Ecological Vegetation Class Assessment

for the Reedy Lake system,

Little Lake Charm and Racecourse Lake

and surrounding areas in the

Kerang Wetlands Ramsar Site

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Ecological Vegetation Class (EVC) assessment for the Kerang Lakes Ramsar Site 2013

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Cover photographs (from top to bottom): Whistling Kite (Haliastur sphenurus) Third Lake; Ranunculus undosus (Swamp Buttercup) Reedy Lake; Female Wolf Spider (Lycosa sp.) Middle Reedy Lake; Drowned River Red Gums Middle Reedy Lake; Stemodia florulenta (Blue Rod) Reedy Lake (Photographs courtesy of Damien Cook Rakali Consulting Pty Ltd)

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The authors wish to extend their thanks to Stuart Simms and Tom Lowe who provided valuable local knowledge of the Kerang Lakes system. Doug Frood of Pathways Bushland and Environment contributed his considerable knowledge of EVCs and past vegetation distribution patterns to this project. Thanks also to Rohan Hogan who managed the project on behalf of the NCCMA and provided comments on draft reports and Pat Feehan of Feehan Consulting for passing on some very relevant scientific papers and also commenting on drafts of the report.
EXEcutive summary

Rakali Ecological Consulting Pty Ltd was engaged by the North Central Catchment Management Authority on behalf of the G-MW Connections Project to assess the ecological values of five wetlands and surrounding lands in the Kerang Lakes Ramsar Site. These wetlands are currently subject to an investigation that is exploring the possibility of their removal from the irrigation conveyance system of the Torrumbarry Irrigation System (TIS). This would restore a more natural hydrological regime and lead to water savings throughout the catchment.

The current assessment included mapping of vegetation communities, Index of Wetland Condition assessments and collection of flora and fauna data. Surrounding lands were also assessed to inform a potential project to create a bypass channel around the lakes.

The diversion of water would require the construction of a pipe or channel system through public and private lands surrounding the lakes. As this scheme could potentially impact on native vegetation, an assessment was undertaken in these areas to investigate the type and condition of habitats. This included a likelihood of occurrence assessment for Matters of National Environmental Significance (MNES) and species and communities listed under the Flora and Fauna Guarantee (FFG) Act.

An assessment of habitat occurring within the proposed bypass area revealed that the vast majority of potential EPBC and FFG listed species are unlikely to rely on these areas. This is due to either a lack of suitable habitat or degradation of the habitat that is present.

The EPBCA listed Chariot Wheels occurs in remnant vegetation south west of Reedy Lake. Winged Peppercress may occur in areas of remnant vegetation west of Reedy Lake or along the railway-line, south east and south west of Racecourse Lake. Disturbance to these areas should therefore be avoided.

The areas west of Reedy Lake and along the railway line support some of the better quality vegetation of the proposed bypass area. The area west of Reedy Lake is also important due to its function as a buffer to the lake. Efforts should be taken to avoid any vegetation clearance of these areas, regardless of whether they support threatened species.

Native vegetation within the study area has been highly modified since European occupation by processes such as land clearing, major changes to hydrological regimes, salinization,
weed invasion, grazing of hard-hoofed stock animals and rabbits and other land management practices.

Despite these modifications, biodiversity within the study area is still relatively high. Much of the vegetation that has developed in response to environmental changes still in many ways resembles natural vegetation associations. This vegetation still supports a number of threatened plant species, and in association with other habitat components including the presence of abundant, relatively good quality water and many dead trees and large logs, provides habitat for a diverse and abundant fauna. This fauna includes the many migratory and rare and threatened birds for which the Kerang Lakes are renowned and are a large part of the reason the area has been listed on the Ramsar convention of internationally significant wetlands.

Future changes to the hydrological regimes of the study area’s wetlands, including instigating new wetting and drying cycles which more closely mimic the pre-European hydrology of the lakes, has the potential to have both positive and negative ecological consequences, depending on how the changes are implemented and how biota and the abiotic environment respond to those changes.

Potential benefits of periodic wetting and drying may include regeneration of and improved diversity in wetland vegetation communities, and a subsequent improvement in habitat quality for many native fauna. For example, Tangled Lignum at Middle Lake has only been reproducing vegetatively since the level of the wetland has been manipulated by its inclusion in the Torrumbarry Irrigation Scheme. At this same wetland dead standing and fallen River Red Gums provide important habitat for nesting and roosting water birds and basking turtles. Standing dead Red Gums will eventually fall over and all timber will eventually rot away, depriving water birds and turtles of important habitat resources.

Under a suitable wetting and drying regime both Tangled Lignum and River Red Gums will regenerate from seed, providing a more sustainable habitat in the long term. Wetting and drying may also assist in the re-establishment of the beds of submerged and floating macrophytes such as Eel Grass (Vallisneria americana), Pondweed (Potamogeton crispus) and Coarse Milfoil (Myriophyllum caput-medusae) that occurred in Middle Lake and the Water Ribbons (Triglochin procer) that occurred in Little Lake Charm up until 1990 (O'Donnell 1990). None of these species were observed during field studies for this investigation despite intensive searching.
The removal of stable, high water levels may also assist in the control of various environmental weeds, including Willows (*Salix* spp.), Water Couch (*Paspalum distichum*) and the potentially catastrophic False Daisy (*Eclipta prostrata*), and introduced fish such as Carp.

Kingsford and Porter (2006) compared the diversity and abundance of waterbirds on wetlands which were kept artificially permanent with those with natural wetting and drying cycles. They found that waterbird density was ten times higher on unregulated wetlands than on wetlands that were artificially permanently flooded. Waterbird diversity on wetting and drying wetlands was almost twice as high as those that were permanently inundated. Species groups that were most noticeably more diverse on wetting and drying wetlands were ducks and small grebes, herbivores and small wading birds. It has been postulated that the diversity of these species groups is most influenced by wetting and drying as they are reliant on diverse assemblages and high biomass of aquatic plants and macro-invertebrates, which are both negatively affected by permanent inundation (Kingsford, Jenkins *et al.* 2004).

The loss of a drying phase in naturally intermittent lakes and wetlands is recognised as a major degrading process (Briggs 1988). Productivity and habitat and species diversity are reduced in naturally intermittent wetlands that are permanently flooded (Gawne and Scholz 2006). Gawne and Scholz (2006) have developed a conceptual model to facilitate management of ephemeral deflation basin lakes, such as the Reedy Lake system. They suggest that although rehabilitation might not require complete drying, restoration of a hydrological cycle that produces changes in trophic structure and the development of vegetation on the lake bed will be important considerations in managing these systems.

Briggs (1988) provides guidelines for the hydrological management of inland wetlands in southern NSW, which are relevant to wetlands in the study area. In summary these guidelines suggest that:

1. Wetlands require periodic drying to maintain their natural productivity
2. As a general rule wetlands should not be flooded continuously for more than 4 years
3. Wetlands should preferably be flooded in late winter or early spring
4. Wetlands should remain inundated continuously for at least 4 to 6 months to ensure appropriate conditions for plant and invertebrate succession, and for successful reproduction of waterbirds

Potential risks of reducing water inputs into the study areas wetland systems include a reduction in vigour or displacement of plant species or communities such as Tall Marsh or
the aquatic form of Tangled Lignum in the Reedy Lake system, which currently provide 
important habitat and nesting substrate for colonial nesting birds, and weed invasion onto 
areas of mud exposed by receding water. While native species may also colonise this habitat 
there is a risk that weed propagules may out-number or outcompete native species and that 
due to the extended period that the wetlands have been kept full that native seed banks 
would be depleted or find the sediments that have accumulated on the wetland floor to be an 
unsuitable substrate for germination and establishment.

If a decision is made to alter the hydrological status quo, fine-scale ecological monitoring will 
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1.0 INTRODUCTION

1.1 Context

Rakali Ecological Consulting Pty Ltd was engaged by the North Central Catchment Management Authority (NCCMA) on behalf of the Goulburn-Murray Water Connections Project to assess the ecological values of five wetlands and surrounding lands in the Kerang Lakes Ramsar Site. These wetlands are currently subject to an investigation that is exploring the possibility of their removal from the irrigation conveyance system of the Torrumbarry Irrigation System (TIS). This would restore a more natural hydrological regime and lead to water savings throughout the catchment. The current assessment included mapping of vegetation communities, Index of Wetland Condition assessments, and collection of flora and fauna data. Surrounding lands were also assessed to inform a potential project to create a bypass channel around the lakes. The field assessments for this study were conducted in February and March 2013.

1.2 Project Objectives

The core objectives of the project are outlined below.

Wetland Vegetation mapping and condition

- Undertake field surveys to delineate vegetation communities (extent and quality), record plant species, record any other significant ecological features.
- Determine likely presence or absence of EPBC Act Matters of National Environmental Significance
- Determine likely presence or absence of FFG Act species and communities
- Re-map the Ecological Vegetation Classes (EVCs) of the five wetlands where EVC mapping was undertaken in 2006 (see Ho et al. 2006) and compare and report on any significant changes
- Conduct condition assessments of wetland EVCs using Index of Wetland Condition assessment method for wetland vegetation and compare to IWC assessments conducted in 2009
- Record and map high threat environmental weeds and pest animals at each site
- Recommend ongoing monitoring to measure change in extent and quality of vegetation

By-Pass vegetation assessment

- Undertake field surveys to delineate vegetation communities (extent and quality), record plant species, record any other significant ecological features
- Map the EVCs within areas identified in the project brief
Discuss the likely presence or absence of EPBC Act Matters of National Environmental Significance and potential impacts of works against EPBC Act criteria. Discuss the likely presence or absence of FFG Act species and communities. Discuss the applicability of relevant Fauna and Flora Guarantee Act threatening processes and amelioration measures.

1.3 Study Area Overview

Wetlands
The study area encompasses five lakes and surrounding lands occurring within the Murray River Catchment in northern Victoria that fall within the Victorian Riverina bioregion (Map 1). The five lakes include:

- The Reedy Lakes system (Reedy Lake, Middle Lake and Third Lake).
- Little Lake Charm and the area known as Scotts Creek (which was formerly floodway which joined Little Lake Charm to the Reedy Lake system, but which is now functionally a backwater of Little Lake Charm)
- Racecourse Lake

These lakes are part of a large system of wetlands originally filled by flooding of the lower Loddon River complex. Distributaries flowing into this wetland system included Wandella and Washpen Creeks. The hydrology of these wetlands and consequently patterns of vegetation communities have been highly modified by their inclusion in the Torrumbarry Irrigation Scheme.

A similar wetland system occurs nearby on the lower Avoca River (Lake Bael Bael and the Koorangie Marshes). Although these wetlands have also been subject to hydrological change their vegetation patterns are more intact and may provide an insight into what the vegetation of the lower Loddon system may once been like prior to gross hydrological modification.

Proposed By-Pass area
The proposed bypass area is comprised of two discrete sections. The first section includes lands to the south and west of the Reedy Lakes. The second section includes a series of predominately private lands to the south-east and west of Racecourse Lake.
Map 1: Location of sites surveyed within the North Central Catchment Management Authority

Survey Effort
- Study Lakes
- Bypass Investigation Area

Transportation
- Highway
- Sealed Arterial Road
- Sealed Road
- Unsealed Road
- 2WD Road
- 4WD Road

Hydrology
- Major River, Creek or Channel
- Perennial Water Body

Legend

Project: Ecological Vegetation Class Assessment for Reedy Lake, Middle Lake, Third Lake, Little Lake Charm and Racecourse Lake and surrounding areas
Client: North Central Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 30th January 2013
Survey Period: February 2013

Aerial Imagery courtesy of the North Central CMA
Major Thomas Mitchell passed through the study area on the 23rd and 24th of June 1836. His journal describes the lakes and wetlands he saw in this area, and their adjacent lunettes. Of the lunettes he mentions “these ridges being always on the eastern shore of hollows or lakes” (Mitchell 1836). The following description from Mitchell’s journal entry on the 23rd of June is probably of the Reedy lake system;

“During the day's journey we passed several ridges connected with extensive basins in a similar manner, and in the bottom of one of these I perceived Polygonum junceum growing amongst yarra trees. On the western shore we saw the remains of large native ash-hills. They were old and overgrown with bushes, but they proved that this lake had once contained mussels and the balyan or bulrush, a root eaten by the natives and cooked in such ovens as these. The other lake was surrounded by a circle of Yarra trees and had but recently become dry, the earth in it being still without vegetation and covered with innumerable native companions and white cockatoos” (Mitchell 1836).

Yarra trees are the name given by Mitchell for River Red Gums (Eucalyptus camaldulensis), while Polygonum junceum is an old name for Tangled Lignum (Duma florulenta). Balyan or Bulrush probably refers to either a species of Typha or Bolboschoenus. Native Companion is a name previously used for the Brogla (Grus rubicunda).

An undated cadastral map for the Parish of Dartagook (Figure 1) shows both Third and Middle Lakes, but not Reedy Lake, supporting dense Tangled Lignum.
Figure 1: Cadastral map for the Parish of Dartagook
2.0 METHODOLOGY

Preliminary to field survey, extant flora and fauna information sources were reviewed, including the following:


DSE (2007b) *Wetlands Extent for Victoria Prior to European Settlement – Deduced* Resource Name: ‘WETLAND_1788’ © The State of Victoria, Department of Sustainability and Environment, East Melbourne

DSE (2013b) Ecological Vegetation Classes by Bioregion – Victorian Riverina Bioregion

DSE (2013c) Extant (2005) and 1750 (pre European settlement) Ecological Vegetation Class mapping, Biodiversity Interactive Map


DSE (2010b) Victorian Biodiversity Atlas ’VBA_FLORA25’ and ’VBA_FLORA100’, August 2010 © The State of Victoria, Department of Sustainability and Environment. The contribution of the Royal Botanical Gardens to the database is acknowledged.


DSE (2010a) Victorian Biodiversity Atlas ’VBA_FAUNA25’ and ’VBA_FAUNA100’, August 2010 © The State of Victoria, Department of Sustainability and Environment

At each of the six wetlands assessed all vegetation communities and high threat weed infestations were mapped, and flora and fauna lists were compiled. The vegetation condition of the six wetland sites was assessed using the Index of Wetland Condition methodology (DSE 2012a).

For the bypass area, all vegetation communities and incidental weed infestations were mapped and flora and fauna lists were compiled. Observations were recorded on habitat quality across the site to inform the likelihood of threatened species utilising these areas.
2.1 Vegetation Mapping

Vegetation mapping for the wetlands and the proposed bypass area was undertaken by field survey in combination with the interpretation of high resolution satellite imagery provided by the NCCMA, or from other more recent sources as available. Units were defined by vegetation structure and dominant species, and where possible were attributed to EVC by either reference to existing mapping or by the judgement of experienced ecologists.

The study area was accessed for field assessment between February and March 2013 using a combination of vehicles, walking and canoe. Data collected included:

- Notes on the type and spatial pattern of all vegetation present;
- Location data and notes for all observed significant flora and fauna species;
- A set of detailed vascular flora and vertebrate fauna lists for each wetland and for various sections of the by-pass areas;
- Location data and notes on the distribution and abundance of high threat weed species.

Vegetation spatial pattern information was annotated directly onto specially prepared A3 field maps showing the high resolution imagery overlayed with the cadastre, study area boundaries and other landscape features to aid navigation. These field annotated maps were then used to digitise patterns onto the satellite imagery directly on screen in ESRI ArcGIS 10.0. Digitisation was completed at a scale of 1:1,000.

In the case of Racecourse Lake, more recent imagery (2013) available in Bing Maps was geo-referenced to assist in capturing the most up-to-date patterns (which were significantly different to the 2011 imagery in some areas - see discussion on comparison with 2006 mapping). At all other wetlands (where the most up-to-date imagery was not available) it was not possible to capture these most recent changes and the mapping follows the 2011 imagery.

Once patterns were digitised, all polygons were attributed with a Mapping Unit number and the following fields: Mapping Unit Name, Ho et al. (2006) Equivalent Unit, Dominant Species, Structural Description; EVC (where possible), VAST Condition (see Section 2.2).

Two analytical approaches were used for the comparison between the 2006 and 2013 mapping of the five wetlands that had been mapped in 2006:

- whole-of-wetland comparison of the relative abundance/extent (proportion of the total area of wetland vegetation mapped in each year) for each equivalent mapping unit;
• for a selected section of each wetland direct contrasts between 2006 and 2013 mapping are described

The former – presented as a simple histogram for each wetland – illustrates bigger picture changes, while the latter defines differences in detail. A brief discussion of the results is provided, which highlights the key points of difference and suggests likely explanations and management implications. It is unclear the extent to which the apparent changes are attributable to scale/resolution differences, mapping and field validation errors, and/or actual change driven by hydrological dynamics such as the major flood in 2011.

2.2 Vegetation Assets and Transition (VAST)
Vegetation Assets, States and Transitions (VAST) is a framework to classify vegetation and habitat according to its degree of modification from a natural state. It was developed to describe, map and account for changes in the status and condition of Australia’s native vegetation (Lesslie et al. 2010). VAST uses seven classes of modification, where the residual class I sets the benchmark, against which classes II to VI are measured (Table 1). The VAST assessment was only undertaken for lands within the proposed bypass area. This was completed to describe the relative ecological integrity of the bypass area.

Table 1: Vegetation Assets and Transitions (VAST) classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naturally bare (VAST 0)</td>
<td>Areas where native vegetation does not naturally persist and recently naturally disturbed areas where native vegetation has been entirely removed. (i.e. open to primary succession)</td>
</tr>
<tr>
<td>Residual (VAST I)</td>
<td>Areas where native vegetation community structure, composition, and regenerative capacity are intact—there is no significant perturbation from land use/land management practice.</td>
</tr>
<tr>
<td>Modified (VAST II)</td>
<td>Native vegetation community structure, composition and regenerative capacity intact—perturbed by land use/land management practice.</td>
</tr>
<tr>
<td>Transformed (VAST III)</td>
<td>Native vegetation community structure, composition and regenerative capacity significantly altered by land use/land management practice.</td>
</tr>
<tr>
<td>Replaced (VAST IV-V)</td>
<td>Adventive: native vegetation replacement—species alien to the locality and spontaneous in occurrence (IV) Managed: native vegetation replacement with cultivated vegetation (V)</td>
</tr>
<tr>
<td>Removed (VAST VI)</td>
<td>Vegetation removed - alienation to non-vegetated land cover</td>
</tr>
</tbody>
</table>

2.3 Wetland Condition Assessment
The condition of each wetland was determined using the Index of Wetland Condition (IWC) Method. This is a recently developed tool for assessing the ecological condition of a wetland at a point in time. The method includes six sub-indices which assess physical and biotic
components occurring within the wetland. For a detailed description of the methodology refer to the *Index of Wetland Condition Methods Manual version 14* (DSE 2012a).

The IWC was designed to provide a condition score for a wetland at a particular point in time. The wetlands condition is compared against a benchmark which is designed to reflect the characteristics of that wetland type prior to degradation caused by European settlement.

This method requires the assessor to determine the original EVC/s of the wetland, so that this can be used as the benchmark to assess condition. If the original EVC has been displaced by another due to human induced changes, then the wetland is assessed against the original EVC. The components of the replacement EVC are thus viewed as an invasion of the original vegetation.

For this project, the NCCMA requested that an additional, non-standard IWC assessment be undertaken to assess the condition of replacement vegetation communities that may have invaded the original vegetation. This is in recognition of the values that these vegetation communities may provide, even though they are the direct result of major human-induced disturbances. As a result two IWC scores are provided per wetland.

In calculating the results of these condition assessments the *indicators of altered processes* section was removed, as it would not make sense to assess this feature of a vegetation type whose very existence was reliant on altered ecological processes. Therefore to provide a biota score for this non-standard IWC assessment, the scores for critical lifeform groups, weeds and vegetation structure and health were added and divided by 4.

It should be noted that the scores derived from these non-standard IWC assessments should not be compared to wetlands assessed used the standard method. Similarly the value of using these scores for future monitoring of wetland condition is questionable.

### 2.4 Incidental Fauna Observations

While no targeted fauna survey was conducted as part of this study, fauna species observed during the course of vegetation assessment and mapping were recorded, and overall fauna lists for the Reedy Lakes system, Scotts Creek and Little Lake Charm and Racecourse Lake were complied (see Appendix 2).

### 2.5 GIS Mapping

Point data collected in the field with a handheld GPS unit, in combination with annotated aerial photographs and high resolution satellite imagery, were utilised to prepare GIS layers
that reflect the type and extent of vegetation communities (see Section 2.2 for detailed description of methodology), the presence of rare and threatened flora and fauna, and the diversity and abundance of high threat environmental weeds and pest animals within the study area.

GIS layers were created in ESRI ArcGIS 10.0 geodatabase format (.gdb) and are registered to GDA94 MGA Zone 54. The completed database was provided to the NCCMA for storage. It comprises the following point and polygon feature classes:

- Predicted distribution of Pre-1750 Ecological Vegetation Classes - polygon
- Extant Vegetation mapping Units/VAST condition classes (bypass only) - polygon
- Location of significant, rare or threatened flora species - point
- Distribution and abundance of high threat weed species – point and polygon
- Flora lists - point
- Fauna lists - point
- Location of pest animal harbours - point

Typically, point data had a positional accuracy of ± 3 metres.

2.6 Nomenclature

Nomenclature in this report follows the Victorian Biodiversity Atlas (DSE 2010b; DSE 2013e), with consideration to the Census of Victoria Vascular Plants (Walsh and Stajsic 2007). An asterisk (*) denotes exotic species and a hash sign (#) denotes indigenous species that may occur outside of their natural range. Fauna taxonomy follows the Victorian Biodiversity Atlas (DSE 2010a; DSE 2013d). The status of flora and fauna was noted as it is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), the Flora and Fauna Guarantee Act 1988 (FFG Act) and the Department of Sustainability and Environment rare or threatened species advisory lists (DSE 2013; DSE 2005).

2.7 Limitations

Due to the cryptic nature and seasonal growth cycles of certain plants and animals, ecological surveys are often unable to detect all species present at a particular site. As fieldwork for this study was carried out in February and March 2013, only flora and fauna that were observed within the study areas over this period were recorded. Ecological surveys can also be limited by project constraints including short timeframes for survey, and it is probable that additional flora and fauna species would be recorded given a greater sampling effort.

When assessing the condition of a wetland using the Index of Wetland Condition ‘the quality of wetland vegetation is assessed by comparison with a relatively undisturbed system of the same vegetation type’ (DSE 2012a). The assessor has to determine which EVCs were likely
to have occurred at a site prior to changes to the vegetation that would have occurred because of, for example, European land use practices such as irrigation, vegetation clearing and levee construction. Some wetlands were significantly modified and historical EVCs and/or their extent were therefore difficult to determine. For these instances it was necessary to use available information sources to make an informed estimate of which EVCs would have occurred at a site and what their distribution would have been. Information sources included the DSE Interactive Map (DSE 2013c) historic descriptions, remnants of prior vegetation – including the current composition of living native vegetation and evidence such as dead trees – and environmental attributes such as soil type, position in the landscape and presumed pre-European hydrology.
3.0 REEDY LAKE

3.1 The Study Area

Reedy Lake is situated approximately 12 kilometres to the north-west of the Kerang township. The lake covers 198 hectares and is part of the Kerang Lakes Ramsar Site. Reedy Lake would originally have filled intermittently in response to flooding events in the Loddon River and Wandella Creek catchments. The lake would likely have filled irregularly and would have remained dry for significant periods. However since it was included with the Torrumbarry Irrigation System in the 1920’s it has been inundated on a permanent basis. It is the deepest lake in the study area, with a natural depth when full of approximately 1.8 metres.

3.2 Vegetation

3.2.1 Original vegetation

DSE pre-1750 mapping (DSE 2013c) predicts that the original vegetation of Reedy Lake was dominated by Lignum Swampy Woodland (EVC 823) fringed by Riverine Chenopod Woodland (EVC 103) on its western shore and Semi-arid Chenopod Woodland (EVC 98) on the lunette on the eastern shore. The mapping of Lignum Swampy Woodland as the dominant EVC in this wetland is considered likely to be inaccurate, as based on the wetland bathymetry and assumed natural hydrology this wetland would have flooded too frequently and for too long to support this EVC. Other wetlands in the Kerang area that supported woodland vegetation prior to hydrological changes in the early 20th century retain evidence of this vegetation type in the form of dead tree stags or stumps, which are absent from the centre of Reedy Lake. The depth of Reedy Lake across much of its floor probably prevented the establishment of trees, as once flooded it would remain inundated for too long for trees to survive.

Although it is difficult to conclusively determine the original vegetation patterns in highly modified wetland systems it is considered more likely that the dominant EVC of deeper sections of Reedy Lake would have been Aquatic Herbland (EVC 653) when inundated and Lake Bed Herbland (EVC 107) when dry. This would have been fringed by Intermittent Swampy Woodland (EVC 813), which is evidenced by the drowned Red Gums around the shallow lake edges and existing remnants of this EVC around its margins. Lignum Swampy Woodland (EVC 823) occurred along Wandella Creek and would have occurred adjacent to Reedy Lake’s south west corner. The other creek flowing into the lake, Washpen Creek, being more frequently inundated, would have supported Intermittent Swampy Woodland. The infrequently inundated area to the north of Reedy Lake would have supported Lignum Shrubland (EVC 808).

The predicted Pre-1750 extent of these EVCs is displayed in Map 2. The IWC assessment was scored against this vegetation pattern.
Map 2: Predicted Pre-1750 Ecological Vegetation Classes Reedy Lake

Legend

Ecological Vegetation Class and IWC Zone

- Aquatic Herbland (EVC 653), Zone 1
- Intermittent Swampy Woodland (EVC 813), Zone 1
- Intermittent Swampy Woodland (EVC 813), Zone 2
- Intermittent Swampy Woodland (EVC 813), Zone 3
- Lignum Shrubland (EVC 808), Zone 1
- Lignum Swampy Woodland (EVC 823), Zone 1
- Riverine Chenopod Woodland (EVC 103), Zone 1

Transportation

- Highway
- Sealed Arterial Road
- Sealed Road
- Unsealed Road
- 2WD Road
- 4WD Road

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

2011 Aerial Imagery courtesy of the North Central CMA

Disclaimer: while every care has been taken to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being inaccurate, incomplete or unsuitable in any way and for any reason will not be accepted.
3.2.2 Current vegetation

The inclusion of Reedy Lake within the Torrumbarry Irrigation System greatly altered the original vegetation and habitat. The Lake has been inundated on a near-permanent basis, leading to displacement of the original vegetation. At the time of this investigation the majority of the lake was open water, with no aquatic vegetation. Descriptions of contemporary EVCs found at this wetland and their Biota scores are provided below. The spatial extent of these EVCs is depicted in Map 3.

Tall Marsh (EVC 821)

Tall Marsh occurs around the wetland perimeter and is dominated reeds, rushes and sedges (Figure 2). *Typha orientalis* (Broad-leaf Cumbungi) and *Typha domingensis* (Narrow-leaf Cumbungi) often formed mixed stands with *Schoenoplectus tabernaemontani* (River Club-rush). Localised areas supported small patches of *Juncus ingens* (Giant Rush) and occasionally *Phragmites australis* (Common Reed). Associated aquatic herbs included *Ludwigia peploides* subsp. *montevidensis* (Clove-strip), *Myriophyllum papillosum* (Robust Water-milfoil) and *Persicaria decipiens* (Slender Knotweed). Weed cover was relatively low and included *Paspalum distichum* (Water Couch), and *Eclipta prostrata* (False Daisy). The modified IWC biota score for this EVC at Reedy Lake was 17, indicating that it was in good condition.

![Figure 2: Tall Marsh dominated by Cumbungi at Reedy Lake. A stand of Giant Rush can be seen in the background.](image)
Note on *Eclipta prostrata* (False Daisy)
False Daisy (Figure 3) is a new weed to have invaded Victoria, having first been officially recognised in this State during this investigation. This species is a perennial member of the daisy family (Asteraceae) and is native to South America. It reproduces from seed and stem fragments and is a potentially serious weed of waterways, lakes and wetlands. It thrives in warm conditions and requires abundant moisture during summer, and is therefore likely to be strongly disadvantaged by summer drying. Given the relatively recent arrival of this weed in Victoria and its potential to invade native vegetation its control should be an extremely high priority.

Figure 3: *Eclipta prostrata* (False Daisy)

**Lignum Swamp (EVC 104)**
This typically treeless shrubland supports a particularly robust growth of *Duma florulenta* (Tangled Lignum) to 4m tall. The ground layer usually includes species tolerant of low rainfall and infrequent inundation such as *Senecio runcinifolius* (Tall Fireweed) or species which respond to flooding such as *Lachnagrostis filiformis* s.l. (Common Blown-grass) and *Lythrum hyssopifolia* (Small Loosestrife). However, at Reedy Lake this EVC is subject to permanent inundation and the Tangled Lignum is associated with aquatic species such as *Ludwigia*
*peploides* subsp. *montevidensis* (Clove-strip) and *Schoenoplectus tabernaemontani* (River Club-rush). The modified IWC biota score for this EVC at Reedy Lake was 15.6, indicating that it was in moderate condition.

**Intermittent Swampy Woodland (EVC 813)**

Intermittent Swampy Woodland occupies low elevation areas on river terraces (mostly at the rear of point-bar deposits or adjacent to major floodways), and lacustrine verges (where it is sometimes localised to a narrow transitional band). Where it is relatively intact this EVC is dominated by flood-stimulated species in association with flora tolerant of inundation (Figure 4).

At Reedy Lake Intermittent Swampy Woodland has an overstorey of *Eucalyptus camaldulensis* (River Red Gum), with an understorey including *Duma florulenta* (Tangled Lignum), *Rhagodia spinescens* (Hedge Saltbush), *Cressa australis* (Rosinweed), *Cyperus gymnocaules* (Spring Flat-sedge) and *Sporobolus mitchellii* (Rat-tail Couch).

![Figure 4: Intermittent Swampy Woodland on the fringe of Reedy Lake in relatively good condition](image)

Close to the lake edge species such as *Eleocharis acuta* (Common Spike-rush) and *Carex tereticaulis* (Poong’ort) are locally dominant. These species may be more common now than
they were prior the increased frequency and duration of inundation caused by the wetlands inclusion in the Torrumbarry Irrigation System. These sedges are associated with a range of herbs characteristic of seasonal inundation including *Eleocharis pusilla* (Small Spike-sedge), *Marsilea hirsuta* (Short-fruit Nardoo), *Lobelia concolor* (Poison Pratia), the rare *Senecio campylocarpus* (Floodplain Fireweed) and the vulnerable *Ranunculus undosus* (Swamp Buttercup). The presence of these species indicates there is still a zone where wetting and drying occurs and provides a source of species that could colonise into the wetland if a more natural water regime were restored.

The highest threat weeds in this EVC included *Juncus acutus* (Spiny Rush), *Phyla canescens* (Fog-fruit) and *Marrubium vulgare* (Horehound). The modified IWC biota score for this EVC at Reedy Lake was 15.8, indicating that it was in moderate condition.

Figure 5: Intermittent Swampy Woodland was once more widespread at Reedy Lake but much of it was drowned when the hydrology of the site was altered.

**Lignum Swampy Woodland (EVC 823)**

A remnant of Lignum Swampy Woodland occurs on the south western corner of Reedy Lake, at its confluence with Wandella Creek. This EVC has an open canopy of *Eucalyptus largiflorens* (Black Box) with an understorey dominated by *Duma florulenta* (Tangled Lignum) and *Chenopodium nitriaceum* (Nitre Goosefoot) with other associated chenopods including *Atriplex leptocarpa* (Slender-fruit Saltbush) and *Atriplex semibaccata* (Berry Saltbush).
Lignum Shrubland (EVC 808)

Lignum Shrubland (Figure 6) consists of relatively open shrubland dominated by species of divaricate growth-form, particularly Tangled Lignum. The ground-layer is typically herbaceous or a turf grassland, rich in annual/ephemeral herbs and small chenopods.

One patch of Lignum shrubland was mapped on the northern edge of Reedy Lake. This vegetation was treeless and had a relatively open cover of *Duma florulenta* (Tangled Lignum), *Chenopodium nitriariaceum* (Nitre Goosefoot) and *Eragrostis australasica* (Cane Grass) with an herbaceous, grassy ground flora. Species recorded here included *Cressa australis* (Rosinweed), *Atriplex lindleyi* subsp. *lindleyi* (Flat-top Saltbush) and *Sporobolus mitchelli* (Rat-tail Couch). Weed cover was relatively low and included *Parapholis incurva* (Coast Barb-grass), *Lolium rigidum* (Wimmera Rye-grass), and *Mesembryanthemum crystallinum* (Common Ice-plant).

The modified IWC biota score for this EVC at Reedy Lake was 15.8, indicating that it was in moderate condition.

Figure 6: Lignum Shrubland on the northern edge of Reedy Lake dominated by the vulnerable *Eragrostis australasica* (Cane Grass) and *Duma florulenta* (Tangled Lignum)
Saltmarsh-grass Swamp (EVC A113)
Localised areas of Saltmarsh-grass Swamp occurred within low-lying depressions surrounded by Lignum Shrubland to the north of Reedy Lake. This EVC consisted of dense, species-poor swards of *Puccinellia stricta* (Saltmarsh Grass). The modified IWC biota score for this EVC at Reedy Lake was 18.6, indicating that it was in excellent condition.

Aquatic Herbland (EVC 653)
Small, localised areas of Aquatic Herbland occurred at Reedy Lake in association with Tall Marsh. While relatively common, no single patch of Aquatic Herbland was larger than 10 square metres and therefore none were mapped. At Reedy Lake this EVC consisted of mixed rafts of *Ludwigia peploides* subsp. *montevidensis* (Clove-strip), *Myriophyllum papillosum* (Robust Water-milfoil) (Figure 7) and *Persicaria decipiens* (Slender Knotweed). Weed cover was relatively low and included *Paspalum distichum* (Water Couch), and *Eclipta prostrata* (False Daisy). The modified IWC biota score for this EVC at Reedy Lake was 17, indicating that it was in good condition.

Figure 7: Aquatic Herbland at Reedy Lake consisting of *Ludwigia peploides* (Clove-strip) and *Myriophyllum papillosum* (Robust Milfoil).
Submerged Aquatic Herbland (EVC 918)
The deepest part of Reedy Lake appeared to be open water with no vegetation. However it is likely that aquatic plants (particularly *Vallisneria americana*) formed large submerged swards throughout the lake in the past. This vegetation would be referable to Submerged Aquatic Herbland (EVC 918). None of this EVC was observed in 2013 so it was not included in the modified IWC assessment.

Semi-arid Chenopod Woodland (EVC 98)
This EVC (Figure 8) occurs on the lunette to the east of Reedy Lake and would have historically occurred on the lunettes of both Middle and Third Lakes. Although degraded and species-poor it still retains a relatively high cover of indigenous species.

In the study area this EVC probably once supported a canopy of *Allocasuarina luehmannii* (Buloke) and *Callitris gracilis* ssp *murrayensis* (Slender Native Pine); however these species are no longer present. A lone specimen of *Acacia oswaldii* (Umbrella Wattle) is all that remains of the small tree or tall shrub layer. A lower shrub layer is dominated by *Nitraria billardierei* (Nitre Bush), with associated chenopods including *Maireana brevifolia* (Short-leaved Blue-bush), *Rhagodia spinescens* (Hedge Saltbush) and *Atriplex lindleyi* (Corky Saltbush). As this EVC is above the level of flooding it was not included in the IWC assessment.
3.2.3 Flora species recorded

During the survey a total of 126 vascular plant taxa were recorded at Reedy Lake (Table 2). Of these taxa, 75 were indigenous and 51 were exotic.

Table 2: Flora species recorded at Reedy Lake March 2013 and corresponding Ecological Vegetation Classes

<table>
<thead>
<tr>
<th>Conservation Status</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Ecological Vegetation Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISW 813</td>
</tr>
<tr>
<td>EPBC</td>
<td>Acacia oswaldii</td>
<td>Umbrella Wattle</td>
<td>x</td>
</tr>
<tr>
<td>FFG</td>
<td>Acacia salicina</td>
<td>Willow Wattle</td>
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<td>Acacia stenophylla</td>
<td>Eumong</td>
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<tr>
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<td>Amaranthus albus</td>
<td>Stiff Tumbleweed</td>
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<td>Asphodelus fistulosus</td>
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<td>x</td>
</tr>
<tr>
<td>*</td>
<td>Aster subulatus</td>
<td>Aster-weed</td>
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<tr>
<td>Atriplex leptocarpa</td>
<td>Slender-fruit Saltbush</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>k</td>
<td>Atriplex lindleyi subsp. lindleyi</td>
<td>Flat-top Saltbush</td>
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<td>Atriplex nummularia</td>
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<td>Atriplex semibaccata</td>
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<td>Atriplex suberecta</td>
<td>Sprawling Saltbush</td>
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<td>Avena barbata</td>
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<td>Avena fatua</td>
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<td>Bromus hordeaceus subsp. hordeaceus</td>
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<td>Cucumis myriocarpus subsp. leptodermis</td>
<td>Paddy Melon</td>
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<td>Cynodon dactylon</td>
<td>Couch</td>
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<td>Cyperus eragrostis</td>
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<td>Rounded Noon-flower</td>
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<td></td>
<td>Distichlis distichophylla</td>
<td>Australian Salt-grass</td>
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</tr>
<tr>
<td></td>
<td>* Dittrichia graveolens</td>
<td>Stinkwort</td>
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</tr>
<tr>
<td></td>
<td>Duma florulenta</td>
<td>Tangled Lignum</td>
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<td>Duma horrida subsp. horrida</td>
<td>Spiny Lignum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Eclipta prostrata</td>
<td>False Daisy</td>
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</tr>
<tr>
<td></td>
<td>Einadia nutans</td>
<td>Nodding Saltbush</td>
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<td>Eleocharis acuta</td>
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<td>Eleocharis pusilla</td>
<td>Small Spike-sedge</td>
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<td>Enchylaena tomentosa var. tomentosa</td>
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<td>Epilobium hirtigerum</td>
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<td>v Eragrostis australasica</td>
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<td>* Hordeum marinum</td>
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<td>Clove-strip</td>
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<td>* Lycium ferocissimum</td>
<td>African Box-thorn</td>
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<td>Lythrum hyssopifolia</td>
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<td>* Malva parviflora</td>
<td>Small-flower Mallow</td>
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<td>* Marrubium vulgare</td>
<td>Horehound</td>
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<td>* Mesoembryanthemum crystallinum</td>
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<td>Swamp Buttercup</td>
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<td>* Rumex conglomeratus</td>
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<td>* Rumex crispus</td>
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<td>Rytidosperma setaceum</td>
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<td>Weeping Willow</td>
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<td>v Sclerolaena patenticuspis</td>
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</tbody>
</table>

Conservation Status:

DSE ADV – DSE Advisory list of rare and threatened vascular flora (DSE 2005) - (e) endangered; (r) rare; (v) vulnerable; (k) poorly known
FFG – (L) Listed under the Flora and Fauna Guarantee Act 1988
EPBC – Environment Protection and Biodiversity Act 1999 – (EN) endangered; (VU) vulnerable

Origin:

(*) Exotic flora, naturalised in Victoria (alien plants that reproduce consistently and sustain populations over many lifecycles without direct intervention by humans (Walsh and Stajsic 2007)
(#) Taxon which is both indigenous and naturalised. A taxon that has extended beyond its geographical of distribution beyond its known or suspected original distribution
(P) Planted

Ecological Vegetation Class:

Intermittent Swampy Woodland (EVC 813); Tall Marsh (EVC 821); Aquatic Herbland (EVC 653); Semi-arid Chenopod Woodland (EVC 98); Lignum Swamp (EVC 104); Lignum Shrubland (EVC 808); Saltmarsh-grass Swamp (EVC A113)
Eight threatened plant species were recorded within the site (Table 3). The spatial distribution of rare and threatened taxa is depicted in Map 4. Note: rare and threatened fauna observed during the course of the field survey are also displayed on this map. An additional threatened species, the EPBCA and FFG-listed Charriot Wheels (*Maireana cheelii*), had been recorded in remnant vegetation to the south west of Reedy Lake in the past (Bypass investigation community panel *pers. comm.*).

Table 3: Rare and threatened flora species recorded at Reedy Lake

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<th>EPBC</th>
<th>FFG</th>
<th>DSE Advisory List</th>
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<td>Poorly known</td>
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<td><em>Atriplex lindleyi</em></td>
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<td>australasica</td>
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<td>horrida subsp.</td>
<td>Spiny Lignum</td>
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<td>Vulnerable</td>
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<td>Sclerolaena</td>
<td>var. muricata</td>
<td>Black Roly-poly</td>
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<td>Rare</td>
<td>Senecio</td>
<td>campyllocarpus</td>
<td>Floodplain Fireweed</td>
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</tbody>
</table>

Conservation Status as per DSE Advisory list of rare and threatened vascular flora (DSE 2005)

Figure 9: The vulnerable *Ranunculus undosus* (Swamp Buttercup)

Twelve species that occur within the vicinity of Reedy Lake were deemed high threat weeds in the context of the study area. The distribution of these taxa is depicted in Map 5.
Map 4: Rare and threatened flora and fauna recorded at Reedy Lake February 2013

Legend

Rare and Threatened Flora Species
- **Ranunculus undosus** (Swamp Buttercup)
- **Senecio campylocarpus** (Floodplain Fireweed)

Graminoids
- **Eragrostis australis** (Cane Grass)

Trees and Shrubs
- **Atriplex lindleyi** subsp. *lindleyi* (Flat-top Saltbush)
- **Duma horrida** subsp. *horrida* (Spiny Lignum)
- **Myoporum montanum** (Waterbush)

Rare and Threatened Fauna Species
- **Nankeen Night Heron** (*Nycticorax caledonicus hilli*)
- **Royal Spoonbill** (*Platalea regia*)
- **Spotted Harrier** (*Circus assimilis*)

Transportation
- **Highway**
- **Sealed Arterial Road**
- **Sealed Road**
- **Unsealed Road**
- **2WD Road**
- **4WD Road**

Coordinate System: **GDA 1994 MGA Zone 54**
Projection: **Transverse Mercator**
Datum: **GDA 1994**

Disclaimer: while every care has been taken care to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being inaccurate, incomplete or unsuitable in any way and for any reason will not be accepted.
Map 5: Spatial distribution of high threat weeds
Reedy Lake February 2013

Legend

High Threat Environmental Weeds

Graminoids
- *Juncus acutus subsp. acutus (Spiny Rush)
- *Phalaris aquatica (Toowoomba Canary-grass)

Herbs
- *Aphelopus fulvus (Onion Weed)
- *Gymnocoronis splendens (Senegal Tea)
- *Phyllis canescens (Fog-fruit)

Trees and Shrubs
- *Casuarina cunninghamiana subsp. cunninghamiana (River Oak)
- *Lycium ferocissimum (African Box-thorn)
- *Marthrum vulgare (Horehound)
- *Populus alba (White Poplar)
- *Rosa rubiginosa (Sweet Briar)
- *Salix spp. (Willows)

Patches or Infestations
- *Juncus acutus subsp. acutus (Spiny Rush)
- *Phyllis canescens (Fog-fruit)
- *Populus alba (White Poplar)
- *Populus alba (White Poplar)/*Schinus molle (Pepper Tree)
- *Salix spp. (Willows)

Transportation
- Highway
- Sealed Road
- Unsealed Road
- 4WD Road

Disclaimer: while every care has been taken care to ensure the accuracy of this product, no representations or warranties about its accuracy, completeness or suitability for any particular purpose is made. Liability of any kind for any expenses, losses, damages and/or costs which are or may be incurred as a result of this product being inaccurate, incomplete or unavailable in any way and for any reason will not be accepted.

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

2011 Aerial Imagery courtesy of the North Central CMA

Project: Ecological Vegetation Class Assessment for Reedy Lake, Middle Lake, Third Lake, Little Lake Chums and Racecourse Lake and surrounding areas in the Kerang Wetlands Ramsar Site
Owner: North Central Catchment Management Authority
Author: Holocene Environmental Science
Map Prepared: 25th March 2013
Surveyors: Damien Goss, Elaine Bayes and Karl Juri (Rakali Consulting Pty Ltd) and Paul Foreman (Blue Devil Consulting)
Survey Period: February 2013
3.3 Comparison of 2006 and current vegetation mapping

A comparison of mapping output for Reedy Lake in 2006 and 2013 reveals numerous similarities and differences in vegetation type and extent. Differences in the total mapped area of each vegetation unit are presented in Figure 10. Broad-scale and fine scale anomalies are itemised in the following paragraphs.

![Figure 10: Histogram of total area by vegetation type at Reedy Lake as mapped in 2006 and 2013](image)

**Summary of broad-scale similarities and differences:**

- **Tall Marsh/Cumbungi (colonising)** has apparently completely disappeared since 2006. However, this is inconclusive because this unit was regarded as problematic to interpret in the field in 2013 at this wetland. A sparse form of Tall Marsh/Cumbungi (possibly equivalent to the colonising unit from 2006) has been mapped elsewhere in 2013 where it has apparently greatly declined possibly as a result of recent flooding.

- The significant increase in Intermittent Swampy Woodland (mapped as Native remnant, Red Gum Woodland & non-native trees in 2006) is probably due to differences in mapping extent or differences in the interpretation of the boundary with Tall Marsh. Examination of the 2006 imagery may help resolve this question.

- There has been little change in the extent of Lignum Swamp (mapped as Lignum Swampy Woodland in 2006).
Overall slight decrease in extent of vegetation (from ~13.7 ha to ~13.4 ha) is probably due to differences in the definition of the study area between 2006 and 2013.

There has been a net reduction in the extent of Tall Marsh since 2006 (~87% down to ~58%), possibly attributable to hydrological change, although the extent of Tall Marsh seems to have been over-emphasised in the 2006 mapping. Note also the finer-scale mixes of dominant species in the 2013 mapping units.

Summary of fine-scale similarities and differences:

- A side-by-side comparison of the wetland vegetation units assigned to the western section of Reedy Lake in 2006 and 2013 is presented in Map 6.

- Tall Marsh on the northern shore of the lake is shown as a much broader band in 2006 than was mapped in 2013. It is unlikely Tall Marsh vegetation would have occurred at higher levels in 2006 and then contracted, as the normal top water level of the lake has not changed over this time.

- The isolated area of Tall Marsh east of the large island of Lignum Swamp was broadly classified in 2006, with no dominant species being recorded. In 2013 this area supported only Giant Rush. This may have been due to other tall graminoids drowning out in the 2011 floods, or because this area was not closely inspected in 2006.

- More discrete patches of Common Reed were mapped in 2006 than in 2013, whereas Common Reed was quite broadly distributed in 2013. This suggests that Common Reed has spread over the intervening period, becoming a more consistent component of the Tall Marsh EVC.

- The area mapped as dominated by Willows (*Salix species) decreased significantly from 2006 to 2013. This indicates real change caused by a successful willow control program. This program should be continued to ensure any Willow regeneration is effectively controlled.
Map 6: Comparison of wetland Ecological Vegetation Classes
Reedy Lake 2006 (left) and 2013 (right)

Legend

Ecological Vegetation Classes and [Mapping Units]
- Intermittent Swampy Woodland (EVC 815) [36]
- Lignum Shrubland (EVC 606) [93]
- Lignum Swamp (EVC 194) [30, 42]
- Tall Marsh (EVC 821) [Ho et al. unit only]
- Tall Marsh / Common Reed (EVC 821) [27]
- Tall Marsh / Cumbungi (EVC 821) [17, 11]
- Tall Marsh / Giant Rush (EVC 821) [10]
- Tall Marsh / Cumbungi and Giant Rush (EVC 821) [18]
- Tall Marsh / Cumbungi and River Club Rush (EVC 821) [16]
- Tall Marsh / Cumbungi, Giant Rush, River Club Rush and Common Reed (EVC 821) [21]
- Tall Marsh / Cumbungi, River Club Rush and Common Reed (EVC 821) [11]

Other Vegetative Features
- Exotic Vegetation / Salicaceae [2, 3, 8, 44, 45, 52, 56]

Note: only EVCs that are visible in the current map extent are displayed on the legend
Note: 2006 mapping [Ho et al., 2006] was provided by the North Central CMA

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3.4 Index of Wetland Condition

Two IWC assessments were undertaken at Reedy Lake (Table 4). The first was assessed against the benchmarks of the original EVC’s while the second was assessed against the currently recognisable EVC’s.

Assessment against the original vegetation

Using the IWC methodology, the overall condition of Reedy Lake was ‘poor’. The Physical Form scored ‘excellent’, Soils were ‘good’, Water Properties and Wetland Catchment were ‘moderate’, and Biota and Hydrology scored ‘very poor’.

Assessment against current vegetation

If assessed against currently recognisable EVC’s, the overall condition of Reedy Lake was ‘moderate’. The Physical Form scored ‘excellent’, Soils and Biota were ‘good’, Water Properties and Wetland Catchment were ‘moderate’ and Hydrology scored ‘very poor’.

The discrepancies between these two assessments are explained by the biota score. If the Tall Marsh and open water are considered to be natural components, then the wetland receives a reasonable score. However, if Tall Marsh and open water are considered to be artefacts of changed hydrology, and the original vegetation of the Lake is considered to be mostly lost, then the wetland receives a low score.

Table 4: Comparison between 2009 and 2013 IWC assessments for Reedy Lake

<table>
<thead>
<tr>
<th>Sub index</th>
<th>2009</th>
<th>2013</th>
<th>2013 (modified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland catchment</td>
<td>9</td>
<td>Poor</td>
<td>12</td>
</tr>
<tr>
<td>Physical form</td>
<td>20</td>
<td>Excellent</td>
<td>20</td>
</tr>
<tr>
<td>Hydrology</td>
<td>0</td>
<td>Very poor</td>
<td>0</td>
</tr>
<tr>
<td>Water properties</td>
<td>20</td>
<td>Excellent</td>
<td>15</td>
</tr>
<tr>
<td>Soils</td>
<td>20</td>
<td>Excellent</td>
<td>15</td>
</tr>
<tr>
<td>Biota</td>
<td>11</td>
<td>Poor</td>
<td>2.3</td>
</tr>
<tr>
<td>Overall Score</td>
<td>6</td>
<td>Moderate</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: all IWC sub-index scores are out of 20, except for overall score which is out of 10. Sub-indices are weighted differently; with biota being very significant in determining the overall score (see DSE 2012a and 2012b).

The overall IWC score given to Reedy Lake in 2009 and 2013 (using the non-standard scoring methodology described in section 2.3) was the same - 6, which is moderate. However, using the standard methodology, where wetland vegetation is scored against pre-European patterns of vegetation it scores 4, which is poor. It is not possible to discuss the
variation in scores given to particular sub-indices without the data that was used to calculate the 2009 scores.

3.5 Fauna
An overall fauna list is provided for the whole of the Reedy Lake system, which includes Reedy Lake, Middle Lake and Third Lake, as these sites are contiguous. However, threatened species observed at these sites were recorded separately. A total of 66 bird, four mammal, six reptile and two frog species were incidentally recorded in this wetland complex. Threatened species observed included the endangered Freckled Duck (*Stictonetta naevosa*), vulnerable Eastern Great Egret (*Ardea modesta*), Royal Spoonbill (*Platalea regia*), and White-bellied Sea Eagle (*Haliaeetus leucogaster*), and the near threatened Nankeen Night-heron (*Nycticorax caledonicus*), Pied Cormorant (*Phalacrocorax varius*), Caspian Tern (*Hydroprogne caspia*) and Whiskered Tern (*Chlidonias hybrida*). The endangered Grey-crowned Babbler (*Pomatostomus temporalis*) and the near threatened Brown Treecreeper (*Climacteris picumnus*) and Spotted Harrier (*Circus assimilis*) were observed in terrestrial habitats around the Reedy Lake system. No EPBCA-listed fauna species were recorded at Reedy Lake during this investigation.

Waterbird species observed with unfledged, dependent young in the Reedy Lake system included Royal Spoonbill (*Platalea regia*) (Figure 11) and Australian White Ibis (*Threskiornis molucca*). In the past Middle Lake is known to have supported more than 10% of the regional

![Figure 11: The vulnerable Royal Spoonbill (*Platalea regia*) feeding dependent young, Middle Lake](image)
breeding population of Australian White Ibis and Straw-necked ibis (*Threskiornis spinicollis*) and more than 5% of the breeding population of the Royal Spoonbill (ANCA 1992).

Three Rakali, or Golden-bellied Water Rat (*Hydromys chrysogaster*) (Figure 12), were observed feeding during the day while vegetation mapping and condition assessments were being conducted in the Reedy Lake system, indicating a high population density of this species. Murray River Turtle (*Emydura macquarii*) and Long-necked Turtle (*Chelodina longicollis*) were also commonly observed basking on logs at both Middle and Third Lake.

![Figure 12: The Rakali, or Golden-bellied Water Rat (*Hydromys chrysogaster*), foraging in Aquatic Herbland, Middle Lake](image-url)
4.0 MIDDLE LAKE

4.1 The Study Area
Middle Lake is situated approximately 13 kilometres to the north-west of the Kerang township. The lake covers 193 hectares and is part of the Kerang Lakes Ramsar Site. Middle Lake would originally have filled intermittently in response to flooding events in the Loddon River and Wandella Creek catchments. The lake would likely have filled irregularly and would have remained dry for significant periods. However since it was included with the Torrumbarry Irrigation System in the 1920’s it has been inundated on a permanent basis. The deepest part of this lake probably had a maximum depth of approximately 1.5 metres, which would have been deep enough to prevent the establishment of trees. From analysis of where dead trees occur now, trees occurred in areas naturally inundated by up to approximately 1 metre.

4.2 Vegetation
4.2.1 Original vegetation
DSE pre-1750 mapping (DSE 2013c) predicts that the original vegetation of Middle Lake was dominated by Lignum Swampy Woodland (EVC 823), fringed by Riverine Chenopod Woodland (EVC 103) on its western shore and Semi-arid Chenopod Woodland (EVC 98) on the lunette on the eastern shore. The mapping of Lignum Swampy Woodland as the dominant EVC in this wetland is considered likely to be inaccurate, as based on the wetland bathymetry and assumed natural hydrology this wetland would have flooded too frequently and for too long to support this EVC. Other wetlands in the Kerang area that supported woodland vegetation prior to hydrological changes in the early 20th century retain evidence of this vegetation type in the form of dead tree stags or stumps, which are absent from the central area of Middle Lake.

Although it is difficult to conclusively determine the original vegetation patterns in highly modified wetland systems it is considered more likely that the dominant EVC of deeper sections of Middle Lake would have been Aquatic Herbland (EVC 653) when inundated and Lake Bed Herbland (EVC 107) when dry. This would have been fringed by Intermittent Swampy Woodland (EVC 813), which is evidenced by the drowned Red Gums around the shallow lake edges and existing remnants of this EVC around its margins. The predicted Pre-1750 extent of these EVCs is displayed in Map 7. The IWC assessment was scored against this vegetation pattern.