-	-	-

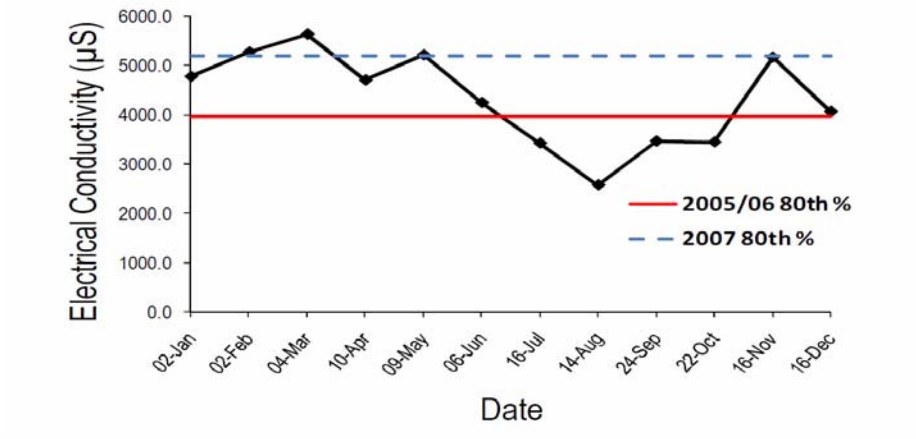

Figure 12: Electrical Conductivity measures at little Waterhouse Lake during 2007, compared to the 2005/06 80th percentile. Source: Northern Water Monitoring Team (2008b).

The high clarity (low turbidity) of the water is an important aspect of the water quality, allowing light to penetrate the water and provide light energy to the submerged macrophytes. Changes to the lake's turbidity through the input of suspended sediments or through high nutrient concentrations leading to algal blooms could severely impact on the macrophyte diversity.

3.2.5 Terrestrial Vegetation

Benefits provided by the terrestrial vegetation of the site are: stabilising the otherwise transgressive dunefield (stabilising the site's geomorphology); filtering rainfall runoff (maintaining water quality); and providing habitat for the green and gold frog (although the extent of this is uncertain).

Vegetation communities within the site (as classified under the TASVEG system, Govt of Tasmania 2010) range from Sand to Water/Sea (Figure 13). Little Waterhouse Lake and its floodplain are placed in the TASVEG vegetation community of OAQ – Water/Sea. The other wetland community mapped in Figure 13 is the SHW – Wet Heathland community. This community, described as Swampy Heath by Corbett (1995), is noted as being common in damp swales near wetlands in the area of Little Waterhouse Lake. The community is rich in reedy monocots, often dominated by seeded rush (*Leptocarpus tenax*), and usually contains dune Sword-sedge (*Lepidosperma concavum*), and pink swamp heath (*Sprengelia incanata*). The wetrland vegetation is discussed in more detail in Section 3.3.

Terrestrial TASVEG communities found at the site are:

- SAC – *Acacia longifolia* coastal Scrub (7.5ha)
- OSM – Sand and mud (the sand dunes of the site; 22.2ha)
- SSC – Coastal Scrub (2.6)
- DAC – *Eucalyptus amygdalina* coastal forest (2.8ha)
- NAV – *Allocasuarina verticillata* forest (0.2ha)

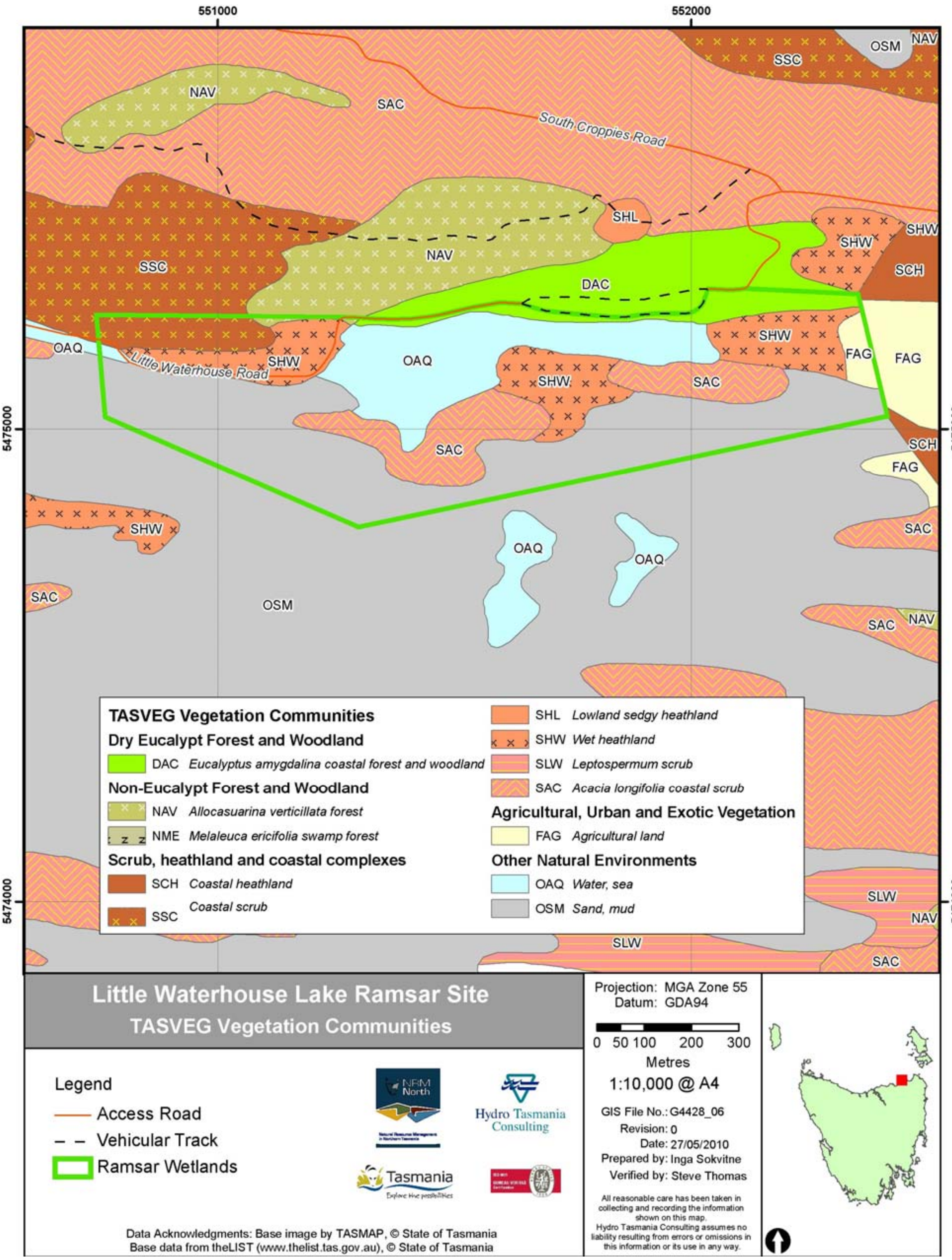

Figure 13: Vegetation Map of the Little Waterhouse Lake Ramsar Site and surrounds (Source: NRM North).

To the east of the Lake, open scrub covers most of the area, with silver banksia (*Banksia marginata*) and grass tree (*Xanthorroea australis*) being the dominant species. West of the site introduced marram grass (*Ammophila arenaria*) occurs on the foredunes with coastal wattle (*Acacia longifolia subsp. sophorae*) silver banksia and prickly moses (*Acacia verticillata*).

The vegetation north of Little Waterhouse Lake is dominated by heaths and coastal shrubberies. Graminoid heath, rich in the spectacular grass tree tends to occupy the dune tops, with tall dense coastal shrubbery in more sheltered areas. She-oaks (*Allocasuarina*) and eucalypt species are found within the shrub communities on well drained dolerite ridges and other sites where soil fertility is favourable. A wind-pruned woody shrubbery extends for several hundred metres inland on most of the western coast and small herbfields, often grazed to 'marsupial lawns', are found throughout.

South of Little Waterhouse Lake the vegetation wages a constant battle with shifting sand. The area is dominated by open sand, sand planted with marram and coastal shrubberies with wetland communities (various *Juncus* and *Lepidosperma* species) occupying the damp swales. The coastal shrubberies change in composition with distance inland:

- the foredunes are colonised by coastal wattle and coast beard heath (*Leucopogon parviflorus*);
- between one and three kilometres inland this *Acacia* scrub is replaced by a dense shrubbery dominated by banksia; and
- she-oak *Allocasuarina verticillata* and eucalypt become important still further inland.

3.3 Critical Components and Processes

3.3.1 Wetland habitat types

Wetland vegetation is a critical component of the site, contributing substantially to its ecological character and providing the habitat and species that form the basis of the site's ecological services. At the site, the variety of wetland habitat types is readily recognisable as a critical component of its character.

<u>Wetland habitat types K - Coastal freshwater lagoon and O – Permanent freshwater lake:</u> These wetland habitat types describe Little Waterhouse Lake, which covers 6 hectares (Table 2). As described previously and evident in Figure 2 and Figure 5, the lake contains many submerged and emergent macrophytes covering a variety of species. These include rushes (eg. species of *Eleocharis*, *Isolepis*, and *Juncus*) and sedges (species of *Carex*, *Baumea* and *Lepidosperma*) among the emergents, and ribbon weed (*Triglochin* spp.), pondweeds (*Potamogeton* spp.) and milfoil (*Myriophyllum* spp.) among the submerged plants. The lake water's clarity (as described 3.2.4) enables good light penetration for photosynthesis through the water column and its naturally high nutrient content would contribute to the lake's rich plant growth.

<u>Wetland habitat type Ts: Seasonal/intermittent freshwater marshes/pools (includes seasonally flooded meadows, sedge marshes):</u> The majority of this wetland type is the large floodplain to the south of the lake and is the largest wetland type in the site at 9.3ha. It includes many of the species identified in Table 5. Views of this habitat type are displayed in Figure 4 and Figure 5. This is the area that became inundated following the large rainfall event just prior to the site inspection in November 2009 and would be expected to contribute a substantial amount of nutrients to the lake during flood periods. Downstream of the dam wall there are also some areas of the marshland that may also be

intermittent/seasonal, although the majority of this area is likely to be permanent freshwater marsh and/or peatland.

Wetland habitat type Tp - Permanent freshwater marshes/pools; Type U – Non-forested peatlands and Type M – Permanent creeks: These wetland types are intermingled and overlap in the area downstream of the dam wall (covering 2.6ha) and are partially displayed in Figure 6. One of the photographs inFigure 6 is shown in full in Figure 14, below. It displays the wet herbfield growing around and within the marshland and includes the species *Lilaeopsis polyantha* (with long and narrow leaves), *Hydrocotyle hirta* (roundish leaf), *Selliera radicans* (Spathulate leaf, white flower), and also the sedge *Schoenus nitens* and the rush *Juncus planifolius*. The area here is very wet underfoot, with a dark brown to black soil and and many rivulets running through the marsh. The rivulets were typically around 10 to 20 centimetres wide; some were readily visible while others were covered by vegetation growth. At times these miniature creeks disappeared underground into the peat, re-emerging some metres away.

A significant feature of this area is the large pool (described in section 2.2.2). The pool is ringed by the introduced cumbungi (*Typha latifolia*) and due to the height of the cumbungi and the width of the ring it formed around the pool, it was not possible to get a clear view of the pool waters or its macrophyte flora. As described earlier, the pool and marshland appear to be an artefact of the dam. However they now provide a wetland area with several wetland types that add considerably to the site.

Figure 14: Plant cover on the marshland downstream of the dam at Little Waterhouse Lake (Photograph by Peter Newall, 2009).

Wetland type N – Seasonal/irregular creek: The creek that drains into Little Waterhouse Lake (Tobacco Creek) is an intermittent drain that carries the runoff from surrounding grazed lands. It is now considered a drain rather than a natural waterway, it only measures 0.2ha in size.

3.3.2 Rare plant species

Two species considered rare within the bioregion have been recorded at the site: *Bolboschoenus caldwellii* (sea clubsedge) and *Schoenoplectus tabernaemontani* (river club-sedge).

Sea clubsedge is a perennial sedge that is typically found in shallow, standing water, generally rooted in heavy black mud (DPIWa 2009). The species can reproduce vegetatively from rhizomes, suggesting some resilience to disturbance. Little Waterhouse Lake is one of three key sites in Tasmania recorded for this species (DPIWa 2009).

River clubsedge is also a perennial sedge that inhabits the margins of lagoons in Tasmania and similar to the sea clubsedge. This species can reproduce vegetatively from rhizomes, and has Little Waterhouse lake listed as one of its key sites. The species is also noted to persist after flooding (DPIWa 2009).

Although unsighted during the site inspections, it appears that this species is most likely to occur around the littoral zone of the lake, either in the open water (Ramsar wetland habitat type O, K) or the nearby floodplain (Ramsar wetland habitat type Ts).

3.3.3 Macrophyte diversity

Information on the aquatic vegetation of the lake around the time of listing is through a survey undertaken by Kirkpatrick and Harwood (1981) (Table 5). The survey was done in a subjective manner (Blackhall 1995) and so species presence is more informative than quantitative measures of cover. The survey was from the littoral area of the lake, dividing the littoral area into three zones: sedgeland, grassland and fernland. The naming of the zones is unusual, as there are no grasses in the "grassland" and no ferns in the "fernland". It appears to be a progression from driest (Zone 1) to wettest (Zone 3). The vast majority of the species in each zone appear to be wetland dependent. The combined species lists from the two surveys produced a total of forty one different species that are either wetland dependent or indicative of wetland conditions. It is not possible to simply allocate any of the zones to a particular Ramsar habitat type. However, the species list does suggest that each of the zones may include two or more of the Ramsar wetland types, with species ranging from submerged aquatics to intermittently inundated sedgeland species.

Blackhall (1995) surveyed the littoral zone and banks more than a decade after Kirkpatrick and Harwood (1981) and compared results (Table 5). The lagoon has dense aquatic growth and high species richness. Tiny duckweed (*Wolffia australiana*) is common at the site as are the river clubsedge (*Schoenoplectus tabernaemontani*) and sea clubsedge (*Bolboschoenus caldwellii*), both clubsedges are listed as rare under the TSPA (1975). A direct comparison between the 1981 and 1993 surveys was difficult, particularly as the original survey was undertaken qualitatively and was unlikely to have been designed for repeat comparisons (Blackhall 1995). However, the two surveys demonstrate the high diversity of the wetland flora in and near the lake. The two state-listed species (*Schoenoplectus tabernaemontani* and *Bolboschoenus caldwellii*), were not found in the second survey, although this may well be due to difficulty in locating and identifying them during non-flowering periods.

Table 5: Wetland plant species showing percentage cover densities at Little Waterhouse Lake and surrounding area in 1993 (Blackhall 1995), compared with a 1981 species list (Kirkpatrick and Harwood 1981). Species names updated with assistance from Micah Visoiu.

Species in Zones	1981	1993
Zone 1 - Sedgeland		
Acaena novae-zelandiae		<5
Actites megalocarpus		5
Agrostis avenacea (now *Lachnagrostis filiforme*)	0-5	
Atriplex prostrata	trace	<5
Baumea arthrophylla†	25-50	
Baumea juncea†		20
Bolboschoenus caldwellii†	0-5	
Bromus diandra		<5
Cardamine heterophylla	0-5	
Carex fascicularis†	0-5	
C. pumila†		5
Cassytha glabella	trace	
Centella cordifolia†	0-5	
Centrolepis strigosa		<5
Cirsium vulgare		15
Crassula helmsii†	5-25	40
Danthonia spp.	0-5	
Eleocharis acuta†	0-5	5-25
Epilobium billardierei. †	0-5	
Holcus lanatus	0-5	<5
Hydrocotyle muscosa†	5-25	
H. pterocarpa†	0-5	
Isolepis cernua† (now *Ficinia nodosa*)	0-5	5
I. nodosus†	0-5	
Juncus articulatus†	0-5	20
J. caespiticius†	0-5	
J.pallidus†		<5
J. kraussii†	0-5	5
Leontodon taraxacoides		<5
Lepidosperma concavum		<5
Lilaeopsis polyantha†	0-5	
Lobelia alata†	0-5	
Mimulus repens†	0-5	
Myrophyllum propinquum(now *M. simulans*)†	5-25	
Potentilla anglica	0-5	
P. anserina		5
Potamogeton australiensis†		<5
Pratia platycalyx†	5-25	
Ranunculus rivularis (now *R. amphitrichus*)†	0-5	

Species in Zones	**1981**	**1993**
Rorippa nasturtium-aquaticum†		5
Salix sp	trace	5
Schoenoplectus pungens†	5-25	40
S. tabernaemontani†	0-5	
Schoenus nitens†	0-5	10
Selliera radicans †	5-25	5
Senecio sp		5
S. pinnatifolius		<5
Triglochin procera†	5-25	<5
Triglochin striata†	0-5	
Typha latifolia	25-50	
Villarsia reniformis†	0-5	
Zone 2 - Grassland		
Baumea rubiginosa†		20
Crassula helmsii†		<5
Eleocharis acuta†		5
Hydrocotyle muscosa†		10
Isolepis fluitans†		5
Lepilaena cylindrocarpa†	0·5	5
Montia australis (now *Neopaxia australasica*)†		20
Myriophyllum salsugineum†		15
M. variifolium†		10
Potamogeton australiensis†		20
Ranunculus amphitrichus†		<5
Rorippa nasturtium-aquaticum†		<5
Salix sp		5
S. cinerea		<5
Schoenoplectus pungens†	0-5	5
Scirpus caldwellii (=Bolboschoenus caldwellii) †	0-5	
Triglochin striata†		5
T. procera†		20
Typha orientalis (?) (probably T. domingensis)		25
Villarsia reniformis†		20
Zone 3 - Fernland		
Baumea rubiginosa†		5
Chara sp. †		5
Crassula helmsii†		10
Eleocharis acuta†		10
Hydrocotyle muscosa†		<5
Lepilaena cylindrocarpa†	5-25	
Myriophyllum elatinoides (now M. salsugineum)†	50-75	30
Potamogeton australiensis†	5-25	15
P. ochreatus†	0-5	
Rorrippa nasturtium-aquaticum†		5

Species in Zones	1981	1993
Ruppia maritime (now *R. polycarpa*)†	0-5	
Triglochin procera†	0-5	20
T. striata†		5
Wolffia australiana†	trace	

† = native species that are either wetland dependent or indicative of wetland conditions

3.3.4 Green and gold frog

The green and gold frog (also known as the growling grass frog and the southern bell frog) has declined dramatically across its range. Population studies have shown that green and gold frog populations are positively influenced by permanent water, the extent of aquatic vegetation, extensive riparian or floodplain grasslands and the presence of other nearby green and gold frog populations (Heard *et. al.* 2004). The species is dependent upon permanent freshwater lagoons for breeding. The ideal breeding habitat is the shallow part of still or slow-flowing lagoons, generally with a complex vegetation structure (DEWHA 2009). Despite their requirement for permanent water for breeding, they also require terrestrial habitat (such as grasslands and forests), feeding mainly on terrestrial invertebrates such as beetles, termites, cockroaches, moths, butterflies and various insect larvae (DEWHA 2009). The combined habitat requirements of permanent waters with still to slow-flowing areas and nearby forests and grasslands is provided by the site. Among the threats to the green and gold frog, habitat loss through stock grazing and irrigation are considered major (DEWHA 2009). Again, the site provides some sanctuary from these impacts, making it a refuge for this species.

3.3.5 Dwarf galaxias

Dwarf galaxias are native to north-eastern and north-west Tasmania, Flinders Island and parts of the south-east Australian mainland (IFS 2006). In Tasmania, sites supporting dwarf galaxias have been associated with sand, gravel and alluvium deposits (Chilcott and Humphreys 1996). The species is usually found in slow-flowing, shallow waters (often stagnant and often less than 30 cm deep), typically in swamps, drains, and backwaters of creeks and streams (SEWPAC 2011). It usually occurs in habitats that are heavily overgrown with aquatic macrophytes (IFS 2006) and when in larger pools, this species is usually collected in the marginal vegetation surrounding the edge of the pool (SEWPAC 2011). The site therefore provides ideal habitat for this species. Spawning occurs around August, when eggs are deposited singly on aquatic plants, stones and leaves. It is believed to live for only one year, with the adults dying after spawning. Their whole life cycle is spent in fresh water (IFS 2006). At the site, the species was found in macrophyte-rich areas and in close proximity to Tobacco Creek. The sampling program undertaken by Chilcott and Humphries (1996) in north-east Tasmania identified a tendency for the dwarf galaxias to be present in permanent waters (mostly creeks) with ample aquatic vegetation (Paul Humphries, personal communication). The permanent nature of Little Waterhouse Lake may mean this is the preferred location rather than upstream Tobacco Creek, however, part of Tobacco Creek is included in the Ramsar site.

3.3.6 Other components and processes of the site

In addition to the critical components and processes of the site and the essential elements that support them, there are other components of the site that may not define its unique character, be directly linked to the Ramsar criteria, or be directly dependent on the wetlands of the site. Nonetheless these non-critical components and processes do contribute to the site's overall character and are described below.

Soils The site is located within the 'Blackmans Lookout' land system (Cronin 2002), a small land system extending up to five kilometres inland and running south along the coast for approximately 15 kilometres from Croppies Point. The soils of the land system are described as undifferentiated on the beach, and only weakly differentiated in the hind dunes, with an inorganic layer restricting drainage in the flat areas. It is this inorganic layer ("coffee rock") that underlies Little Waterhouse Lake.

Avifauna No bird data were found specifically for the Ramsar site. A list for the whole of the Waterhouse Conservation Area (Parks and Wildlife Service, 2003) presents a total of 138 bird species, including six of Tasmania's 14 endemic species.

Birds of particular conservation significance found in the Waterhouse Conservation Area include nine species listed in the TSP Act 1995 (all listed as vulnerable unless otherwise indicated). These are:

- Tasmanian wedge-tailed Eagle (*Aquila audax fleayi*) (endangered, TSPA);
- shy albatross (*Thalassarche cauta*);
- black-browed albatross (*Thalassarche melanophrys*) (endangered, TSPA);
- blue petrel (*Halobaena caerulea*);
- fairy prion (Southern Sub-species; *Pachyptila turtur subantarctica*) (endangered, TSPA);
- light-mantled sooty albatross (*Phoebetria palpebrata*);
- white –headed petrel (*Pterodroma lessonii*);
- little tern (*Sterna albifrons simensis*) (endangered, TSPA); and
- fairy tern (*Sterna nereis nereis*).

The wedge-tailed eagle (also Listed as Endangered under the EPBC Act 1999), and fairy tern (also listed as Vulnerable on the IUCN Red List) may breed in the Waterhouse Conservation Area but there are no records of them within the Ramsar site. The little tern breeds on this coast and is listed as endangered. The caspian tern is protected under the Japan/Australia Migratory Bird Agreement and the China/Australia Migratory Bird Agreement. The nationally vulnerable hooded plover breeds within the Waterhouse Conservation Area. The wetland and open waterbodies provide excellent habitat for waterfowl. However, it is the marine and coastal areas of the Waterhouse Conservation Area that are likely to provide habitat for most of the birds of conservation significance and it is unlikely that any of the above species use the Little Waterhouse Lake Ramsar Site. The dominant waterfowl of wetland habitat in the Waterhouse Conservation Area (including Little Waterhouse Lake) include black swan (*Cygnus atratus*), Pacific black duck (*Anas superciliosa*), chestnut teal (*Anas castanea*), musk duck (*Biziura lobata*), hoary-headed grebe (*Poliocephalus poliocephalus*), little pied cormorant (*Phalacrocorax melanoleucos*), little-black cormorant (*Phalacrocorax sulcirostris*) and great cormorant (*Phalacrocorax carbo*) (Bryant and Holdsworth 1995).

Mammals Similar to the avifauna there were no mammal data found specifically for the Ramsar site. The Waterhouse Conservation Area contains at least three, and possibly four, of Tasmania's six species of mammals considered to be potentially vulnerable and requiring monitoring (Parks and Wildlife Service, 2003). They are the spotted-tailed quoll, eastern quoll, Tasmanian bettong and possibly the eastern or little pygmy possum. The Waterhouse

Conservation Area may also contain the only mammal species considered rare in Tasmania, the New Holland mouse (Parks and Wildlife Service, 2003). The Conservation Area contains extensive areas of apparently suitable habitat and the species has been recorded to its west and east. However, despite extensive trapping, the species has not been recorded in the Conservation Area itself (Parks and Wildlife Service, 2003).

The Tasmanian devil was recorded in the Waterhouse Conservation Area in 1993 as part of the Parks and Wildlife mammal survey (Driessen et al. 1995). The Tasmanian devil has subsequently been listed as endangered nationally (EPBC Act 1995) and at the State level (TSP Act 1995). The swamp rat (*Rattus lutreolus*) and the water rat (*Hydromys chrysogaster*) were also present at the site and are likely to be found around lagoons such as Little Waterhouse Lake (Driessen et al. 1995).

Reptiles and amphibians Reptile density and diversity within the Waterhouse Conservation Area was found to be low (Parks and Wildlife Service, 2003). Five species were recorded during a survey in 1993: mountain dragon (*Tympanocryptis diemensis*), three-lined skink (*Bassiana duperryi*), Whites skink (*Egernia whitei*), metallic skink (*Niveoscincus metallicus*) and tiger snake (*Notechis ater*) (Brereton 1995). Bougainville's skink, *Lerista bougainvillii* is reportedly well known amongst herpetologists as being present on the site (Micah Visoiu, personal communication) and a white-lipped snake (*Drysdalia coronoides*) was observed in February 2010 (Ken Morgan, SEWPaC, pers comm).

Apart from the green and gold frog (*Litoria raniformis*), recorded within the Conservation Area (Brereton 1995, Brown 1995) and observed at the Little Waterhouse Lake Ramsar Site (D. Wilson, personal communication), five other species of frog have been recorded in the Waterhouse Conservation Area (Brown 1995). These are: banjo frog (*Limnodynastes dumerili*), spotted marsh frog (*Limnodynastes tasmanisnsis*), striped marsh frog (*Limnodynastes peroni*), brown tree frog (*Litoria ewingi*) and brown froglet (*Crinia signifera*). The striped marsh frog has been heard calling within the site, in the marsh area below the dam wall (Micah Visoiu, personal communication).

Aquatic macroinvertebrates A Freshwater Wetland Rapid Biological Assessment of Little Waterhouse Lake was carried out in late autumn 2009. The combined taxa identified from all samples included:

> Planorbidae and Hydrobiidae (Snails); Sphaeridae; Oligachaeta (Segmented worms); Hydracarina (Water mites); Ceinidae (Sideswimmers); Dytiscidae (Beetles); Tipulidae, Tanypodinae, Orthocladiinae, Chironominae and unidentified pupae (Flies); Baetidae, Caenidae (Mayfly larvae); Corixidae, Naucoridae, Notonectidae, Pleidae (Bugs); Pyralidae; Coenagrionidae, Lestidae (Damselfly larvae); Aeshnidae, Gomphidae (Dragonfly larvae); Leptoceridae (Caddisfly larvae).

A SIGNAL score (Stream Invertebrate Grade Number – Average Level) was calculated for each sample, which varied from 3.1 to 3.4. The number of families collected from each sample varied from 11 to 14 (Searle 2009).

Crustacea recorded at Little Waterhouse Lake in 1991 and 1992 include Ostracoda, Copepoda-Calanoida, Copepoda-Cyclopoida, Copepoda-Harpacticoida, *Cladocera*, Conchostraca *Lynceus* sp. and Eulimnadia sp, Amphipoda *Austrochiltonia* sp., Amphipoda *Neoniphargus* (*?tasmanicus*) and Decopoda *Engaeus cunicularius* (Horwitz, 1992). Harpacticoids were only found in a few selected wetlands of north eastern Tasmania, including Little Waterhouse Lake and three other permanent lakes (Horwitz 1992).

Fish The Natural Values Atlas states that southern short-finned eel (*Anguilla australis*), eastern dwarf galaxias (*Galaxiella pusilla*), jollytail (*Galaxias maculatus*) and brown trout (*Salmo trutta*) are present in the Little Waterhouse Lake Ramsar Site (NVA 2011). In addition, Lloyd (personal observation) observed schools of a galaxias species (probably the common galaxias, *Galaxias maculatus* but this is unconfirmed) on site and the southern pygmy perch (*Nannoperca australis*) has been seen in Little Waterhouse Lake (Micah Visoiu, personal communication). A comprehensive fish survey is required to understand the fish fauna of the Little Waterhouse Lake Ramsar Site.

Although Little Waterhouse Lake was originally managed as a rainbow trout fishery, it has been stocked with both brown and rainbow trout since 1935-36. Brook trout were also released in 1966 (1820 fingerlings) and again in 1968/69 (5500 fish), but stocking of the species was short lived. Little Waterhouse Lake was stocked with either rainbow or brown trout on nine occasions between 2005 and 2009 (Inland Fisheries Service, 2010) (Table 6).

Table 6: Fish stocking of Little Waterhouse Lake between 2005 and 2009 (Provided by: Inland Fisheries Service, 2010).

Date Stocked	Species	Category	Average Weight (g)	Number
14/10/2005	Rainbow trout	Fingerling	90	2000
16/02/2006	Rainbow trout	Fingerling	20	2500
16/08/2007	Rainbow trout	Fingerling	35	2900
28/11/2007	Brown trout	Fingerling	2.5	2500
28/06/2008	Brown trout	Adult	200	200
14/08/2008	Brown trout	Adult	200	200
16/10/2008	Rainbow trout	Yearling	270	221
11/12/2008	Brown trout	Fry	2.5	1000
16/09/2009	Rainbow trout	Yearling	100	500

3.4 Benefits and Services of the Site

3.4.1 Identifying benefits and services

DEWHA (2008), states that benefits and services should be described in accordance with the Millennium Ecosystem Assessment (2005) definition of ecosystem services. This definition is: 'the benefits that people receive from ecosystems'. This definition focuses on the benefits that people receive from ecosystems (economic, social and cultural) although they may not benefit humans directly.

The Millennium Ecosystem Assessment (2005) identifies four main categories of ecosystem benefits and services:

1. **Provisioning services —** the products obtained from the ecosystem such as food, fuel and fresh water
2. **Regulating services —** the benefits obtained from the regulation of ecosystem processes such as climate regulation, water regulation and natural hazard regulation
3. **Cultural services —** the benefits people obtain through spiritual enrichment, recreation, education and aesthetics
4. **Supporting services —** the services necessary for the production of all other ecosystem services such as water cycling, nutrient cycling and habitat for biota. These services will generally have an indirect benefit to humans or a direct benefit over a long period of time.

The Little Waterhouse Lake Ramsar site is not operated for any extraction of products such as food (other than recreational fishing for stocked trout), fuel or water, nor is it used for any regulatory services. The site's small area means that any climatic regulation or hazard reduction would only occur at a very local scale. The Waterhouse Conservation Area is popular for passive recreation, camping, fishing, hunting and four-wheel driving.

A scientific study of the site was undertaken in 1993 (Holdsworth and Bryant 1995), although this was part of a larger study examining Waterhouse Conservation Area. There is some possibility that the site is of importance to Indigenous cultural heritage as the Parks and Wildlife Service (2003) reported that significant Indigenous values are known to exist in the Waterhouse Conservation Area. However no other information was found to determine whether this includes Little Waterhouse Lake.

Benefits and services of Ramsar listed sites include:

- direct benefits to humans derived from the site (provisioning, regulating and cultural services); and,
- non-anthropocentric ecosystem supporting services derived from the site (DEWHA 2008).

Benefits to humans derived from the site include:

- Tourism/recreation
- Cultural heritage (Indigenous and European)
- Potential for educational and scientific values including studies on wetland ecology

The ecosystem supporting services provided by the site include a site which:

- supports wetland types representative of the bioregion;
- supports two plant species which are of State conservation significance (and therefore rare in bioregion) - river/lake club rush (*Schoenoplectus tabernaemontani*) and sea clubsedge (*Bolboschoenus caldwellii*);
- Supports a diverse macrophyte flora;
- supports species of national significance (green and gold frog and dwarf galaxias); and
- Provides habitat for abundant fish and macroinvertebrate communities.

The benefits and services provided by the site are displayed in Table 7.

Table 7: Ecosystem benefits and services provided by the Little Waterhouse Lake Ramsar site

Category of Ecosystem Benefit / service	Ecosystem Benefit / service	Description
Cultural services	Tourism/recreation	The site is used for campling, fishing, four-wheel driving and hunting, as well as aesthetic enjoyment (passive recreation)
	Scientific/educational	The site has been the subject of biological studies, as part of larger regional studies
	Heritage	The site could potentially be of Indigenous cultural significance.
Supporting services	Supports representative wetland types	The near-natural condition, geomorphology, hydrology and water quality of the site contribute to its support of representative Ramsar wetland types.
	Supports regionally rare/threatened species	The site supports two plant species, listed as rare within the bioregion
	Supports biodiversity	Through its impressive macrophyte biodiversity, the Site supports a range of species dependent upon lake and coastal freshwater lagoon habitat.
	Supports nationally listed species	The site supports populations of the nationally listed green and gold frog and dwarf galaxias.
	Habitat provision	The site provides habitat for fish and macroinvertebrate communities.

3.4.2 Critical Benefits and Services

The critical services supporting the ecosystem(s) of the site can be identified using the same determinants as those used for selecting the critical components and processes (DEWHA 2008). These are the services:

1. that are important determinants of the site's unique character;
2. that are important for supporting the Ramsar criteria under which the site was listed;
3. for which change is reasonably likely to occur over short to medium time scales (<100 years); and
4. that will cause significant negative consequences if change occurs.

Four of the five supporting services listed in Table 7 meet all of the four selection determinants above. In the following section (section 3.4.3) these critical services are presented and discussed in relation to the processes that link them with the critical components of the site. Although the provision of habitat for fish and macroinvertebrates is a valuable service of the site, it does not contribute to the site's unique character nor does it contribute to the site's Ramsar listing. This assessment also applies to the three cultural services identified in Table 7.

3.4.3 Linking services to processes and components of the site

The critical ecosystem services identified in section 3.4.2 provide support for numerous other services and benefits of the site. Each critical ecosystem service supports one or more criteria for which the site is designated, and links in with specific components of the site through ecological processes. These are presented in Table 8. The linkages between the components, process and services are provided in Figure 15.

Table 8:Ecosystem services provided by the Little Waterhouse Lake Ramsar Site with relevant processes and components

Ecosystem Services	Ecological Processes Creating/Supporting the Service	Specific Components & Processes
Supports representative wetland types for the bioregion (Criterion one)	Maintenance of landforms that provide the base for the wetland ecosystem	Geomorphology, terrestrial vegetation, climate
	Provision of fresh water volumes for ecosystem requirements	Hydrology
	Provision of fresh water quality for a range of wetland flora	Terrestrial vegetation, water quality
Supports regionally rare/threatened species (Criterion three)	Provision of a habitat for rare plant species	Hydrology, water quality, geomorphology, climate

Ecosystem Services	Ecological Processes Creating/Supporting the Service	Specific Components & Processes
Supports biodiversity (Criterion three)	Provision of water regime to meet the ecological needs and the maintenance of regionally threatened plant species, macrophyte diversity and a nationally listed frog species	Hydrology, Geomorphology, terrestrial vegetation, climate, water quality
Supports nationally listed species (Criterion two)	Provision wetland habitat for wetland-dependent, listed species	Geomorphology, Hydrology, Climate, and terrestrial vegetation

Figure 15 is a landscape conceptual model of the Little Waterhouse Lake Ramsar Site. The macrophyte flora of the Little Waterhouse Lake is not only a critical component of the site's ecological character, it is also a key indicator of the ecological condition of the lake. The floristic and structural diversity, as well as the presence of listed species, provide a strong basis of the site's listing as well as its ecological character.

The importance of ecosystem components to the aquatic flora include the quality of the lake water with excesses in salinity potentially leading to changes in macrophyte species or dominance of halophytic (salt-loving) algae. Similarly, the existing nutrient concentrations contribute to the macrophyte richness of the lake. However, increases in nutrient concentrations of the water could lead to phytoplankton (free-floating algae) increasing in the water column. Excessive concentrations of phytoplankton can lead to these algae shading out the submerged macrophytes that grow beneath the water surface, and changing the ecology of the lake from macrophyte dominated to phytoplankton dominated. The turbidity (or 'mudiness') of the water also contributes to the delicate balance of the system, with its characteristic high clarity assisting light penetration to the lake bed, and therefore enhancing growth opportunities for the bottom-dwelling macrophytes. Aquatic macrophytes are critical to providing habitat to fish (including the dwarf galaxias) and invertebrates which breed, feed and shelter in aquatic vegetation beds.

The water clarity also contributes to the abundant and diverse nature of the aquatic macrophytes of the lake. The turbidity of the water could increase through poor land use in the catchment upstream of the lake, leading to the input of fine silts and clays to Tobacco Creek, which runs into Little Waterhouse Lake. Turbidity of the lake's water could also be increased through the growth of the phytoplankton, which themselves contribute to the 'muddiness' of the water. Similarly, poor land use in the catchment could contribute to elevated inputs of nutrients, leading to phytoplankton blooms as described above.

The hydrologic regime of the lake clearly influences the floristic make-up of the site, through the coverage, depth, timing and rate of delivery of water to the system. Inputs of groundwater and surface water (through local catchment runoff and also through the inputs of Tobacco Creek), maintain the water volumes and variations that contribute to the ranges and variability in depths and habitat zones that characterise the site. Changes to the hydrologic regime through climate change (e.g. less rainfall and more evaporation), groundwater abstraction or damming of surface water up-catchment may lead to less water being delivered to the site. This has the potential to increase concentrations of salt and nutrients, as well as reduce the areal extent and depth of the lake, leading to a lower quantity and a lower quality aquatic habitat.

The natural damming of the site, which was washed away by heavy rains and subsequently rebuilt by the local fishing club, is also a vital aspect of the site's hydrology, providing a barrier (albeit permeable) to flow from the lake. This contributes to a permanence of water, important to the dwarf galaxias. Through the leaking of water, either through or under the reconstructed dam, the site also contains a swampy marshland downstream of the dam wall, with green herbfields and wet soils with high organic matter content. This area also contains a small network of rivulets, fed by the throughflow from and around the dam, sometimes under the peaty soils, sometimes forming small springs and sometimes expressed as small channels within the marshland. This habitat, mixed with tussock grassland and with scrubland nearby, provides high quality potential habitat for the green and gold frog (Figure 15).

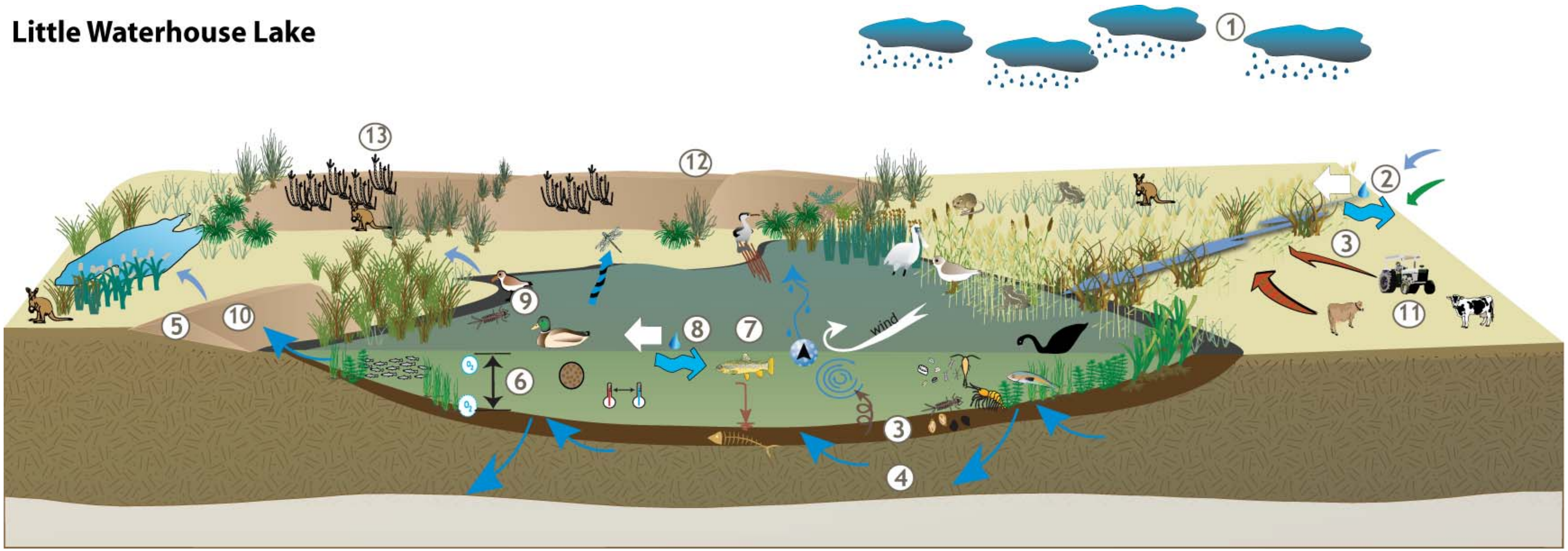

Figure 15: Little Waterhouse Lake Ramsar Site Conceptual Model showing components and processes

Physical & Water Quality Components

(1) Climate is an essential element in supporting the site's ecological character. Rainfall is across a small catchment and there some evidence is that this is changing.

(2) Tobacco Creek is a major source of water for the system. The hydrology has been changed due to climate change and also upstream landuse change such as clearing and forestry practices. (7) The Lake's water regime is also altered (8) via a dam (5) wall.

(3) The lake's sediment is a peaty loam organic soil with poor drainage.

(4) The subsoil is an inorganic layer called "coffee rock" and this layer underlies the sediment on the bed of Little Waterhouse Lake.

(12) Coastal dunes are present around the Lake from current dune processes.

(6) Water depth ranges from shallow to deep (>2 m) depending on Inundation level and it fluctuates widely over time.

Dissolved oxygen concentrations are temporally and spatially variable, low dissolved oxygen may be experienced near the sediment-water interface due to organic matter.

Water temperature also varies temporally and spatially within the Lake.

Lake water is fresh to slightly brackish. Groundwater is unknown. Salinity increases as the Lake dries out.

Turbidity levels are variable - high on initial fill but reducing to very low but wind can contribute to re-suspension of sediments in open waters.

Processes

Inputs from inflowing creeks are the most important inputs of water to the Site. Seepage though the dam wall sustains the Pool and Marshland habitat. Water outflows under extreme inflows around the dam wall into an outlet creek.

Biota may disperse into the Site from the inflowing Tobacco Creek.

Seed and egg banks in the Lake's sediments replenish the aquatic communities following refilling.

Wind results in mixing, causing resuspension of sediments and evaporation of water from the lake.

Mixing increases turbidity but also ensure oxygen is also distributed through the water column.

Sediment resuspension raises turbidity and can result in nutrients being released into the water column.

Evaporation increases with mixing and wind and is a vital process which causes drying and exposure of sediments for mudflats (9), which are important for waders.

Decomposition of biota is an important process for nutrient cycling in the Lake.

Sediment and nutrient run-off from the surrounding landscape is an important source of nutrients which may cause impacts if native vegetation is cleared and landuse is agricultural.

Nutrients and carbon exported to the surrounding terrestrial fauna through export and predation of aerial stages of aquatic invertebrates.

Biota

Aquatic Invertebrates are important source of food for fish, birds and other fauna. Initially, these colonise by invertebrates that emerge from egg banks and resting stages. Other invertebrates colonise the lake via aerial (wind & bird) and aquatic dispersal.

Submerged and floating macrophytes are very important in their own right as well as habitat for macroinvertebrates, substrates for epiphytes, breeding sites and shelter for fish and their role in physico-chemical processes in settling sediment and uptake of nutrients.

Fringing vegetation: around the lake margins and floodplain is vital foraging and nesting habitat and also stabilises the edge and controls erosion. The reeds, rushes and sedges provide vital habitat for cryptic bird species such as snipes and crakes and rare frog species such as green and gold frog

The surrounding lands are largely cleared but parts have remnants of the open woodlands, shrublands, grasslands and herblands. which are important to species such as green and gold frog for feeding and habitat for terrestrial fauna such as small mammals and macropods.

Coastal scrub and tussocks are present on moving sand dunes but blow-outs occur (12) which has resulted in the planting of the invasive species marram grass which binds the dunes but displaces native species. The marram grass is an effective agent in dune stablisation (13) but changes the local geomorphology and is a poor habitat compared to native species.

Herbivores and ducks prefer the deeper water with submerged aquatic vegetation or open water but shelter in marginal vegetation or trees.

Shorebirds and the larger waders prefer the mud flats and shallows.

Piscivores prefer the open water where they can hunt and capture fish or large crustaceans and utlise rare woody debris to perch and rest upon.

Fish are present on site and utilised as food. The extensive aquatic vegetation beds and are excellent habitats for the listed species , dwarf galaxias, which are recorded as present (NVA 2011). Trout have been regularly stocked into the Lake.

Key Threats

Agriculture and land clearance (10) provide a local threat to the Lake through run-off (11) of sediments, nutrients, and possibly toxicants. These impacts can be managed through better on-farm practices and catchment works.

Recreational access to the site impacts by cutting new tracks and clearing vegetation for access. Shacks and recreation on site impacts through himan waste, litter, etc.

The invasive species marram grass which binds the dune, changes the local geomorphology, displaces native species and is poor habitat compared to native species.

Trout are regarded as a threat to both dwarf galaxias and green and gold frog, both EPBC Act listed species and critical components of the site's ecological charcater.

4. KEY ACTUAL OR POTENTIAL THREATS TO THE SITE

The key threats identified for Little Waterhouse Lake Ramsar Site are long standing and most of these threats would have been occurring prior to the time of listing. These threats include:

- changes to the lakes water quality through inappropriate land use in the Tobacco Creek catchment, upstream of the site;
- changes to the site's hydrology through groundwater extractions elsewhere within the aquifer;
- change to the site's hydrology through breaching of the dam wall;
- alien fish stocking;
- vegetation clearance on-site and in surrounding areas;
- vehicle and Recreational use at the site;
- weeds;
- animal and plant diseases and pathogens;
- duck hunting; and,
- climate change.

Water quality and land use The threat of land use impacts on the site has been described in section 3.4.3, in relation to the importance of water quality to the site's ecological character. The importance of this threat is high, although its extent to which it may impact the site cannot be easily determined. The current land use (grazing) existed at the time of listing and to date there do not seem to have been impacts on the critical components of the site. Further, fencing has been erected along Tobacco Creek (the input drainage line to Little Waterhouse Lake) to exclude cattle and therefore reduce the likely input of nutrients from the catchment. However, the lake and marshland may be acting as nutrient traps, gradually increasing in nutrient concentration and eventually leading to a shift in the state of primary production, from macrophyte dominated to algal dominated. This potential threat has little information to support or discount it. Long-term or intensive water quality sampling with sufficient data points to determine trends would be required for assessing the potential of this threat.

Hydrology – groundwater extractions The management plan for the Waterhouse Conservation Area (Parks and Wildlife Service 2003) identifies increased intensification of farming in the region, and increasing use of irrigation, potentially leading to changes in water tables within the Conservation Area. Water is currently being pumped from Blackmans Lagoon for agricultural purposes. There is no information on the extent of the aquifer under Little Waterhouse Lake, nor whether extractions from nearby surface waters are impacting on its hydrology.

Hydrology – breaching of dam wall Little Waterhouse Lake was naturally blocked by dune movements and in the 1950's the natural blocking was washed away by a large rainfall event. Subsequently, the local fishing club built a dam wall to replace the washed out one. The geomorphologist, Ian Houshold, has suggested that water levels in the lake are controlled by natural downstream structures (beach ridge, see Figure 3) rather than the very sandy wall which is present. However, the sandy dam wall, still impedes water. The dam built by the fishing club is unlikely to be structurally sound (it is already leaking). If the dam wall washes away or collapses, it may result in a significant loss of lake area.

Alien fish stocking Regular stocking of trout species is a significant impact on the native fish populations of the lake. At least two species of galaxias are confirmed at the site, most of these fish are known to be negatively impacted by trout predation with the threatened dwarf galaxias particularly vulnerable. Since trout species have been stocked in the lake for over 70 years, the dwarf galaxias population may be reduced but the Chilcott and Humphries (1996) survey and NVA (2011) records confirm they are present. The extensive suitable habitat for dwarf galaxias would mean their populations would expand without trout presence. Trout are voracious feeders and are also likely to prey on tadpoles and adults of frog species (when in the water) and in particular on the green and gold frog. Given the presence of the green and gold frog and the dwarf galaxias at the site, stocking the lake with trout would appear to be in conflict with the site's Ramsar listing.

Vegetation clearance Vegetation clearance for agricultural development has occurred around the site margins, resulting in severe erosion of dunes. The creation of blowouts in the dunes has led to dune movement and a highly mobile geomorphology (possibly covering the lake). Nearby Big Waterhouse Lake is currently being filled by a sandblow (Parks and Wildlife Service 2003), indicating that this threat is more than theoretical. In recent years there has been increased intensification of farming in the region (Parks and Wildlife Service 2003).

Vehicle and recreational use The Waterhouse Conservation Area has management issues in relation to the high numbers of people camping and four-wheel driving in the Conservtion area. Although much of this activity is concentrated in areas away from Little Waterhouse Lake, there is largely uncontrolled access to the site and this has the potential to cause significant impact to the ecological character if not managed. Impacts could include damage to vegetation and banks through trampling and off-track use, resulting in bank erosion and reduced water quality as well as loss of macrophyte diversity and abundance.

Weeds Cumbungi (*Typha latifolia*), poplar (*Populus* spp.), willows (*Salix* spp) and other weeds are present in parts of the site and could proliferate, altering the ecological character of the site. In particular, cumbungi have been seen forming thick bands in the lake and in the pond downstream of the dam, and appear to be close to causing serious impact. Marram grass plantings in the vicinity have altered natural geomorphic process.

Diseases and pathogens [Phytophthora cinnamomi (dieback fungus) and *Batrachochytrium dendrobatidis* (chytrid fungus)] *Phytophthora cinnamomi (Pc)* is a destructive and widespread exotic species of water mould carried in soil and water that causes root-rot disease symptoms (dieback) and eventual death to a wide variety of native and introduced plant species (DEH 2009). Species impacted by *Pc* include a large number of Tasmanian native plant species in moorland, sedgeland, heath, open forest and disturbed rainforest (DPIW 2009b). Pc has the potential to significantly alter the ecology of these vegetation types. Although no record of the disease was found specifically for the site, it has certainly been found in the area (DPIW 2009b) and must be considered a threat to the ecological character of the site, through its potential to impact the site's vegetation.

Chytrid fungus is a fungus that infects the skin of frogs, destroying its structure and function, and can ultimately cause death (DPIWE 2010). The site was tested and found to be positive for chytrid by DPIPWE (tested 26/11/2008) (DPIPWE unpublished information). Although green and gold frogs are present at the site, the long term impacts of chytrid fungus on this species are currently unknown. Accordingly, this pathogen should also be considered a threat to the ecological character of the site, through its amphibian fauna.

<u>Fire</u> Fire is potentially a very high risk to all components of the site. Potential loss of the site’s vegetation cover through either very hot or frequent burning would impact landform stability, and therefore ultimately the site’s geomorphology and hydrology.

<u>Duck hunting</u> Duck hunting currently occurs within the Waterhouse Conservation area and in the past this has included Little Waterhouse Lake. Due to the Ramsar status of the lake, duck hunters have agreed not to continue shooting at Little Waterhouse Lake (Parks and Wildlife Service 2003). There is a possibility that lead shot remains in the sediments of the lake, possibly within reach of waterfowl and other species that feed in the lake’s benthic zone.

<u>Climate change</u> Climate change could also change the ecological character of the site through changes to rainfall and temperatures, potentially altering the hydrology and the nature of the vegetation cover of the site. Although climate change projections contain a high level of uncertainty in terms of magnitude, climate modelling predicts higher temperatures and increased evaporation across south-eastern Australia (Timbal and Jones 2008). This could lead to reduced water availability for the site’s wetland communities.

The key threats identified have been presented in a driver/stressor model (Figure 16).

The likelihood ratings provided in Table 9, are allocated as follows:

- Certain = known to occur at the site or has occurred in the past
- Medium = not known from the site but occurs at similar sites; and
- Low = theoretically possible, but not recorded at this or similar sites

Driver-stressor models of the type presented in Figure 16 can help with the determination of limits of acceptable change (Davis and Brock 2008). Figure 16 displays the major threats and their pathways of impact upon the critical components, processes and services. However, due to the large number of potential effects from each threat, not all pathways can be displayed.

Table 9: Summary of actual or potential threats to the Little Waterhouse Lake Ramsar site

Threat	Potential impacts to wetland component or service	Critical CPS Impacted	Likelihood	Time frame
Catchment land use	• increased nutrient concentrations (& increased algal growth • hydrological changes • increased turbidity	- macrophyte diversity - green and gold frog	Medium	5 – 20 years
Groundwater extractions	• lowering of water table, resulting in less habitat diversity (spatial and temporal), less water to support ecosystem	all CPS	Low	Current
Dam wall breaching	• rapid loss of water from lake • period of low lake levels until wall reinstated	all CPS	Certain	Unknown
Trout stocking	• predation on small fish and amphibia	green and gold frog	Medium	Current
Vegetation clearance (surrounding land)	• geomorphic instability • infilling of lake	all CPS	Certain	<10 years (commencement)
Vehicle & recreation use	• lake bank/shore damage and erosion • reduced water quality	- rare species - macrophyte diversity	Low	Current
Weeds	• invasion of wetlands, reducing habitat availability for other species • changes to geomprphic process and directions of surrounding lands	- rare species - macrophyte biodiversity	Certain	Current
Pathogens/diseases	• loss of vegetation communities (Pc) • loss of amphibia (Chytrid)	- wetland habitat - green and gold frog - biodiversity	Medium (Pc) Certain (Chytrid)	Unknown (Pc) Current (Chytrid)
Fire	• changes to vegetation communities • changes to geomorphology via erosion • changes to hydrology via infiltration and landform	- wetland habitat - biodiversity	Medium	Current
Duck hunting	• lead shot poisoning of benthic feeders	- biodiversity	Low	Current (diminishing)
Climate change	• reduced inflows and rainfall and evaporation rates mean changes to all water dependent ecosystems	- all	Medium	20-50 years

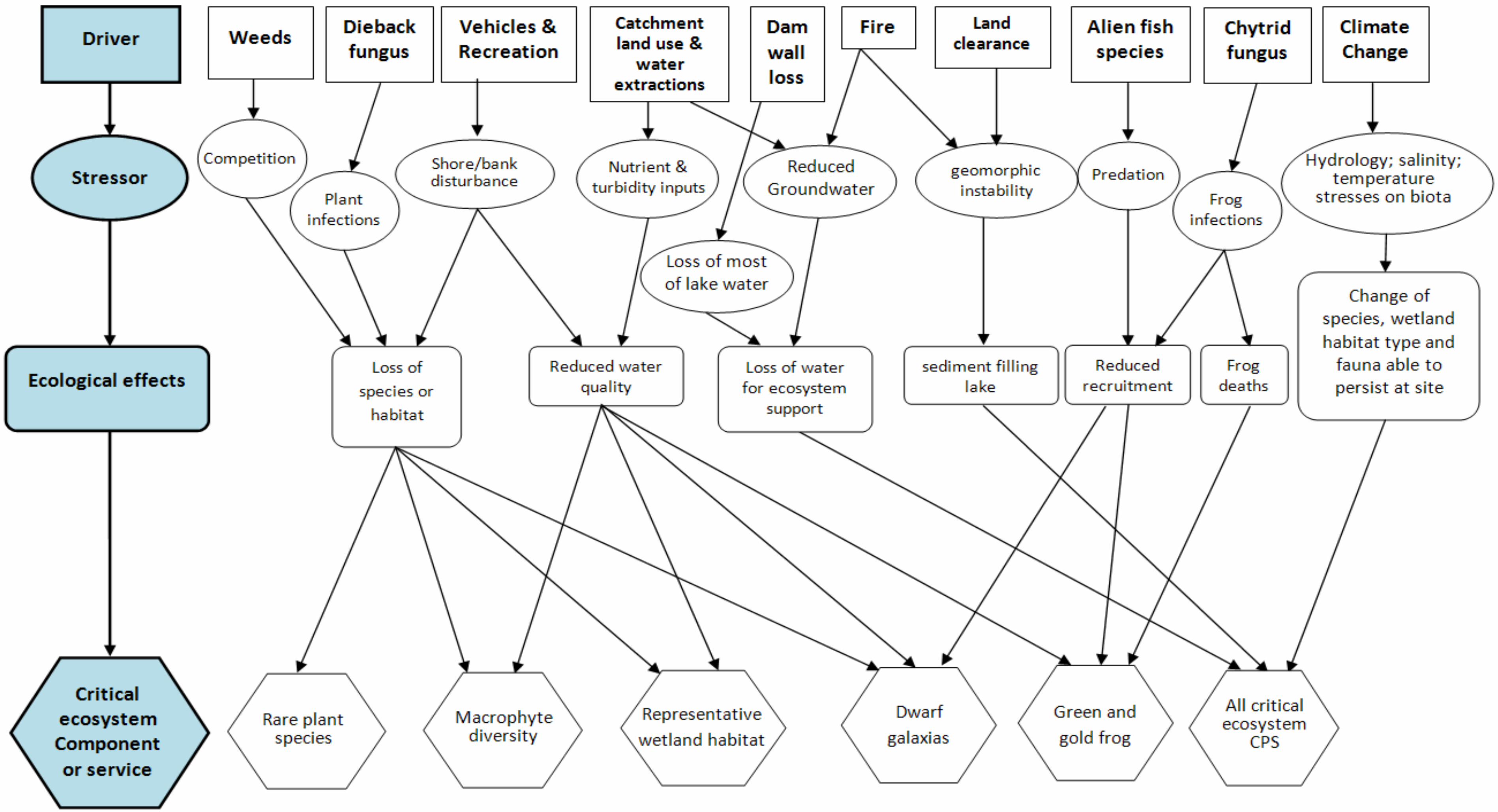

Figure 16: Driver Stressor Model of threats to the Little Waterhouse Lake Ramsar Site.

5. LIMITS OF ACCEPTABLE CHANGE

The aim of deriving limits of acceptable change is to make it easier to determine when the ecological character of a wetland is likely to change or when it has changed due to pollution or other human interference (DEWHA 2008). Limits of acceptable change are defined by Phillips (2006) as:

"…the variation that is considered acceptable in a particular measure or feature of the ecological character of the wetland. This may include population measures, hectares covered by a particular wetland type, the range of certain water quality parameter etc. The inference is that if the particular measure or parameter moves outside the 'limits of acceptable change' this may indicate a change in ecological character that could lead to a reduction or loss of the values for which the site was Ramsar listed. In most cases, change is considered in a negative context, leading to a reduction in the values for which a site was listed."

Hale and Butcher (2008) noted problems associated with using extreme measures of a selected parameter and then setting the limits outside those extremes. These include the possibility of missing shifts in character that stay within the extremes, including more frequent events, changes in seasonal patterns, and changes in central tendency (mean/median). In Little Waterhouse Lake Ramsar site there were no quantitative data available for any of the critical components prior to this ECD, creating difficulty in defining medians, natural variability and extreme conditions. However, a vegetation map produced as part of this ECD can be used in setting limits of acceptable change, allowing some quantification.

It is important to recognise the difference between limits of acceptable change and management triggers. Limits of acceptable change incorporate natural variability (where appropriate) into a quantitative assessment (where possible) of the components that define the Ramsar site's unique character. Using data, expert judgment and the precautionary principle, limits of acceptable change set a quantitative limit which, if breached, will lead to a genuine change in the site's unique ecological character.

In contrast, management triggers represent smaller changes towards exceeding limits of acceptable change (or other resource management goals of the site). This is an important distinction, as management triggers should be set at a level that allows appropriate management responses *well in advance* of the limits of acceptable change being breached. It is not appropriate to provide management triggers in an ECD, as these must be derived as part of a detailed management plan. However, the information provided in an ECD should be used as part of the management planning process for a Ramsar site.

The following components and processes were identified (Section 3.1) as critical to the ecological character of the Little Waterhouse Lake Ramsar Site ecosystem:

- wetland habitat types;
- rare plant species;
- macrophyte diversity; and
- the dwarf galaxias population and the green and gold frog population.

The following services were identified (Section 4) as critical to the ecological character of the Little Waterhouse Lake Ramsar Site ecosystem:

- supports wetland types representative of the bioregion;

- supports two plant species which are of State conservation significance (and therefore rare in bioregion) - river/lake club rush (*Schoenoplectus tabernaemontani*) and sea clubsedge (*Bolboschoenus caldwellii*);
- supports a diverse macrophyte flora; and
- supports species of national significance (green and gold frog and dwarf galaxias).

The components and the services largely overlap, leaving the list of components, processes and services that require limits of acceptable change as:

- wetland habitat types;
- rare plant species;
- diverse macrophyte flora; and
- supporting a significant proportion of a species –green and gold frog, dwarf galaxias.

Limits of Acceptable Change have been derived for these 4 components (Table 10). Baseline information, justification and comments are also provided in Table 10.

The confidence levels for the limits of acceptable change represent the degree to which the authors are confident that the LAC represents the point at which a change in character has occurred and follow the approach of Hale (2010):

High – Quantitative site specific data; good understanding linking the indicator to the ecological character of the site; LAC is objectively measureable.

Medium – Some site specific data or strong evidence for similar systems elsewhere derived from the scientific literature; or informed expert opinion; LAC is objectively measureable.

Low – no site specific data or reliable evidence from the scientific literature or expert opinion, LAC may not be objectively measurable and / or the importance of the indicator to the ecological character of the site is unknown.

Additional Explanatory Notes for LAC

Limits of Acceptable Change are a tool by which ecological change can be measured. However, ECDs are not management plans and LACs do not constitute a managememnt regime for the Ramsar site.

Exceeding or not meeting LACs does not necessarily indicate that there has been a change in ecological character within the meaning of the Ramsar Convention. However, exceeding or not meeeting LACs may require investigation to determine whether there has been a change in ecological character.

While the best available information has been used to prepare this ECD and define LAC for the site, a comprehensive understanding of site character may not be possible as in many cases only limited information and data is available for these purposes. The LAC may not accurately represent the variability of the critical components, processes, benefits or services under the management regime and natural conditions that prevailed at the time the site was listed as a Ramsar wetland.

Users should exercise their own skill and care with respect to their use of the information in this ECD and carefully evaluate the suitability of the information for their own purposes.

LAC can be updated as new information becomes available to ensure they more accurately reflect the natural variability (or normal range for artificial sites) of critical components, processes, benefits or services of the Ramsar wetland.

Table 10: Limits of Acceptable Change for Little Waterhouse Lake Ramsar Site.

Critical component, process or service	Baseline information	Limit of acceptable change	Justification and Comments	Confidence
Wetland habitat types	The baseline information used in this assessment is the vegetation map produced as part of this ECD (Figure 13).	The limits of acceptable change for the wetland are: • No more than ten percent reduction in wetland types **K** (coastal freshwater lagoon) and **Ts** (sedgeland floodplain) Areas for **K** and **Ts** are 6 and 9.3 hectares, respectively. • No more than ten percent loss in the combined area of wetland habitat types **Tp** (Permanent freshwater marshes/pools), type **U** (Non-forested peatlands) and type **M** (Permanent creeks). These wetland types overlap and together have a combined area of 2.6 hectares.	There are no data on the variability of the wetland habitat types and, until this ECD, there was no mapping of the wetland types. These limits have been set as a common sense approach to defining a significant loss in wetland types. The second limit recognises the overlap of the three wetland types and the virtually impossible task of separating them. As the wetland habitat map was made without proper field surveying, it will need verification.	Low-medium
Rare plant species	The only baseline information available is that two rare species were recorded as being at the site at the time of designation.	Presence of: • *Bolboschoenus caldwellii* (sea club-rush) and • *Schoenoplectus tabernaemontani* (river club-sedge)	There is very little quantitative information on either of these species within the site. Both species were allocated a percentage cover of between 0 and 5 percent, recorded as part of a survey described as subjective. Therefore quantitative limits of acceptable change cannot be set and a qualitative LAC based on presence / absence of these five species is provided.	Low
Macrophyte diversity	Two surveys of wetland habitats at the site have been undertaken: Kirkpatrick	**At least 36 species of wetland dependent/indicative native plants** in the	At least forty-five native wetland dependent or indicative species were present in the	Medium-High

Critical component, process or service	Baseline information	Limit of acceptable change	Justification and Comments	Confidence
	and Harwood (1981) and Blackhall (1995). Together these have established at least 45 species of wetland dependent or wetland indicative native plant species present together with some indicative information on the percent cover of key species.	semi-aquatic and aquatic zones of the wetland.	combined surveys by Kirkpatrick and Harwood (1981) and Blackhall (1995). An 80th percentile of the average of this figure results in an estimate of 36 species for the LAC.	
Supporting populations of rare/threatened species (green and gold frog, dwarf galaxias)	The baseline information for the presence of the green and gold frog is the qualitative recording and subsequent personal communication of a DPIPWE field officer. The baseline information for the presence of the dwarf galaxias is a published recording of 92 individuals. Subsequent fish surveys of Little Waterhouse Lake did not record any of this fish species.	Presence of the green and gold frog (*Litoria raniformis*). Presence of the dwarf galaxias (*Galaxiella pusilla*).	Similar to the rare plant species, there is no quantitative information on *Litoria raniformis* at the site. Therefore quantitative limits of acceptable change cannot be set and a qualitative LAC based on presence / absence of the species is provided. A single sampling event, recorded in the Natural Values Atlas, found 92 individuals of the dwarf galaxias in the early to mid-1990s. Subsequent sampling events have not recorded the species and its presence at the site has been questioned by fish biologists in Tasmania. This provides no information on the variability of the species at the site and some uncertainty about its current presence. Therefore the qualitative LAC based on presence / absence of the species will require future sampling to verify whether the species is still at the site.	Low

6. CHANGES IN ECOLOGICAL CHARACTER SINCE LISTING

There have been no substantial changes to the site since listing, apart from low water levels during the last decade of drought. Recent rains (commencing September 2009), however, have given the site a much needed reinjection of water, organic matter and significant biological activity, indicating the site is still meeting its ecological character at the time of listing.

7. KNOWLEDGE GAPS

Highest priority for filling of knowledge gaps is given to the components most critical to the site's listing and ecological character and to components and processes that pose greatest risk to this ecological character. These are presented in Table 11 along with lower priority knowledge gaps. Despite the almost complete lack of quantitative data for the site, the high priority knowledge gaps are relatively few.

Baseline data should be gathered using standard methods that allow a derivation of a 'point in time' baseline that can be compared to future monitoring programs. Therefore, an initial sampling strategy should be designed in a way that is cognisant of repeatability (see section 8, below). This is particularly the case for the biota (e.g. vegetation, amphibians and fish) and water quality. The data should also be gathered using methods that allow comparison with other Tasmanian data sets to allow assessment of rare/threatened status.

Table 11: Key Knowledge gaps for the site

Component / service	Identified Knowledge Gaps	Recommended Data collection or other action to address the gap.	Priority
Vegetation and habitat	Baseline quantitative vegetation data of the lake and the rest of site	Quantitative baseline vegetation survey using standard DPIPWE methods Verification of baseline map produced for this ECD	High
	Extent of listed vegetation species	As part of baseline vegetation survey described above, quantify cover and/or frequency of listed species	
	Macrophyte diversity	As part of baseline vegetation survey described above, list wetland dependent species	
	Natural variation in flora (cover abundance), seasonally and inter-annually	Follow-up vegetation community surveys at intervals required to identify natural variation in response to events such as droughts and floods	Medium
Fish and frogs	Green and gold frog	Quantitative survey of species numbers Strategic surveys to determine natural variation in response to events such as droughts and floods	High
	Dwarf galaxias	Intensive survey for presence of species at site If species is found to still be at site, strategic surveys to determine natural variation in response to events such as droughts and floods	
Water Quality	Water quality data for the site, including quality of	Baseline monitoring of water quality, including seasonal and interannual	High

Component / service	**Identified Knowledge Gaps**	**Recommended Data collection or other action to address the gap.**	**Priority**
	inflowing surface and groundwater	variation. This should incorporate assessment of trends potential changes to water quality that may promote the growth of algae and weeds.	
Weeds	Introduced flora species onsite – extent and problems of cumbungi	Surveying of weed communities, particularly cumbungi, in conjunction with assessing ecological impacts.	High
	Introduced flora species onsite – extent and problems of marram grass	Surveying of marram grass establishment, in conjunction with assessing geomorphic impacts.	Medium
Hydrology	Structural water management	Stability of the dam wall and the extent to which it affects depth, duration of inundation and area of lake must be determined	High
	Contribution of Tobacco Creek (versus groundwater)	Determine the sources and volumes of inflow to Little Waterhouse Lake	Medium
	Changes to the catchment affecting regime of surface water and groundwater inflowing to the site	Collect data on dams and water abstraction in the catchment	Medium
Fauna	Comprehensive fish data is unavailable	Surveying of fish community	Low
	Introduced fish populations within the Ramsar site	Surveying of introduced fish species, documenting their potential impacts on native species.	Medium
	No bird, mammal, reptile or amphibian data is available specifically for the Ramsar Site	Surveying of avifauna, mammals, reptiles and amphibians found on-site.	Low
Lead shot in lake	Presence and/or impact of remnant lead shot in lake, from historical duck shooting on site	Sediment sampling to identify potential issues	Low

8. KEY SITE MONITORING NEEDS

The monitoring needs of the site focus upon:

- Identified knowledge gaps;
- Limits of Acceptable Change for the maintenance of the site's ecological character; and
- The major threats to the site.

The major threats have been discussed in Section 3.6 and the limits of acceptable change in Section 3.7. These are presented in with associated monitoring needs and prioritisations (Table 12). Priorities for monitoring were established by considering the highest value components which face the highest threat.

Table 12: Key monitoring needs for the site.

Component, process, or threat	Key Indicator(s)	Monitoring needs (type & frequency)	Priority
Vegetation and habitat	Vegetation extent and condition (health) Structural and floristic diversity and flux	Vegetation surveying (species abundance/ mapping and condition; including rare / threatened species). 2-5 yearly, relating results to hydrological data.	High
Hydrology- structural water management	Stability of dam wall Extent to which dam wall affects depth, duration of inundation and area of lake	Undertake dam safety inspection Monitoring flow events and GIS modelling	High
Water quality	Salinity, nutrients, biocides, water clarity, dissolved oxygen, chlorophyll-ɑ	Water quality monitoring (both physical and chemical properties) at the site as well Tobacco Creek inflows, (preferably monthly, otherwise seasonally).	Baseline – High; Ongoing - Moderate
Dwarf galaxias (if still present)	Population numbers, particularly at times of flooding; recruitment rates	Survey to determine presence/absence. If present, survey abundance to gain information on population and age structure across the site.	High
Hydrology- groundwater and surface flows	Contribution of Tobacco Creek Quantified relationships between ground water and flows in catchment	Monitor inflow volumes to Little Waterhouse Lake Modelling of dams and water extraction in the catchment to determine the impact on groundwater and surface flows in the region	Moderate to High

Component, process, or threat	Key Indicator(s)	Monitoring needs (type & frequency)	Priority
Introduced flora species	Species abundance Impacts of introduced species on the ecosystem	Weed surveying (species abundance), including aquatic weeds; 2-5 yearly. Identification of the ecosystem impacts of cumbungi and geomorphic impacts of marram grass	Moderate to High
Water quality	Salinity, nutrients, biocides, water clarity, dissolved oxygen, chlorophyll-ɑ	Water quality monitoring (both physical and chemical properties) at the site as well Tobacco Creek inflows, (preferably monthly, otherwise seasonally).	Baseline – High; Ongoing - Moderate
Native fauna of the site	Numbers, trends	Population surveys of mammal, bird, fish, reptile, amphibian and aquatic invertebrate species onsite. 3-5 yearly	Moderate
Introduced fish species	Numbers, trends	Abundance of introduced fish species survey, 2-3 yearly.	Moderate
Habitat use by fauna species	Diversity and abundance of species using habitat types	Surveying of habitat use by fauna species	Low

9. COMMUNICATION, EDUCATION AND PUBLIC AWARENESS (CEPA) MESSAGES

The aim of CEPA messages is to highlight any important messages which may need to be addressed in a management or Wetland Communication, Education and Public Awareness (CEPA) action plan. This includes the identification of important communication, education and public awareness messages that may have been identified during the preparation of the description (DEWHA 2008).

9.1 Current CEPA activities

Currently, the only CEPA activity occurring in Little Waterhouse Lake Ramsar Site is the display of a DEWHA sign stating the site is of international significance, providing information on aspects of the site's ecological character. There is also a sign at the entrance of the Waterhouse Conservation Area, providing details on the conservation zone and conditions of visitor use. Outside the site, there are information booklets on Ramsar sites of Tasmania (e.g. Tasmanian Environment Centre, undated).

9.2 Proposed CEPA messages

The primary message that needs to be communicated to relevant stakeholders is:

"An ECD which reflects the ecological character of the Little Waterhouse Lake Ramsar Site at the time of listing in 1982 is complete. The site is listed against three Ramsar Criteria:

- *Criterion one (representative/rare/unique wetland type in appropriate biogeographic region);*
- *Criterion two (vulnerable/endangered/critically endangered species or ecological communities);*
- *Criterion three (supports populations of plant and/or animals important for regional biodiversity).*

This site is a coastal freshwater lagoon which provides habitat for important nationally and state listed threatened species. The ECD documents past and current conditions, determines approaches to assess changes in condition and identifies potential threats to the wetland's character. The ECD also identifies appropriate management considerations for future management planning and critical information gaps for management. Without active management intervention the ecological character of the site is under threat."

The stakeholders of Little Waterhouse Lake Ramsar Site are numerous and the messages required for each may be different, especially as part of management planning. We have separated the stakeholders for the site into four groups, according to their role and interest in the site (Table 13). Initially, however, a combined set of messages relevant to the ECD can be used to communicate the importance of the site, why it was listed, the threats to the site and future actions required. The combined key communication and public education messages for the Little Waterhouse Lake Ramsar Site are displayed in Table 14.

Table 13: Stakeholder groups for the site

Stakeholder Group	Stakeholders
Managers	NRM North DPIPWE Dorset Municipal Council Department of Environment, Water, Heritage and the Arts (Commonwealth)
Regulators	Department of Primary Industries, Parks Water and Environment Department of Environment, Water, Heritage and the Arts (for the EPBC Act)
Advisors and Funders	Australian Government –Department of the Environment, Water, Heritage and the Arts Consultants and Contractors Universities and Researchers: • University of Tasmania • Queen Victoria Museum and Art Gallery
Broader Community	Landholders Birds Australia (Tasmania) General Public

Table 14: Key communications and public education messages for the site.

Message No.	Simple Message	Detailed Message
1	Little Waterhouse Lake is an internationally important wetland.	The Little Waterhouse Lake Ramsar Site is an internationally important wetland and is now listed under criteria one to three: One. The site is a quality example of a dune-barred lake in north-east Tasmania. Its high floristic diversity, high biological productivity and near-natural condition contribute to it being considered a representative example of this type of permanent freshwater lake within the drainage division. Two. The site supports the nationally and state listed green and gold frog (*Litoria raniformis*) Vulnerable (EPBC and TSPA) and the dwarf galaxias (*Galaxiella pusilla*, Vulnerable, EPBC Act *1999*). Little Waterhouse Lake has also been noted to support a significant population of the freshwater planktonic dinoflagellate, *Prorocentrum foveolata*, a recently described species classified in a taxonomic group that was previously considered entirely marine (Croome and Tyler 1987). Three. As previously mentioned, Little Waterhouse Lake is one of two lakes in the region that support *P. foveolata*. The site has been observed to support a local pair of white-bellied sea eagles *(Haliaeetus leucogaster*, vulnerable, TSPA) and also contains two plant species listed as rare under Tasmania's TSPA 1995; river clubsedge (*Schoenoplectus tabernaemontani*) and sea clubsedge (*Bolboschoenus caldwellii*).
2	The site is a zone of high biodiversity.	The site is floristically diverse containing over 30 species of aquatic and semi-aquatic plants, having high biological productivity, as well as habitat diversity.
3	The site contains national and state threatened species.	The site supports the green and gold frog (*Litoria raniformis*) and the dwarf galaxias (*Galaxiella pusilla*), which are nationally and state listed as Vulnerable (EPBC and TSPA). Little Waterhouse Lake supports a local pair of white-bellied sea eagles *(Haliaeetus leucogaster*, vulnerable, TSPA) and two plant species listed as rare under Tasmania's TSPA 1995;river clubsedge (*Schoenoplectus tabernaemontani*) and sea clubsedge (*Bolboschoenus caldwellii*).

Message No.	Simple Message	Detailed Message
4	The site provides many important services and benefits to the region.	The site provides many important services and benefits to the region including: • A wetland of international importance • Supports two plant species which are of State conservation significance (and in bioregion) • Supports flora and fauna populations important for regional biodiversity Benefits to humans derived from the site include: • Macrophyte Diversity; • Fish Habitat; • Tourism/recreation; • Cultural heritage (indigenous and European); and, • Potential for educational and scientific values including studies on wetland ecology.
5	Understanding the ecology of the site will enhance future management of the site.	Understanding the ecology of the site will enhance future management of the site. The ECD provides a complete description of the wetland's character at the time of listing, changes since listing, threats likely to cause changes in the wetland's ecological character (including the ecological benefits the site provides), key knowledge gaps of the site's ecology and functioning, monitoring requirements and triggers for management actions.

Message No.	**Simple Message**	**Detailed Message**
6	Past and present management practices provide some threats to the site's values such as human use, alterations to the hydrologic regime, grazing, vegetation clearance and introduction of pest plants and animals.	Past and present management practices within and beyond the site provide some threats to the site's values. The major threats to the site include: • Alien fish stocking; in particular, the stocking of trout may result in (or already resulted in) the loss of a threatened Australian native fish; • Structural water management; • Catchment dams and abstraction; • Vegetation clearance; • Vehicle and recreational access; and, • Weeds.
7	The ECD project has summarized the available information on the site which describes its ecological character.	The ECD project has: • collated all the available information on the site; • provided a description of the site, its biodiversity and functions; • brought stakeholders together in the management of the site; and, • noted that despite its regional and international significance, the site has gaps in the information required for its management and protection indicating more research and monitoring is required.
8	Landholders, managers and users should promote the wise use of wetlands.	Landholders, managers and users should promote the wise use of wetlands: • The wise use of wetlands is a key concept of the Ramsar Convention on Wetlands. It is defined as the 'sustainable utilisation for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem'.

10. GLOSSARY

Definitions of words associated with ecological character descriptions. These are taken from DEWHA (2008) unless otherwise indicated.

Adverse conditions	Ecological conditions unusually hostile to the survival of plant or animal species, such as occur during severe weather like prolonged drought, flooding, cold, etc.
Assessment	The identification of the status of, and threats to, wetlands as a basis for the collection of more specific information through monitoring activities
Baseline	Condition at a starting point. For Ramsar wetlands it will usually be the time of listing of a Ramsar site
Benchmark	A standard or point of reference
	A pre-determined state (based on the values which are sought to be protected) to be achieved or maintained
Benefits	Benefits/services are defined as "the benefits that people receive from ecosystems. See also "Ecosystem Services".
Biogeographic region (also 'bioregion')	A scientifically rigorous determination of regions as established using biological and physical parameters such as climate, soil type, vegetation cover, etc.
Biological diversity	The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species (genetic diversity), between species (species diversity), of ecosystems (ecosystem diversity), and of ecological processes.
Catchment	The total area draining into a river, reservoir, or other body of water.
Change in ecological character	Is defined as the human-induced adverse alteration of any ecosystem component, process, and/or ecosystem benefit/service.
Community	An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another.
Community Composition	All the types of taxa present in a community.
Conceptual model	Wetland conceptual models express ideas about components and processes deemed important for wetland ecosystems.
Contracting Parties	Countries that are Member States to the Ramsar Convention on Wetlands. Membership in the Convention is open to all states that are members of the United Nations, one of the UN specialized agencies, or the International Atomic Energy Agency, or is a Party to the Statute of the International Court of Justice.
Critical stage	Stage of the life cycle of wetland-dependent species. Critical stages being those activities (breeding, migration stopovers, moulting etc.) which if interrupted or prevented from occurring may threaten long-term conservation of the species.

Ecological character	The combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time. Within this context, ecosystem benefits are defined in accordance with the variety of benefits to people (Ecosystem Services). The phrase "at a given point in time" refers to Resolution VI.1 paragraph 2.1, which states that "It is essential that the ecological character of a site be described by the Contracting Party concerned **at the time of designation for the Ramsar List**, by completion of the Information Sheet on Ramsar Wetlands
Ecological communities	Any naturally occurring group of species inhabiting a common environment, interacting with each other especially through food relationships and relatively independent of other groups. Ecological communities may be of varying sizes, and larger ones may contain smaller ones
Ecosystems	Complex of living communities (including human communities) and non-living environment (Ecosystem Components) interacting (through Ecological Processes) as a functional unit which provides inter alia a variety of benefits to people (Ecosystem Services).
Ecosystem components	The physical, chemical and biological parts of a wetland (from large scale to very small scale, e.g. habitat, species and genes)
Ecosystem processes	The dynamic forces within an ecosystem. They include all those processes that occur between organisms and within and between populations and communities, including interactions with the non-living environment that result in existing ecosystems and bring about changes in ecosystems over time. They may be physical, chemical or biological.
Ecosystem services	The benefits that people receive or obtain from an ecosystem. The components of ecosystem services are provisioning (e.g. food & water), regulating (e.g. flood control), cultural (e.g. spiritual, recreational), and supporting (e.g nutrient cycling, ecological value). See also "Benefits".
Geomorphology	The study of landforms.
Indicator species	Species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem; taxa that are sensitive to environmental conditions and which can therefore be used to assess environmental quality.
Indigenous species	A species that originates and occurs naturally in a particular country.
Introduced (non-native) species	A species that does not originate or occur naturally in a particular country .
Limits of Acceptable Change	The variation that is considered acceptable in a particular component or process of the ecological character of the wetland without indicating change in ecological character which may lead to a reduction or loss of the criteria for which the site was Ramsar listed'.
List of Wetlands of International Importance ("the Ramsar List")	The list of wetlands which have been designated by the Ramsar Contracting Party in which they reside as internationally important, according to one or more of the criteria that have been adopted by the Conference of the Parties [http://www.ramsar.org/about/about_glossary.htm].
Monitoring	the collection of specific information for management purposes in response to hypotheses derived from assessment activities, and the use of these monitoring results for implementing
Ramsar	City in Iran, on the shores of the Caspian Sea, where the Convention on Wetlands was signed on 2 February 1971; thus the Convention's short title, "Ramsar Convention on Wetlands" [http://www.ramsar.org/about/about_glossary.htm].
Ramsar Criteria	Criteria for Identifying Wetlands of International Importance, used by Contracting Parties and advisory bodies to identify wetlands as qualifying for the Ramsar List on the basis of representativeness or uniqueness or of biodiversity values. http://www.ramsar.org/about/about_glossary.htm

Ramsar Convention	*Convention on Wetlands of International Importance especially as Waterfowl Habitat*. Ramsar (Iran), 2 February 1971. UN Treaty Series No. 14583. As amended by the Paris Protocol, 3 December 1982, and Regina Amendments, 28 May 1987. The abbreviated names "Convention on Wetlands (Ramsar, Iran, 1971)" or "Ramsar Convention" are more commonly used [http://www.ramsar.org/index_very_key_docs.htm].
Ramsar Information Sheet (RIS)	The form upon which Contracting Parties record relevant data on proposed Wetlands of International Importance for inclusion in the Ramsar Database; covers identifying details like geographical coordinates and surface area, criteria for inclusion in the Ramsar List and wetland types present, hydrological, ecological, and socioeconomic issues among others, ownership and jurisdictions, and conservation measures taken and needed (http://www.ramsar.org/about/about_glossary.htm).
Ramsar List	The List of Wetlands of International Importance [http://www.ramsar.org/about/about_glossary.htm].
Ramsar Sites	Wetlands designated by the Contracting Parties for inclusion in the List of Wetlands of International Importance because they meet one or more of the Ramsar Criteria [http://www.ramsar.org/about/about_glossary.htm].
Ramsar Sites Database	Repository of ecological, biological, socio-economic, and political data and maps with boundaries on all Ramsar sites, maintained by Wetlands International in Wageningen, the Netherlands, under contract to the Convention [http://www.ramsar.org/about/about_glossary.htm].
Taxa, Taxon	A general name for a taxonomic group whatever level e.g. species or genus of any biota.
Wetlands	Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.
Wetland Assessment	The identification of the status of, and threats to, wetlands as a basis for the collection of more specific information through monitoring activities.
Wetland Ecological Risk Assessment	A quantitative or qualitative evaluation of the actual or potential adverse effects of stressors on a wetland ecosystem.
Wetland types	As defined by the Ramsar Convention's wetland classification system [http://www.ramsar.org/ris/key_ris.htm#type].
Wise use of wetlands	The maintenance of their ecological character, achieved through the implementation of ecosystem approaches[1], within the context of sustainable development[2]". 1. Including *inter alia* the Convention on Biological Diversity's "Ecosystem Approach" (CBD COP5 Decision V/6) and that applied by HELCOM and OSPAR (Declaration of the First Joint Ministerial Meeting of the Helsinki and OSPAR Commissions, Bremen, 25-26 June 2003). 2. The phrase "in the context of sustainable development" is intended to recognize that whilst some wetland development is inevitable and that many developments have important benefits to society, developments can be facilitated in sustainable ways by approaches elaborated under the Convention, and it is not appropriate to imply that 'development' is an objective for every wetland.

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12. APPENDICES

12.1 Appendix 1: The Consultants

Lance Lloyd, Principal Ecologist, Lloyd Environmental Pty Ltd

Principal Ecologist, Lance Lloyd, BSc, MSc, MAIBiol., provides high level strategic advice and services to industry and Government across Australia. He has 29 years experience in environmental consulting, research and management. His key expertise developed over this time is in relating the ecology of aquatic systems to the needs of management issues. The majority of his work during his professional life, since 1979, has been in the ecology of aquatic and floodplain ecosystems and water regimes in flowing & lentic waters and their management. His M.Sc. studies, some of his major research projects, and several published papers, focused upon the central role of environmental water management to the ecology and biological requirements of fish, invertebrates and plants. Lance also undertook some ground breaking research on fish and invertebrates as a Research Officer at the University of Adelaide, working on the River Murray.

Lance has extensive experience in studying and understanding the ecology of wetlands (including Ramsar and sites of national significance). During his M.Sc., Lance sampled the Lower Lakes Ramsar Site on a regular basis for fish and invertebrate species and also contributed to University studies and teaching programs on the Coorong. He undertook water management and ecology studies along the mid-Murray wetlands at sites such as Barmah, Gunbower, and Hattah (see below) as well as developing a Strategic Management Plan for the Kerang Lakes Ramsar Site for Parks Victoria. Lance also led a project to develop a wetlands inventory on Commonwealth Lands as a contribution to the "Directory of Important Wetlands in Australia (3rd Edition)". In 2003, Lance led an expert team to review the Environmental Water Requirements for Internationally significant Wetlands Framework where he undertook detailed studies on the Wyndgate Wetlands which are part of Coorong and Lakes Alexandrina and Albert Ramsar Site.

He has contributed significantly to the MDBC Floodplain Wetlands Management Strategy. He was the lead author of the paper entitled "Natural Processes in Floodplain Ecosystems" which synthesised the current knowledge of floodplain wetland ecosystems and was produced as part of the MDBC Floodplain Wetlands Management Strategy. Lance has also assisted the MDBC's Sustainable Rivers Audit team and the Independent SRA Group to develop indicators of floodplain ecosystem health.

In 2004, Lance was a key team member in the "Framework to Assess the Condition of Wetlands of the South Australian River Murray" project. This project identified wetland types, developed conceptual models for each wetland type and used these models to identify measures of floodplain health. Lance has had extensive experience in developing conceptual models of various ecosystems and in developing monitoring and assessment programs.

Further, he became a board member of the Fisheries Co-management Council (FCC) of Victoria (an advisory group to the Victorian Minister of Agriculture) in 2002. He also served on the board of the Victorian Fisheries Research Advisory Board for the Fisheries R&D Corporation. He has been the Translocation Evaluation Panel Chair for the Dept of Primary Industry in Victoria since 2005. Lance was appointed to these Ministerial or high-level positions based upon his expertise in fisheries and fish ecology.

He led the teams which developed the Riverland Ramsar Site and Floodplain Lower Ringarooma Ramsar Site Ecological Character Descriptions. He led the fish and invertebrate ecology team which, in part, developed the Gippsland Lakes and Corner Inlet Ecological Character Description Projects. He is currently completing ECDs for Lavinia, Little Waterhouse Lake, Jocks Lagoon and Bool and Hacks Lagoons Ramsar Sites.

Peter Newall, Independent Consulting Aquatic Ecologist

Peter Newall specialises in aquatic ecology and catchment management. He has a detailed understanding of Government requirements, roles and responsibilities in the water sector and has been involved in drafting policies on the management of aquatic ecosystems and catchments at the regional, State and National level. Peter has 20 years experience as a consultant, ecologist, policy developer and research scientist within the water industry. He holds a BSc Honours degree in Botany/Physical Geography (wetland ecology), a MEnvSci degree in stream ecology and a PhD in aquatic ecoregions and fish distributions.

Peter's training in Physical Geography has provided him with the skills to assimilate and synthesise data and information from a broad range of environmental disciplines, including biology, soil science, soil geomorphology, fluvial geomorphology, climatology and hydrology.

As an aquatic ecologist his work has included: examining the ecological condition of a broad range of streams; developing systems for the use of biological indicators in ecosystem assessment and management; and developing river management policy for the management and protection of rivers. Peter has been involved in developing guidelines and objectives for stream ecosystem health, deriving biological regions for the assessment of stream condition across Victoria, developing the EPA protocol for the monitoring of licensed discharges to streams across Victoria and furthering the development of biological indicators of stream condition. His work in these areas has been incorporated into the Victorian State Environment Protection Policy (Waters of Victoria) and it's supporting documents.

Peter was a member of the CRC for Freshwater Ecology for five years, and has also worked in Environmental Auditing with EPA and URS, focusing on waterway and catchment auditing. During his time at URS, Peter instigated water quality monitoring programs for wetlands and streams for a range of clients, incorporating a risk-based approach to program design and implementation. Since working as an independent consulting aquatic ecologist Peter has worked on a number of ecological assessments, including several Ecological Character Descriptions of Ramsar wetland sites and also several Ecological Risk Assessments of aquatic ecosystems.

Elisha Atchison, Ecologist, Lloyd Environmental Pty Ltd

Elisha recently completed a Bachelor of Environmental Science (Environmental Management) with Distinction at Deakin University. Whilst at university, Elisha undertook a broad range of subjects that provided her with background in various areas of environmental management such as policy instruments, catchment and coastal management, managing environmental projects, vegetation management and GIS. She developed an interest in water and vegetation management and chose to specialise in these areas in her final years of study. Elisha worked for Maroondah City Council as a Student Environmental Planner, which evolved her passion for environmental education. Elisha has since been working with Lloyd Environmental in a number of projects including Ecological Character Descriptions, SA Murray Weir Operating Strategy and Management Recommendations for Blue Green Algae in the Glen Waverley Golf Course Lake.

12.2 Appendix 2: Methodology to Develop the ECD

This ecological character description was prepared following the general approach presented in National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands (DEWHA 2008). This approach is presented in Figure A1.

Figure A1: Summary of steps for the production of an ECD (Source: DEWHA 2008)

Completion of the ECD comprised eight major steps:

1. Project Inception and site visit
2. Literature and Information Review
3. Content of the ECD
4. Preparation of 1st Draft ECD for review by DEWHA
5. Preparation of revised RIS, using the ECD
6. Revision of 1st Draft ECD (with DEWHA comments)
7. Distribution of 2nd Draft ECD to stakeholders, seeking comments/feedback
8. Finalisation of ECD, incorporating stakeholder comments

Client-consultant partnership was an important component of the process to ensure alignment of goals and common understanding of approaches. This included client-consultant meetings to ensure a high level of communication. The team also conducted interviews and informal discussions with relevant stakeholders and resource managers, to further develop our understanding of the site. The structured workshop (Task 7) assisted with crystallising our understanding of the site and developing the conceptual model for the wetland.

The steps outlined above are described in the following sections;

Step 1: Project Inception and Site Inspection

The project commenced with an inception meeting with the Client Project Manager and the Consultants' project manager. This meeting was to:

- **Confirm** project objectives, and outputs sought;
- **Discuss and finalise** timeframes and key dates for delivery of project outputs**;** and,
- **Confirm** existing information sources and **obtain** relevant reports, information, and data from the client.

This component was vital for ensuring alignment of objectives and discussion of approaches. The inception meeting was also used as a springboard for making contacts, obtaining details of key stakeholders and pursuing reference documents.

Site Inspection: Following the inception meeting a site inspection was undertaken to view the key areas and habitats of the Little Waterhouse Lake Ramsar Site. The site inspection was led by the client Project Manager and included members of the Steering Committee.

Step 2: Literature and Information Review

The literature review initially focussed on the condition of the Ramsar site at the time of Ramsar listing. Information on changes to condition since listing was subsequently reviewed and documented. Information reviewed included documents prepared prior to and during the listing process, as well as through perusal of subsequent reports and studies on the condition of the wetland.

Collate/summarise information from inception meeting and Stakeholders: At the inception meeting relevant available documents held by the client were requested, as well as contact details of stakeholders and their relevant roles in relation to the Ramsar site. Subsequent to the inception meeting contact was made with relevant stakeholders as part of document searching/gathering. The collated and summarised information contributed to an assessment of information gaps and needs.

Information and data search and review: Using the approaches and structures identified at the inception meeting and the collated information, information needs were prioritised and the most likely sources (people and documents) were identified. The data search and summary was a key component of the project and was allocated a substantial amount of time. An "information log" was developed to document the reports and information resources available to the project. The "information log" was used during the course of the project to inform stakeholders which documents the project team possessed and which ones were missing for the project.

Literature Summary: The information and data obtained was summarised to facilitate review of knowledge status and gaps and used as an important basis for the production of the ECD. The literature summary was structured to enable ready assessment against ECD requirements.

Discussions with NRM North and Government Agencies: Discussion with the client and key Government stakeholders was a regular and vital part of the project, both in the collection of information and also in the compilation of the literature summary. Regular feedback maximised the opportunity to uncover all relevant information.

Step 3: Content of the ECD

A scientific panel was convened and focussed on identifying:

- key ecological components and processes in the site;
- the benefits and services that characterise the site;
- key actual or potential threats to the site;
- knowledge gaps;
- monitoring needs; and,
- an appropriate preliminary conceptual model of the system.

The Panel workshop consisted of the project team, NRM North, DPIPWE, DEWHA and stakeholders.

Step 4: Preparation of a Draft ECD for review by DEWHA

A Draft of the ECD was prepared from the information gathered through the literature review, Scientific Panel and through liaison with the client. The draft was provided to the client manager, for distribution to relevant staff within DEWHA.

The Draft ECD generally followed the draft national framework, which includes:

- Executive Summary
- Acknowledgements
- Table of Contents
- List of Abbreviations
- **Introduction**, including site details, purpose of the ECD, legislative context
- **Detailed Description of the site**, including overview of the site; ECD context; Ramsar/DIWA criteria; geographic and ecosystem description
- **Description of Ecological Character of the Site**, focusing on components, processes & benefits/services; conceptual model of site & system, quantified limits of change. Consideration will need to include biological, physical and chemical aspects of wetland condition and processes

- **Key Actual or Potential Threats or Risks to the Site**, to aid identification of potential changes and their importance
- **Knowledge Gaps** (and suggested approaches for addressing them)
- **Changes in Ecological Character** (if appropriate), including whether changes have occurred since listing
- **Key Site Monitoring Needs**, identified from conceptual model, and covering knowledge gaps, assessing trends/changes and relevant triggers, monitoring management outcomes
- **Triggers for Management Action**, to be quantitative and place high importance on identified risks/threats
- **Communication, Education and Public Awareness (CEPA) Messages**, summarising key ecological messages that will facilitate management planning and action
- Glossary
- References
- Appendices

The 'Executive Summary' to 'List of Abbreviations' and 'Glossary' to 'Appendices' were not completed at this draft stage.

Describing the Components, Processes and Benefits/Services: The development of ecological character required a description of the ecosystem components, processes and benefits/services that characterise the Ramsar site. An important requirement within this task was the need to document the condition of the site at the time of its designation for the Ramsar list as well as current condition. This included assessments of trends in the condition of relevant components, processes and services and past and current changes in its character.

Development of Conceptual Models: Conceptual models were developed to represent the ecological processes and components of the Ramsar site in a simplified way, to assist in describing the ecological character of the site.

Prepare Draft ECD: The ecological character was described in accordance with the Draft National Framework. This required a description of the ecosystem components, processes and benefits/services that characterise the wetland as well as the conceptual model of the ecological functioning of the wetland system (described above).

Beyond the description of the wetland site, knowledge gaps were identified and recommendations made accordingly, including the development of monitoring recommendations. As well as filling of knowledge gaps, monitoring recommendations considered information required for assessment of trends, triggers for management action (including assessments of threats/risks), and feedback on management actions.

Step 5: Preparation of revised RIS, using the ECD

The preparation of the revised RIS used the existing RIS as a basis and incorporated changes to the site boundaries as well as any relevant changes to the ecology of the site since the preparation of the previous RIS. Much of the work undertaken as part of the Literature Review and also stakeholder discussion and team-member knowledge of the site fed into this task.

Step 6: Revision of 1st Draft ECD

The project team collated the comments provided by NRM North and its stakeholders (Steering Committee) and incorporated those comments into a revision of the draft ECD, producing a 2nd Draft ECD for DEWHA review. The 2nd draft ECD was also circulated to the Steering Committee for further comments.

Step 7: Revision of 2nd Draft ECD

The 2nd Draft was circulated to independent reviewers, DEWHA and the Steering Committee and detailed comments received.

Step 8: Finalisation of ECD.

The ECD was finalised, incorporating the stakeholder comments following feedback.

12.3 Appendix 3: Vegetation species present at Little Waterhouse Lake Ramsar Site (NVA 2011)

Note: this species list is presented as extrated from the database noting that old or alternative species names are used for some organisms, as this accurately represents the records.

Species Name	Preferred Common Names
Agrostis avenacea	blown grass
Atriplex hastata	
Atriplex prostrata	creeping orache
Baumea arthrophylla	fine twigsedge
Bolboschoenus caldwellii	sea clubsedge
Bolboschoenus sp.	
Calamanthus fuliginosus	striated fieldwren
Calamanthus fuliginosus subsp. diemenensis	striated fieldwren or striated calamanthus
Cardamine gunnii	tuberous bittercress
Cardamine heterophylla	
Carex fascicularis	tassel sedge
Carex pseudocyperus	
Cassytha glabella	slender dodderlaurel
Centella cordifolia	swampwort
Danthonia sp.	
Deyeuxia forsteri	
Eleocharis acuta	common spikesedge
Epilobium sp.	willowherb
Ficinia nodosa	knobby clubsedge
Holcus lanatus	yorkshire fog
Hydrocotyle muscosa	mossy pennywort
Hydrocotyle pterocarpa	winged pennywort
Isolepis cernua	nodding clubsedge
Isolepis nodosa	knobby clubsedge
Juncus articulatus	jointed rush
Juncus caespiticius	grassy rush
Juncus kraussii	sea rush
Juncus kraussii subsp. australiensis	sea rush
Juncus maritimus	
Lachnagrostis filiformis	common blowngrass
Lepilaena cylindrocarpa	longfruit watermat
Lilaeopsis brownii	

Species Name	Preferred Common Names
Lilaeopsis polyantha	jointed swampstalks
Lobelia alata	angled lobelia
Lobelia anceps	angled lobelia
Lobelia irrigua	salt pratia
Mimulus repens	creeping monkeyflower
Myriophyllum elatinoides	
Myriophyllum propinquum	
Myriophyllum salsugineum	lake watermilfoil
Myriophyllum simulans	amphibious watermilfoil
Myriophyllum variifolium	variable watermilfoil
Ornduffia reniformis	running marshflower
Potamogeton australiensis	thin pondweed
Potamogeton ochreatus	blunt pondweed
Potamogeton praelongus	
Potentilla anglica	trailing cinquefoil
Prasophyllum secutum	northern leek-orchid
Pratia irrigua	salt pratia
Ranunculus amphitrichus	river buttercup
Ruppia maritima	
Ruppia polycarpa	manyfruit seatassel
Salix sp.	willow
Schoenoplectus pungens	sharp clubsedge
Schoenoplectus tabernaemontani	river clubsedge
Schoenoplectus validus	river clubsedge
Schoenus nitens	shiny bogsedge
Scirpus americanus	
Scirpus caldwellii	
Scirpus cernuus	
Scirpus lacustris	
Scirpus maritimus	
Scirpus nodosus	
Scirpus pungens	
Scirpus riparius	
Scirpus validus	
Selliera radicans	shiny swampmat
Sericornis fuliginosus	striated calamanthus

Species Name	**Preferred Common Names**
Triglochin procera	
Triglochin procerum	greater waterribbons
Triglochin striata	
Triglochin striatum	streaked arrowgrass
Typha latifolia	great reedmace
Villarsia reniformis	running marshflower
Wolffia arrhiza	
Wolffia australiana	tiny duckweed

12.4 Appendix 4: Fauna species present at Little Waterhouse Lake Ramsar Site (NVA 2011)

Note: this species list is presented as extrated from the database noting that old or alternative species names are used for some organisms, as this accurately represents the records. Further, the record of dwarf galaxias in the Natural Value Atlas at this site has been questioned by fish biologists in Tasmania, however the initial investigations appear to verify it as accurate.

Species Name	Preferred Common Names
Acanthiza pusilla	brown thornbill
Acanthiza pusilla subsp. archibaldi	brown thornbill (king island) ?????
Acanthiza pusilla subsp. diemenensis	brown thornbill
Anguilla australis	southern short-finned eel
Ardea alba	great egret
Ardea modesta	eastern great egret
Artamus cyanopterus	dusky woodswallow
Artamus cyanopterus subsp. cyanopterus	dusky woodswallow
Calamanthus fuliginosus	striated fieldwren
Calamanthus fuliginosus subsp. diemenensis	striated fieldwren or striated calamanthus
Chalcites lucidus	shining bronze-cuckoo
Chroicocephalus novaehollandiae	silver gull
Chrysococcyx lucidus subsp. plagosus	shining bronze-cuckoo
Circus aeruginosus subsp. gouldi	swamp harrier
Circus approximans	swamp harrier
Circus approximans subsp. gouldi	swamp harrier
Colluricincla harmonica	grey shrike-thrush
Colluricincla harmonica subsp. harmonica	grey shrike-thrush
Corvus tasmanicus	forest raven
Corvus tasmanicus subsp. tasmanicus	forest raven
Cracticus torquatus	grey butcherbird
Cracticus torquatus subsp. cinereus	grey butcherbird
Crassula helmsii	swamp stonecrop
Crinia signifera	brown froglet
Egretta alba	great egret
Engaeus cunicularius	crayfish
Galaxias maculatus	jollytail
Galaxiella pusilla	eastern dwarf galaxias
Gallinula mortierii	tasmanian native hen
Hirundo neoxena	welcome swallow

Species Name	Preferred Common Names
Larus novaehollandiae	silver gull
Larus novaehollandiae subsp. novaehollandiae	silver gull
Larus pacificus	pacific gull
Larus pacificus subsp. pacificus	pacific gull
Limnodynastes dumerili	banjo frog
Limnodynastes dumerili subsp. insularis	banjo frog
Litoria ewingi	brown tree frog
Litoria raniformis	green and golden frog
Malurus cyaneus	superb fairy-wren
Malurus cyaneus subsp. cyaneus	blue wren or superb fairy wren
Megalurus gramineus	little grassbird
Megalurus gramineus subsp. gramineus	little grassbird
Mustela furo	ferret
Neoniphargus tasmanicus	amphipod
Phalacrocorax carbo	great cormorant
Phalacrocorax carbo subsp. novaehollandiae	great cormorant
Phalacrocorax melanoleucos	little pied cormorant
Phalacrocorax melanoleucos subsp. melanoleucos	little pied cormorant
Phalacrocorax sulcirostris	little black cormorant
Porphyrio porphyrio	purple swamphen
Porphyrio porphyrio subsp. melanotus	purple swamphen
Ranidella signifera	common eastern froglet or brown frog
Rhipidura albiscapa	grey fantail
Rhipidura albiscapa subsp. albiscapa	grey fantail
Rhipidura fuliginosa subsp. albiscapa	grey fantail
Salmo trutta	brown trout
Sericornis fuliginosus	striated calamanthus
Tachybaptus novaehollandiae	australasian grebe
Tachybaptus novaehollandiae subsp. novaehollandiae	australasian grebe
Tribonyx mortierii	tasmanian native hen
Vanellus miles	masked lapwing
Vanellus miles subsp. novaehollandiae	masked lapwing