Ecological Strategic Directions Framework for Tootgarook Wetland, Rosebud

ECOLOGICAL VALUES AND KNOWLEDGE GAPS REPORT

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An important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide an assessment of the Ecological Values of the Tootgarook Wetland and associated knowledge gaps in accordance with the scope of services set out in the contract between Jacobs and Melbourne Water. That scope of services, as described in this report, was developed by Melbourne Water and the Mornington Peninsula Shire Council.

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1. Introduction

The Tootgarook Wetland is a large, shallow freshwater swamp located on the Mornington Peninsula, near Rosebud. The wetland supports significant biodiversity, cultural and social values and is important for flood mitigation and water quality treatment.

Melbourne Water and the Mornington Peninsula Shire Council (MPSC) are in the process of preparing a strategic management plan for the Tootgarook Wetland. The strategic management plan will look to work with a range of stakeholders to protect the significant wetland and riparian values in the area as well as Port Phillip Bay. In addition, Melbourne Water and the MPSC require robust, evidence based information on the wetland to inform statutory planning and the development and implementation of management actions.

To feed into the strategic management plan and to provide evidence based information about the wetland, Melbourne Water and the MPSC engaged Jacobs to review the ecological and natural values of the wetland and to identify any significant knowledge and information gaps.

The current report presents the review of ecological values and knowledge gaps. This report was informed by the numerous studies and investigations previously completed in the Tootgarook Wetland and the surrounding area and following consultation with a Technical Working Group made up of representatives from Melbourne Water, the MPSC, the Department of Environment and Primary Industries (DEPI) and the Trust for Nature.

Following this review, Jacobs will design a monitoring program in consultation with Melbourne Water and the Mornington Peninsula Shire Council to address the priority knowledge and information gaps and to facilitate the evaluation of future management actions at the wetland.

1.1 Exclusions

This report reviews and identifies only the ecological values of the wetland. This report does not consider the range of additional ‘services’ the wetland provides that would not be classed as strictly ecological. For example, the wetland is situated within the Bun wurrung Language Group and a number of cultural heritage sites (middens and artefact scatters) have been identified at the edge of the wetland (Heritage Insight 2007). There is also the possibility of aboriginal burial sites associated with the wetland (Gidga Walker 2011, pers. comm. in Condina 2011). A number of European cultural heritage sites are also present at the wetland (e.g. windmill, limestone chimneys, former dwellings, Heritage Insight 2007).

The wetland also provides significant flood mitigation for the suburb of Rosebud, reducing peak flows by over 90% (Condina 2011). The protection of storage capacity of the wetland into the future is therefore of considerable importance.

The wetland also has considerable social value, in terms of amenity, recreational and educational use. It also has value as a tourist destination, which has the potential to be further capitalised on into the future.

1.2 Systematic literature review process

A Technical Advisory Group (TAG) was formed to guide the development and direction of the project. The TAG was made up of representatives from a number of project stakeholders, chiefly Melbourne Water and the Mornington Peninsula Shire Council. Representatives from Trust for Nature and Birdlife Australia were invited but were unable to attend.

The TAG directed Jacobs to over seventy reports and datasets that have been produced focussing on the Tootgarook Wetland and surrounds. These reports covered a range of technical disciplines including ecological surveys, hydraulic and flooding studies and cultural heritage assessments. Each of the reports provided to Jacobs were reviewed and those relevant to determining the ecological values of the wetland and to identifying knowledge gaps were described in detail.
Many of the studies and assessments completed in the area over the recent past have concentrated on a small geographic area or have been focussed on answering a specific question (for example to support a planning application). For the purposes of the current project, it was deemed important to as far as possible provide a systematic and comprehensive review of the relevant studies/assessments completed in the area. In order to make this review systematic, our assessment of each of the reports has been guided by the following questions:

- **Geographic extent**: Where was the study/monitoring program conducted (i.e. which part of the wetland/area was focussed on)?

- **Method**: What data did the study use? Did it generate the data (i.e. was it a monitoring program or involve survey)?

- **Timing**: When was the study/monitoring program conducted? If it was a monitoring program, over what time scale was the monitoring conducted?

- **Results**: What were the results of the study/monitoring program (e.g. what values were recorded)?

- **Significant knowledge gaps**: Were there any significant gaps in the study/monitoring program in the context of determining the ecological values of the wetland (i.e. to do with the survey design or geographic coverage)?

The reports/studies that were reviewed but not deemed relevant for determining the ecological values of the wetland are identified in Appendix A. A brief justification for not including these reports/studies is also provided.

### 1.3 Format of this report

Following this introduction, the wetland and the surrounding catchment is described briefly. Also noted briefly in this section are the threats and risks to the wetland.

The relevant literature is then systematically reviewed, organised by category (flora, fauna, water quality and quantity and hydrogeology/groundwater).

Following the systematic literature review, the reports/monitoring programs are considered together to compile the current state of understanding of the ecological values for the wetland. The breath of reports and monitoring activities will are considered as a whole to determine the major knowledge gaps.

The values and knowledge gaps are then summarised. The identified values and knowledge gaps will inform the setting of monitoring objectives in the next stage of the project.
2. The Tootgarook Wetland and surrounding catchment

A detailed account of the history of the wetland has been compiled by Pat Condina and Associates (2011). The *Tootgarook Swamp, Rosebud: Literature Review and Directions Report* also provided a review of the ecological, social and cultural values of the wetland. Condina's (2011) study has been used as an important reference for the current report. Outlined briefly below is a description of history of the catchment and its current state. Reference to Condina (2011) should be made for a more detailed description of the catchment.

The Tootgarook Wetland (also called Boneo Swamp) is a large, shallow freshwater swamp located on the Mornington Peninsula, near Rosebud. It forms on Chinaman's Creek and in the north Drum Drum Alloc Creek (Figure 2-1). These two creeks join in the northern section of the wetland, just downstream of the urban area of Rosebud West, and drain north to Port Phillip Bay. The pre-European extent of the wetland was approximately 480 hectares, however today it is estimated to be approximately 380 hectares (Condina 2011).

2.1 Historic use of the wetland

There has been a variety of land uses in the catchment over the years. It is likely that the Tootgarook Wetland was used extensively by indigenous people of the Boonwurrung (or Bunurong) people of the Kulin nation as a reliable source of food and resources (Condina 2011). The number of individuals that used the site is unlikely to have ever been high (Calder 1986), however there are a number of indigenous historical sites that have been identified in the wetland area (Heritage Insight 2007).

The Mornington Peninsula was first settled by Europeans in 1803 (at Sorrento) but for a variety of reasons the area was soon abandoned (Heritage Insight 2007). It was not until the 1840s that permanent settlement occurred. The early settlers came to the area in search of bark and fish and to produce lime to supply mortar to Melbourne's building industry (Condina 2011). A number of lime kilns are known from the Tootgarook Wetland. These kilns would likely have been stoked with the local vegetation, which may have significantly changed the character of the area (Hollinshead 1982). Dairy farming started in the Boneo area (south of the wetland) in about 1850 and was accompanied by extensive land clearing (Condina 2011).

2.2 Chinaman’s Creek and Drum Drum Alloc Creek

The changes in landuse have led to an alteration in the hydrological regime of the two major waterways in the area, Chinaman's Creek and the Drum Drum Alloc Creek. The upper catchment of Chinaman's Creek is poorly defined, with a complex and dynamic set of flow paths contributing water to the creek following storms, in addition to groundwater contribution (Condina 2011). Downstream of Browns Road however, Chinaman's Creek is now essentially a channelised drain approximately 3 m wide and 1.5 m deep (Condina 2011). The wetland was first drained in the 1870s, but the first major efforts came with the channelization of Chinaman's Creek in 1911. The 1911 works did not lead to extensive drainage of the wetland, however further works carried out in the 1950s and 1960s is thought to have led to some of the reduction in the wetland area (Condina 2011).

Drum Drum Alloc Creek in contrast, is still in a relatively natural state, particularly in the upper reaches (east of Jetty Road). This section of the creek is in near pristine condition with natural riparian vegetation such as old Tea Trees, Blackwoods, Grass Trees and Tree Ferns (Condina 2011). The creek is highly modified lower in the catchment, and downstream of Boneo Road it is essentially a manmade drain.
Figure 2-1 Tootgarook Wetland (blue shaded area) and surrounding catchment including Chinaman’s Creek and Drum Drum Alloc Creek.
2.3 Wetland ownership

The majority of the Tootgarook Wetland is privately owned, with less than 20% in public sector ownership (Condina 2011). The majority of the land is owned by Mr Robert McNaught (62% of the remaining wetland area). The McNaught property has had a variety uses over the years, and has been heavily impacted by grazing and agriculture. In recent years the land has been placed under a covenant and managed as a vegetation offset site for the construction of the Peninsula Link freeway (G. Walker pers. comm.).

Other private owners account for nearly 20% of the wetland area. The Mornington Peninsula Shire Council owns a number of parcels of land within the wetland area totalling about 12%. South East Water owns a parcel near the southern extent of the wetland (the Boneo Wastewater Treatment Plant) and a 15 m wide easement through the wetland (Condina 2011). In total South East Water owns just over 5% of the wetland area. There is a VicRoads corridor set aside for the possible future construction of an extension to Peninsula Link accounting for 1.6% of the wetland area (Condina 2011).

2.4 Current landuse

There is a mix of land-uses in the area surrounding the wetland. There are high yield market gardens located to the south-east of the wetland. The Boneo Wastewater Treatment Plant, operated by South East Water is located at the southern extent. A golf course (Eagle Ridge) is located to the south west of the wetland.

Along the eastern side of the wetland, within the McNaught property, is a large equestrian centre (Boneo Park) that is owned and operated by the McNaught family. North of the equestrian centre is an industrial park and urban development. The suburb of Rosebud West borders the north-west (near the entry point of Drum Drum Alloc Creek) and northern edges of the wetland.

A dune ridge runs along the western edge of the wetland. Moonah Woodland borders the wetland on the north-west edge. A disused landfill site is also located to the north-west.

Downstream of the confluence with the Drum Drum Alloc Creek, Chinaman’s Creek drains north in a constructed channel through the suburb of Rosebud West. The original outlet is now a drainage reserve and no longer conveys overland flows from the wetland.

2.5 Melbourne Water’s vision for the Tootgarook Wetland

The Tootgarook Wetland has been recognised by Melbourne Water in their Healthy Waterways Strategy as a priority area for birds (the wetland area itself) and amenity in Chinaman’s Creek from the wetland to Port Philip Bay. Under this strategy, the ecological objective for the wetland (defined as the middle and lower reaches of Chinaman’s Creek in the strategy) regarding birds is to “Improve species richness and abundance of streamside and wetland bird populations” (Healthy Waterways Strategy – Melbourne Water 2013, p213). The amenity objective is to maintain the amenity value of the lower Chinaman’s Creek.

2.6 Threats and risks to the wetland

A detailed description and investigation of the threats and risks to the wetland is beyond the scope of the current project. However, the main threats have also been reviewed by Condina (2011) and are outlined briefly below.

2.6.1 Direct threats

- **Weed spread:** A number of potentially harmful and noxious weeds have been identified in the wetland including aquatic and terrestrial species.

- **Pest animals:** Foxes, feral cats, rabbits and rodents have all been recorded. Pest birds include Spotted Dove, Common Blackbird, House Sparrow.
- **Cinnamon Fungus**: Cinnamon Fungus attacks the roots of vegetation. Has been recorded in the wetland (Picone and Walker 2003), however the impact in the wetland is currently not known.

- **Fire**: Fire has the potential to be a management tool, but uncontrolled fires, particularly in a peat environment could be catastrophic.

- **Stock Grazing**: Stock grazing has been nearly eliminated from the wetland primarily as the result of cooperative and environmentally responsible owners, but the impact of past grazing has been severe. As the majority of the wetland is in private ownership, the risk that stock grazing could resume is high.

- **Slashing, ploughing and pasture improvement**: Instances of slashing etc. has been recorded to reduce flora and fauna values to facilitate residential or industrial development.

- **Edge development**: Industrial and urban encroachment on the wetland and associated edge effects is a significant threat.

- **Proposed freeway development**: VicRoads own a corridor of the land through the wetland that may be developed in the future for a major road.

- **Surface water and groundwater pollution**: A range of potential pollutants are located around the wetland. Agricultural run-off, stormwater and pollutants from urban and industrial areas, seepage from the old landfill site. Particular concern is high nitrate levels in the wetland, possibly from market gardens to the east of the wetland. These market gardens are irrigated with Class A recycled water from the Boneo Wastewater Treatment Plant and are also probably high users of fertilizer.

- **Hydrological changes**: Changes to the catchment (e.g. urbanisation) can change the permeability of the surrounding landscape, changing runoff patterns and affecting hydrological regimes. Groundwater drawdown also has the potential to impact hydrological regimes. Widespread and intensive irrigation nearby may also be a threat.

- **Acidification**: Although not directly identified by Condina (2011) potential Acid Sulphate Soils pose a risk to the wetland, particularly if groundwater drawdown is severe.

- **Climate change/sea level rise**: Extreme scenarios could see sea level rise impacting the wetland.

### 2.6.2 Indirect threats

- **Incomplete knowledge of wetland ecosystems and processes**: There is a number of significant knowledge gaps (water quality, hydrological regime, aquatic flora and fauna). Until these are addressed, it is a risk that the management regimes are incomplete or inadequate.

- **Lack of legislative power and tools to enable protection**: There is currently no strong legislative instrument (i.e. the designation of the wetland as a Ramsar site etc.) that allows coordinated management and protection.

- **Fragmented and ad-hoc management responsibilities**: The wetland is managed by a diverse range of stakeholders (e.g. MPSC, Melbourne Water, private landholders), with potentially different remits and responsibilities.

- **Ignorance of real values of the swamp**: There is a detailed knowledge of the swamp held by local people and some agencies, however this knowledge is fragmented at present.

- **Lack of strong public support to wetland protection**: Despite some very engaged and strong community groups (e.g. Friends of the Tootgarook Wetland), there is limited appreciation for the wetland in the wider community.

- **Lack of buffer zones to the wetland**: Much of the development to date has occurred immediately adjacent to the wetland.

- **Private ownership of the wetland**: The private ownership of much of the wetland means that it is difficult to ensure the future management.

- **Development of the upstream catchment**: Development of the catchment upstream has the potential to impact a range of wetland processes.
2.7 Wetland areas

The diverse ownership and stewardship of the Tootgarook Wetland is also exhibited by the diverse and sometimes inconsistently applied names for different sections of the wetland. The following names are regularly used for the various sections of the wetland by a range of stakeholders including the Mornington Peninsula Shire Council and community groups.

- **“Tootgarook Wetland Reserve”:** An approximately 22 ha section of the wetland, south of Browns Road, and east of Eagle Ridge Golf Course and the Mornington Peninsula Country Club.

- **“Tootgarook Wetland and Tern Avenue Reserve”:** A six hectare parcel of the wetland located on Tern Avenue and north of the Hiscock Road corridor. Adjacent to the Tootgarook Sports Reserve.

- **“The McNaught Property” or the “Tootgarook Swamp and Moonah Woodland”:** An approximately 230 ha area of the wetland roughly bounded by Browns Rd in the south, the Hiscock Road corridor in the north, Truemans Road in the west and Boneo Road in the East. The majority of the land within this boundary is owned by Mr Robert McNaught and his family.

- **“Sanctuary Park Bushland Reserve”:** The Sanctuary Park Bushland Reserve is located in the north-east of the wetland, north of the Hiscock Road corridor and south of the Village Green retirement village. The area of the site is approximately 12 ha.

- **North of the wetland:** Studies have also investigated the area in the northern section of the wetland (near the confluence of Chinaman’s Creek and Drum Drum Alloc Creek) and north along Chinaman’s Creek to the bay. For the purposes of the current study, we have defined this area as “North of the wetland”.

These broad wetland areas are shown in Figure 2-2.

For the purposes of the current report, unless otherwise stated, “Tootgarook Wetland” or “the wetland” is used to describe the total area covered by the various wetland areas described above. Furthermore, unless otherwise stated, when reference is made to Chinaman’s Creek and Drum Drum Alloc Creek, this is within the wetland area outlined above.
Figure 2-2 Tootgarook Wetland showing the approximate boundaries of wetland areas(properties and surrounding landuse).
3. Flora

3.1 Review of literature

The following references are those that relate to specific flora values only. Incidental flora observations such as those included in targeted fauna survey are of limited value and not explicitly considered here.

3.1.1 Picone and Walker – Vegetation Management Plan for Tootgarook Wetland and Moonah Woodland


Geographic extent: The McNaught property including large section of Tootgarook Wetland north of Brown’s Road, Chinaman’s Creek and Moonah Woodlands to the west of the wetland.


Results: Identified Coastal Alkaline Scrub, Wetland Formation, Swamp Scrub, Reed Swamp Formation and Creekline Grassy Woodland in area, ranging in quality from poor to excellent across the properties. Comprehensive flora survey and species list provided including records of rare and threatened species Coast Wirilda (Acacia uncifolia), Coast Bitter-bush (Adriana quadripartita), Rare Bitter-bush (Adriana quadripartita s.s. - glabrous form), Leafy Twig-sedge (Cladium procerum), Ruddy Bent (Agrostis rudis), Pale Spike-sedge (Eleocharis pallens) and Leafy Greenhood (Pterostylis cucullata, also EPBC listed). The location of these species is described although exact locations were not recorded for any except Leafy Greenhood. Also recorded significant species within each community but no basis for why they are significant. Coastal Alkaline Scrub is also consistent with FFG listed Moonah Woodland community.

Significant knowledge gaps: Limited to western section of the McNaught Property. Hand drawn maps are difficult to interpret.

3.1.2 Rakali Consulting – Flora Survey and Weed Mapping at Tootgarook Wetland Bushland Reserve


Geographic extent: Tootgarook Wetland Bushland Reserve (south of Browns Road)

Method: Meandering field assessment of entire reserve with mapping of EVCs and weed infestations, and incidental records of flora.

Timing: 5th and 6th of March 2013

Results: Identified Swamp Scrub, Sedge Wetland and Tall Marsh covering the entire site with basic descriptions of each EVC included although no quantitative measurement of quality was included. No EPBC communities or species were detected however numerous weed species were identified throughout the site and recommendations are provided to direct weed control resources to best effect. 96 native species and 49 introduced species recorded.

3.1.3 Vegetation Mapping – Offset assessment for Tootgarook Wetland

Study/Program: Peter Gannon and Damian Cook undertook vegetation mapping within Tootgarook Wetland for Trust for Nature and Linking Melbourne Authority to assess offsets. No report is available for reference but we have reviewed the mapping of vegetation extent, type and quality.

Geographic extent: The McNaught property including large section of Tootgarook Wetland north of Brown’s Road including Chinaman’s Creek and Adjacent Moonah Woodlands to the west of the swamp.

Method: Vegetation Quality Assessment was undertaken assessing the extent and type of vegetation present.

Timing: 2012 (unknown timing).

Results: Identified and mapped numerous EVCs within the study area which covers most of the northern section of Tootgarook Wetland although quality assessments not available at this time (Figure 3-1). Discussion with Peter Gannon indicated there are differences between the data presented and field assessment of EVCs assessed due to DEPI requirements for offset mapping. Identified the presence and extent of Coastal Alkaline Scrub, Tall Marsh, Swamp Scrub, Brackish Sedgeland, Sedge Wetland, Brackish Grassland and Brackish Wetland. The results of the mapping are shown in Figure 3-1.

Significant knowledge gaps: Likely to provide one of the most complete assessments of vegetation but the information is not currently within an easy to understand format and will require some effort to understand. The raw data collected by Peter Gannon and Damien Cook is likely to be more informative than the mapping assessed.

3.1.4 Biosis Research – Flora and fauna assessment of the VicRoads freeways extension reserve


Geographic extent: VicRoads freeway extension reserve which bisects the McNaught Property, running east to west in the northern section of the wetland.

Method: Desktop review (Victorian Biodiversity Atlas (VBA), DSE Biodiversity Interactive Map (BIM), Protected Matters Search Tool) and additional reports.

Timing: Desktop assessment conducted in 2012.

Results: Assessed extent and type of native vegetation through the area using data from Mornington Peninsula Shire (see section 3.1.9 and Figure 3-2). Vegetation classes present include Coastal Alkaline Scrub, Plains Grassland, Swamp Scrub, Gahnia Sedgeland, Tall Marsh, Brackish Wetland, and Sedge Wetland. Also determined the significant species that have been recorded or are likely to occur within 5 km of the study area and then assessed the likelihood of occurrence. Significant species that are likely to occur and the location of occurrence are outlined in Table 3-1.

Significant knowledge gaps: No field surveys undertaken for the report. Study had a limited geographic extent.
Figure 3-1 Vegetation mapping at the McNaught Property undertaken as part of the offset assessment.
Figure 3-2 Mornington Peninsula Shire Council Vegetation Mapping at Tootgarook Wetland.
3.1.5 Brett Lane and Associates – Henry Wilson Drive Flora and Fauna assessment


**Geographic extent:** Small property located at Henry Wilson Drive, Rosebud West. Location of a proposed stormwater treatment and associated drainage into Hiscocks Road Drain (extension of Drum Drum Alloc Creek).

**Method:** Desktop review (FIS, Protected Matters Search), field assessment including habitat hectares assessment (one day in February 2007).

**Timing:** Snapshot survey completed in 2007.

**Results:** A total of 45 plant species detected, 38 of which were exotic. Area is dominated by exotic species. Some low quality Swamp Scrub exists along drain. There is little habitat present for rare or threatened species.

**Significant knowledge gaps:** Small area considered.

3.1.6 Greening Australia – Boneo Park development flora and fauna recommendations


**Geographic extent:** North-east quarter of the Boneo Park property.

**Method:** Desktop surveys and diurnal survey conducted on one day (15th April, 2008).

**Timing:** Snapshot survey (April 2008).

**Results:** Records that extensive weed control has been undertaken since 2001 improving the quality of native vegetation present. Provides a flora list detailing presence of 28 native and 38 non-native species including 8 noxious weeds. Mentions that Swamp Scrub and Wetland Formation (an EVC aggregate class) occur on the property but does not detail where.

**Significant knowledge gaps:** Little detail on the location of native vegetation identified, small geographic extent.

3.1.7 DSE Approval letter for Mornington Peninsula Shire detailing vegetation removal for Village Glen extension.

**Study/Program:** DSE (2012). Response from DSE to Mornington Peninsula Shire regarding planning permit P12/0527. References and summarises the findings of a number of assessments and refining letters produced by Ecology and Heritage Partners for Bosco Johnson for extensions to the Village Green development.

**Geographic extent:** ‘Sanctuary Park’ - Approximately 2.6 ha area south of the current extent of The Village Green housing development (retirement village) (end of St. Elmos Cl.).

**Method:** Background assessment and Net Gain Survey in 2010.

**Timing:** Snapshot survey (2010).

**Results:** Swamp Scrub is present on site that is of high quality. A small amount has been approved to be removed.

**Significant knowledge gaps:** Only summarises results of assessments, limited extent, indicates vegetation is being removed due to further development.
3.1.8  Biosite information for Tootgarook Wetland (ID# 4984)

Study/Program: Summary of Biosite database information for Tootgarook Wetland. Biosite database maintained by DEPI and identifies locations of important biodiversity.

Geographic extent: Undefined other than Tootgarook Wetland.

Method: Undefined.

Timing: Undefined.

Results: Identifies the presence of Swampy Riparian Woodland, Swamp Scrub and Wetland Formation communities. Provides brief assessment of quality indicating some sections have high diversity and are likely to be regionally to nationally significant according to Biosite criteria. A brief discussion of the dominant species in each community is undertaken but no species list is provided. Identifies potential threats including Agriculture, grazing, habitat fragmentation, invasion by weeds clearing of vegetation and development.

Significant knowledge gaps: Simply a database output with no context. No information provided on when, where or how the information presented was collected and no reference is provided which may provide greater detail.

3.1.9  Ecological Vegetation Class Mapping – Mornington Peninsula Shire Council

Study/Program: Mornington Peninsula Shire Council maintains a spatial database of Ecological Vegetation Classes that are extant within the council boundaries

Geographic extent: Mornington Peninsula Shire Council municipal area only

Method: Unknown from data available at the time of review.

Timing: Unknown from data available at the time of review.

Results: The Ecological Vegetation Classes present within the Tootgarook Wetland are shown in Figure 3-2.

Significant knowledge gaps: Although the mapping does cover the Tootgarook Wetland, the data set does not agree with recent field mapping carried out (3.1.3) with areas considered to be non-native vegetation mapped as native. The database also does not include any data by which the quality of the vegetation communities could be determined.

3.1.10  Victorian Biodiversity Atlas

Study/Program: DEPI (2014). DEPI maintained database of species records across Victoria. Records are from a variety of sources and are indicative of survey effort

Geographic extent: Only the area comprising Tootgarook Wetland and associated areas was included as shown in Figure 3.1.
Figure 3-3 Victorian Biodiversity Atlas records within the Tootgarook Wetland Area. Produced from VBA website on 24 June 2014. Only flora recording sites shown.

Method: Mixture of quadrat, defined area species lists and Herbarium records across 25 locations (see Figure 3.1).

Timing: Includes records from 1952 to 2005. Any later surveys have not yet been included in the database at this time.

Results: Records for .118 flora species with 78 native and 40 introduced species across the greater wetland area.

Significant knowledge gaps: Is an incomplete record of surveys undertaken to date with greater species diversity recorded in other assessments reviewed here.

3.1.11 Natureprint and Strategic Biodiversity Score

Study/Program: DEPI (2014). DEPI developed method for collating known biodiversity information across Victoria into a single measure. Natureprint was used to develop the recently released Strategic Biodiversity Score which is used to measure the relative importance to Victoria's biodiversity of any area within Victoria. Both Natureprint (version 2.0) and Strategic Biodiversity Score values are accessed through the Biodiversity Interactive Map tool (DEPI 2014).

Geographic extent: While Natureprint and Strategic Biodiversity Scores consider biodiversity values across Victoria, only the extent shown below is considered for this review. As Strategic Biodiversity Scores are a later iteration only
3.2 Summary of Flora values

The vegetation across the majority of the site has been mapped according to Ecological Vegetation Classes through various assessments by a number of different people and organisations and is generally in broad agreement. The quality of vegetation present has been assessed quantitatively in areas north of Brown’s Road but this information is currently unavailable (Trust for Nature assessment and Ecology Partners assessment of Village Green) or has been greatly simplified (Piccone and Walker 2003). Flora lists indicate that the areas supporting native vegetation have considerable native floral biodiversity in areas west of Chinaman’s Creek (over 100 native species) whilst most assessments east of Chinaman’s Creek indicate the area is dominated by exotic species and has limited native vegetation. Records of a number of significant weed species are recorded in almost all surveys undertaken with locations of serious infestations mapped by Piccone and Walker (2005) and by Rakali Consulting (2014) across most of the wetland.
The following vegetation communities are known to occur within Tootgarook Swamp based on field assessments: Coastal Alkaline Scrub (is also listed under the FFG Act as Coastal Moonah Woodland), Tall Marsh, Swamp Scrub, Brackish Sedgeland, Sedge Wetland, Brackish Grassland, Brackish Wetland, Wetland Formation, Swamp Scrub, Reed Swamp Formation, Creekline Grassy Woodland, Plains Grasslands.

Few rare and threatened flora species have been recorded in the area. The best summary of those with potential to occur is included below in Table 3-1.

Table 3-1 Significant flora species identified by Biosis Research as being likely to occur within the VicRoads free extension reserve (adapted from Biosis 2012).

<table>
<thead>
<tr>
<th>Common name</th>
<th>Species name</th>
<th>Last record (as of 2012)</th>
<th>Likelihood of occurrence</th>
<th>Area of value within the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federally Listed Species (EPBC Act)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy Greenhood</td>
<td>Pterostylis cucullata</td>
<td>2006</td>
<td>Known</td>
<td>Known in Moonah Woodland near Truman Road</td>
</tr>
<tr>
<td>State Listed species (FFG Act, Advisory list)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coast Wirilda</td>
<td>Acacia uncinifolia</td>
<td>2012</td>
<td>Known</td>
<td>Known in Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
<tr>
<td>Coast Bitter-bush</td>
<td>Adriana quadripartita</td>
<td>2011</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
<tr>
<td>Rare Bitter-bush</td>
<td>Adriana quadripartita s.s. (glabrous form)</td>
<td>1999</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
<tr>
<td>Water Parsnip</td>
<td>Berula erecta</td>
<td>2000</td>
<td>Known</td>
<td>Known in wetlands and Sedgeland</td>
</tr>
<tr>
<td>Leafy Twig-sedge</td>
<td>Cladium procerum</td>
<td>1995</td>
<td>Known</td>
<td>Known in wetlands and Sedgeland</td>
</tr>
<tr>
<td>Coast Helmet-orchid</td>
<td>Corybas despectans</td>
<td>2009</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
<tr>
<td>Slender Tick-trefoil</td>
<td>Desmodium varians</td>
<td>2001</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub, Plains Grasslands</td>
</tr>
<tr>
<td>Dune Poa</td>
<td>Poa poiformis var. ramifer</td>
<td>2002</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
<tr>
<td>Large River Buttercup</td>
<td>Ranunculus papulentus</td>
<td>1994</td>
<td>Known</td>
<td>Known in wetlands and Sedgeland</td>
</tr>
<tr>
<td>Coast Twin-leaf</td>
<td>Zygophyllum billardiarei</td>
<td>2008</td>
<td>High</td>
<td>Swamp Scrub, Coastal Alkaline Scrub</td>
</tr>
</tbody>
</table>

3.3 Summary of Knowledge Gaps

The mapping of vegetation communities and assessment of their quality has been undertaken by a number of different people for a variety of reasons and is therefore difficult to align and provide a coherent picture of what values occur within the site. Given that the vegetation communities present are obligate wetland communities and provide significant habitat for many fauna species, a lack of comprehensive data on the extent and quality of vegetation communities represents the greatest knowledge gap regarding flora values.

As one of the greatest threats to the condition of the wetland communities appears to be weed invasion from surrounding areas, there is also a paucity of information across some of the site as to the extent of weed invasion, particularly in the north west of the wetland area.

With the exception of the Leafy Greenhood population, in the Moonah Woodland near Truemans Road (see Piccone and Walker 2003), little is known about the location of threatened species within the wetlands. No
systematic targeted surveys have been recorded from the wetland and therefore it is difficult to truly assess the likelihood of threatened species occurrence.

Few of the assessments reviewed have been undertaken at a suitable time of year to identify the majority of flora species and there is a significant likelihood that additional species would be detected during spring and summer surveys.
4. Fauna

The fauna of the Tootgarook Wetland has been investigated across a number of studies. A series of detailed surveys were carried out by Malcolm Legg from 2002 through to 2008. Additional targeted surveys and desktop reviews have been carried out by a range of different groups, usually focussing on a single taxa or a small geographic area in response to a planning application or specific question.

4.1 Review of literature

4.1.1 Victorian Biodiversity Atlas (VBA)

Study/Program: The Victorian Biodiversity Atlas (VBA) is the web based repository of wildlife information in Victoria. Records come from a variety of sources.

Geographic extent: Tootgarook Wetland area (roughly the area bounded by Limestone Road, Truemans Road, Boneo Road and Rosebud West).

Method: Wildlife records contributed from a range of sources organised into a searchable online database.

Timing: Variety of record sources including

Results: Detailed results are presented in Section 4.2. Results summarised below:

- Amphibians: Six species (all native)
- Reptiles: Ten species (all native). One species record (Tree Dragon, *Amphibolurus muricatus*) is from 1900 and is not included in Section 4.1.
- Mammals: Eight species (four of which are native species)
- Birds: 92 species (83 of which are native species)

Significant knowledge gaps: It is difficult to identify the methods used to collect the various species records. More complete species records captured by other datasets and reports (e.g. Legg, Birdlife Australia).

4.1.2 BirdLife Australia Atlas and ongoing monitoring of Tootgarook Wetland

Study/Program: BirdLife Australia. Extract of records held by the Birdlife Australia Atlas and records captured as part of ongoing routine monitoring undertaken of the Tootgarook Wetland.

Geographic extent: A number of locations around the Tootgarook Wetland and surrounding areas including the McNaught Property and lands owned by the MPSC.

Method: The Birdlife Australia Atlas contains records from previous surveys that have been submitted for uploading.

Birdlife Australia have also been undertaking standardised bird counts at a number of locations within and around the wetland area as part of a project in partnership with Melbourne Water and the Mornington Peninsula Shire Council. Four separate bounded survey sites are located throughout the McNaught Property. At each of the four survey sites, 20min ‘500m Area Searches’ are conducted along a consistent transect. At the other locations (the MPSC sites) 500m area searches are conducted and point searches from the edge of the wetland (Chris Purnell, Birdlife Australia pers. comm.).

Timing: Opportunistic surveys and recent standardised surveys of the McNaught Property and MPSC properties undertaken every two months.
Results: Estimated 1,696 survey records and 148 bird species captured in the Tootgarook Wetland area. Species recorded are presented in Section 4.2. To give an indication of the coverage of the records, the locations of records made within the wetland are shown in Figure 4-1.

Significant knowledge gaps: The methods are suitable to allow population condition to be tracked over time. This ongoing survey represents one of the few robust, long-term monitoring programs currently being undertaken at the wetland.

4.1.3 Legg – Comprehensive fauna survey of the Chinaman’s Creek (from the northern section of Tootgarook Wetland to the Bay) and Drum Drum Alloc Creek (from Boneo Road to the confluence with Chinaman’s Creek)

Study/Program: Legg (2002). Fauna survey and management prescriptions for Chinaman’s Creek (from Boneo/Tootgarook Swamp to Port Philip Bay) and Drum Drum Alloc Creek (from Boneo Road to Boneo/Tootgarook Swamp), December 2001 to February 2002. Report by Mal’s Environmental and Ecological Services for the Mornington Peninsula Shire Council.

Geographic extent: Chinaman’s Creek (from Tootgarook Wetland to Port Philip Bay) and Drum Drum Alloc Creek (from Boneo Road to the confluence with Chinaman’s Creek). Survey encompasses the northern section of the Tootgarook Wetland.

Method: Field surveys, nocturnal and diurnal surveys, range of environmental conditions over survey period.

The following survey techniques were employed for each group:

- Fish: Scoop nets, bait and opera house traps
- Amphibians: Call recognition
- Reptiles: Elliott Traps, direct searching (under rubbish, logs, tin)
- Mammals: Elliott Traps, cage traps nocturnal spotlighting, scat and diggings analysis
- Birds: Call recognition and visually during diurnal and nocturnal surveys

Timing: Surveys were carried out throughout the survey period (December 2001 to February 2002).

Results: This study provides the most comprehensive known faunal survey to date of the section of the Tootgarook Wetland upstream of Hiscock Lane. Detailed results are presented in Section 4.2. Results summarised below:

- Fish: Seven species (five native)
- Amphibians: Six species of frog
- Reptiles: 10 Reptile species (seven lizard species, three snake species)
- Mammals: 14 species (10 native)
- Birds: 56 species (50 native)

Significant knowledge gaps: Surveys completed over only 3 months in summer, in only a small section of the wetland.
Figure 4-1 Locations of Birdlife Australia records from the Tootgarook Wetland.
4.1.4 Legg – Comprehensive fauna survey for Tootgarook Wetlands and Tern Avenue Reserve, Rosebud West


Geographic extent: Northern section of the Wetland, north of Hiscock Avenue, south of Tootgarook Sports Fields.

Method: Field surveys, nocturnal and diurnal surveys, range of environmental conditions over survey period.

The following survey techniques were employed for each group:

- Amphibians: Call recognition
- Reptiles: Direct searching (under rubbish, logs, tin)
- Mammals: Elliott Traps, cage traps nocturnal spotlighting, scat and diggings analysis, Anabat analysis for bat detection
- Birds: Call recognition and visually during diurnal and nocturnal surveys

Timing: Surveys were carried out throughout the survey period (September 2003 to November 2003).

Results: Most comprehensive survey to date of the north-west section of the wetland. Detailed results are presented in Section 4.2. Results summarised below:

- Amphibians: Four species
- Reptiles: Seven species (one tortoise, four species of lizards. two snake species)
- Mammals: Ten species (six native)
- Birds: 57 species of Birds (51 native)

Significant knowledge gaps: Surveys conducted in spring over a relatively short time frame, in only a small section of the wetland.

4.1.5 Legg – Comprehensive fauna survey of the Tootgarook Wetland and Moonah Woodland


Geographic extent: McNaught Property (‘Boneo Park’), 307 ha roughly bounded by Browns Road, Boneo Road, Hiscock Avenue and Truemans Road.

Method: Field surveys, nocturnal and diurnal surveys, range of environmental conditions over survey period.

The following survey techniques were employed for each group:

- Fish: Bait and opera house traps in Chinaman’s Creek and associated dams
- Decapod crustaceans: Surveyed incidentally throughout period
- Amphibians: Call recognition
- Reptiles: Elliott Traps, direct searching (under rubbish, logs, tin)
- Mammals: Elliott Traps, cage traps nocturnal spotlighting, scat and diggings analysis
- Birds: Call recognition and visually during diurnal and nocturnal surveys
Timing: Surveys were carried out throughout the survey period (April 2003 to May 2004).

Results: This study provides the most comprehensive survey to date of the section of the Tootgarook Wetland that is on Robert McNaught’s property. Detailed results are presented in Section 4.2. Results summarised below:

- Fish: Five species (four native)
- Decapod crustaceans: One species
- Amphibians: Five species
- Reptiles: 13 Reptile species (one tortoise species, eight lizard species, four snake species)
- Mammals: 14 species (10 native)
- Birds: 86 species (79 native)

Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area). Survey carried out over a period greater than one year, however the wetland did not flood during that time.

4.1.6 Legg – Comprehensive fauna survey of the Sanctuary Park Bushland Reserve (June 2005 to January 2006)


Geographic extent: Sanctuary Park Bushland Reserve, located in the northern section of the wetland, south of The Village Green retirement village. Study area was approximately 12 ha.

Method: Field surveys, nocturnal and diurnal surveys, range of environmental conditions over survey period.

The following survey techniques were employed for each group:

- Fish: Bait traps in Chinaman’s Creek
- Decapod crustaceans: Surveyed incidentally throughout period
- Amphibians: Call recognition
- Reptiles: Elliott Traps, direct searching (under rubbish, logs, tin)
- Mammals: Elliott Traps, nocturnal spotlighting, scat and diggings analysis
- Birds: Call recognition and visually during diurnal and nocturnal surveys

Timing: Surveys were carried out throughout the survey period (June 2005 to January 2006).

Results: This study provides the most comprehensive survey to date of the Sanctuary Park section of the Tootgarook Wetland. Detailed results are presented in Section 4.2. Results summarised below:

- Fish: Four species (three native)
- Decapod crustaceans: One species
- Amphibians: Four species
- Reptiles: 11 reptile species (one tortoise species, seven lizard species, three snake species)
- Mammals: 12 species (8 native)
- Birds: 60 species (55 native)
Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area).

4.1.7 Legg – Comprehensive fauna survey of the Tootgarook Wetland Reserve, Boneo


Geographic extent: Tootgarook Wetland Reserve, south of Browns Road, east of Eagle Ridge Golf Course. Study area approximately 22 ha.

Method: Field surveys, nocturnal and diurnal surveys, range of environmental conditions over survey period.

The following survey techniques were employed for each group:

- Fish: Bait traps in Chinaman’s Creek
- Decapod crustaceans: Surveyed incidentally throughout period
- Amphibians: Call recognition
- Reptiles: Elliott Traps, corrugated iron, direct searching (under rubbish, logs, tin)
- Mammals: Elliott Traps, corrugated iron, nocturnal spotlighting, scat and diggings analysis
- Birds: Call recognition and visually during diurnal and nocturnal surveys

Timing: Surveys were carried out throughout the survey period (June 2005 to January 2006). Birds: Bird counts throughout the wetland, four nocturnal surveys throughout study period.

Results: This study provides the most comprehensive survey to date of the southern section of the Tootgarook Wetland. Detailed results are presented in Section 4.1. Results summarised below:

- Fish: Three species (two native)
- Decapod crustaceans: One species
- Amphibians: Four species
- Reptiles: Nine reptile species (one tortoise species, six lizard species, two snake species)
- Mammals: 12 species (9 native)
- Birds: 54 species (48 native)

Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area).

4.1.8 Legg – White-footed Dunnart survey at Tootgarook Swamp Reserve, Boneo and Sanctuary Park Bushland Reserve


Geographic extent: Tootgarook Swamp Reserve, Boneo and Sanctuary Park Bushland Reserve, Rosebud West.

Method: Pitfall traps, Elliott Traps and hair tubes.

Timing: August 2006
Results: Low numbers of White-footed Dunnart (*Sminthopsis leucopus*) recorded. One individual caught at Sanctuary Park and two individuals at Tootgarook Swamp Reserve Boneo.

Significant knowledge gaps: Limited geographic extent, large areas of the wetland (McNaught Property) not surveyed.

4.1.9 Legg – Swamp Skink survey, Chinaman’s Creek

Study/Program: Legg (2007). Swamp Skink (*Egernia (Lissolepis) coventryi*) Survey at Chinaman’s Creek, between Eastbourne Road and Point Nepean Road, Rosebud West, January 2007. Report by Mal’s Environmental and Ecological Services for the Friends of Chinaman’s Creek

Geographic extent: 500 m of Chinaman’s Creek between Eastbourne Road and Point Nepean Road, Rosebud West, north of Tootgarook Wetland.

Method: Elliott Traps (180 trapping nights) and direct searching.

Timing: November 2007

Results: Increase in the numbers of Swamp Skinks observed in the study area since 2002, likely as a result of re-vegetation efforts by the Friends of Chinaman’s Creek.

Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area).

4.1.10 Legg – Swamp Skink survey, Drum Drum Alloc Creek from Boneo Road to Chinaman’s Creek

Study/Program: Legg (2008). Swamp Skink Survey of Kings Creek, Hastings, Limestone Road Boneo and Drum Drum Alloc Creek from Boneo Road to Chinaman’s Creek, April 2008.

Geographic extent: Drum Drum Alloc Creek from Boneo Road to Chinaman’s Creek.

Method: Elliott Traps and direct searching.

Timing: April 2008

Results: Swamp Skinks observed in the study area.

Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area).

4.1.11 Robertson and Steane – Swamp Skink survey, lower reaches of Drum Drum Alloc Creek

Study/Program: Robertson and Steane (2007). Field assessment of the status of the Swamp Skink (*Egernia coventryi*) along the lower reaches of Drum Drum Alloc Creek, Rosebud.

Geographic extent: 1300 m of Drum Drum Alloc Creek west of Boneo Road to Chinaman’s Creek.

Method: Elliott Traps and direct searching.

Timing: Four days in March 2007

Results: Swamp Skinks observed in the study area.

Significant knowledge gaps: Limited geographic extent.
4.1.12 Ecology Partners - Frogs of the Mornington Peninsula


Geographic extent: Mornington Peninsula from Point Nepean to Cranbourne-Frankston Road and South Gippsland Highway, including the Tootgarook Wetland, Chinaman's Creek and Drum Drum Alloc Creek.

Method: Desktop review (biological databases, Atlas of Victorian Wildlife (AVW), Protected Matters Search), field surveys (call playback and spotlighting at selected locations) between May and June.

Timing: Snapshot study conducted in 2007, field assessment undertaken between May and June.

Results:

- Victorian Froglet (*Geocrinia victoriana*) – Unlikely to be common but potential habitat is found in the Drum Drum Alloc Creek and Tootgarook Wetland.
- Pobblebonk (*Limnodynastes dumerilii*) – Common and widespread throughout the peninsula.
- Striped Marsh Frog (*Limnodynastes peronii*) – Possible on the peninsula but more often from the northern end.
- Spotted Marsh Frog (*Limnodynastes tasmaniensis*) – Common and widespread throughout the peninsula.
- Common Spadefoot Toad – Unlikely to occur.
- Haswell's Frog (*Paracrinia haswelli*) – Not likely to be common on the Mornington Peninsula but there is potential habitat (remnant vegetation near permanent water) found near the Drum Drum Alloc Creek.
- Southern Toadlet (*Pseudophryne semimarmorata*) – Found historically, with good habitat found at the Tootgarook Wetland, Drum Drum Alloc Creek and Chinaman's Creek.
- Common Froglet (*Crina signifera*) - Common and widespread throughout the peninsula, likely in the Tootgarook Wetland.
- Southern Brown Tree Frog (*Litoria ewingii*) - Common and widespread throughout the peninsula.
- Peron's Tree Frog (*Litoria peronii*) – Unlikely to be common or widespread on the peninsula.
- Growling Grass Frog (*Litoria raniformis*) – Unlikely to occur and unlikely to have occurred historically.
- Whistling Tree Frog (*Litoria verreauxii*) – Likely to be common and widespread on the Mornington Peninsula and likely to occur in the Tootgarook Wetlands.

Significant knowledge gaps: Reliant on existing databases (survey records unlikely to be systematic, AVW data used likely outdated). Surveys conducted outside breeding season of several species (Growling Grass Frog, Southern Bullfrog, Haswell's Frog). Tootgarook Wetland not surveyed directly.

4.1.13 Ecology Partners – Flora and fauna assessment of proposed stormwater treatment wetland at Henry Wilson Drive, Rosebud West, Victoria


Geographic extent: Small property located at Henry Wilson Drive, Rosebud West. Location of a proposed stormwater treatment and associated drainage into Hiscocks Road Drain (extension of Drum Drum Alloc Creek).

Method: Desktop review (Melbourne Water Fish Database (MWFD), AVW) and one day field assessment for Swamp Skink, Dwarf Galaxias (*Galaxiella pusilla*) and Southern Toadlet.

Timing: Snapshot study conducted in 2009, field assessment undertaken in September.
Results: Desktop review indicated that Dwarf Galaxias are unlikely to currently occur in the study area. Not recorded in the study area during the field survey.

Suitable habitat for the Swamp Skink occurs at the study location, but the species was not recorded during field surveys. Swamp Skink considered likely to occur alongside Drum Drum Alloc Creek.

Habitat for Southern Toadlet was identified at the study location, however individuals were not recorded during the field survey. One common frog species, the Common Froglet was recorded.

No significant bird species recorded during field surveys, however several state significant species recorded in the local area by the AVW: Australian Shoveler (Anas rhynchotis), Royal Spoonbill (Platalea regia), Eastern Great Egret (Ardea alba modesta), Hardhead (Aythya australis) and Australasian Bittern (Botaurus poiciloptilus). Habitat for the Nakeen Night Heron (Nycticorax caledonicus) also identified.

Significant knowledge gaps: The field assessment was undertaken over only one day (24<sup>th</sup> September 2008). Geographic extent of the study was small. Reliant on existing databases (survey records unlikely to be systematic, AVW data used likely outdated).

4.1.14 Streamline Research - Fish survey of Drum Drum Alloc Creek


Geographic extent: Drum Drum Alloc Creek

Method: Unknown (study reviewed in Ecology Partners 2009)

Timing: Unknown (study reviewed in Ecology Partners 2009)

Results: Spotted Galaxias (Galaxias truttaceus), Short-finned Eel (Anguilla australis)

Significant knowledge gaps: Unknown (study reviewed in Ecology Partners 2009)

4.1.15 Biosis Research – Flora and fauna assessment of the VicRoads freeways extension reserve


Geographic extent: VicRoads freeway extension reserve which bisects the Tootgarook Wetland from east to west in the northern section of the wetland.

Method: Desktop review (Victorian Biodiversity Atlas (VBA), DSE Biodiversity Interactive Map (BIM), Protects Matters Search Tool, Melbourne Water Fish Database (MWFB)) and additional reports.

Timing: Desktop assessment conducted in 2012.

Results: Determined the significant (those with conservation protection) species that have been recorded or are likely to occur within 5 km of the study area and then assessed the likelihood of occurrence. Instances where Biosis have predicted species have a medium or high likelihood of occurrence but the species has not been recorded in the wetland is outlined in Section 4.2.

Significant knowledge gaps: No field surveys. Study had a limited geographic extent.
4.1.16  Brett Lane and Associates – Henry Wilson Drive Flora and Fauna assessment


Geographic extent: Small property located at Henry Wilson Drive, Rosebud West. Location of a proposed stormwater treatment and associated drainage into Hiscocks Road Drain (extension of Drum Drum Alloc Creek).

Method: Desktop review (Victorian Fauna Database (VFB), Protected Matters Search), field assessment to identify suitable habitat (one day in February 2007)

Timing: Snapshot survey completed in 2007

Results: Estimated that the local areas supports 128 faunal species: 13 mammal species (4 introduced), 101 species of birds (9 introduced), 8 species of reptile and 6 frog species (fish not considered).

Significant knowledge gaps: No field studies.

4.1.17  Ecology Partners – Dwarf Galaxias and Swamp Skink surveys for The Village Green housing development in Rosebud West

Study/Program: Ecology Partners (2010). Targeted Swamp Skink and Dwarf Galaxias surveys for the proposed Stage 6 of The Village Green, Rosebud West, Victoria.

Geographic extent: Approximately 2.6 ha area south of the current extent of The Village Green housing development (retirement village) (end of St. Elmos Cl.). Area also known as ‘Sanctuary Park’.

Method: Swamp Skink and Dwarf Galaxias surveys.

Swamp Skink – 90 Trap days using baited Elliott Traps (A Type).

Dwarf Galaxias – Dip netting (10 mins per surveyed site), Bait trapping (20 traps set overnight, baited with glow sticks).

Timing: Snapshot assessment - surveys conducted in October 2010

Results: No Swamp Skinks or Dwarf Galaxias recorded.

Desktop review indicated that Swamp Skink have been recorded in habitat adjacent to the study area. Dwarf Galaxias however have not been recorded from nearby.

Numerous Swamp Rats and Brown Rat recorded from the site (caught in Elliott Traps).

Significant knowledge gaps: Small geographic study area.

4.1.18  Friends of Chinaman’s Creek – Frogs of Chinaman’s Creek and Tootgarook Swamp


Geographic extent: Chinaman’s Creek and the Tootgarook Wetland

Method: Local knowledge. Newsletter written by Peter Roberston from Wildlife Profiles, a respected and credible source on frogs in Victoria.

Timing: N/A
Results:

- Haswell’s Frog – Not likely to be common on the Mornington Peninsula, not many details about its occurrence in the Tootgarook Wetland.
- Pobblebonk – Common and widespread throughout the peninsula, including the Tootgarook Wetland. Most common near farm dams and heard following winter rains.
- Spotted Marsh Frog – Common and widespread throughout the peninsula, and found in the wetland in marshes and associated with farm dams.
- Common Froglet – Common and widespread throughout the peninsula, including the Tootgarook Wetland. Heard throughout the year and is found associated with wetlands, farm dams and in wet areas throughout the suburbs.
- Southern Toadlet – Found historically, with good habitat found at the Tootgarook Wetland, Drum Drum Alloc Creek and Chinaman’s Creek however over the last decade it has almost disappeared from the Peninsula.
- Southern Brown Tree Frog - Common and widespread throughout the peninsula, one of the most common at the creek and the wetlands.
- Whistling Tree Frog – Occurs at the Tootgarook Wetlands and Chinaman’s Creek, but appears to have declined in recent years.
- Peron’s Tree Frog – The Tootgarook Wetland is not within the normal range of this species, but is has been recorded at the wetland. Individuals likely introduced from elsewhere in its range.

Significant knowledge gaps: Source of background data unknown.

4.1.19 Greening Australia – Boneo Park development flora and fauna recommendations


Geographic extent: North-east quarter of the Boneo Park property.

Method: Desktop surveys and diurnal survey conducted on one day (15th April, 2008).

Timing: Snapshot survey (April 2008)

Results: Concluded that Australasian Bittern and Swamp Skink are unlikely to occur in the study area as there is no suitable habitat.

Swamp Skink have been recorded nearby in the Chinaman’s Creek area.

Incidental records of Fox (Vulpes vulpes) and Southern Brown Tree Frog.

Significant knowledge gaps: Limited field survey, small geographic extent.

4.1.20 Legg – Comprehensive fauna survey of the MPSC properties in the Tootgarook Wetland area


Geographic extent: MPSC sites within the wetland area (3 Dutton Street, 66 Henry Wilson Drive, Hiscock Road Reserve, MPS Reserve at 20 Colchester Road, Sanctuary Park, Truemans Road at the former landfill site, Tern Avenue Bushland Reserve).

Method: Standard survey techniques, as described in previous surveys completed by Legg.

Timing: October 2013 – May 2014
Results: This study provides a comprehensive survey of a number of locations around the wetland that have not been surveyed before and an update for some sites (e.g. Sanctuary Park, Tern Avenue Bushland Reserve. Detailed results are presented in Section 4.1. Important result from this survey is the continued detection of White-footed Dunnart and Australasian Bittern in the wetland area. Results summarised below:

- Fish: Six species (two introduced)
- Decapod crustaceans: One species
- Amphibians: Seven species
- Reptiles: 14 reptile species (one tortoise species, ten lizard species, three snake species)
- Mammals: 16 species (11 native)
- Birds: 108 species (102 native)

The most recent survey program undertaken by Legg provides a comprehensive and robust survey of the fauna of a number of sites around the study area and an assessment of a number of other important features such as habitat value. Given the timing of the delivery of this report in the context of the current review, it has not been able to be summarised fully here. The results and assessment included in Legg (2014) should however be considered when determining management priorities and actions in the surveyed areas (MPSC properties) but also in the wetland more broadly.

Significant knowledge gaps: Limited geographic extent (however with the other Legg surveys, represents a comprehensive assessment of the area).

4.2 Summary of faunal values

The summary of the faunal values in the Tootgarook Wetland has been compiled from the reviewed reports. Malcolm Legg across a number of studies from 2002-2008 has provided a detailed and comprehensive survey of nearly the entire extent of the Tootgarook Wetland. The species list for each animal group (below) has been generated based strongly on the work of Legg, with additional records from other studies and the VBA. Where other studies have indicated that a species is likely to occur but was not directly recorded during that study, or by Legg, this has been noted. To give an indication of the coverage of the records, the locations within the wetland are shown in Figure 4-2. These data come from the MPSC records and come substantially from Legg’s surveys.

As outlined in Section 2.7, the various names of the broader wetland area (e.g. Sanctuary Park) are used frequently by a range of stakeholders including local residents and community groups. To help to make the compiled records useful for these stakeholders, the section of the Tootgarook Wetland that the faunal records have been made are also indicated in the following tables where possible.

Bird records from three main sources; Birdlife Australia, Legg’s study series and the VBA, are also presented below. Unlike the other fauna records, broad wetland areas where these records were made have not been provided in the following tables.
4.2.1 Table legend

The following codes have been used to indicate the broad locations within the wetland where records of each species have been made. These areas are broadly consistent with Legg’s studies (2002-2008). Spatial representations of these point source data have been produced where possible and are provided as an addition to this report.

**TWR** – Tootgarook Wetland Reserve, Boneo, south of Browns Road, east of Eagle Ridge Golf Course (broadly consistent with Legg 2006b)

**TA** – Tootgarook Wetland, Tern Avenue, north of Hiscock Avenue, south of Tootgarook Sports Fields (broadly consistent with Legg 2003)

**N** – Area north of the wetland encompassing Chinaman’s Creek and Drum Drum Alloc Creek (broadly consistent with Legg 2002)

**MNP** – The McNaught Property, also called the Tootgarook Wetland and Moonah Woodland (broadly consistent with Legg 2004)

**SP** – Sanctuary Park Bushland Reserve, south of The Village Green retirement village broadly consistent (broadly consistent with Legg 2006)

As part of Legg’s studies, the relative abundance of each species recorded in the study area was estimated. While this represents the estimates of only one survey, it may provide some information to inform informal or indicative future comparisons.

The conservation significance of each species is also recorded. If the species has any legislative protection under federal (Environmental Protection and Biodiversity Act (EPBC) 1999) or State (Flora and Fauna Guarantee Act (FFG) 1988 or the DSE Advisory List of Threatened Vertebrate Fauna (DSE Ad List)) law, as identified in DSE (2013) this has been noted. For the bird species, if they are protected under international treaties such as the Japanese (JAMBA), Chinese (CAMBA) or Republic of Korea (ROKAMBA) Australia Migratory Bird Agreement this has also been flagged.Introduced species have also been identified.
Figure 4-2 Locations of Mornington Peninsula Shire Council records from the Tootgarook Wetland.
### 4.2.2 Fish

Table 4-1 Fish species recorded from the Tootgarook Wetland and Chinaman’s Creek and Drum Drum Alloc Creek within the area bounded by the Tootgarook Wetland. (Estimated Relative Abundance taken from Legg studies).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Location of records in the study area</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anguilla australis</td>
<td>Short-finned Eel</td>
<td>Common</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Galaxias brevipinnis</td>
<td>Broad-finned Galaxias</td>
<td>Rare</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Galaxias maculatus</td>
<td>Common Galaxias</td>
<td>Abundant</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Galaxias truttaceus</td>
<td>Spotted Galaxias</td>
<td>Rare</td>
<td>MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Pseudaphritis urvilli</td>
<td>Tupong</td>
<td>Common</td>
<td>MNP, N</td>
<td></td>
</tr>
<tr>
<td>Carassius auratus</td>
<td>Goldfish</td>
<td>Common</td>
<td>N</td>
<td>Introduced</td>
</tr>
<tr>
<td>Tinca tinca</td>
<td>Tench</td>
<td>Common</td>
<td>N</td>
<td>Introduced</td>
</tr>
<tr>
<td>Gambusia holbrooki</td>
<td>Eastern Gambusia</td>
<td>Common</td>
<td>TWR, MNP, SP, N</td>
<td>Introduced</td>
</tr>
<tr>
<td>Neochanna cleaveri</td>
<td>Australian Mudfish</td>
<td>Predicted (Biosis 2012)</td>
<td></td>
<td>FFG, DSE Ad. List (Crit. End.)</td>
</tr>
</tbody>
</table>

Although Biosis 2012 indicate that the likelihood of occurrence for Dwarf Galaxias is Medium, the failure to record this species in any of the surveys and the lack of historic records strongly suggests that the species has a Very Low likelihood of occurrence in the study area.

### 4.2.3 Frogs

Table 4-2 Frog species recorded from the Tootgarook Wetland and Chinaman’s Creek and Drum Drum Alloc Creek within the area bounded by the Tootgarook Wetland. (Estimated Relative Abundance taken from Legg studies).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Location of records in the study area</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crinia signifera</td>
<td>Common Eastern Froglet</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Paracrinia haswelli</td>
<td>Haswell’s Frog</td>
<td>Rare</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Limnodynastes dumerilii</td>
<td>Pobblebonk</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Limnodynastes tasmaniensis</td>
<td>Spotted Marsh Frog</td>
<td>Uncommon</td>
<td>N, MNP</td>
<td></td>
</tr>
<tr>
<td>Litoria ewingii</td>
<td>Southern Brown Tree Frog</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Litoria verreauxii verreauxii</td>
<td>Verreaux’s Tree Frog</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Pseudophryne semimarmorata</td>
<td>Southern Toadlet</td>
<td>Uncommon</td>
<td>MNP, N</td>
<td>DSE Ad. List (Vuln.)</td>
</tr>
<tr>
<td>Geocrinia victoriana</td>
<td>Victorian Froglet</td>
<td>Predicted to occur</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Abolitins and Organ 2007, Brett Lane and Assoc. 2007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litoria peronii</td>
<td>Peron’s Tree Frog</td>
<td>Outside normal range, possible introduction (FOCC 2006)</td>
<td></td>
<td>Introduced</td>
</tr>
</tbody>
</table>
4.2.4 Crustaceans and macroinvertebrates

Table 4-3 Crustaceans and macroinvertebrates recorded from the Tootgarook Wetland and Chinaman’s Creek and Drum Drum Alloc Creek within the area bounded by the Tootgarook Wetland. (Estimated Relative Abundance taken from Legg studies).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Location of records in the study area</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaeus sp.</td>
<td>Burrowing Cray</td>
<td>Common</td>
<td>TWR, MNP, SP, N</td>
<td></td>
</tr>
<tr>
<td>Plectrotarsus gravenhorsti</td>
<td>Caddisfly</td>
<td>Recorded in 1981, predicted to be a Medium likelihood of occurrence (Biosis 2012)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2.5 Reptiles

Table 4-4 Reptiles recorded from the broader Tootgarook Wetland area. (Estimated Relative Abundance from Legg studies).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Location of records in the study area</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egernia (Lissolepis) coventryi</td>
<td>Swamp Skink</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td>FFG, DSE Ad. List (Vuln)</td>
</tr>
<tr>
<td>Lampropholis delicata</td>
<td>Delicate Skink</td>
<td>Common</td>
<td>MNP, N</td>
<td></td>
</tr>
<tr>
<td>Lampropholis guichenoti</td>
<td>Garden Skink</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Bassiana (Pseudemoia) duperreyi</td>
<td>Eastern Three-lined Skink</td>
<td>Common</td>
<td>MNP, N</td>
<td></td>
</tr>
<tr>
<td>Saproscincus mustelinus</td>
<td>Weasel Skink</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Tiliqua nigrolutea</td>
<td>Blotched Blue-tongue</td>
<td>Common</td>
<td>TA, N</td>
<td></td>
</tr>
<tr>
<td>Tiliqua scincoides</td>
<td>Eastern Blue-tongue</td>
<td>Common</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Amphibolurus muricatus</td>
<td>Tree Dragon</td>
<td>Uncommon</td>
<td>MNP</td>
<td></td>
</tr>
<tr>
<td>Niveoscincus metallicus</td>
<td>Metallic Skink</td>
<td>Uncommon</td>
<td>SP</td>
<td></td>
</tr>
<tr>
<td>Pseudemoia rawlinsoni</td>
<td>Glossy Grass Skink</td>
<td>Common</td>
<td>MNP, SP</td>
<td>FFG, DSE Ad. List (Vuln)</td>
</tr>
<tr>
<td>Austrelaps superbus</td>
<td>Lowland Copperhead</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Drysdalia coronoides</td>
<td>White-lipped Snake</td>
<td>Uncommon</td>
<td>MNP, N</td>
<td></td>
</tr>
<tr>
<td>Notechis scutatus</td>
<td>Tiger Snake</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Pseudonaja textilis</td>
<td>Eastern Brown Snake</td>
<td>Common</td>
<td>MNP</td>
<td></td>
</tr>
<tr>
<td>Chelodina longicollis</td>
<td>Common Long-necked Tortoise</td>
<td>Common at times</td>
<td>TWR, MNP, SP</td>
<td>DSE Ad. List (Data Def.)</td>
</tr>
</tbody>
</table>
### Mammals

Table 4-5 Mammals recorded from the broader Tootgarook Wetland area. (Estimated Relative Abundance from Legg studies).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Location of records in the study area</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MARSUPIALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sminthopsis leucopus</td>
<td>White-footed Dunnart</td>
<td>Rare</td>
<td>TWR, SP</td>
<td>FFG, DSE Ad. List (Near Threatened)</td>
</tr>
<tr>
<td>Tachyglossus aculeatus</td>
<td>Short-beaked Echidna</td>
<td>Common</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Pseudocheirus peregrinus</td>
<td>Common Ringtail Possum</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Trichosurus vulpecula</td>
<td>Common Brushtail Possum</td>
<td>Common</td>
<td>TWR, TA, MNP</td>
<td></td>
</tr>
<tr>
<td>Wallabia bicolor</td>
<td>Black Wallaby</td>
<td>Common</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Macropus giganteus</td>
<td>Eastern Grey Kangaroo</td>
<td>(Presumed uncommon)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MICRO BATS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tadarida australis</td>
<td>White-striped Free-tail Bat</td>
<td>Rare</td>
<td>MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Chalinolobus gouldii</td>
<td>Gould’s Wattled Bat</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td></td>
</tr>
<tr>
<td>Vespadelus regulus</td>
<td>Southern Forest Bat</td>
<td>Rare</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Nyctophilus geoffroyi</td>
<td>Lesser Long-eared Bat</td>
<td>Uncommon</td>
<td>TWR, MNP, SP, N</td>
<td></td>
</tr>
<tr>
<td>Vespadelus darlingtoni</td>
<td>Large Forest Bat</td>
<td>Rare</td>
<td>TWR, MNP, TA, SP, N</td>
<td></td>
</tr>
<tr>
<td>Vespadelus vulturnus</td>
<td>Little Forest Bat</td>
<td>Common</td>
<td>TWR, MNP, TA</td>
<td></td>
</tr>
<tr>
<td><strong>RODENTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rattus lutreolus</td>
<td>Swamp Rat</td>
<td>Common</td>
<td>TWR, MNP, N, SP</td>
<td></td>
</tr>
<tr>
<td>Hydromys chyrogaster</td>
<td>Water Rat</td>
<td>Rare</td>
<td>MNP</td>
<td></td>
</tr>
<tr>
<td><strong>INTRODUCED MAMMALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mus musculus</td>
<td>House Mouse</td>
<td>Abundant</td>
<td>TWR, MNP, TA, N, SP</td>
<td>Introduced</td>
</tr>
<tr>
<td>Rattus rattus</td>
<td>Black Rat</td>
<td>Uncommon</td>
<td>TA, N, SP, MNP</td>
<td>Introduced</td>
</tr>
<tr>
<td>Canis lupus familiaris</td>
<td>Domestic Dog</td>
<td>Common</td>
<td>N</td>
<td>Introduced</td>
</tr>
<tr>
<td>Vulpes vulpes</td>
<td>Fox</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td>Introduced</td>
</tr>
<tr>
<td>Felis catus</td>
<td>Cat</td>
<td>Common</td>
<td>TWR, MNP, TA, N, SP</td>
<td>Introduced</td>
</tr>
<tr>
<td>Oryctolagus cuniculus</td>
<td>European Rabbit</td>
<td>Common</td>
<td>MNP</td>
<td>Introduced</td>
</tr>
</tbody>
</table>
### 4.2.7 Birds

Table 4-6 Birds recorded from the broader Tootgarook Wetland area (Estimated Relative Abundance from Legg studies). Source of Records: Birdlife Australia = BA (date of last record), Legg = recorded in Legg fauna survey, Victorian Biodiversity Atlas = VBA (date of last record).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Estimated Relative Abundance (Legg)</th>
<th>Source of records</th>
<th>Significance</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botaurus poiciloptilus</td>
<td>Australasian Bittern</td>
<td>Rare</td>
<td>BA (May-14), Legg, VBA (June-95)</td>
<td>EPBC (End.), FFG, DSE Ad List (End.)</td>
<td>Breeding obs. (BA)</td>
</tr>
<tr>
<td>Tachybaptus novaehollandiae</td>
<td>Australasian Grebe</td>
<td>Not recorded by Legg</td>
<td>BA (Nov-13), VBA (Sep-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthus novaeseelandiae</td>
<td>Australasian Pipit</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14), VBA (April-89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anas rhynchos</td>
<td>Australasian Shoveler</td>
<td>Rare</td>
<td>BA (Sep-99), VBA (Sep-01)</td>
<td>DSE Ad List (Vulnerable)</td>
<td></td>
</tr>
<tr>
<td>Falco longipennis longipennis</td>
<td>Australian Hobby</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (April-89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cracitus tibicen</td>
<td>Australian Magpie</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (May-09)</td>
<td>Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Pelecanus conspicillatus</td>
<td>Australian Pelican</td>
<td>Common at times</td>
<td>BA (May-14), Legg, VBA (Feb-92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corvus corone corone</td>
<td>Australian Raven</td>
<td>Common</td>
<td>BA (Feb-14), Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acrocephalus australis</td>
<td>Australian Reed-Warbler</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tadorna tadornoides</td>
<td>Australian Shelduck</td>
<td>Rare</td>
<td>BA (Oct-11), Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porzana fluminea</td>
<td>Australian Spotted Crake</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14), VBA (Jan-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threskiornis moluccus</td>
<td>Australian White Ibis</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Sep-01)</td>
<td>Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Chenonetta jubata</td>
<td>Australian Wood Duck</td>
<td>Common</td>
<td>BA (Oct-11), Legg, VBA (Jan-87)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porzana pusilla</td>
<td>Baillon's Crane</td>
<td>Not recorded by Legg</td>
<td>BA (May-14)</td>
<td>FFG, DSE Ad List (Vuln.)</td>
<td></td>
</tr>
<tr>
<td>Cygnus atratus</td>
<td>Black Swan</td>
<td>Common at times</td>
<td>BA (May-14), Legg, VBA (Sep-01)</td>
<td>Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Coracina novaehollandiae</td>
<td>Black-faced Cuckoo-shrike</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg</td>
<td></td>
<td></td>
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<tr>
<td>Elseymornis melanops</td>
<td>Black-footed Dotterel</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (June-99)</td>
<td></td>
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<tr>
<td>Elanus axillaris</td>
<td>Black-shouldered Kite</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (June-10)</td>
<td>Breeding obs. (BA)</td>
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<tr>
<td>Himantopus himantopus</td>
<td>Black-winged Stilt</td>
<td>Not recorded by Legg</td>
<td>BA (Apr-13)</td>
<td></td>
<td></td>
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<tr>
<td>Falco bengara</td>
<td>Brown Falcon</td>
<td>Rare</td>
<td>BA (Apr-13), Legg, VBA (April-89)</td>
<td></td>
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<tr>
<td>Accipiter fasciatus fasciatus</td>
<td>Brown Goshawk</td>
<td>Uncommon</td>
<td>BA (Feb-13), Legg, VBA (April-89)</td>
<td></td>
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<tr>
<td>Coturnix ypsilophora</td>
<td>Brown Quail</td>
<td>Rare</td>
<td>BA (Oct-11), Legg</td>
<td></td>
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<tr>
<td>Acanthiza pusilla</td>
<td>Brown Thornbill</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-01)</td>
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<tr>
<td>Phaps elegans</td>
<td>Brush Bronze-wing</td>
<td>Not recorded by Legg</td>
<td>VBA (Oct-87)</td>
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<tr>
<td>Gallirallus philippensis</td>
<td>Buff-banded Rail</td>
<td>Uncommon</td>
<td>BA (Mar-14), Legg</td>
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<tr>
<td>Acanthiza reguloides</td>
<td>Buff-rumped Thornbill</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-99), VBA (Feb-99)</td>
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<tr>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Estimated Relative Abundance (Legg)</td>
<td>Source of records</td>
<td>Significance</td>
<td>Notes</td>
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<tr>
<td>Bubulcus ibis</td>
<td>Cattle Egret</td>
<td>Not recorded by Legg</td>
<td>BA (Jun-90), VBA (June-88)</td>
<td>JAMBA, CAMBA</td>
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<tr>
<td>Anas castanea</td>
<td>Chestnut Teal</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (Sep-01)</td>
<td>Breeding obs. (BA)</td>
<td></td>
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<tr>
<td>Acrocephalus stentoreus</td>
<td>Cimarous Reed-Warbler</td>
<td>Common at times</td>
<td>Legg, VBA (Jan-01)</td>
<td></td>
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<tr>
<td>Accipiter cirrocephalus</td>
<td>Collared Sparrowhawk</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14)</td>
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<tr>
<td>Turdus merula merula</td>
<td>Common Blackbird</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td>Introduced</td>
<td></td>
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<tr>
<td>Phaps chalcoptera</td>
<td>Common Bronzewing</td>
<td>Uncommon</td>
<td>BA (April-01), Legg, VBA (April-01)</td>
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<tr>
<td>Carduelis chloris</td>
<td>Common Greenfinch</td>
<td>BA (Mar-02), Legg</td>
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<tr>
<td>Tringa nebularia</td>
<td>Common Greenshank</td>
<td>Uncommon</td>
<td>Legg</td>
<td>JAMBA, CAMBA, ROKAMBA</td>
<td></td>
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<tr>
<td>Acrocephalus palustris</td>
<td>Common Myna</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-01)</td>
<td>Introduced</td>
<td></td>
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<tr>
<td>Sturnus vulgaris</td>
<td>Common Starling</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-01)</td>
<td>Introduced</td>
<td>Breeding obs. (BA)</td>
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<tr>
<td>Phylidonyris pyrrhoptera</td>
<td>Crescent Honeyeater</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-89)</td>
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<tr>
<td>Ocypopoda lophotes</td>
<td>Crested Pigeon</td>
<td>Not recorded by Legg</td>
<td>BA (April-12)</td>
<td></td>
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<tr>
<td>Platypteryx elegans</td>
<td>Crimson Rosella</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (June-10)</td>
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<tr>
<td>Gallinula tenebrosa</td>
<td>Dusky Moorhen</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (Sep-01)</td>
<td>Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Ardea alba modesta</td>
<td>Eastern Great Egret (and Great Egret)</td>
<td>Rare</td>
<td>BA (Feb-14), Legg, VBA (Sep-01)</td>
<td>JAMBA/CAMBA, FFG, DSE Ad List (Vuln.)</td>
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<tr>
<td>Platypteryx eximius</td>
<td>Eastern Rosella</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jul-00)</td>
<td></td>
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<tr>
<td>Acanthophorus tenuirostris</td>
<td>Eastern Spinebill</td>
<td>Rare</td>
<td>BA (Mar-14), Legg</td>
<td></td>
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<tr>
<td>Eopsaltria australis</td>
<td>Eastern Yellow Robin</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-01)</td>
<td></td>
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<tr>
<td>Fulica atra</td>
<td>Eurasian Coot</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td>Breeding obs. (BA)</td>
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<tr>
<td>Alauda arvensis</td>
<td>Eurasian Skylark</td>
<td>Not recorded by Legg</td>
<td>BA (Nov-13), VBA (May-09)</td>
<td>Introduced</td>
<td></td>
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<tr>
<td>Carduelis carduelis britannica</td>
<td>European Goldfinch</td>
<td>Uncommon</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td>Introduced</td>
<td>Breeding obs. (BA)</td>
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<tr>
<td>Carduelis chloris</td>
<td>European Greenfinch</td>
<td>Not recorded by Legg</td>
<td>VBA (Dec-99)</td>
<td>Introduced</td>
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<tr>
<td>Petrochelidon ariel</td>
<td>Fairy Martin</td>
<td>Not recorded by Legg</td>
<td>BA (Mar-14)</td>
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<tr>
<td>Cacomantis flabelliformis</td>
<td>Fan-tailed Cuckoo</td>
<td>Common</td>
<td>BA (April-12), Legg</td>
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<tr>
<td>Petroica phoenicea</td>
<td>Flame Robin</td>
<td>Rare/migratory</td>
<td>BA (Oct-11), Legg</td>
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<tr>
<td>Eolophus roseicapilla alboceps</td>
<td>Galah</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (June-10)</td>
<td>Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Pachycephala pectoralis</td>
<td>Golden Whistler</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (Sep-99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cisticola exilis</td>
<td>Golden-headed Cisticola</td>
<td>Common at times</td>
<td>BA (May-14), Legg, VBA (May-05)</td>
<td></td>
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<tr>
<td>Phalacrocorax carbo</td>
<td>Great Cormorant</td>
<td>Not recorded by Legg</td>
<td>BA (Mar-14)</td>
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<td></td>
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<tr>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Estimated Relative Abundance (Legg)</td>
<td>Source of records</td>
<td>Significance</td>
<td>Notes</td>
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<tr>
<td>Cracticus torquatus torquatus</td>
<td>Grey Butcherbird</td>
<td>Common</td>
<td>BA (Feb-14), Legg, VBA (May-09)</td>
<td></td>
<td>Breeding</td>
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<tr>
<td>Strepera versicolour</td>
<td>Grey Currawong</td>
<td>Not recorded by Legg</td>
<td>BA (Mar-02)</td>
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<tr>
<td>Rhipidura fuliginosa</td>
<td>Grey Fantail</td>
<td>Common at times</td>
<td>BA (May-14), Legg, VBA (Jul-00)</td>
<td></td>
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<tr>
<td>Colluricincla harmonica</td>
<td>Grey Shrike-thrush</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (May-09)</td>
<td></td>
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<tr>
<td>Anas gracilis</td>
<td>Grey Teal</td>
<td>Not recorded by Legg</td>
<td>BA (Mar-14), VBA (Sep-01)</td>
<td>Breeding obs. (BA)</td>
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<tr>
<td>Aythya australis</td>
<td>Hardhead</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (Sep-01)</td>
<td>DSE Ad List (Vulnerable)</td>
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<tr>
<td>Poliocephalus poliocephalus</td>
<td>Hoary-headed Grebe</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14), VBA (Feb-93)</td>
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<tr>
<td>Chalcites basalis</td>
<td>Horsefield’s Bronze Cuckoo</td>
<td>Uncommon</td>
<td>BA (Dec-99), Legg, VBA (Dec-99)</td>
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<tr>
<td>Passer domesticus</td>
<td>House Sparrow</td>
<td>Not recorded by Legg</td>
<td>BA (Jan-11), VBA (April -89)</td>
<td>Introduced</td>
<td></td>
</tr>
<tr>
<td>Ardea (Mesophoyx) intermedia</td>
<td>Intermediate Egret</td>
<td>Not recorded by Legg</td>
<td>BA (Oct-11)</td>
<td></td>
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<tr>
<td>Larus dominicanus</td>
<td>Kelp Gull</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14)</td>
<td></td>
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<tr>
<td>Gallinago hardwickii</td>
<td>Latham’s Snipe</td>
<td>Uncommon</td>
<td>BA (Dec-99), Legg, VBA (May-09)</td>
<td></td>
<td>CAMBA, JAMBA, ROKAMBA, FFG, DSE Ad List (Near Thr.)</td>
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<tr>
<td>Dacelo novaeguineae</td>
<td>Laughing Kookaburra</td>
<td>Uncommon</td>
<td>BA (Apr-12), Legg, VBA (May-99)</td>
<td>FFG, DSE Ad List (Vuln.) Breeding obs. (BA)</td>
<td></td>
</tr>
<tr>
<td>Rallus pectoralis pectoralis</td>
<td>Lewin’s Rail</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (Sep-01)</td>
<td></td>
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<tr>
<td>Phalacrocorax sulcirostris</td>
<td>Little Black Cormorant</td>
<td>Uncommon</td>
<td>BA (Nov-13), Legg, VBA (Feb-92)</td>
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<tr>
<td>Cacatua sanguinea</td>
<td>Little Corella</td>
<td>Not recorded by Legg</td>
<td>BA (Jan-12)</td>
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<tr>
<td>Hieraaetus morphnoides</td>
<td>Little Eagle</td>
<td>Rare</td>
<td>Legg</td>
<td></td>
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<tr>
<td>Megalurus gramineus</td>
<td>Little Grassbird</td>
<td>Common</td>
<td>BA (Nov-13), Legg, VBA (Sep-01)</td>
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<tr>
<td>Microcarbo melanololecos</td>
<td>Little Pied Cormorant</td>
<td>Rare</td>
<td>BA (Mar-14), Legg, VBA (Feb-96)</td>
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<tr>
<td>Corvus mellori</td>
<td>Little Raven</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Apr-04)</td>
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<td>Breeding obs. (BA)</td>
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<tr>
<td>Anthocephala chrysoptera</td>
<td>Little Wattlebird</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Apr-01)</td>
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<tr>
<td>Grallina cyanoleuca</td>
<td>Magpie-lark</td>
<td>Common</td>
<td>BA (Feb-14), Legg, VBA (April-01)</td>
<td></td>
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<tr>
<td>Tringa stagnatilis</td>
<td>Marsh Sandpiper</td>
<td>Rare</td>
<td>BA (Oct-11), Legg</td>
<td>JAMBA, CAMBA, ROKAMBA</td>
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<tr>
<td>Vanellus miles novaehollandiae</td>
<td>Masked Lapwing</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (Apr-09)</td>
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<tr>
<td>Dicaeum hirundinaceum hirundinaceum</td>
<td>Mistletoebird</td>
<td>Uncommon</td>
<td>Legg</td>
<td></td>
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<tr>
<td>Bizinia lobata</td>
<td>Musk Duck</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-92), VBA (Feb-92)</td>
<td>DSE Ad List (Vuln.)</td>
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<tr>
<td>Glossospitta concinna</td>
<td>Musk Lorikeet</td>
<td>Common at times</td>
<td>BA (Feb-13), Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falco cenchroides</td>
<td>Nankeen Kestrel</td>
<td>Rare</td>
<td>BA (May-14), Legg</td>
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<tr>
<td>Nycticorax caledonicus</td>
<td>Nankeen Night Heron</td>
<td>Uncommon</td>
<td>BA (Mar-14), Legg</td>
<td>DSE Ad List (Near Thr.) Breeding obs. (BA)</td>
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<td>Scientific Name</td>
<td>Common Name</td>
<td>Estimated Relative Abundance (Legg)</td>
<td>Source of records</td>
<td>Significance</td>
<td>Notes</td>
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<tr>
<td><em>Phylidonyris novaehollandiae</em></td>
<td>New Holland Honeyeater</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-01)</td>
<td></td>
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<tr>
<td><em>Manorina melanocephala</em></td>
<td>Noisy Miner</td>
<td>Common</td>
<td>BA (April-12), Legg</td>
<td></td>
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<tr>
<td><em>Anas platyrhynchos</em></td>
<td>Northern Mallard</td>
<td>Not recorded by Legg</td>
<td>BA (Jul-00), VBA (Jul-00)</td>
<td>Introduced</td>
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<tr>
<td><em>Anas superciliosa</em></td>
<td>Pacific Black Duck</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Sep-01)</td>
<td></td>
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<tr>
<td><em>Larus pacificus</em></td>
<td>Pacific Gull</td>
<td>Rare</td>
<td>BA (April-13), Legg, VBA (Jun-88)</td>
<td>DSE Ad List (Near Thr.)</td>
<td></td>
</tr>
<tr>
<td><em>Cuculus (Cacomantis) pallidus</em></td>
<td>Pallid Cuckoo</td>
<td>Rare</td>
<td>Legg</td>
<td></td>
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<tr>
<td><em>Falco peregrinus</em></td>
<td>Peregrine Falcon</td>
<td>Rare</td>
<td>BA (May-14), Legg</td>
<td></td>
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<tr>
<td><em>Phalacrocorax varius</em></td>
<td>Pied Cormorant</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-14)</td>
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<tr>
<td><em>Porphyrio porphyrio melanotus</em></td>
<td>Purple Swamp Hen</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Sep-01)</td>
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<td>BREEDING OBS. (BA)</td>
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<tr>
<td><em>Trichoglossus haematodus moluccanus</em></td>
<td>Rainbow Lorikeet</td>
<td>Common</td>
<td>BA (May-14), Legg</td>
<td></td>
<td></td>
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<tr>
<td><em>Anthochaera carunculata</em></td>
<td>Red Wattlebird</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jun, 10)</td>
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<tr>
<td><em>Neochima temporalis</em></td>
<td>Red-browed Finch</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (April-89)</td>
<td></td>
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<tr>
<td><em>Erythrogonys cinctus</em></td>
<td>Red-kneed Dotterel</td>
<td>Not recorded by Legg</td>
<td>BA (April-13)</td>
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<tr>
<td><em>Columba livia</em></td>
<td>Rock Dove</td>
<td>Not recorded by Legg</td>
<td>VBA (Mar-89)</td>
<td>Introduced</td>
<td></td>
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<tr>
<td><em>Platalea regia</em></td>
<td>Royal Spoonbill</td>
<td>Rare</td>
<td>BA (Feb-14), Legg, VBA (Sep-01)</td>
<td>DSE Ad List (Near Thr.)</td>
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</tr>
<tr>
<td><em>Pachycephala rufiventris</em></td>
<td>Rufous Whistler</td>
<td>Uncommon</td>
<td>Legg</td>
<td></td>
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<tr>
<td><em>Petroica boodang</em></td>
<td>Scarlet Robin</td>
<td>Not recorded by Legg</td>
<td>BA (May-00), VBA (May-00)</td>
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<tr>
<td><em>Calidris acuminata</em></td>
<td>Sharp-tailed Sandpiper</td>
<td>Rare</td>
<td>BA (Feb-14), Legg, VBA (Mar-03)</td>
<td>JAMBA/CAMBA/ROKAMBA</td>
<td></td>
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<tr>
<td><em>Chrysocephalus lucidus</em></td>
<td>Shining Bronze Cuckoo</td>
<td>Rare</td>
<td>Legg</td>
<td></td>
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<tr>
<td><em>Lichenostomus virescens sonorous</em></td>
<td>Singing Honeyeater</td>
<td>Uncommon</td>
<td>BA (April-12), Legg</td>
<td></td>
<td></td>
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<tr>
<td><em>Chroicocephalus novaehollandiae</em></td>
<td>Silver Gull</td>
<td>Common</td>
<td>BA (Nov-13), Legg, VBA (Sep-01)</td>
<td></td>
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<tr>
<td><em>Zosterops lateralis westermensis</em></td>
<td>Silvereye</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (May-05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Alauda arvensis</em></td>
<td>Skylark</td>
<td>Common</td>
<td>Legg</td>
<td>Introduced</td>
<td></td>
</tr>
<tr>
<td><em>Turdus philomelos</em></td>
<td>Song Thrush</td>
<td>Not recorded by Legg</td>
<td>BA (April-13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ninox novaseelandiae</em></td>
<td>Southern Boobook</td>
<td>Rare</td>
<td>Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stipiturus malachurus</em></td>
<td>Southern Emu-wren</td>
<td>Not recorded by Legg</td>
<td>BA (April-14), VBA (May-05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Passer domesticus</em></td>
<td>Sparrow</td>
<td>Common</td>
<td>Legg</td>
<td>Introduced</td>
<td></td>
</tr>
<tr>
<td><em>Acanthagenys rufogularis</em></td>
<td>Spiny-cheeked Honeyeater</td>
<td>Common at times</td>
<td>BA (May-14), Legg, VBA (May-05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Porzana tabuensis</em></td>
<td>Spotless Crake</td>
<td>Uncommon</td>
<td>BA (April-12), Legg, VBA (Feb-92)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pardalotus punctatus</em></td>
<td>Spotted Pardalote</td>
<td>Common</td>
<td>BA (Oct-11), Legg, VBA (May-05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Spilopelia (Streptopelia) chinensis</em></td>
<td>Spotted Dove</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td>Introduced</td>
<td></td>
</tr>
<tr>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Estimated Relative Abundance (Legg)</td>
<td>Source of records</td>
<td>Significance</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------------</td>
<td>---------------------------------</td>
<td>--------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Threskiornis spinicollis</td>
<td>Straw-necked Ibis</td>
<td>Common</td>
<td>BA (Feb-14), Legg, VBA (May-05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calamanthus fuliginosus albitoris</td>
<td>Striated Fieldwren</td>
<td>Common</td>
<td>BA (Feb-14), Legg, VBA (April-89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanthiza lineata</td>
<td>Striated Thornbill</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coturnix pectoralis</td>
<td>Stubble Quail</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cacatua galerita galerta</td>
<td>Sulphur-crested Cockatoo</td>
<td>Uncommon</td>
<td>BA (April-12), Legg, VBA (Jan-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malurus cyanus cyanochlamys</td>
<td>Superb Fairy-wren</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (May-09)</td>
<td>Breeding</td>
<td>obs. (BA)</td>
</tr>
<tr>
<td>Circus approximans</td>
<td>Swamp Harrier</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (June-10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallinula mortieri</td>
<td>Tasmanian Native-hen</td>
<td>Rare</td>
<td>Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquila audax</td>
<td>Wedge-tailed Eagle</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg, VBA (April-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hirundo neoxena</td>
<td>Welcome Swallow</td>
<td>Common</td>
<td>BA (Feb-14), Legg, VBA (May, 09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haliastur sphenurus</td>
<td>Whistling Kite</td>
<td>Uncommon</td>
<td>BA (Feb-14), Legg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haliaeetus leucogaster</td>
<td>White-bellied Sea-Eagle</td>
<td>Not recorded by Legg</td>
<td>BA (Jan-12)</td>
<td>FFG, DSE Ad List (Vuln.)</td>
<td></td>
</tr>
<tr>
<td>Sericornis frontalis frontalis</td>
<td>White-browed Scrubwren</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artamus superciliosus</td>
<td>White-browed Woodswallow</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lichenostomus leucolis</td>
<td>White-eared Honeyeater</td>
<td>Not recorded by Legg</td>
<td>BA (Mar-14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egretta novaehollandiae</td>
<td>White-faced Heron</td>
<td>Common</td>
<td>BA (May-14), Legg, VBA (Jan-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ephianura albifrons</td>
<td>White-fronted Chat</td>
<td>Not recorded by Legg</td>
<td>BA (Feb-91), VBA (April-89)</td>
<td>Breeding</td>
<td>obs. (BA)</td>
</tr>
<tr>
<td>Ardea pacifica</td>
<td>White-necked Heron</td>
<td>Not recorded by Legg</td>
<td>BA (Nov-13), VBA (Feb-97)</td>
<td>Breeding</td>
<td>obs. (BA)</td>
</tr>
<tr>
<td>Lichenostomus penicillatus</td>
<td>White-plumed Honeyeater</td>
<td>Common</td>
<td>BA (Jan-11), Legg, VBA (Jan-00)</td>
<td>Breeding</td>
<td>obs. (BA)</td>
</tr>
<tr>
<td>Hirundapus caudactus</td>
<td>White-throated Needletail</td>
<td>Common at times</td>
<td>Legg</td>
<td>CAMBA, JAMBA, ROKAMBA DSE Ad. List (Near Th.)</td>
<td></td>
</tr>
<tr>
<td>Lalage tricolor</td>
<td>White-winged Triller</td>
<td>Not recorded by Legg</td>
<td>BA (April-12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhipidura leucophrys</td>
<td>Willie Wagtail</td>
<td>Common</td>
<td>BA (Mar-14), Legg, VBA (April-01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platalea flavipes</td>
<td>Yellow-billed Spoonbill</td>
<td>Uncommon</td>
<td>BA (Oct-11), Legg, VBA (Mar-89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lichenostomus chrysops</td>
<td>Yellow-faced Honeyeater</td>
<td>Common</td>
<td>BA (April-13), Legg, VBA (Jul-00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanthiza chrysorhoa</td>
<td>Yellow-rumped Thornbill</td>
<td>Common</td>
<td>Legg, VBA (Mar-90), VBA (April-89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calyptorhynchus funeorus</td>
<td>Yellow-tailed Black-Cockatoo</td>
<td>Not recorded by Legg</td>
<td>BA (Oct-11)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3 Summary of Knowledge Gaps

The field studies by Malcolm Legg provide a detailed and comprehensive baseline of the terrestrial faunal values of the Tootgarook Wetland. Across all of his studies the main faunal groups have been surveyed across the geographic extent of the wetland. One possible gap is that not all of the surveys were conducted throughout the year, and therefore raise the possibility that some seasonally active species may have been missed. However, when considered as a whole, and in conjunction with the other studies reviewed above and the VBA, it is likely that we have a good understanding of the species that occur in the wetland.

The birdlife of the wetland is also extremely well studied. The Birdlife Australia data, supplemented by records from Legg and the VBA provide a very detailed understanding of the bird assemblages of the wetland. The ongoing monitoring conducted by Birdlife Australia not only provides a standardised baseline of the species present, but the repeat surveys will provide an indication of change over time.

Regarding the ‘significant’ terrestrial species (those with conservation protection), we have a good understanding of the locations of populations of Swamp Skink and the Southern Toadlet. Although targeted White-footed Dunnart surveys have been undertaken in Sanctuary Park and the Tootgarook Wetland Reserve in Boneo, no targeted surveys have been undertaken to our knowledge at the McNaught Property.

Finally, although there is a good baseline of the terrestrial faunal species of the Tootgarook Wetland, to our knowledge there has not been ongoing population health monitoring for any of these species.
5. Water quality

The water quality in the Tootgarook Wetland has been examined as part of long-term ongoing monitoring programs, a snapshot assessment as part of other studies and a series of rapid, targeted assessments.

5.1 Review of literature

5.1.1 Long term Melbourne Water water quality monitoring

**Study/Program:** Long term Melbourne Water quality monitoring

**Geographic extent:** Water quality monitoring undertaken at Eastbourne Road, Rosebud

**Method:** Water quality variables collected: Temperature, dissolved oxygen, salinity (EC), pH, Turbidity, Suspended solids, NO₃, NO₂, NH₃, TKN, Total N, PO₄-filtered, Total P, *E. coli*, and a range of metals (As, Cd, Cr, Cu, Pb, Ni, Zn)

**Timing:** Samples collected monthly.

**Results:** Results are reviewed in Condina 2011 (see below).

**Significant knowledge gaps:** Water quality collected on Chinaman’s Creek at Eastbourne Road, which is close to the outfall of Chinaman’s Creek into the bay, within the suburb of Rosebud. Water quality at this location is likely to be heavily impacted by inputs from urban and industrial areas downstream of the Tootgarook Wetland. Monitoring data from this location therefore may not give an accurate indication of water quality in the wetland itself.

5.1.2 Review of Melbourne Water water quality data (included in Condina 2011)


**Geographic extent:** Review of Melbourne Water long term water quality monitoring

**Method:** Review of Melbourne Water long term water quality monitoring

**Timing:** Review of Melbourne Water long term water quality monitoring

**Results:** According to Condina (2007) the water quality in Chinaman’s Creek is determined by a number of major factors; urban and rural inputs, groundwater discharge to Chinaman’s Creek as it moves through the wetland area, and the erosion of the bed and bank. As the Melbourne Water long term water quality monitoring is collected from only one location very low in the catchment, it is not possible to discriminate the relative contributions of these potential contaminant sources.

The levels of Dissolved Oxygen in Chinaman’s Creek are frequently well below the State Environmental Protection Policy (SEPP) guidelines of 4.5 mg/L. The most extreme low concentrations were observed in the summer months, with levels as low as 1.2 mg/L recorded (Condina 2011). These low levels may indicate that there is significant organic matter in the water, or that the groundwater that is discharged to the creek is low in DO. Concentrations less than 4.5 mg/L are expected to stress fish (Condina 2011).

Turbidity of the water at the sampling point on Eastbourne Road is generally low, likely due to high levels of sediment settling in the wetland, rather than high bank stability. High turbidity flows are observed upstream of the wetland (Condina 2011).
Nitrogen concentrations are high compared to the SEPP guidelines with the highest levels recorded in July to November (Condina 2011). The highest concentration recorded was 9.0 mg/L (the SEPP guideline in 0.6 mg/L). The source of this high nitrogen is not known, but it likely to be related to the use of fertilizer and possibly recycled wastewater irrigation on the nearby market gardens, however whether the input to Chinaman’s Creek is via groundwater or surface water is unknown. High nitrogen in the wetland could also be related to natural physiochemical processes (Condina 2011), but this is less likely than a human source.

Metals in Chinaman’s Creek generally meet water quality guidelines. The Melbourne Water water quality monitoring began in 1994 and although there is considerable variation across the year, there has been no mean change in the concentrations across the years.

Condina (2011) also reviewed a number of other water quality studies that have been completed in the Tootgarook Wetlands and the surrounding area. A study of stormwater pollution in the catchment indicated that runoff from agricultural and industrial areas was a potential issue (Condina 2003). This was further emphasised by sediment sampling at Eastbourne Road, which recorded metal concentrations well above guidelines, indicative of industrial pollution. The macroinvertebrate fauna recorded at this site was dominated by pollution tolerant taxa (Ecwise Environmental 2007).

**Significant knowledge gaps:** Water quality collected on Chinaman’s Creek at Eastbourne Road, which is close to the outfall of Chinaman’s Creek into the bay, within the suburb of Rosebud. Water quality at this location is likely to be heavily impacted by inputs from urban and industrial areas downstream of the Tootgarook Wetland. Monitoring data from this location therefore may not give an accurate indication of water quality in the wetland itself.

### 5.1.3 Chinaman’s Creek hotspot investigation and sediment assessment

**Study/Program:** Sharley and MacMahon (2013). Chinaman’s Creek Hotspot Investigation. Report by CAPIM for Melbourne Water, and;


**Geographic extent:** Northern section of the wetland, near the confluence of Drum Drum Alloc Creek and Chinaman’s Creek.

**Method:** Pollutant loads in drains emanating from the industrial zones on Drum Drum Alloc Creek were investigated using passive samplers (polypropylene mesh bags containing granular activated carbon - GAC). A number of drains identified in the first part of the study were also targeted for additional investigation using sediment catchers.

**Timing:** Snapshot assessment undertaken in 2012.

**Results:** A number of drains identified in the industrial areas were discharging concentrations of zinc, copper and Total Petroleum Hydrocarbons that would pose a probable risk to the biota of the Drum Drum Alloc Creek and Chinaman’s Creek. The concentrations of nickel, lead and cadmium were at a level that would pose a possible risk to the aquatic biota of the creeks.

**Significant knowledge gaps:** The study concentrated on the upstream ends of the wetland, and only looked at metal contaminants and other industrial pollutants.

### 5.1.4 Snapshot water quality assessment of Chinaman’s Creek 2003

**Study/Program:** Legg (2004). Fauna survey and management prescriptions for Tootgarook Swamp and Moonah Woodland. Report by Mal’s Environmental and Ecological Services for Rob McNaught.

**Geographic extent:** Chinaman’s Creek in the Tootgarook Wetland (McNaught Property)
Method: Fifteen sites along Chinaman’s Creek and associated dams assessed for temperature, dissolved oxygen, salinity (conductivity), pH, nitrates.


Results: Temperature ranged between approximately 8.7 °C and 10.7 °C. pH was around 8 at all sites. Dissolved oxygen levels were reasonably high, ranging from 7.7 to 8.8 mg/L. Salinity in the main channel of Chinaman’s Creek was around 1500 ns. Nitrates were reasonably high throughout the catchment ranging from 1.8 mg/L to 5.2 mg/L (the SEPP guideline value is 0.6 mg/L).

Significant knowledge gaps: Snapshot assessment of water quality in Chinaman’s Creek completed on just one day. Limited indication of the sources of high nitrates.

5.1.5 Friends of Chinaman’s Creek WaterWatch data

Study/Program: Friends of Chinaman’s Creek (2011). Water quality sampling for Chinamans Creek and Drum Drum Alloc Creek undertaken during Melbourne Water zinc investigation period.

Geographic extent: Chinaman’s and Drum Drum Alloc Creek in the Tootgarook Wetland

Method: 10 sites along Chinaman’s Creek and one bore at Capel Sound Foreshore assessed for a full suite of chemical parameters.

Timing: Assessment carried out in August – September 2011.

Results: Turbidity ranged between 7 and 42 NTU, with high recordings at Chinamans Creek @ Browns Road, Drum Drum Alloc Creek @ Boneo Road and Dum Drum Alloc Creek @ Lymbie Court.

pH ranged between 7 and 8.5, with high recordings at Chinamans Creek downstream of Nepean Highway, Drum Drum Alloc Creek @ Old Cape Shank Road, Drum Drum Alloc Creek @ Boneo Road, Drum Drum Alloc Creek @ Jennings Court (Readymix) and Dum Drum Alloc Creek @ Lymbie Court.

Nitrate ranged between <0.01 and 2.5 with high recordings at Chinamans Creek @ Elizabeth Avenue, Chinamans Creek @ Eastbourne Road, Chinamans Creek downstream of Nepean Highway and Dum Drum Alloc Creek @ Lymbie Court.

Significant knowledge gaps: Assessment of water quality in Chinaman’s and Drum Drum Alloc Creek over two months therefore limited indication of historical and seasonal fluctuations.

5.2 Summary of water quality data

As indicated by the Condina (2011) review of the Melbourne Water long term water quality monitoring, there are some considerable pollutants in Chinaman’s Creek, and by extension, possibly the wetland itself. High nitrogen input is likely coming from the market gardens which are located nearby the wetland. There is also high metal contamination from the industrial areas on Drum Drum Alloc Creek.

5.3 Summary of knowledge gaps

The majority of water quality data for the area has been collected downstream of the wetland. It is therefore difficult to separate the impacts of industrial, urban, agricultural and natural processes.
6. Hydrogeology / Groundwater Dependence

The hydrogeology/groundwater dependence associated within the Tootgarook Wetland has been researched as part of the Melbourne Water Groundwater Dependent Ecosystem (GDE) program. Groundwater monitoring is also undertaken by Southern Rural Water as part of the state-wide State Observation Bore network monitoring.

6.1 Review of literature

6.1.1 Groundwater Dependent Ecosystem Conceptualisation of Tootgarook Wetland/ Boneo Swamp


Geographic extent: Whole of wetland and surrounding landscape

Method: Conceptualisation of the Toogarook Wetland was undertaken to understand its hydrology and ecohydrology and the role groundwater plays at the site to inform targeted monitoring to understand environmental water requirements and inform management actions. The key components of the conceptualisation which were presented in simplified A3 posted and a more detailed table format included ecosystem types, land use, values, hydrology, hydrogeology, ecosystem services, threats, sensitivity to groundwater changes and key knowledge gaps.

Timing: Conceptualisation undertaken in 2012.

Results: Shallow water tables maintain permanent saturation of the soils within the Tootgarook Wetland system. Permanent soil saturation helps maintain surface water runoff reducing any losses of surface water to the groundwater and prevents potential acid sulphate soils (PASS) from turning acidic. Through these processes groundwater helps maintain a healthy aquatic ecosystem, and provides an additional source of water to maintain evapotranspiration potential of terrestrial vegetation during dry periods.

Tootgarook wetland is highly sensitive to changes in the groundwater regime. The consistently shallow (<1m below ground level) watertable since monitoring records began maintain the current hydrological regime and relatively neutral/ slightly alkaline soils. Wetland species are reliant on this stable environment; even slight changes in the groundwater and hence hydrological regime will likely lead to temporary or permanent loss of species. More importantly, it could cause potentially irreversible species loss/habitat damage from acidification of soils, groundwater and receiving waters.

Threats to the Tootgarook Wetland include extensive stock and domestic groundwater extraction in the immediate vicinity and within the wetland boundary. Lowering of the watertable from drainage/extraction/extreme climate changes could lead to acidification of soil, groundwater and subsequent receiving waters (via leaching from soil). The wetland is at risk from land use change such as urban and industrial development with around 80% of wetland in private ownership, which would result in increased urban stormwater runoff and hence changes to the groundwater/ hydrological regime and water quality of the remaining wetland area. The old tip site, now a recreational reserve, in the north west of the wetland is likely influencing groundwater quality locally through subsurface leaching. Saltwater intrusion could be an issue in the future if groundwater levels continue to fall and extraction increases causing migration of the freshwater-saltwater interface. Impact of extraction is evident in the changes to the seasonal amplitude of groundwater levels across the landscape, causing lower (deeper) seasonal watertables during high demand periods. During dry periods (droughts) increased evapotranspiration demands exacerbates the impact of groundwater extraction (SKM, 2014).

Significant knowledge gaps: Significant knowledge gaps exist around the impact of changes to the seasonal variation of groundwater levels due to pumping in dry periods. There is a need to understand and quantify links between the saturation within the wetland caused by shallow watertables, variations in seasonal drawdown and potential impacts on water quality and ecosystem health. A significant knowledge gap exists around the impact on groundwater quality of treated waste water used for irrigation in the Chinaman’s Creek catchment.
6.1.2 Melbourne Water Groundwater and Surface Water Monitoring Program


**Geographic extent:** Whole of Tootgarook wetland and surrounding landscape

**Method:** Development of a groundwater and surface water monitoring network at Tootgarook Wetland to help understand the role that groundwater plays on GDE health and inform Melbourne Water’s long term management. Groundwater monitoring network design recommendations previously provided to Melbourne Water by EarthEon (2012) were also review in the development of the groundwater monitoring network.

**Timing:** The monitoring network was designed in 2014 with bore drilling to be undertaken in the immediate future.

**Results:** The proposed monitoring network includes:

<table>
<thead>
<tr>
<th>Monitoring Site</th>
<th>Location</th>
<th>Proposed Monitoring</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface water monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current monitoring site: ID unknown; staff gauge</td>
<td>Chinaman’s Creek Approximate coordinates (414274 E: 5748560 N)</td>
<td>Replace existing surface water “staff gauge” with a datalogger to improve accuracy and provide correlation with proposed groundwater bores at this location. A dual pressure and Electrical Conductivity (EC) gauge is preferred. Download surface water level data quarterly and obtain a field measurement of TDS during data download Review surface water data concurrently with available groundwater data, to further develop the appreciation of potentially connected systems.</td>
<td>Various Ecological Vegetation Classes in the vicinity</td>
</tr>
<tr>
<td><strong>Groundwater monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MW 001</td>
<td>Central-west portion of the wetland. Approximate coordinates: (313555 E; 5748809 N)</td>
<td><strong>Recommendation</strong> Drill and install a shallow bore (approx. 5 m depth) to monitor groundwater levels in shallow wetland sediments. <strong>Priority:</strong> High <strong>Target Vegetation</strong> Tall Marsh and Coastal Moonah Woodland Threatened species population: <em>Cladium procerum</em> adjacent</td>
<td>Bore to be located on low elevation (approx. 5mAHD) immediately down-gradient of the higher elevation vegetation dune system and adjacent to a near-permanent water body</td>
</tr>
<tr>
<td>MW 002</td>
<td>Central portion of the wetland, adjacent to Chinaman’s Creek. Approximate coordinates: (314296 E; 3748602 N)</td>
<td><strong>Recommendation</strong> Drill and install a deeper bore (approx. 30 m depth) to monitor groundwater levels in a deeper interval of the Quaternary sediments. This will provide hydraulic head information and inform groundwater dependence by correlating with groundwater level data from the shallower bore and the surface water gauge. <strong>Priority:</strong> High <strong>Target vegetation</strong> Swamp Scrub. Abundant dieback of Tea-tree at this point, perhaps worthy of monitoring. Photo points nearby to monitor vegetation condition over time.</td>
<td>Bore to be location on low elevation (&lt;5 mAHD) within the central wetland area and down-gradient of the regional vegetation dune system.</td>
</tr>
<tr>
<td>Monitoring Site</td>
<td>Location</td>
<td>Proposed Monitoring</td>
<td>Rationale</td>
</tr>
<tr>
<td>----------------</td>
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<td>-----------</td>
</tr>
<tr>
<td>MW 003</td>
<td>Central portion of the wetland, adjacent to Chinaman’s Creek Approximate coordinates: (314296 E; 5748602 N)</td>
<td><strong>Recommendation</strong> Drill and install a shallow bore (approx. 5 m depth) to monitor groundwater levels amongst various native vegetation and to correlate groundwater levels with surface water monitoring at the nested surface water level gauge on Chinaman’s Creek. <strong>Priority:</strong> High <strong>Vegetation Targeted</strong> Swamp Scrub. Abundant dieback of Tea-tree at this point, perhaps worthy of monitoring. Photo points nearby to monitor vegetation condition over time.</td>
<td>Bore to be located on low elevation (&lt;5 mAHD) within the central wetland area and down-gradient of the regional vegetated dune system.</td>
</tr>
<tr>
<td>MW 004</td>
<td>Southwest of sand dune. Approximate coordinates: (312580 E; 5748404 N)</td>
<td><strong>Recommendation</strong> Assess whether Truemans Road Landfill bores can be accessed by Melbourne Water for ongoing water level monitoring. If not, consider installing additional bore on eastern road verge of Truemans Road. <strong>Priority:</strong> Medium <strong>Target Vegetation</strong> N/A Bore will help with regional understanding of shallow groundwater levels.</td>
<td>Bore required for monitoring of water levels in the area southwest of the sand dune situated in the southwest portion of the wetland. This area is higher elevation to the lower wetland area.</td>
</tr>
<tr>
<td>MW 005</td>
<td>Central-west portion of the wetland, along a potential receded sand spit. Approximate coordinates: (313,624 E; 5,749,191 N)</td>
<td><strong>Recommendation</strong> Drill and install a shallow bore (approx. 5 m depth) to monitor groundwater levels in shallow wetland sediments. <strong>Priority:</strong> Low <strong>Target Vegetation</strong> Gahnia sedgeland. Brackish Aquatic Herbland Coastal Moonah Woodland</td>
<td>Bore to be located on low elevation (&lt;5 mAHD) within the central wetland area and down-gradient of the regional vegetated dune system.</td>
</tr>
</tbody>
</table>

**Significant knowledge gaps:** Drilling of the bores will be undertaken in 2014, therefore no on-site monitoring data is currently available.

6.1.3 **Visualising Victoria’s Groundwater – Groundwater Monitoring Data**

**Study/Program:** Victorian groundwater monitoring data held by the Department of Environment and Primary Industries (DEPI), Department of State Development, Business and Innovation (DSDBI), Federation University Australia (FedUni), Victoria Mineral Water Committee (VMWC) and the Environmental Protection Authority Victoria (EPA).

**Geographic extent:** Victorian wide datasets

**Method:** A web-GIS that federates groundwater data from disparate sources to assist groundwater researchers and help water managers make the correct choices for the sustainable use of a precious resource. Data includes:
- Water Measurement Information System (WMIS) - formerly GMS (help by DEPI)
- Victorian Aquifer Framework (VAF) (help by DEPI)
- Salinity bore database from Future Farming Systems Research (FFSR) (help by DEPI)
- Seamless Geology (held by DSBDI)
- Geological Exploration and Development Information System (GEDIS) (held by DSBDI)
- Groundwater research bores and other bores not recorded elsewhere (UB Spatial/FedUni Spatial)

- Victorian Mineral Water Committee (VMWC)
- Victorian Mineral Springs database (VMSD) (held by VMSD)
- Certificates and statements of environmental audit (EPA audit reports)
- Groundwater quality restricted use zones (GQRUZs) in Victoria (held by EPA)
- Priority Sites Register (PSR) for Victoria (held by EPA)

**Timing:** Bi-monthly

**Results:** There are currently 10 State Observation Bore network bores being monitored by Southern Rural Water (SRW) in the vicinity of the Tootgarook Wetland, details and locations are provided in the following table.

<table>
<thead>
<tr>
<th>Bore ID</th>
<th>Location</th>
<th>Monitoring Authority</th>
<th>Monitoring Frequency and Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>100017</td>
<td>Boneo Road, north of Browns Road 315598.2 E; 5748152.8 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100018</td>
<td>Boneo Road, south of Browns Road 315597.6 E; 5747730.6 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100020</td>
<td>West of wetland on Browns Road 313592.8 E; 5747808.4 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100021</td>
<td>Truemans Road, South of the Tootgarook Sports Reserve 312858.8 E; 5749434.8 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100022</td>
<td>Boneo Road north of the Mornington Peninsular Freeway 315600.3 E; 5750507.2 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100023</td>
<td>Adjacent Western Treatment Plant 315190.5 E; 5746739.8 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100024</td>
<td>Tootgarook Sports Reserve north west of wetland (depth 50 m) 313445.0 E; 5749700.9 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>100025</td>
<td>Tootgarook Sports Reserve north west of wetland (depth 19 m) 313454.1 E; 5749709.2 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>S62034/1</td>
<td>Downstream Chinamans Creek at Eastbourne Road approx. 500m inland from coast (depth 80 m) 314693.1 E; 5751354.1 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
<tr>
<td>S62034/2</td>
<td>Downstream Chinamans Creek at Eastbourne Road approx. 500m inland from coast (depth 80 m) 314693.1 E; 5751357.1 N</td>
<td>DEPI/ SRW – State Observation Bore Network bore.</td>
<td>Bi-Monthly groundwater levels</td>
</tr>
</tbody>
</table>

**Significant knowledge gaps:** The State Observation Bore Network bores currently being monitored are located in the area around Tootgarook Wetland; therefore no actual onsite groundwater monitoring data is currently available for the wetland. Water quality is currently not monitored at any of these sites and there is limited historical groundwater quality data available for each bores, with records generally only available from monitoring in the 1980’s.

**6.2 Summary of groundwater data**

The current groundwater monitoring as part of the State Observation Bore network provides detailed historical records of regional groundwater levels in the Tootgarook Wetland region. The proposed groundwater and surface water monitoring as part of the Melbourne Water GDE program will provide more localised monitoring data and an understanding of the role that groundwater plays on GDE health at Tootgarook Wetland.
The conceptualisation of the Tootgarook Wetland identified the importance that groundwater plays in maintaining the health of the swamp, particularly in maintain the saturation of the wetland system. Specifically, it identified that groundwater provides significant habitat for wetland and terrestrial vegetation ecosystems, maintains the saturation of PASS and maintains surface water runoff, therefore highlighting the importance of the management of groundwater in the vicinity and within the wetland.

6.2.1 Groundwater Resource Appraisal for Southeast Melbourne


Geographic extent: South-eastern Melbourne. The study area comprised the Quaternary and Upper Tertiary aquifers of south-east Melbourne and the Mornington Peninsula, extending from St Kilda in the north to Point Nepean in the south, while Port Phillip Bay forms its western boundary.

Method: The Quaternary and Upper Tertiary aquifers across south-east Melbourne were divided into five groundwater flow systems based on physical features of the system; the Moorabbin, Frankston, Mornington, Dromana and Nepean. Tootgarook Wetland is located in the Nepean groundwater flow system. For each system, the study provided a water balance calculation, any uncertainty associated with the water balance calculations and an investigation into the contribution of groundwater extractions to the overall water balance and the potential impacts resulting from these extractions.

Timing: 2010

Results: The following conclusions are made for the Nepean groundwater flow system:

- Hydrographs indicate that since 1997 water levels have declined by up to 2 m to the east of the system while they have generally remained stable to the west.
- Rainfall data indicates a significant reduction (by between 100 and 200 mm/year) in mean annual rainfall from 1997-2009 when compared to 1970-1996, with a greater reduction being predicted by the CSIRO Mk3.5 model for all climate change scenarios up to 2030.
- The Nepean system had the greatest increase in the number of Stock and Domestic bores (40% of total licences in this area have been granted in the last 5 years) and more than 60% of the total potential extraction of groundwater in the whole study area occurs in the Nepean system (0.8 GL/year from S & D bores and 5.2 GL/year from licensed bores).
- Recharge was estimated to be approximately 17% of rainfall in the system (14.8 GL/year) where the soil is sandy and surface drainage is poorly developed. Recharge has fallen by approximately 50% since 1997 in the system.
- Leakage from the water supply and waste water infrastructure is contributing approximately 10.1 GL/year of water to recharge across the whole study area, with an additional 3 GL/year of recharge in the Nepean area due to infiltration from septic tanks.
- The overall water balance for the Nepean system is deficit by approximately 1.3 GL/year and may be due to a combination of reduced rainfall increased groundwater extraction. This situation may lead to greater intrusion of saline groundwater into the freshwater aquifer.

Significant knowledge gaps: There is a need to constrain the uncertainties associated with recharge estimates, through the collection of more rive gauging data and field studies. Further investigation of the impacts of stock and domestic bores in the Nepean system is also required, particularly constraining the estimates of groundwater extractions and verifying groundwater elevations in the area. Further investigation is also required to verify the dependence of GDEs (including Tootgarook Wetland) on groundwater and potential risk if groundwater levels or quality change.

It should also be noted that this study does not look at Tootgarook Wetland specifically, but rather the groundwater flows systems in is contained in and therefore provides a regional water balance rather than a local, site specific water balance.
6.2.2 South East Water Groundwater Monitoring

**Study/Program:** Groundwater monitoring at the South East Water Groundwater Monitoring

**Geographic extent:** Boneo Water Recycling Plant and Browns Road.

**Method:** It is assumed that groundwater levels and quality are monitored at the 16 on-site bores (and one additional control site bore) in line with the State Environment Protection Policy (Groundwaters of Victoria) (SEPP), however details of the monitoring program were not available at the time of the report completion.

**Timing:** Details were not available at the time of the report completion.

**Results:** Details were not available at the time of the report completion.

**Significant knowledge gaps:** It is difficult to make an assessment on any knowledge gaps due to the limited data provided on the monitoring program.

6.2.3 Mornington Peninsular Shire Groundwater Monitoring – Landfill, Truemans Road

**Study/Program:** Groundwater monitoring at the landfill site on Truemans Road.

**Geographic extent:** Landfill site on Truemans Road, bordering the west of Tootgarook Wetland.

**Method:** It is assumed that groundwater levels and quality are monitored at the 23 on-site bores in line with the State Environment Protection Policy (Groundwaters of Victoria) (SEPP), however details of the monitoring program were not available at the time of the report completion.

**Timing:** Details were not available at the time of the report completion.

**Results:** Data were not available at the time of the report completion.

**Significant knowledge gaps:** It is difficult to make an assessment on any knowledge gaps due to the limited data provided on the monitoring program.

6.3 Summary of knowledge gaps

The locations of current and proposed groundwater monitoring is presented in FIGURE...

No onsite groundwater level morning data is currently available for Tootgarook Wetland, however the proposed monitoring network will address the gap. Until a consistent period of data is collected from these proposed onsite bores, there is currently a lack of historical groundwater monitoring data at the site. This lack of data makes it difficult to understand the interaction between groundwater and surface water at the site, seasonal variations in groundwater levels and the impact of groundwater pumping in the area.

There is also currently a lack of regional and on site groundwater quality data available, making it difficult to understand the impact on groundwater quality from treated waste water used for irrigation in the Chinaman’s Creek catchment.
Figure 6-1 Locations of groundwater monitoring bores in the Tootgarook Wetland and surrounding areas.
7. Conclusion

Based on the review of key studies and investigations previously completed on the ecological values of the Tootgarook Wetland and the surrounding area, a number of key knowledge gaps have been identified. A summary of the key knowledge gaps identified that will be used as the basis for the design of an ecological monitoring program for the wetland in subsequent stages of this project is provided below.

Flora
- The mapping of vegetation communities and assessment of their quality has been undertaken by a number of different people for a variety of reasons and is therefore difficult to align and provide a coherent picture of what values occur within the site.
- With the exception of the Leafy Greenhood population known in the Moonah woodland near Truemans Road (See Piccone and Walker 2003), little is known about the location of threatened species within the wetlands. No systematic targeted surveys have been undertaken in the wetland and therefore it is difficult to truly assess the likelihood of their occurrence.
- Few of the assessments reviewed have been undertaken at a suitable time of year to identify the majority of flora species and there is a significant likelihood that additional species would be detected during spring and summer surveys.

Fauna
- Not all field studies on the faunal values of the Tootgarook Wetland (by Malcolm Legg) were conducted throughout the year; therefore it is possible that some seasonally active species may have been missed.
- Although targeted White-footed Dunnart surveys have been undertaken in Sanctuary Park and the Tootgarook Wetland Reserve in Boneo, no targeted surveys have been undertaken to our knowledge at the McNaught Property.
- Although there is a good baseline of the terrestrial and aquatic faunal species of the Tootgarook Wetland, from the review of data available it appears there has not been ongoing population health monitoring for any of the species.
- This in contrast however to the bird species in the area. Ongoing monitoring is being conducted by Birdlife Australia which is designed to detect changes over time.

Water Quality
- The majority of water quality data for the area has been collected downstream of the wetland. It is therefore difficult to separate the impacts of industrial, urban, agricultural and natural processes.

Groundwater
- Currently there is no onsite groundwater level morning data available for wetland, although it is recognised that the proposed Melbourne Water GDE monitoring network for the wetland will address this gap in the future.
- Until a consistent period of data is collected from these proposed onsite bores, there is currently lack of historical groundwater monitoring data at the site. This lack of data makes it difficult to understand the interaction between groundwater and surface water at the site, seasonal variations in groundwater levels and the impact of groundwater pumping in the area.
- The current lack of regional and on site groundwater quality monitoring makes it difficult to understand the impact on groundwater quality from treated waste water used for irrigation in the Chinamans Creek catchment.
8. References


Ecology Partners (2010). Targeted Swamp Skink and Dwarf Galaxias surveys for the proposed Stage 6 of The Village Green, Rosebud West, Victoria.


Legg, N. (2002). Fauna survey and management prescriptions for Chinaman’s Creek (from Boneo/Tootgarook Swamp to the mouth) and Drum Drum Alloc Creek (from Boneo Road to Boneo/Tootgarook Swamp), December 2001 to February 2002. Report by Mal’s Environmental and Ecological Services for Mornington Peninsula Shire Council.


Robertson and Steane (2007). Field assessment of the status of the Swamp Skink (*Egernia coventryi*) along the lower reaches of Drum Drum Alloc Creek, Rosebud.


Appendix A. Reports reviewed but not included


*Management plan only, no new data created as part of this study.*


*Early draft of Condina (2011) which was reviewed in detail.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*


*Considers primarily hydrological and hydraulic management and wetland design. Outside scope of the current project.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*

EastEon Pty Ltd. (2013) Tootgarook Wetland Proposed Groundwater Monitoring Network (v2)

*Report provides groundwater monitoring network design recommendations which were reviewed as part of the development of the proposed GDE monitoring at Boneo Swamp (GHD 2014) and therefore was not considered further as part of the current project.*


*No new data created as part of this study.*

*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*

Heritage Insight (2004). An Archaeological Field Assessment of a Property at 282 Boneo Road, ROSEBUD. Report for Watsons Pty Ltd.

*Considers primarily cultural heritage. Outside scope of the current project.*


*Considers primarily cultural heritage. Outside scope of the current project.*

Hunt, D. (undated). Management plan to maintain or enhance the population of Swamp Skinks Egernia coventryi along Drum Drum Alloc Creek and adjacent Ten Hectare Reserve (The Skink Triangle) Tootgarook, Mornington Peninsula. Assessment Project for Chisholm Institute, Rosebud.

*No surveys conducted as part of this study.*


*Report provides important background information to the hydrogeology of the wetland. Report provided input to the conceptualisation of the wetland (MW and SKM 2013) and therefore was not considered further as part of the current project.*


*Tootgarook Wetland not considered explicitly.*


*No new data created as part of this study.*


*Considers primarily hydrological and hydraulic management. Outside scope of the current project.*


*Town planning submission, no new data created as part of this study.*


*Tootgarook Wetland area not considered.*

*Town planning submission, no new data created as part of this study.*


*No new data created as part of this study.*


*Management plan only, no new data created as part of this study.*