

Knowledge document of the impact of priority wetland weeds

Part 2 – Impacts of priority wetland weeds

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Photo credit

Sagittaria platyphylla, *Sagittaria*, Delta Arrowhead (Anonymous, Agriculture Victoria, DEDJTR)

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1 Introduction

This document reports on Part 2 of a project undertaken by Agriculture Victoria for DELWP Water and Catchments Group to provide a knowledge document describing the impacts on wetland values of 28 priority wetland weeds, including information about knowledge gaps. This is part of a larger DELWP project 'The effectiveness of invasive species management in wetlands', which is detailed in the Part 1 report (Weiss et al. 2017).

The Part 1 report (Weiss et al. 2017) documented how 31 weeds were selected as priority wetland weeds from an initial list of 174 species (30 species were initially listed; *Glyceria maxima* was added after stakeholder feedback). The prioritisation process relied upon expert judgment and most importantly, species that wetland weed managers requested information on the biology, impact and control methods.

There were three widespread native species in the list of 31 priority species; *Azolla* spp. *Phragmites australis* and *Typha* spp. (see Part 1: Weiss et al. 2017). The impacts of these have not been documented here because this project is focused on invasive species, i.e. non-native, however it is acknowledged that these species can have a negative effect on wetland values.

Part 1 and Part 2 together provide the information needed for Phase 1 of a three-phase project to develop a Wetland Weed Management Tool. Phase 1 provides information that can be used to determine the impact of each weed species on wetland values. This information will be used to inform two further phases of the project. Section 4.3 describes Phase 2 and 3 of the Wetland Weed Management Tool.

1.1 How to use this report

This report collates information on priority wetland weeds and summarises their mechanism of impact on wetlands and impacts to wetland values. In addition, confidence values based on the quality of the information on which the impacts were assessed are also recorded. Within the same section there is greater detail of the impacts that each species has. Finally, the Appendix provides all of the information that was used to describe the impacts.

The impacts described are almost exclusively those that have been documented. Collation of local knowledge from wetland managers and ecologists would provide additional power. In addition, the impacts documented are restricted to those which impact upon the ecology of wetlands. Socioeconomic factors such as impacts on recreation, wetland access, aesthetics, etc. are not considered.

It is important to point out that this report is not a traditional literature review. It extracts information from different literature or knowledge sources, on the impacts of the weed to show that an impact occurs. It does not list and summarise all citations that describe the impact of a particular weed.

2 Methods – Impacts of priority wetland weeds

Information on the impacts of the weeds was extracted from a range of sources. Where the species has been assessed as part of the Victorian Weed Risk Assessment process, the relevant information (i.e. that which relates to environmental impact on watercourses) from the 'Impact Assessment' was used as the primary source of information. These data can be found at:

http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/invasive_plants_common_a

Weed textbooks and online databases and webpages were also used. Searches were conducted for any reported impact of the weed and were recorded under the following headings:

- Fauna
- Flora
- Hydrology
- Water quality
- Wetland soils
- Provision of habitat, food or harbour for pests
- Drought refuge and 'Other' (any other additional information) were included but no useful information was found.

The context and habit definitions used to classify wetland weeds are listed in Table 1.

Table 1. Context and habit definition used to classify wetland weeds.

Context
IA: Opportunistic introduced annual (to biennial) grasses and forbs of drier phases of wetlands (or highly ephemeral/shallow wetland communities).
IE: Very small introduced ephemeral species, generally relatively minor weeds, sometimes competitive to other small plants in very shallow ephemeral wetland habitats.
IO: Introduced obligate wetland species.
IS: Introduced species of seasonal wetland habitats.
IT: Primarily terrestrial (at least short-lived) introduced perennial species, extending into at least margins of seasonal wetlands, generally very difficult to manage.
Habit
AF: Surface floating aquatic.
AQ: At least substantially submerged aquatic, mostly attached.
AM: Amphibious / semi-aquatic species.
MH: Herbaceous species (forbs and grasses) expressing during drawdown phase (including 'mud herbs').
SM: Obligate (usually coastal) saltmarsh species. Note that species placed in other categories can also be relatively salt-tolerant.
BM: Bogs and moss beds
FR: Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats.
TR: Primarily terrestrial species, to some extent tolerant of waterlogging and potentially problematic on floodplains, or sometimes marginal to wetlands and managed within wetland reserves.
RI: Riparian verges of streams

3 Results – Impacts

3.1 Impacts of amphibious wetland weeds

The impacts of the wetland weeds classified as ‘Amphibious – semi-aquatic species (AM)’ are provided in this section. The impacts by species are summarised in Table 2 and then detailed in the following section. The full extracts from all sources are shown in Appendix 1.

Table 2. Impacts of the wetland weeds classified as ‘Amphibious – semi-aquatic species (AM)’.

Habit and context codes described in Table 2.

LI = Low Impact; MI = Medium Impact; HI = High Impact; LC = Low Confidence; MC = Medium Confidence; HC = High Confidence.

Species	Habit	Context	Number of wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Cyperus eragrostis</i> Drain Flat-sedge	Amphibious / Fringing	Introduced seasonal wetland	6	No impact reported but threat to six EVCs indicates some impact.	MI LC	LI LC	None
<i>Glyceria maxima</i> Reed Sweetgrass	Amphibious / Fringing	Introduced obligate wetland / Introduced seasonal wetland	None	Dense rhizomatous growth on land and floating over the water. Smothers flora, so alters habitat for fauna, and changes physico-chemical properties of water.	HI HC	HI HC	Water quality, hydrology and soils
<i>Iris pseudacorus</i> Yellow Flag Iris	Amphibious / Fringing	Introduced obligate wetland / Introduced seasonal wetland	1	Dense rhizomatous growth on land and floating over the water. Smothers flora, so alters habitat for fauna, and changes physico-chemical properties of water.	HI HC	HI HC	Water quality, hydrology and soils
<i>Juncus acutus</i> subsp. <i>acutus</i> Spiny Rush	Amphibious / Fringing	Introduced seasonal wetland	8	Dense growth overtops and displaces other vegetation. Formation of dense 2 m tall clumps may prevent large bodied fauna from easily accessing water.	HI HC	MI MC	Harbour for vermin
<i>Juncus microcephalus</i> Tiny-headed Rush	Amphibious	Introduced seasonal wetland	None	Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. Likely to have ecosystem impacts, with direct impacts recorded for several flora and fauna species and communities.	HI HC	HI MC	None
<i>Lilaea scilloides</i> (syn. <i>Triglochin scilloides</i>) Lilaea	Amphibious	Introduced seasonal wetland	13	No specific information on impacts available. Small stature and annual nature suggest the impact would be small, but large number of EVCs where it is considered a high threat indicate otherwise.	MI LC	LI LC	None
<i>Mentha pulegium</i> Pennyroyal	Amphibious / Fringing	Introduced seasonal wetland	3	Forms dense stands that crowd out other vegetation, so displacement of desirable flora likely to occur. Impacts on wetland fauna documented in USA, may cause similar problems in Victoria.	MI LC	MI LC	None

Species	Habit	Context	Number of Wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Paspalum distichum</i> Water Couch	Amphibious / Fringing	Introduced obligate wetland / Introduced seasonal wetland	26	Dense smothering growth creating monocultures and altering the habitat.	MI LC	LI LC	Water quality
<i>Phalaris arundinacea</i> , Reed Canary-grass	Amphibious / Fringing	Introduced seasonal wetland	2	Dense perennial monocultures displace native plants, therefore changing the character of the vegetation. Altered habitat leads to changes to fauna. Despite this, the changed habitat clearly provides valuable habitat.	MI LC	MI HC	Hydrology

3.1.1 *Cyperus eragrostis*, Drain Flat-sedge

Context and habit

Context: Introduced species of seasonal wetland habitats (IS)

Habit: Amphibious – semi-aquatic species – Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Plant description

Perennial sedge to 1 m tall, frequent in roadside gutters, drains and rocky creeks; shallow permanent or ephemeral water of creeks, drain channels or damp margins of larger waterbodies (Sainty and Jacobs, 2003). Found in sites that are seasonally flooded, replaced by other species when water is permanent. Widely distributed (Romanowski, 2011).

Wetland EVCs it is listed to threaten

High threat weed of the following six EVCs: Floodplain Riparian Woodland, Swampy Riparian Woodland, Billabong Wetland Aggregate, Plains Sedgy Wetland, Swampy Woodland, Herb-rich Gilgai Wetland.

Impact (Flora)

Medium impact / Low confidence

No serious impact reported but threat to six EVCs indicates some impact.

Impact (Fauna)

Low impact / Low confidence

No serious impact reported

Other reported impacts

None.

3.1.2 *Glyceria maxima*, Reed Sweetgrass

Context and habit

Amphibious – semi-aquatic species – Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Introduced obligate wetland species / Introduced species of seasonal wetland habitats (IO/IS).

Plant description

Robust perennial grass to 0.25 m high, probably introduced as a pasture species (Sainty and Jacobs, 2003). Grows on banks of slow moving rivers, creeks, spring fed gullies and seepage areas, canals, ditches, farm dams, wetlands and the margins of wetlands. It will grow in water to around 1.5 metres in depth, and in deeper water it can form floating mats (Parsons and Cuthbertson 2001).

Wetland EVCs it is listed to threaten

None

Impact (Flora)

High Impact / High confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. Dense rhizomatous growth on land and floating over the water that smothers flora.

Impact (Fauna)

High Impact / High confidence

Dense mats floating over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna.

Dense beds growing along the margins of river and in moist areas results in reduced macroinvertebrate community diversity.

Other reported impacts

Hydrology: Dense stems and rhizomes floating over and growing in the water can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself *G. maxima* may reduce water holding capacity by increasing evapotranspiration and silt accumulation.

Water quality: Thick mats which form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low dissolved oxygen (DO). The impact of low DO can be high in standing water. There are no native plants that form such dense floating mats.

Wetland soils: Dense infestations changing flow patterns and thus erosion and deposition dynamics (increased sedimentation). Dense infestations accumulating organic matter. However, build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay. Impacts of changed flow dynamics on erosion and deposition is not clear.

3.1.3 *Iris pseudacorus*, Yellow Flag Iris

Context and habit

Introduced obligate wetland species / Introduced species of seasonal wetland habitats (IO/IS).

Amphibious / semi-aquatic species (AM).

Plant description

Herbaceous perennial monocot growing to 1.5 m tall, with showy yellow flowers. A vigorous weed species which occasionally escapes from gardens and colonizes ditches and banks of watercourses (AVH, 2014).

Wetland EVCs it is listed to threaten

High threat weed of the EVC Floodplain Riparian Woodland

Impact (Flora)

High Impact / High confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Impact (Fauna)

High Impact / High confidence

Dense growth altering the habitat.

Dense mats floating over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna. Dense beds in riparian zones and wetlands are likely to alter macroinvertebrate community diversity (though no direct data).

Other reported impacts

Hydrology: Dense stems and rhizomes floating over and growing in the water. Although uncertain, it is likely to reduce water holding capacity by increasing evapotranspiration and silt accumulation, as well as altering the flow of creeks. The dense beds may also obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs.

Water quality: Thick mats which form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low DO. The impact of low DO can be high in standing water. There are no native plants that form such dense floating mats.

Wetland soils: Dense infestations changing flow patterns and thus erosion and deposition dynamics (increased sedimentation). Dense infestations accumulating organic matter. Build-up of organic material is

only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay. Impacts of changed flow dynamics on erosion and deposition is not clear.

3.1.4 *Juncus acutus* subsp. *acutus*, Spiny Rush

Context and habit

Context: Introduced species of seasonal wetland habitats (IS)

Habit: Amphibious – semi-aquatic species / Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Plant description

Shortly rhizomatous perennial to more than 1.5 m tall (Sainty and Jacobs, 2003). Spiny Rush invades lowland grassland and grassy woodland, riparian vegetation, freshwater wetland (seasonal), and saline and subsaline wetlands (Carr et al. 1992).

Wetland EVCs it is listed to threaten

High threat weed of the following eight EVCs: Estuarine Wetland, Brackish Sedgeland, Grey Clay Drainage-line Aggregate, Brackish Wetland Aggregate, Plains Grassy Wetland/Brackish Herbland Complex, Plains Saltmarsh, Brackish Lignum Swamp, Plains Grassy Wetland/Lignum Swamp Complex.

Impact (Flora)

High Impact / High confidence

Dense growth overtops and displaces other vegetation.

Impact (Fauna)

Medium Impact / Medium confidence

Formation of dense 2 m tall clumps may prevent large bodied fauna from easily accessing water.

Other reported impacts

Habitat, food or harbour/ refuge for pests: Provides harbour for vermin.

3.1.5 *Juncus microcephalus*, Tiny-headed Rush

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Amphibious – semi-aquatic species (AM).

Plant description

Tufted rhizomatous perennial, culms 0.2 to 1 m tall. In Victoria, it occurs in riparian situations, where it is apparently associated with pebbly river banks (AVH, 2014). Occurs in disturbed wetlands and rivers. Mature plants release a large amount of seed (Flora Base, 2016).

Wetland EVCs it is listed to threaten

None

Impact (Flora)

High impact / High confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. Not listed as threatening any wetland EVCs but it listed threatening two endangered plants (Smooth Bush-pea (*Pultenaea glabra*) in NSW and *Grevillea brachystylis* subsp. *grandis* in Western Australia; see Section 0 for detail).

Impact (Fauna)

High impact / Medium confidence

Invasion resulting in altered floristic community likely to have ecosystem impacts, with direct impacts recorded for several species and communities (Blue Mountains Water Skink (*Eulamprus leuraensis*), Giant Dragonfly (*Petalura gigantean*); Upland Swamps, Alluvial Forests and Wetlands, Blue Mountains Western Escarpment, Blue Mountains Sedge Swamps; see Section 0 for detail).

Other reported impacts

None

3.1.6 *Lilaea scilloides* (syn. *Triglochin scilloides*), Lilaea

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Amphibious – semi-aquatic species (AM).

Plant description

Annual emergent aquatic herb. Basal leaves 0.3 to 0.6 m long. Occurs in freshwater of swamps, lakes and creeks, up to a depth of about 0.3 m. Smaller plants occur on damp mud (AVH, 2014).

Wetland EVCs it is listed to threaten

High threat weed of the following 13 wetland EVCs: Lignum Swamp, Plains Grassy Wetland, Cane Grass Wetland, Aquatic Grassy Wetland, Cane Grass Wetland/Aquatic Herbland Complex, Cane Grass Wetland/Brackish Herbland Complex, Aquatic Herbland, Ephemeral Drainage-line Grassy Wetland, Plains Grassy Wetland/Aquatic Herbland Complex, Spike-sedge Wetland, Plains Grassy Wetland/Sedge-rich Wetland Complex, Plains Grassy Wetland/Spike-sedge Wetland Complex, Lava Plain Ephemeral Wetland.

Impact (Flora)

Medium impact / Low confidence

No specific information available. Small stature and annual nature suggest the impact would be small, but large number of EVCs where it is considered a high threat indicate otherwise.

Impact (Fauna)

Low impact / Low confidence

Unknown impact.

Other reported impacts

None

3.1.7 *Mentha pulegium*, Pennyroyal

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Amphibious – semi-aquatic species / Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Plant description

Sprawling to upright herb to 0.5 m tall, sometimes rhizomatous. Scattered and locally common on ground prone to seasonal waterlogging, usually in open sites (pasture, grassland etc.) (AVH, 2014). Invaded grasslands, alluvial plains and wetter habitats (e.g. riparian areas and freshwater wetlands) in southern Australia.

Wetland EVCs it is listed to threaten

High threat weed of the following three wetland EVCs: Plains Grassy Wetland, Lava Plain Ephemeral Wetland, Alkaline Basaltic Wetland Aggregate.

Impact (Flora)

Medium impact / Low confidence

Displacement of desirable flora likely to occur. Clearly invades moist areas but its impact is not well understood.

Impact (Fauna)

Medium impact / Low confidence

Impacts on wetland fauna (reduced species richness) documented in USA, may cause similar problems in Victoria.

Other reported impacts

None

3.1.8 *Paspalum distichum*, Water Couch

Context and habit

Amphibious – semi-aquatic species – Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Introduced obligate wetland species / Introduced species of seasonal wetland habitats (IO/IS).

Plant description

Stoloniferous and rhizomatous perennial grass to 0.5 m high. Forming dense mats. Reproduces by seed and rhizome. Grows in damp areas and margins of water bodies (Sainty and Jacobs, 2003). May form sprawling mounds at water edge, will also grow in deeper more ephemeral waters (Romanowski, 2011). Status as native or introduced is disputed.

Wetland EVCs it is listed to threaten

High threat weed of the following 26 EVCs: Floodplain Riparian Woodland, Swampy Riparian Woodland, Floodplain Wetland Aggregate, Red Gum Swamp, Aquatic Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland, Brackish Wetland Aggregate, Plains Grassy Wetland/Aquatic Herbland Complex, Plains Swampy Woodland/Lignum Swamp Complex, Rushy Riverine Swamp, Floodplain Grassy Wetland, Intermittent Swampy Woodland, Riverine Swamp Forest, Sedgy Riverine Forest/Riverine Swamp Forest Complex, Spike-sedge Wetland, Tall Marsh, Lignum Swampy Woodland, Brackish Grassland, Floodway Pond Herbland/Riverine Swamp Forest Complex, Estuarine Reedbed, Plains Grassy Wetland/Spike-sedge Wetland Complex, Plains Rushy Wetland, Plains Sedgy Wetland/Sedge Wetland Complex, Red Gum Swamp/Cane Grass Wetland Complex, Red Gum Swamp/Plains Rushy Wetland Complex.

Impact (Fauna)

Low impact / Low confidence

Dense smothering growth altering the habitat. Although *P. distichum* invades wetland areas there is little evidence that it has a serious effect on fauna.

Impact (Flora)

Medium impact / Low confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. There are few reports quantifying or describing the impact of *P. distichum* on floristic composition.

Other reported impacts

Water quality: Swards leave thick organic layer that can cause anoxia upon refilling of wetlands.

3.1.9 *Phalaris arundinacea*, Reed Canary-grass

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Amphibious – semi-aquatic species / Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (AM/FR).

Plant description

Rhizomatous perennial grass to 2 m tall. Usually found in water or in winter-wet areas (AVH, 2014). Moist to wet soil which may be flooded for long periods of time, becoming increasingly weedy (Romanowski, 2011). It is considered a serious threat in wet meadows, wetlands (including marshes, fens), old fields, floodplains, wet prairies, roadsides and ditchbanks, tolerates frequent and prolonged flooding as well as submergence. Spreads by creeping rhizomes and seed (GISD, 2016).

Wetland EVCs it is listed to threaten

High threat weed of the following two EVCs: Floodplain Wetland Aggregate, Wet Verge Sedgeland.

Impact (Flora)

Medium impact / High confidence

Dense smothering monocultures and competitiveness.

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Impact (Fauna)

Medium impact / Low confidence

Dense smothering growth altering the habitat.

Invades wetlands altering habitat, leading to changes to fauna (by displacing some desirable taxa). Despite this, the changed habitat clearly provides valuable habitat (e.g. positive association with amphibians). For more detail see Section 0).

Other reported impacts

Hydrology: Dense stands restricting water movement. It is not clear to what extent *P. arundinacea* can impact on water exchange in wetlands, and between areas. Probably not important.

3.2 Impacts of aquatic wetland weeds

The impacts of the wetland weeds classified as 'At least substantially submerged aquatic, mostly attached (AQ)' are provided in this section. Their impacts by species are summarized in Table 3 and then detailed below. The full extracts from all sources are shown in Appendix 1.

Table 3. Impacts of the wetland weeds classified as ‘At least substantially submerged aquatic, mostly attached (AQ)’.

Context and habit codes are described in Table 2. LI = Low Impact; MI = Medium Impact; HI = High Impact; LC = Low Confidence; MC = Medium Confidence; HC = High Confidence.

Species	Habit	Context	Number of wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Aponogeton distachyos</i> Cape Pond Lily, Water Hawthorn	Aquatic / Amphibious	Introduced obligate wetland	4	Floating foliage can alter habitat by shading out native plants, reduce gas exchange, and physical access to the water for fauna, but it is doubtful whether the foliage is dense enough for these impacts to be serious. Further, the floating foliage does not seem to cover extensive areas. Because of this it is likely that the plant provides useful habitat.	MI MC	LI MC	Water quality, mosquito habitat
<i>Cabomba caroliniana</i> Fanwort, Cabomba	Aquatic	Introduced obligate wetland	2	Dense perennial monocultures displace native plants (where permanent water regime allows), therefore changing the character of the vegetation. Dense beds reduce access to aquatic fauna (physical and reducing oxygen), however there are no strong data demonstrating this. In fact, the limited data available suggests that there is no impact.	HI HC	Low LI / MI MC	Hydrology, water quality, soils
<i>Egeria densa</i> Dense Waterweed	Aquatic	Introduced obligate wetland	None	Dense perennial monocultures displace native plants (where permanent water regime allows), therefore changing the character of the vegetation. Dense beds reduce access to aquatic fauna (physical and reducing oxygen), with different fish assemblages and macroinvertebrate abundance reported from <i>Egeria</i> beds, relative to native macrophytes. Although this species can change aquatic fauna communities, <i>Egeria</i> does provide habitat for aquatic fauna.	HI HC	MI MC	Hydrology, water quality, soils
<i>Elodea canadensis</i> Canadian Pondweed Elodea	Aquatic	Introduced obligate wetland	None	Dense perennial monocultures displace native plants (where permanent water regime allows), therefore changing the character of the vegetation. Little information available relating to fauna but has similar, though less robust, growth form as <i>Egeria</i> and <i>Cabomba</i> , so likely to have similar impacts.	HI HC	MI LC	Hydrology, water quality, soils

Species	Habit	Context	Number of wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Hydrocleys nymphoides</i> Water Poppy	Aquatic	Introduced obligate wetland	None	Floating foliage forms mats that displace native plants, therefore changing the character of the vegetation. Foliage also reduces access to aquatic fauna (physical and reducing oxygen).	HI MC	HI MC	Hydrology, water quality
<i>Ludwigia palustris</i> Marsh Ludwigia, Swamp Ludwigia, Red Ludwigia	Aquatic	Introduced obligate wetland	None	Has the potential to form floating mats that crowd out other plants and alter the habitat. Direct impacts on fauna have not been recorded.	MI MC	LI LC	None
<i>Myriophyllum aquaticum</i> Parrots Feather, Parrotfeather, Brazilian Milfoil	Aquatic	Introduced obligate wetland	5	Perennial monocultures of extremely dense stems form floating rafts that displace native plants, therefore changing the character of the vegetation, and reduce water quality (anoxia) light penetration and physical access to the water for fauna.	HI HC	HI HC	Hydrology, water quality, mosquito habitat
<i>Nasturtium officinale</i> Watercress	Aquatic	Introduced obligate wetland	2	Although it appears on several lists of environmental weeds its impacts are not documented. Given it has been naturalised in Victoria for over 100 years it appears to be an innocuous weed.	LI HC	LI HC	None
<i>Sagittaria platyphylla</i> Sagittaria, Delta Arrowhead	Aquatic	Introduced obligate wetland	6	Dense perennial monocultures displace native plants, therefore changing the character of the vegetation. Little information available relating to fauna.	HI HC	LI LC	Hydrology, soils

3.2.1 *Aponogeton distachyos*, Cape Pond Lily, Water Hawthorn

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached / Amphibious – semi-aquatic species (AQ/AM).

Plant description

Perennial aquatic rooted in the substrate with floating leaves to 0.15 m long; flowers white, showy and fragrant. Forms tubers that allow it to tolerate a wide range of environmental conditions. Stationary and slow flowing water bodies, permanent pools in shallow creeks. Minor weed in cooler areas, not the serious weed it was once predicted to become (Sainty and Jacobs, 2013). Spread by seeds and tubers (Biosecurity Queensland, 2016).

Wetland EVCs it is listed to threaten

High threat weed of the following four EVCs: Aquatic Grassy Wetland, Aquatic Herbland, Plains Grassy Wetland/Aquatic Herbland Complex, Sedge Wetland/Aquatic Herbland Complex.

Impact (Flora)

Medium impact / Medium confidence

Dense perennial monocultures crowd out native plants, therefore changing the character of the vegetation. Although the floating foliage can reduce light penetration (eliminating algae and other aquatic plants), it is doubtful whether the foliage is dense enough for these impacts to be serious. Further, the floating foliage does not seem to cover extensive areas.

Impact (Fauna)

Low impact / Medium confidence

Floating foliage can alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna, but it is doubtful whether the foliage is dense enough for these impacts to be serious. Further, the floating foliage does not seem to cover extensive areas. Because stands are not overly dense or large it is likely that the plant provides useful habitat.

Other reported impacts

Hydrology: The floating mat can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself it may reduce water holding capacity by increasing evapotranspiration and silt accumulation.

Water quality: Thick floating foliage can form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low DO. The floating foliage is probably not dense enough to have a large impact on DO in standing water as this species does not form mats as thick as some of the more troublesome weeds (e.g. Parrots Feather, Reed Sweetgrass).

Habitat, food or harbour for pests: Mosquito habitat may be provided in the still water areas among the floating mats but it is not clear to what extent mosquito habitat is improved by Cape Pond Lily.

3.2.2 *Cabomba caroliniana*, Fanwort, Cabomba

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Perennial dicot with fan-shaped feathery leaves. Grows rooted in the mud of stagnant to slow flowing water, including streams and smaller rivers. Also grows in ponds, lakes, reservoirs, sloughs, ditches and canals (VICWRA). Dense infestations are only associated with permanent water (Dugdale et al. 2013).

Wetland EVCs it is listed to threaten

High threat weed of the following two EVCs: Aquatic Sedgeland, Aquatic Herbland.

Impact (Flora)

High impact/ High confidence

Dense perennial monocultures displacing native plants, where water regime allows, therefore changing the character of the vegetation. Not weedy in wetlands with regular drying cycle.

Impact (Fauna)

Low – Medium impact / High confidence

Dense surface reaching beds alter habitat. Dense beds reduce access to aquatic fauna (physical and reducing oxygen), however there are no strong data demonstrating this. In fact, the limited data available suggests that there is little impact.

Other reported impacts

Hydrology: The dense beds formed by *Cabomba* could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs (e.g. Lake Nagambie). Despite this, it is likely that wetlands would continue to function as valuable habitat.

Water quality: Dense beds reducing the capacity for gas exchange with the atmosphere, increasing diurnal fluctuations of DO and pH and increased respiration rates associated with dieback.

Wetland soils: Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter. Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests: Mosquito habitat may be provided in the still water areas among the surface reaching mats. It is not clear to what extent mosquito habitat is improved by *Cabomba*.

3.2.3 *Egeria densa*, Dense Waterweed, *Egeria*

Context and habit

Context: Introduced obligate wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Submersed perennial growing rooted in substrate with stems extending several metres into the water column. Commonly sold as an aquarium plant in Australia (Stephens and Dowling, 2002). Grows in lakes and slow moving watercourses with permanent water (Romanowski, 2011). Dense infestations are only associated with permanent water (Dugdale et al. 2013).

Wetland EVCs it is listed to threaten

Not recognised as a high threat to any EVCs.

Impact (Flora)

High impact / High confidence

Dense surface reaching habit crowding out native species; competitiveness.

Dense perennial monocultures displace native plants, where water regime allows, therefore changing the character of the vegetation. Not weedy in wetlands with regular drying cycle.

Impact (Fauna)

Medium impact / Medium confidence

Dense surface reaching beds alter habitat. Access to the wetland for fauna is impacted by dense beds (either physically or by altering oxygen levels), with different fish assemblages and macroinvertebrate abundance reported from *Egeria* beds, relative to native macrophytes. Although this species can change aquatic fauna communities, the impact is probably not high considering aquatic fauna are found within *Egeria* beds.

Other reported impacts

Hydrology: Dense beds reducing lateral water movement. The dense beds formed by *Egeria* could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs (e.g. Lake Mulwala). Despite this, it is likely that wetlands would continue to function as valuable habitat.

Water quality: Dense beds reducing the capacity for gas exchange with the atmosphere, increasing diurnal fluctuations of DO and pH and increased respiration rates associated with dieback.

Wetland soils: Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter. Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests: Mosquito habitat may be provided in the still water areas among the surface reaching mats. It is not clear to what extent mosquito habitat is improved by *Egeria*.

3.2.4 *Elodea canadensis*, Canadian Pondweed, Elodea

Context and habit

Context: Introduced obligate wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Submersed perennial growing rooted in substrate with stems extending three metres into the water column. Grows in stationary and slow moving watercourses, coastal rivers and creeks, especially in colder areas (Sainty and Jacobs, 2003), can also grow in flowing streams (Parsons and Cuthbertson, 2001). Dense infestations are only associated with permanent water (Dugdale et al. 2013). Abundance and distribution appears to be much less now than previously reports (Bowmer et al. 1995; Sainty and Jacobs, 2003).

Wetland EVCs it is listed to threaten

Not recognised as a high threat to any EVCs.

Impact (Flora)

High impact / High confidence

Dense surface reaching habit crowding out native species; competitiveness.

Dense perennial monocultures displace native plants (where permanent water regime allows), therefore changing the character of the vegetation.

Impact (Fauna)

Medium impact / Low confidence

Dense surface reaching beds alter habitat.

Little information available relating to fauna but has similar, though less robust, growth form as *Egeria* and *Cabomba*, so likely to have similar impacts.

Other reported impacts

Hydrology: Dense beds reduce lateral water movement. The dense beds formed by *Elodea* could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs. Despite this, it is likely that wetlands would continue to function as valuable habitat. Further, it is not weedy in wetlands with a regular drying cycle.

Water quality: Dense beds reducing the capacity for gas exchange with the atmosphere, increasing diurnal fluctuations of DO and pH and increased respiration rates associated with dieback.

Wetland soils: Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter. Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests: Mosquito habitat may be provided in the still water areas among the surface reaching mats. It is not clear to what extent mosquito habitat is improved by *Elodea*.

3.2.5 *Hydrocleys nymphoides*, Water Poppy

Context and habit

Context: Introduced obligate wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Stoloniferous perennial aquatic herb with yellow flower and floating leaves connected by a network of creeping stems which form thick mats. It is an aggressive coloniser of streams, ponds, farm dams and lake margins to 2 m water depth (VICWRA).

Wetland EVCs it is listed to threaten

Not listed as a high threat to any EVC.

Impact (Flora)

High impact / Medium confidence

Dense perennial monocultures crowd out native plants, therefore changing the character of the vegetation. Floating foliage forms mats that displace native plants, therefore changing the character of the vegetation.

Impact (Fauna)

High impact / Medium confidence

Dense mats of floating foliage over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna.

Other reported impacts

Hydrology: Dense beds reduce lateral water movement. The dense stands could form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water.

Water quality: Thick mats of foliage form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low DO. The impact of low DO can be high in standing water, this species does not form mats as thick as some of the more troublesome weeds (e.g. Parrots Feather, Reed Sweetgrass).

3.2.6 *Ludwigia palustris*, Marsh Ludwigia, Swamp Ludwigia, Red Ludwigia

Context and habit

Context: Introduced obligate wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Sprawling perennial herb, with branching floating stems to 0.5 m long. In Victoria, confined to stream and lake margins mostly along the Murray River system upstream from about Barmah and also along the Mitchell River and its tributaries (AVH, 2014). Will grow on flooded and waterlogged soils. Dispersal via broken stems fragment and possibly seed (Ramanowski, 2011).

Wetland EVCs it is listed to threaten

Not listed as a high threat to any wetland EVCs.

Impact (Flora)

Medium impact / Medium confidence

Dense foliage on land and floating over water crowding out native species. Has the potential to form floating mats that crowd out other plants and alter the habitat.

Impact (Fauna)

Low impact / Low confidence

Dense foliage on land and over water alter habitat. No direct impacts on fauna have been recorded, potential for impact remains.

Other reported impacts

None

3.2.7 *Myriophyllum aquaticum*, Parrots Feather, Parrotfeather, Brazilian Milfoil

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Perennial aquatic or semi-aquatic herb, stems to 2 m long with upper portions held above the water. Only female flowers present in Australia, it spreads by vegetative means with broken stem fragments rooting adventitiously (AVH, 2014). Occurs in flowing and standing fresh to slightly brackish water, streams, lakes, drains and canals, seasonal and permanent wetlands and can persist on saturated soils (VICWRA).

Wetland EVCs it is listed to threaten

High threat weed of the following five EVCs: Aquatic Grassy Wetland, Aquatic Sedgeland, Billabong Wetland Aggregate, Aquatic Herbland, Sedge Wetland/Aquatic Herbland Complex.

Impact (Flora)

High impact / High confidence

Perennial monocultures of extremely dense stems form floating rafts that displace native plants, therefore changing the character of the vegetation.

Impact (Fauna)

High impact / High confidence

Perennial monocultures of extremely dense stems form floating rafts that alter habitat by reducing water quality (anoxia), light penetration and physical access to the water for fauna.

Other reported impacts

Hydrology: The floating mats formed by Parrots feather can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself parrots feather is unlikely to impact hydrology.

Water quality: Thick mats form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low DO. The impact of low DO can be high in standing water. There are no native plants that form such dense floating mats.

Wetland soils: Dense infestations changing flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter. Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests: Mosquito habitat is provided in the still water areas among the floating mats. It is not clear to what extent mosquito habitat is improved by Parrotfeather.

3.2.8 *Nasturtium officinale*, Watercress

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Sprawling perennial stoloniferous herb. Growing in mud or shallow water. Stems to 2.5 m long. Common aquatic weed of lowland creeks and drains, mostly in southern Victoria (AVH, 2014). Reproduces by seed and stem fragments. A common weed of waterways, wetlands (including swamps, lakes, ponds), irrigation channels, drainage lines and other wetter habitats in temperate and sub-tropical regions. (Biosecurity Queensland, 2016). Synonym: *Rorippa nasturtium-aquaticum*.

Wetland EVCs it is listed to threaten

High threat weed of the following two EVCs: Swampy Riparian Woodland, Alkaline Basaltic Wetland Aggregate.

Impact (Flora)

Low impact / High confidence

Although it appears on several lists of environmental weeds its impacts are not documented. Given it has been naturalised in Victoria for over 100 years it appears to be an innocuous weed.

Impact (Fauna)

Low impact / High confidence

No impacts documented or suggested.

Other reported impacts

None.

3.2.9 *Sagittaria platyphylla*, Sagittaria, Delta Arrowhead

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: At least substantially submerged aquatic, mostly attached (AQ).

Plant description

Perennial stoloniferous monocot. Basal submersed strap leaves or petiolate emerged leaves, to 1.5 m long. Invasive weed of shallow waterbodies or marshy areas, including floodplain wetlands (Adair et al. 2012).

Wetland EVCs it is listed to threaten

High threat weed of the following six EVCs: Red Gum Swamp, Aquatic Herbland, Rushy Riverine Swamp, Floodplain Grassy Wetland, Spike-sedge Wetland, Floodway Pond Herbland/Riverine Swamp Forest Complex.

Impact (Flora)

High impact / High confidence

Dense perennial monocultures displace native plants, therefore changing the character of the vegetation.

Impact (Fauna)

Low impact / Low confidence

Altered habitat but little information available relating to fauna.

Other reported impacts

Hydrology: Dense stems restrict water flow. Water flow restriction certainly occurs and would be greater for *Sagittaria*, because of its very dense growth habit, than many (but not all) native species. However, it is unclear how large they are and therefore the magnitude of the impact.

Water quality: High biomass produces high levels of organic matter but the impact of low DO is likely to be small because, although this occurs, it is unlikely to occur at a rate greater than what would occur around native vegetation.

Wetland soils: Dense stems slowing water flow and increasing sedimentation. Impact of sedimentation may not be as great in natural wetlands, which are the focus of this project, particularly ephemeral ones. Further, wetlands are natural deposition zones anyway.

3.3 Impacts of saltmarsh wetland weeds

The impacts of the wetland weeds classified as ‘Obligate (usually coastal) saltmarsh species (SM)’ are provided in this section. Their impacts by species are summarized in Table 4 and then detailed below. The full extracts from all sources are shown in Appendix 1.

Table 4. Impacts of the wetland weeds classified as ‘Obligate (usually coastal) saltmarsh species (SM)’.

Context and habit codes are described in Table . LI = Low Impact; MI = Medium Impact; HI = High Impact; LC = Low Confidence; MC = Medium Confidence; HC = High Confidence.

Species	Habitat	Context	Number of wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Limonium hyblaëum</i> , Sea Lavender, Sicilian Sea Lavender	Salt-marsh	Introduced seasonal wetland	1	Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation, resulting in altered habitat for fauna.	HI HC	HI MC	None
<i>Spartina</i> spp. Cord Grass, Rice Grass	Salt-marsh/AQ	Introduced obligate wetland	5	Formation of dense monotypic swards on areas otherwise absent of dense vegetation (intertidal mud flat), or on saltmarshes (resulting in displacement of native plants). Both scenarios result in altered ecosystem function (sedimentation rates, biomass accumulation, water quality, fauna use i.e. waders, benthos, fish).	HI HC	HI HC	Hydrology, Wetland soils

3.3.1 *Limonium hyblaenum*, Sea Lavender, Sicilian Sea Lavender

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Obligate (usually coastal) saltmarsh species. Note that species placed in other categories can also be relatively salt-tolerant (SM).

Plant description

Cushion-forming perennial with dense canopy and semi woody rootstock. Occurs in coastal, sand dunes, rocky boulder coast, saltmarsh. Reproduces vegetatively and by seed (Adair, undated). In Victoria, known only from coastal saltmarsh on basaltic clay at Port Fairy but probably more widespread (as along the South Australian coast where also occurring on limestone) (AVH, 2014).

Wetland EVCs it is listed to threaten

High threat weed of the following one EVC: Riverine Chenopod Woodland.

Impact (Flora)

High impact / High confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Impact (Fauna)

High impact / Medium confidence

Dense smothering growth results in floristic community structure changes and altered habitat for fauna.

Other reported impacts

None

3.3.2 *Spartina* spp., Cord Grass, Rice Grass

Context and habit

Context: Introduced Obligate Wetland species (IO).

Habit: Obligate (usually coastal) saltmarsh species. Note that species placed in other categories can also be relatively salt-tolerant / At least substantially submerged aquatic, mostly attached. (SM/AQ).

Plant description

Deep-rooted perennial grass, reproducing vegetatively only, initially forming clumps but later spreading to near pure swards, culms erect, 0.3 to 1.3 m tall (AVH, 2014). Rhizomatous perennial of inter tidal mudflats and saltmarsh (Romanowski, 2011).

Wetland EVCs it is listed to threaten

High threat weed of the following five EVCs: Coastal Saltmarsh Aggregate, Estuarine Wetland, Mangrove Shrubland, Sea-grass Meadow, Wet Saltmarsh Herbland.

Impact (Flora)

High impact / High confidence

Competition with, and subsequent displacement of, native saltmarsh species

Impact (Fauna)

High impact / High confidence

Formation of dense swards in areas otherwise absent of dense vegetation (intertidal mud flat) result in altered habitat and ecosystem function (sedimentation rates, biomass accumulation, water quality, fauna use i.e. waders, benthos, fish).

Other reported impacts

Hydrology: Dense stems modify hydrodynamics

Wetland soils: Dense stems and rhizomes accelerate sediment accretion, elevating shorelines resulting in saltmarsh islands, intertidal terraces and changes to flow dynamics.

3.4 Impacts of fringing or marginal wetland weeds

The impacts of the wetland weeds classified as 'Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland (FR)' are provided in this section. Their impacts by species are summarized in Table 5 and then detailed below. The full extracts from all sources are shown in Appendix 1.

Table 5. Impacts of the wetland weeds classified as ‘Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland (FR)’.

Context and habit codes are described in Table 2. LI = Low Impact; MI = Medium Impact; HI = High Impact; LC = Low Confidence; MC = Medium Confidence; HC = High Confidence.

Species	Habitat	Context	Number of wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Gymnocoronis spilanthoides</i> , Senegal Tea	Fringing	Introduced seasonal wetland	None	Dense infestations forming monocultures outcompeting and displacing native flora in wet and moist environments, thus changing the habitat for fauna.	HI HC	MI MC	Hydrology, water quality
<i>Nassella hyalina</i> , Cane Needle-grass	Fringing	Introduced seasonal wetland		It is unlikely that <i>N. hyalina</i> will result in significant displacement of true wetland plants. Invasion is likely to be the symptom of prolonged drying.	LI MC	LI MC	None
<i>Phalaris aquatica</i> , Toowoomba Canary Grass	Fringing	Introduced seasonal wetland / Introduced terrestrial	29	Forms dense perennial monocultures that displace native plants, therefore changing the character of the vegetation (impact restricted to dryer areas of wetlands).	HI HC	MI LC	None
<i>Phyla canescens</i> , Fog-fruit, Lippia	Fringing	Introduced seasonal wetland / Introduced terrestrial	9	Dense perennial monocultures displace native plants and changes the floristic community structure completely, resulting in a low growing monoculture with no structure for fauna.	HI HC	HI HC	Hydrology, water quality, soils
<i>Salix cinerea</i> , Grey Sallow, Grey Willow, Pussy Willow	Fringing/BM	Introduced seasonal wetland	6	Forms dense thickets, which change the floristic composition of the wetlands and riparian areas in which they grow, changing the ecological character and reducing suitability for native fauna.	HI HC	HI HC	Hydrology, water quality, harbour
<i>Salix</i> spp., Willows	Fringing/RI	Introduced seasonal wetland / Introduced terrestrial	2	Willows change the floristic composition of the wetlands and riparian areas in which they grow, changing the ecological character and reducing suitability for native fauna.	HI HC	HI HC	Hydrology, water quality

3.4.1 *Gymnocoronis spilanthoides*, Senegal Tea

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (FR).

Plant description

Senegal Tea is a perennial, semi aquatic herb, growing to 1.5 m when flowering, commonly found as a scrambling form extending from the edge of waterways and forming dense tangled mats in open water (VICWRA). Infestation at Goulburn Weir is the only extant infestation known in Victoria (Author pers. obs.). Humid tropics, subtropics and warm-temperate regions. Confined to wet marshy soils and still or very slowly flowing waters (Parsons & Cuthbertson 2001).

Wetland EVCs it is listed to threaten

Not listed as a high threat to any EVCs

Impact (Flora)

High impact / High confidence

Dense infestations forming monoculture outcompeting and displacing native flora in wet and moist environments.

Impact (Fauna)

Medium impact / Medium confidence

No direct impacts recorded, but formation of dense swards is likely to result in altered floristic community and thus have ecosystem impacts.

Other reported impacts

Hydrology: Dense growths obstruct lateral water movement and could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs. Despite this, it is likely that wetlands would continue to function as valuable habitat. May increase evapotranspiration, thus reducing water volume in wetlands.

Water quality: Die back of dense growths increasing respiration and reducing oxygen, dense growth reduces light but the magnitude of these impacts are not likely to be significantly greater than native species.

3.4.2 *Nassella hyalina*, Cane Needle-grass

Context and habit

Context: Introduced species of seasonal wetland habitats / Primarily terrestrial (at least short-lived) introduced perennial species, extending into at least margins of seasonal wetlands, generally very difficult to manage (IS/IT).

Habit: Fringing or marginal species, tolerant of seasonal – intermittent shallow inundation or marginal wetland habitats / Primarily terrestrial species, to some extent tolerant of waterlogging and potentially problematic on floodplains, or sometimes marginal to wetlands and managed within wetland reserves (FR/TR).

Plant description

It is found in variable situations on fertile soils (McLaren et al. 1998). It has also been observed growing in areas subject to seasonal waterlogging and riparian vegetation (McLaren et al. 1998). Cane needle grass invades lowland grassland and grassy woodland (Carr et al. 1992). In Victoria, it has invaded open woodlands and native and introduced grasslands. It appears to be spreading, especially in wetter areas within open native grasslands. It has the potential to affect the biodiversity of riverbank vegetation and grassland, especially in areas that remain wet for long periods (CRC, 2003).

Wetland EVCs it is listed to threaten

High threat weed of the following two EVCs: Plains Grassy Wetland/Aquatic Herbland Complex, Lava Plain Ephemeral Wetland.

Impact (Flora)

Low impact / Medium confidence

It is unlikely that *N. hyalina* will result in significant displacement of true wetland plants it (invades the wetland fringe and terrestrial habitats). Invasion is likely to be the symptom of prolonged drying.

Impact (Fauna)

Low impact / Medium confidence

No reported impacts on fauna.

Other reported impacts

None

3.4.3 *Phalaris aquatic*, Toowoomba Canary Grass, phalaris

Context and habit

Context: Introduced species of seasonal wetland habitats / Primarily terrestrial (at least short-lived) introduced perennial species, extending into at least margins of seasonal wetlands, generally very difficult to manage. (IS/IT).

Habit: Fringing or marginal species, tolerant of seasonal – intermittent shallow inundation or marginal wetland habitats (FR).

Plant description

Rhizomatous perennial grass to 1.6 m tall. Grown as a fodder-grass but also widely naturalised in ditches along roadsides and in low-lying ground mostly in the vicinity of agricultural land. The plant was popularized as a fodder grass in the early 1900s when seed was distributed (as *P. commutata*) from Toowoomba Botanic Gardens in Queensland (AVH, 2014). *Phalaris aquatica* spreads vegetatively and by seed, short rhizomes can grow from established plants and cause phalaris to spread (FFICRC, 2011).

Wetland EVCs it is listed to threaten

High threat weed of the following 29 EVCs: Brackish Sedgeland, Floodplain Riparian Woodland, Swampy Riparian Woodland, Grey Clay Drainage-line Aggregate, Plains Grassy Wetland, Cane Grass Wetland, Red Gum Swamp, Billabong Wetland Aggregate, Brackish Herbland, Cane Grass Wetland/Aquatic Herbland Complex, Plains Swampy Woodland, Brackish Wetland Aggregate, Freshwater Lignum Shrubland, Ephemeral Drainage-line Grassy Wetland, Plains Grassy Wetland/Aquatic Herbland Complex, Plains Swampy Woodland/Lignum Swamp Complex, Sedgy Riverine Forest, Wet Verge Sedgeland, Brackish Grassland, Swampy Woodland, Brackish Lignum Swamp, Freshwater Lignum – Cane Grass Swamp, Herb-rich Gilgai Wetland, Plains Grassy Wetland/Sedge-rich Wetland Complex, Plains Rushy Wetland, Lava Plain Ephemeral Wetland, Coastal Ephemeral Wetland, Plains Sedgy Wetland/Sedge Wetland Complex, Plains Grassy Wetland/Lignum Swamp Complex.

Impact (Flora)

High impact / High confidence

Forms dense perennial monocultures that displace native plants, therefore changing the character of the vegetation (impact restricted to dryer areas of wetlands).

Impact (Fauna)

Medium impact / Low confidence

Dense smothering growth likely to alter habitat. Scant information on the impacts of *P. aquatica* on wetland fauna. Invasion resulting in altered floristic community likely to have ecosystem impacts, although restricted to dryer areas of wetlands.

Other reported impacts

None

3.4.4 *Phyla canescens*, Fog-fruit, Lippia

Context and habit

Context: Introduced species of seasonal wetland habitats / Primarily terrestrial (at least short-lived) introduced perennial species, extending into at least margins of seasonal wetlands, generally very difficult to manage (IS/IT).

Habit: Fringing or marginal species, tolerant of seasonal / intermittent shallow inundation or marginal wetland habitats (FR).

Plant description

Lippia is a prostrate perennial plant that spreads both vegetatively and by seed, enabling it to spread to vast areas of land. Vegetative material breaks off the main plant during flooding events and can remain dormant until suitable environmental conditions present. It appears to be particularly adapted to floodplain clay soils but has been found occurring on lighter soils and in non-flood-prone environments (Leigh and Walton, 2004).

Wetland EVCs it is listed to threaten

High threat weed of the following nine EVCs: Lignum Swamp, Grassy Riverine Forest, Red Gum Swamp, Intermittent Swampy Woodland, Riverine Swamp Forest, Sedgy Riverine Forest/Riverine Swamp Forest Complex, Intermittent Swampy Woodland/Riverine Grassy Woodland Complex, Lignum Swampy Woodland, Plains Grassy Wetland/Lignum Swamp Complex.

Impact (Flora)

High impact / High confidence

Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Impact (Fauna)

High impact / High confidence

Floristic community structure changes completely, resulting in a low growing monoculture with no structure for fauna.

Other reported impacts

Hydrology: Deep root system and high transpiration rate reduces soil moisture on stream banks. Based on its described behaviour on stream banks it is likely to severely reduce wetland soil moisture during wetland dry phase.

Water quality: Indirectly reduces wetland water quality by increasing erosion of stream banks (via drying and cracking of soil leading to increased slumping) that then flow into wetlands.

Wetland soils: Growth destabilises stream banks, increasing erosion and suspended sediment load in streams, probably increasing the siltation rate in receiving wetlands.

3.4.5 *Salix cinerea*, Grey Sallow, Grey Willow, Pussy Willow

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Fringing or marginal species, tolerant of seasonal – intermittent shallow inundation or marginal wetland habitats / Bogs and moss beds (FR/BM).

Plant description

A deciduous shrublike tree to 10 metres tall, occurring in swamps and on stream banks of higher rainfall areas of Victoria (Sainty and Jacobs, 2003). In its invasive range, it has found its way into riparian habits, brackish wetlands on coastland, wet forests, alpine bogs, as well as disturbed and undisturbed land on national park land and elsewhere. Can grow on a wide range of soils and can tolerate permanent water logging, poor aeration and a pH down to 3.5 making it an extremely hardy species (Cremer, 2003 cited by GISD, 2014).

Wetland EVCs it is listed to threaten

High threat weed of the following six EVCs: Montane Riparian Thicket, Riparian Thicket, Montane Sedgeland, Alpine Heath Peatland, Forest Creekline Sedge Swamp, Alpine Hummock Peatland.

Impact (Flora)

High impact / High confidence

Forms dense monotypic thickets which change the floristic composition of the wetlands and riparian areas in which they grow.

Impact (Fauna)

High impact / High confidence

Dense thickets change the ecological character of the wetlands, changing the habitat and reducing suitability for native fauna.

Other reported impacts

Hydrology: Results in increased evapotranspiration, possibly reducing volume and duration of inundation of wetlands.

Water quality: Increased leaf fall during a short autumn period increasing microbial decay (respiration), increased shade reducing light, increased erosion resulting in muddy water during floods.

Habitat, food or harbour for pests: May provide habitat for foxes and rabbits.

3.4.6 *Salix* spp., Willows

Context and habit

Context: Introduced species of seasonal wetland habitats / Primarily terrestrial (at least short-lived) introduced perennial species, extending into at least margins of seasonal wetlands, generally very difficult to manage (IS/IT).

Habit: Fringing or marginal species, tolerant of seasonal – intermittent shallow inundation or marginal wetland habitats / Riparian verges of streams (FR/RI).

Plant description

A broad group of deciduous trees and shrubs varying in height from 5 to 30 m or more, occurring on streambanks and wetland areas. Invades freshwater wetland (seasonal and permanent) and riparian vegetation (Carr et al. 1992).

Wetland EVCs it is listed to threaten

High threat weed of the following two EVCs: Floodplain Wetland Aggregate, Tall Marsh

Impact (Flora)

High impact / High confidence

Forms dense monocultures, which change the floristic composition of the wetlands and riparian areas in which they grow.

Impact (Fauna)

High impact / High confidence

Dense thickets change the ecological character of the wetlands, changing the habitat and reducing suitability for native fauna.

Other reported impacts

Hydrology: Results in increased evapotranspiration, possibly reducing volume and duration of inundation of wetlands.

Water quality: Increased leaf fall during a short autumn period increasing microbial decay (respiration), increased shade reducing light.

3.5 Impacts of Bogs and Moss beds, Mud Herbs Wetland Weeds

The impacts of the wetland weeds classified as 'Bogs and moss beds (BM)' and 'Herbaceous species (forbs and grasses) expressing during drawdown phase (including 'mud herbs') (MH)' are provided in this section. Their impacts by species are summarized in Table 6 and then detailed below. The full extracts from all sources are shown in Appendix 1.

Table 6. Impacts of the wetland weeds classified as ‘Bogs and moss beds (BM)’ and ‘Herbaceous species (forbs and grasses) expressing during drawdown phase (including ‘mud herbs’) (MH)’.

Context and habit codes are described in Table . LI = Low Impact; MI = Medium Impact; HI = High Impact; LC = Low Confidence; MC = Medium Confidence; HC = High Confidence.

Species	Habitat	Context	Number of Wetland EVCs it is listed to threaten	Impact summary	Flora	Fauna	Other impact
<i>Juncus effusus</i> Soft Rush	Bogs and moss beds	Introduced seasonal	6	Closed perennial swards likely to displace native plants. No direct impacts recorded, but formation of dense swards is likely to result in altered floristic community and thus have ecosystem impacts.	MI LC	MI LC	None
<i>Xanthium strumarium</i> spp. agg. Noogoora Burr species aggregate	Mud herbs	Introduced annual	5	Competitive plant displaces native species on wetland fringes or during dry periods. Likely to result in altered floristic community and thus have ecosystem impacts.	HI MC	MI MC	None

3.5.1 *Juncus effusus*, Soft Rush

Context and habit

Context: Introduced species of seasonal wetland habitats (IS).

Habit: Bogs and moss beds (BM).

Plant description

Densely tufted rhizomatous perennial, culms 0.3 to 1.5 m tall. Occurs in cool, high-rainfall and often higher altitude regions of eastern Victoria. Recorded from roadside drains, borrow pits, lakes, dams, subalpine woodland, bogs, wet heathland and wet grassland, montane forests and cool-temperate rainforest (AVH, 2014).

Wetland EVCs it is listed to threaten

High threat weed of the following six wetland EVCs: Montane Sedgeland, Alpine Fen, Sub-alpine Wet Heathland, Alpine Heath Peatland, Sub-alpine Wet Sedgeland, Alpine Hummock Peatland.

Impact (Flora)

Medium impact / Low confidence

Closed perennial swards likely to displace native plants.

Impact (Fauna)

Medium impact / Low confidence

No direct impacts recorded, but formation of dense swards is likely to result in altered floristic community and thus have ecosystem impacts.

Other reported impacts

None

3.5.2 *Xanthium strumarium* spp. agg, Noogoora Burr species aggregate

Context and habit

Context: Opportunistic introduced annual (to biennial) grasses and forbs of drier phases of wetlands (or highly ephemeral/shallow wetland communities) (IA).

Habit: Herbaceous species (forbs and grasses) expressing during drawdown phase (including 'mud herbs') (MH).

Plant description

Erect, usually branched annual herb to 2 m tall, with burrs covered in hooked spines. Scattered across northern Victoria from Mildura to Corryong, on river flats, in pastures and irrigated land (AVH, 2014). A widespread weed of crops, cultivation, pastures, waterways (i.e. riparian areas), floodplains, roadsides, disturbed sites and waste areas in temperate, semi-arid, sub-tropical and tropical environments. Reproduces entirely by seed (Biosecurity Queensland, 2016).

Wetland EVCs it is listed to threaten

High threat weed of the following five wetland EVCs (including *Xanthium* spp.): Grassy Riverine Forest, Floodway Pond Herbland, Grassy Riverine Forest/Floodway Pond Herbland Complex, Grassy Riverine Forest/Riverine Swamp Forest Complex, Riverine Ephemeral Wetland.

Impact (Flora)

High impact / Medium confidence

Competitive plant displaces native species on wetland fringes or during dry periods.

Impact (Fauna)

Medium impact / Medium confidence

Dense growth altering the habitat.

Likely to result in altered floristic community and thus have ecosystem impacts.

Other reported impacts

None

4 Discussion

4.1 Summary of knowledge of impacts

A summary of the information about the impacts, as they relate to wetlands, and knowledge gaps for the priority wetlands weeds is shown in Table 7.

Most noticeable is the general lack of documented information about the impact of these species as they relate to ecological values of wetlands. For most aquatic species, there was considerable documentation that indicated their impact on socioeconomic factors such as recreation, aesthetics, blocking drainage and irrigation channels, boat navigation, hydroelectricity, and entanglement. As these impacts are of little relevance to ecological values of natural wetlands, they have been excluded from the assessments.

Almost all the weed species have documentation that relates to displacement of, and/ or competition with, native vegetation as an important impact. This is perhaps unsurprising as it is the easiest and most obvious impact of invasive weeds to observe and measure. This is reflected in the high proportion of species for which there is a high impact with a high degree of confidence for the impact on flora (Table 7). It should be noted, however, that there are few rigorous studies that quantify this impact.

There is often information, usually implied rather than based on data, on the impacts of wetland weeds on native fauna. These impacts are usually indirect and relate to how the invasive species changes the habitat or character of the vegetation rather than on direct impacts (such as poisoning). Sometimes rigorous data exist on habitat use of the invasive weed (e.g. *Cabomba caroliniana* and *Phalaris arundinacea*), showing that it is used by native fauna.

The final area where evidence was reasonably common was the impact on water quality by the aquatic wetland weeds (Table 7). Weed species that form mats or rafts of floating rhizomes and stems, and to a lesser degree the submersed species which form surface reaching beds, reduce dissolved oxygen concentrations in the water. This occurs via several mechanisms (less water movement resulting in increased strength of stratification; less gas exchange with the atmosphere; high biomass elevating respiration).

Many species have documented hydrology and/or flooding impacts because they block river channels. This has generally been recorded as low importance because, although these impacts are real, they typically occur outside wetlands.

4.2 Recommendations

The recommendations for each species are provided in the footnotes associated with each species in Table 7. There are 16 species (as listed below) for which developing a control guide would be worthwhile. Each control guide could consist of information about controlling the weed, but also provide a concise summary of what we know about its impacts and biology. Control guides already exist in some form or another for several of these species, which can be used as a basis for developing Victorian specific control guides. These species are:

- *Aponogeton distachyos*
- *Cabomba caroliniana*
- *Egeria densa*
- *Elodea canadensis*
- *Glyceria maxima*
- *Hydrocleys nymphoides*
- *Iris pseudacorus*
- *Juncus acutus*
- *Limonium hyblaenum*
- *Myriophyllum aquaticum*
- *Paspalum distichum*
- *Phalaris arundinacea*
- *Phyla canescens*
- *Sagittaria platyphylla*
- *Salix cinerea*
- *Spartina* spp.

There are 10 species for which there are significant knowledge gaps and more information on biology and/ or control tools would be useful. However, it is important to note that understanding of almost all species would improve with additional research (either desk top and/or field based research projects). However, a knowledge gap in this context is that there is very little information available. These species are:

- *Cyperus eragrostis*
- *Gymnocoronis spilanthoides*
- *Limonium hyblaenum*
- *Myriophyllum aquaticum*
- *Paspalum distichum*
- *Phalaris arundinacea*
- *Phyla canescens*
- *Sagittaria platyphylla*
- *Salix cinerea*
- *Spartina* spp.

Finally, there are several aquatic species with known, or suspected, habitat limitations based on water regime and water quality. The future potential of these being weedy in any particular wetland could be determined by collating information on habitat tolerances (or undertaking targeted trials in some cases) and matching these against landscape scale water quality data (e.g. electrical conductivity and turbidity) and water inundation characteristics for particular wetlands. These species are:

- *Aponogeton distachyos*
- *Cabomba caroliniana*
- *Egeria densa*
- *Elodea canadensis*
- *Glyceria maxima*
- *Hydrocleys nymphoides*
- *Iris pseudacorus*
- *Myriophyllum aquaticum*
- *Sagittaria platyphylla*
- *Gymnocoronis spilanthoides*

4.3 Next steps

This report provides the information on the impacts of weed species on wetlands needed for Phase 1 of a three Phase project to develop a Wetland Weed Management Tool.

Phase 2 is to develop control guides for the priority species, summarising the key information and providing recommended control techniques.

Phase 3 is to develop a Wetland Weed Management Tool, which will allow wetland managers to prioritise weed control activities in the context of having many different weed species spread across many wetland sites.

The tool will consist of a MS Excel workbook with a series of fields that a manager populates, which serves to describe the problem(s) that the weed is causing, on what wetland value, and where in the wetland. It will also describe the likely feasibility of control. The tool will generate a score that can be used to rank particular weed control activities.

The tool will use the following inputs:

- a. the impact of the weed (from the information in this report)
- b. the values of the site (inputs provided by wetland manager)
- c. the feasibility of control (from the Control Guides to be developed)

By populating such a tool the wetland manager will be developing a strong rationale for why a weed control program is going ahead, what it aims to achieve and why. Such information can be used in developing a case to receive funding and developing a control and monitoring program.

Table 7. Summary of impacts, stakeholder survey responses and associated knowledge gaps for each of the priority wetland weeds, along with the recommended actions for each species.

Impacts: L = Low, M = Medium, H = High. Blank cells in impacts means no information was found.

Survey responses: Survey Rank for each question in the survey is only shown if it is in the top 11, except Question 1 'which weeds are actively controlled?', shows all ranks.

Knowledge gaps: KG = Knowledge Gap identified. NKG = Not Knowledge Gap.

Recommendations: Bio = need more information on biology and / or impacts. CO = need more information on Control Options / management strategies. +CG = Enough information available to prepare a Control Guide (subject to initial review / knowledge search) and species is of high enough priority to do so (based on survey responses). -CG = Not enough information available to prepare Control Guide, and / or not high enough priority to prepare a control guide. Disparity = apparent difference in reported weed priority by stakeholder and knowledge found about the weed.

Species	Impact / Confidence	Flora	Fauna	Hydrology	Water quality	Wetland soils	Provision for pests	Survey rank / Knowledge gap	Q1 – Actively controlled	Q2 – Confident controlling	*Q3 – Not Confident controlling	Q4 – No time to control	*Q5 – Need more biology information	*Q6 – Need more control information	*Q7 – Future weed	*Q3,5,6,7 rank	Recommendation
<i>Aponogeton distachyos</i>	I	M	L	M	M		L	SR	49		7		KG	KG	KG	18	Bio
	C	M	M	M	M		L	KG			KG						+CG ¹
<i>Cabomba caroliniana</i>	I	H	L/M	L	M	L	L	SR	23		7		5	11	3	2	+CG
	C	H	M	H	H	H	L	KG			KG		NKG	NKG	KG		Disparity ²
<i>Cyperus eragrostis</i>	I	M	L					SR	12		7	3	7	2	KG	4	Bio
	C	L	L					KG			KG		KG	KG			CO -CG Disparity ³

- 1 Developing a Control Guide for *A. distachyos* would be a useful way of collating information on control strategies and biology, however this species is lower on the priority list.
- 2 Disparity for *C. caroliniana* = biology and control options well studied but survey respondents apparently unaware of these; a lot recently learned for control options; an updated Control Guide could resolve lack of confidence in control (although undertaking control of this submersed species would require specialist advice). Future weed threat is real knowledge gap, targeted research on suitable habitat combined with existing water quality and regime information could easily refine areas and situations of Victoria in which it could become weedy.
- 3 Disparity for *C. eragrostis* = Identified as high priority weed but very little information that says it is a bad weed, sources say it is innocuous.

Species	Impact / Confidence	Flora	Fauna	Hydrology	Water quality	Wetland soils	Provision for pests	Survey rank / Knowledge gap	Q1 – Actively controlled	Q2 – Confident controlling	*Q3 – Not Confident controlling	Q4 – No time to control	*Q5 – Need more biology information	*Q6 – Need more control information	*Q7 – Future weed	*Q3,5,6,7 rank	Recommendation
<i>Egeria densa</i>	I C	H H	M M	L H	M H	L H	L L	SR KG	38				11 NKG	11 NKG	2 KG	7	+CG Disparity ⁴
<i>Elodea canadensis</i>	I C	H H	M L	L H	M H	L H	L	SR KG	49		3 KG		NKG	KG	5 KG	15	+CG ⁵
<i>Glyceria maxima</i>	I C	H H	H H	M M	H M	L M		SR KG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	+CG ⁶
<i>Gymnocoronis spilanthoides</i>	I C	H H	M M	M M	M M			SR KG	38				KG	KG	4 KG	10	Bio ⁷ -CG
<i>Hydrocleys nymphoides</i>	I C	H M	H M	L H	M H			SR KG	49		7 KG		KG	KG	KG	22	Bio +CG ⁸
<i>Iris pseudacorus</i>	I C	H H	H H	M M	H M	M M		SR KG	28		7 KG		KG	KG	KG	16	+CG

-
- 4 Disparity for *E. densa* = biology and control options well studied (although not much from Australia) but survey respondents unaware; a lot recently learned for control options; an updated Control Guide could resolve (although undertaking control of this species submersed would require specialist advice). Future weed threat is a real knowledge gap, targeted research on suitable habitat combined with existing water quality and regime information could easily refine areas and situations of Victoria in which it could become weedy.
- 5 *Elodea* is only known to be weedy in irrigation channels; information on *Elodea* biology available and could be collated into an updated Control Guide to resolve. Future weed threat is a real knowledge gap, targeted research on suitable habitat combined with existing water quality and regime information could easily refine areas and situations of Victoria in which it could become weedy.
- 6 *G. maxima* = given Melbourne Water have an entrenched control program there is likely to be enough information to build a control guide. The evidence for effectiveness of program etc and room for improvement is unknown at this stage.
- 7 Collation of available information on the biology of *G. spilanthoides* may be useful to predict its future impact in Victoria (long been known from a single population at Lake Nagambie). Not in the top 10 of any survey question (except future weed), so not useful to develop Control Guides or research to fill knowledge gaps.
- 8 Little known of *H. nymphoides* biology; collation of existing information into Control Guide could resolve lack of confidence (or highlight exact needs to fill gaps).

Species	Impact / Confidence	Flora	Fauna	Hydrology	Water quality	Wetland soils	Provision for pests	Survey rank / Knowledge gap	Q1 – Actively controlled	Q2 – Confident controlling	*Q3 – Not Confident controlling	Q4 – No time to control	*Q5 – Need more biology information	*Q6 – Need more control information	*Q7 – Future weed	*Q3,5,6,7 rank	Recommendation
<i>Juncus acutus</i>	I C	H H	M M	L H			M M	SR KG	3	7	7 NKG	3	7 KG	7 KG		6	Bio +CG Disparity ⁹
<i>Juncus effusus</i>	I C	M L	M L					SR KG	49							28	Disparity ¹⁰ –CG
<i>Juncus microcephalus</i>	I C	H H	H M	L H	L H	L H		SR KG	49							28	Disparity ¹⁰ –CG
<i>Lilaea scilloides</i>	I C	M L	L L	L M				SR KG	38							19	Disparity ¹⁰ –CG
<i>Limonium hyblaenum</i>	I C	H H	H M					SR KG	38				3 KG	4 KG	6 KG	9	Bio CO +CG ¹¹
<i>Ludwigia palustris</i>	I C	M M	L L	L H				SR KG	28				KG	KG	6 KG	25	Bio ¹² –CG
<i>Mentha pulegium</i>	I C	M L	M L					SR KG	28							26	Disparity ¹⁰ –CG

9 *J. acutus* is ranked 7th for wetland managers being confident in controlling and 7th for lacking confidence in control. Clearly there is enough information to control it effectively, but this information is not known by all wetland managers.

10 *J. effusus*, *J. microcephalus*, *L. scilloides*, *M. pulegium*, *N. officinale* *Phalaris aquatica* and *Xanthium strumarium* spp. agg. are not in the top 10 of any survey question, so not useful to develop Control Guides or research to fill knowledge gaps.

11 Ability of *L. hyblaenum* to invade saltmarsh habitats and displace species is clear but would benefit from basic research into biology. An interim Control Guide could collate information on biology and control options, but studies are needed to determine effective control options and likely future distribution and habitat.

12 A greater understanding of *L. palustris* biology would allow predictions to be made about its future distribution and impact as a weed in Victorian wetlands. This could be in the form of an information sheet, but targeted research on its biology in Australia should also occur. Not in the top 10 of any survey question (except future weed), so not useful to develop Control Guides or research to fill knowledge gaps.

Species	Impact / Confidence	Flora	Fauna	Hydrology	Water quality	Wetland soils	Provision for pests	Survey rank / Knowledge gap	Q1 – Actively controlled	Q2 – Confident controlling	*Q3 – Not Confident controlling	Q4 – No time to control	*Q5 – Need more biology information	*Q6 – Need more control information	*Q7 – Future weed	*Q3,5,6,7 rank	Recommendation
<i>Myriophyllum aquaticum</i>	I C	H H	H H	L M	H H	L L	H L	SR KG	6		1 KG	1	4 KG	5 KG	KG	2	Bio CO +CG ¹³
<i>Nassella hyalina</i>	I C	L M	L M					SR KG	49			8				24	–CG
<i>Nasturtium officinale</i>	I C	L H	L H					SR KG	49				KG	NKG		27	Disparity ¹⁰ –CG
<i>Paspalum distichum</i>	I C	M L	L L		M M			SR KG	8		3 KG	3	11 KG	9 KG		10	Bio CO +CG ¹⁴
<i>Phalaris arundinacea</i>	I C	M L	M H	L L		L M		SR KG	23		7 KG	8	11 KG	11 KG	KG	12	Bio CO +CG ¹⁵
<i>Phalaris aquatica</i>	I C	H H	M L					SR KG	17	10 NKG						28	Disparity ¹⁰ –CG

13 Enough information on biology of *M. aquaticum* to compile into a Biology section of a Control Guide, however, there is a need for Australian specific biology studies. Targeted research on suitable habitat combined with existing water quality and regime information could easily refine areas and situations of Victoria in which it could become weedy. Control Guide would have basic control techniques, no herbicides available that provide effective control. Opportunity to explore native beetle as an augmented biocontrol option.

14 *Paspalum distichum* is controlled by several authorities, collation of their information into a Control Guide could resolve lack of confidence and need for control options, and provide insight to depth of knowledge on biology.

15 Limited information on biology of *P. arundinacea* in Australia, clearly a knowledge gap. Preparation of interim Control Guide with information on Biology will crystallise knowledge gaps.

Species	Impact / Confidence	Flora	Fauna	Hydrology	Water quality	Wetland soils	Provision for pests	Survey rank / Knowledge gap	Q1 – Actively controlled	Q2 – Confident controlling	*Q3 – Not Confident controlling	Q4 – No time to control	*Q5 – Need more biology information	*Q6 – Need more control information	*Q7 – Future weed	*Q3,5,6,7 rank	Recommendation
<i>Phyla canescens</i>	I C	H H	H H	M M	M M	M M		SR KG	49		3 KG		11 KG	KG	KG	13	Bio +CG ¹⁶
<i>Sagittaria platyphylla</i>	I C	H H	L L	M M	L M	L M	L H	SR KG	23		3 KG		1 NKG	1 KG	NKG	1	CO +CG ¹⁷
<i>Salix cinerea</i>	I C	H H	H H	M M	M H	L H	L M	SR KG	3	4		8	11 KG	11 NKG	NKG	22	Bio +CG ¹⁸
<i>Spartina</i> spp.	I C	H H	H H	H H		H H		SR KG	17		2 KG	8	1 KG	2 KG	NKG	5	Bio CO +CG ¹⁹
<i>Xanthium strumarium</i> spp. agg.	I C	H M	M M				L L	SR KG	8	7					6 KG	19	Disparity ¹⁰ -CG

16 *P. canescens* biology well documented from upper M-D Basin but how this relates to Victorian wetlands is a knowledge gap. Collation of information on biology and management techniques would be a useful first step, which would then highlight knowledge gaps.

17 Agencies spend considerable resources controlling *S. platyphylla*, so a useful step will be to extract information from them and collate into an interim Control Guide. Clearly additional control options, and strategies to employ them, are required. Another important consideration is the likely release of new biocontrol agents for this species in the next 2-3 years, so information on how to incorporate these agents into control programs, and the situations that they are likely to be most effective in, is required. Recent research relating to the development of a biocontrol agent has provided adequate information on its biology.

18 *S. cinerea* is actively controlled by several agencies and rated by several agencies as a weed that they are confident in controlling. Collation of management information from these agencies into a Control Guide is needed to spread this information (e.g. to those agencies who have indicated they are not confident in managing it). This would also be a useful first step in identifying the magnitude of the knowledge gap on its Biology.

19 Given *spartina* has been actively managed successfully for many years (+10) by Melbourne Water and Parks Victoria, as well as agencies in Tasmania, it is unlikely that these are true knowledge gaps (Biology and Control Options). Information from these agencies could be collated, along with literature sources, into a Control Guide. This process would clarify the knowledge gaps, from which a decision for undertaking further research could be made.

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Appendix 1. Information extracts of the impact of each priority weed

Full references for all citations are provided in the references section of this report, except for citations within 'VICWRA', which are provided at the following:

http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/invasive_plants_common_a

and

http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_pest_plants_ref_ah

A.1 Amphibious wetland weeds

A.1.1 *Cyperus eragrostis*, Drain Flat-sedge

Fauna	
VICWRA	—
Other sources	Innocuous weed, primarily a weed of disturbed ground, doesn't spread far in relatively undisturbed wetlands (Romanowski, 2011). In many situations, this sedge provides competition against less desirable species, stabilises earth banks and provides habitat for animals (Sainty and Jacobs, 2003).
Mechanism of impact	No serious impact reported.
Summary of importance	Low impact / Low confidence
Flora	
VICWRA	—
Other sources	Innocuous weed, primarily of disturbed ground, does not spread far in relatively undisturbed wetlands (Romanowski, 2011). In many situations, this sedge provides competition against less desirable species, stabilises earth banks and provides habitat for animals (Sainty and Jacobs, 2003). High threat weed of the following six EVCs: Floodplain Riparian Woodland, Swampy Riparian Woodland, Billabong Wetland Aggregate, Plains Sedgy Wetland, Swampy Woodland, Herb-rich Gilgai Wetland.
Mechanism of impact	—
Summary of importance	Medium impact / Low confidence No serious impact reported but threat to six EVCs indicates some impact.

A.1.2 *Glyceria maxima*, Reed Sweetgrass

Fauna	
VICWRA	In a study of <i>G. maxima</i> , Clarke et al. (2004) record that it may convert sections of fast flowing streams into anaerobic, swampy environments. Such a dramatic change would affect recreational fishing as downstream fish habitat would be significantly affected by reduced water flow. Strong evidence that cattle have been killed by cyanide poisoning from eating <i>G. maxima</i> when in maximal vegetative growth – but most stock can readily detoxify sub-lethal doses of cyanogenic glycosides. No evidence of toxicity to native herbivores; either dead animals are disposed of without autopsy, or <i>Glyceria</i> does not provide an alternative food source. DPIWE (2007) suggest that <i>Glyceria</i> can provide shelter for waterbirds or other aquatic organisms. Conversely, ISSG (2006) state that <i>Glyceria</i> is, '...a poor nesting substrate for wetland wildlife.' May provide some limited benefit through alternative food source or habitat. May out-compete food plants for some animals also it contains toxins which may harm some species. Access to such water bodies can be seriously restricted and even dangerous to grazing animals. 'Livestock have also become bogged when attempting to reach water through dense Reed Sweet Grass infestations;' (MW, 2003). Assume similar

	scenario for native large bodied fauna.
Other sources	<p>This weed is largely avoided by native animals, possibly because of its seasonally toxic nature (Romanowski, 2011).</p> <p>No evidence of cyanide toxicity to native grazing animals.</p> <p>'Clarke et al. (2004) undertook a study of three upland streams in Gippsland, Victoria, Australia to infer the impacts of <i>G. maxima</i> on macroinvertebrate abundance, morphospecies density, and morphospecies and functional feeding group (FFG) composition. The results of their study concluded that invasion by <i>G. maxima</i> appears to drive changes in macroinvertebrate morphospecies composition and FFG composition, reducing a diverse array of macroinvertebrates to a more uniform fauna. The authors describe <i>G. maxima</i> as an autogenic ecosystem engineer, with the ability to convert sections of fast-flowing aerobic streams into partially anaerobic swamps. They further observe that by generating a root-mat swamp with a high capacity to process nutrients, <i>G. maxima</i> may facilitate its own growth and spread, as well as that of secondary invaders' (GISD, 2016).</p>
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	<p>High impact /High confidence.</p> <p>Dense mats floating over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna.</p> <p>Dense beds and growing along the margins of river and in moist areas results in reduced macroinvertebrate community diversity.</p>

Flora

VICWRA	<p>Has a strong allelopathic effect (Rice, 1984). It is clear from the literature that once <i>G. maxima</i> establishes in open areas it becomes the dominant species.</p> <p>Within the area of infestation <i>G. maxima</i> is known to develop as a monoculture. 'Even within its native range, the ability of <i>G. maxima</i> to create virtual monocultures under varying levels of disturbance is of conservation concern,' (Anderson and Reznicek 1994). Forms a monoculture in open, wet areas. Lambert (1947) cited in ISSG (2006) states that plants are usually found in fully exposed situations but are tolerant to slight shade. <i>Glyceria</i> then, would not have as great an impact in the heavier shade of overstorey trees.</p> <p>EVC= Riparian scrub (V); Bioregion= Gippsland Plain; CMA= West Gippsland; VH CLIMATE match.</p> <p>Within the area of infestation, <i>Glyceria</i> is known to develop as a monoculture. Forms a monoculture in open, wet areas. Established infestations expand rapidly at the boundaries, while density within the infestation increases more slowly (Parsons and Cuthbertson 2001). Serious impact within the infestation and, over time, the likely displacement of indicator species in the lower or mid strata.</p> <p>EVC= Wet heathland (D); Bioregion= Otway Ranges; CMA= Corangamite; VH CLIMATE match.</p> <p>This EVC is typified by tall graminoid species with medium to tall graminoids representing about 10% of total cover. Invasion in this EVC would likely displace existing grasses or reeds, particularly in the areas with permanent water cover. Likely to displace dominant species in mid stratum.</p> <p>EVC= Riverine swamp forest (LC); Bioregion= Murray Fans; CMA= North Central; VH CLIMATE match.</p> <p>Eucalypt woodland to open woodland, ground-layer grassy to sedgy to herbaceous. Similar impacts as described in above.</p>
Other sources	<p><i>G. maxima</i> forms dense monocultures, displacing native plants growing in the shallow water and riparian zones and reducing species diversity (author pers. obs.).</p> <p><i>G. maxima</i> forms monocultures in wetlands that reduce plant species diversity. In areas of introduction, including North America and Australia, it also forms monocultures and is now of conservation concern. The large, dense monospecific stands are capable of crowding out native wetland vegetation. Because it is both a poor food source and a poor nesting substrate for wetland wildlife, it has a significant potential to negatively affect wetland habitat dynamics (GISD, 2016).</p> <p>Not listed as a high threat to any EVC.</p> <p>It has the potential to invade and transform shallow waterbodies by accumulating biomass and sediments filling the free water areas while overwhelming the native plants growing at the location. <i>Glyceria</i> is a weed of concern for Melbourne Water anywhere aquatic east of Cardinia Creek. Melbourne Water spend considerable ongoing resources on controlling <i>Glyceria maxima</i> (David Carew, Melbourne Water, pers. com., 2016).</p>

Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High Confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Hydrology

VICWRA	In a study of <i>G. maxima</i> , Clarke et al. (2004) record that it may convert sections of fast flowing streams into anaerobic, swampy environments. Information on its rate of transpiration is also lacking although 'may grow out over open water as a vast floating mat, attached to the bank by its roots. (MW, 2003). Therefore transpiration by <i>G. maxima</i> is potentially high. The holding capacity of farm dams can be significantly reduced due to siltation (Parsons and Cuthbertson 2001).
Other sources	It can block and redirect the path of slow moving streams, changing the nature of entire habitats (Romanowski, 2011).
Mechanism of impact	Dense stems and rhizomes floating over and growing in the water.
Summary of importance	Medium impact / Medium confidence The dense stands can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself <i>G. maxima</i> may reduce water holding capacity by increasing evapotranspiration and silt accumulation.

Water quality

VICWRA	In a study of <i>G. maxima</i> , Clarke et al. (2004) record that it may convert sections of fast flowing streams into anaerobic, swampy environments. Such a dramatic change would affect recreational fishing as downstream fish habitat would be significantly affected by reduced water flow. Clarke et al. (2004) observed that <i>Glyceria</i> '...may convert fast-flowing, aerobic streams into partially anaerobic, swampy environments.' Noticeable effects on both dissolved oxygen and light in streams potentially leading to increased algal growth. In Victoria, Melbourne Water records that in some instances, infested dams have become unusable due to putrid water (MW, 2003).
Other sources	The floating mats formed by <i>G. maxima</i> form a thick barrier between the atmosphere and water, eliminating gas exchange and light. Without water exchange this would reduce DO considerably. In addition, the high biomass of floating mats produce a source of organic material that decays and further reduces DO (Author pers. obs.).
Mechanism of impact	Thick mats which form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low dissolved oxygen.
Summary of importance	High impact / Medium confidence

Wetland soils

VICWRA	In Tasmania, it is recorded to impede water flow in rivers creeks and irrigation and drainage channels, initially by stem abundance slowing water velocity and increasing the deposition of silt and debris (DPIWE 2007).
Other sources	It is possible that organic matter will accumulate under the dense mats, thus creating organic sediments in wetlands.
Mechanism of impact	Dense infestations changing flow patterns and thus erosion and deposition dynamics (increased sedimentation). Dense infestations accumulating organic matter.
Summary of importance	Low impact / Medium confidence Build-up of organic material is only likely to occur in wetlands with permanent water. In natural wetlands which have dry periods, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

A.1.3 *Iris pseudacorus*, Yellow Flag Iris

Fauna	
VICWRA	<p>Once established, <i>I. pseudacorus</i> can colonize in large numbers and form dense single-species stands, outcompeting native wetland plants and excluding native animals (The Nature Conservancy, 2008). High density weed beds affect water quality and weed bed fauna, which in turn affect the nature of wildlife and fisheries values. Benthic fauna maybe affected by less dissolved oxygen and accumulation of flocculent organic detritus beneath weed beds (Champion et al. 2002).</p> <p>Forms almost impenetrable thickets. This weed restricts access considerably.</p> <p><i>I. pseudacorus</i> does not provide food for native animals and contains large amounts of glycosides that are poisonous to grazing animals. All parts of the plant are poisonous, especially the rhizomes (Sutherland, 1990; The Nature Conservancy, 2008).</p>
Other sources	Once established, the thick tuberous rhizomes can tolerate both prolonged anoxic and/or drought conditions (GISD, 2016).
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	<p>High impact / High confidence</p> <p>Dense mats floating over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna.</p> <p>Dense beds in riparian zones and wetlands are likely to alter macroinvertebrate community diversity (though no direct data).</p>
Flora	
VICWRA	<p>EVC = Flood Plain Riparian Woodland (E); CMA = Goulbourn Broken; Bioregion = Goldfields; Moira Plain Wetland (D); CMA = Goulbourn Broken; Bioregion = Murray Fans; EVC = Riparian Forests (LC); CMA = Goulbourn Broken; Bioregion = Highlands Northern Fall; VH CLIMATE potential.</p> <p><i>I. pseudacorus</i> can form dense colonies in low elevation freshwater or brackish wetlands, lake and pond shorelines, and in floodplain riparian areas. In natural areas, these colonies can invade and dominate a variety of vegetation types, displacing native plant and animal diversity, and altering successional trajectories (The Nature Conservancy, 2008). 'It forms rafts of floating rhizomes that are strong enough to support the weight of a human' (Greater Wellington Regional Council et al. 2008).</p> <p>Rhizome mat can prevent the germination and seedling growth of other plant species. Rhizome mat also creates improved habitat for <i>I. pseudacorus</i> by compacting soil and elevating the topography, therefore creating a habitat that is drier and with increased rates of siltation and sedimentation (The Nature Conservancy 2008). Displacement of submerged native species by these weeds has led to a significant decline in the seed-bank densities of invaded sites, and a reduction in biodiversity on account of reduced seed rain and accelerated burial (Champion <i>et al.</i> 2002). Major effects on all layers. Forms monoculture; no other strata/layers present.</p>
Other sources	<p>The rhizome mat can prevent the germination and seedling growth of other plant species (GISD, 2016).</p> <p><i>I. pseudacorus</i> often invades open marsh areas, where it can form dense stands. It is a fast-growing and fast-spreading invasive plant that can out compete other wetland plants, forming almost impenetrable thickets, in much the same as cat-tails (GISD, 2016).</p> <p>It forms dense monocultures, displacing native plants growing in the shallow water and riparian zones and reducing species diversity (author pers. obs.).</p> <p>High threat weed of the following EVC: Floodplain Riparian Woodland</p>
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

Hydrology	
VICWRA	—
Other sources	No direct evidence of this. Its growth form and habit is similar to <i>G. maxima</i> , therefore it is likely to have similar impacts (i.e. increased evapotranspiration, increased silt accumulations which can block streams and convert them to anaerobic swampy environments).
Mechanism of impact	Dense stems and rhizomes floating over and growing in the water.
Summary of importance	Medium impact / Medium confidence Although uncertain, it is likely to reduce water holding capacity by increasing evapotranspiration and silt accumulation, as well as altering flow of creeks. The dense beds may also obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs.
Water quality	
VICWRA	Forms dense mats of rhizomes thick enough to support the weight of a human (Greater Wellington Regional Council, 2008), therefore it will decrease the ability of oxygen diffusing into the water through the surface and it will also considerably reduce the amount of sunlight filtering through the water.
Other sources	
Mechanism of impact	Thick mats which form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low dissolved oxygen.
Summary of importance	High impact / Medium confidence The impact of low DO can be high in standing water. There are no native plants that form such dense floating mats.
Wetland soils	
VICWRA	'it has also been extensively planted since the early 1800s for erosion control as it is effective at trapping sediments' (The Nature Conservancy, 2008).
Other sources	The rhizome mat also creates improved habitat for <i>I. pseudacorus</i> by compacting soil and elevating the topography, therefore creating a habitat that is drier and with increased rates of siltation and sedimentation (GISD, 2016).
Mechanism of impact	Dense infestations changing flow patterns and thus erosion and deposition dynamics (increased sedimentation). Dense infestations accumulating organic matter.
Summary of importance	Medium impact / Medium confidence Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.
Habitat, food or harbour for pests	
VICWRA	Members of this genus are rarely if ever troubled by browsing deer or rabbits. May provide harbour for rats, mice etc. Does not provide harbour for serious pest species, but may provide for minor pest species.
Other sources	—
Mechanism of impact	Unknown impact
Summary of importance	Unknown impact

A.1.4 *Juncus acutus subsp. acutus*, Spiny Rush

Fauna	
VICWRA	<p>'The occurrence of Spiny Rush along waterways can be quite important in keeping animals from water.'</p> <p>Limited impact on fauna.</p> <p><i>Note: above statement are from two separate sources within VICWRA database.</i></p>
Other sources	Spiny Rush is avoided by large bodied animals, although it may provide shelter to small animals (Romanowski, 2011).
Mechanism of impact	Formation of dense 2 m tall clumps may prevent large bodied fauna from easily accessing water.
Summary of importance	Medium impact / Medium confidence
Flora	
VICWRA	<p>'In Australia it is commonly found as a weed of coastal flats, mine dumps and disturbed saline areas. Once firmly established, it completely covers an area and eliminates almost all other vegetation.' Major effect on >60% of the floral strata.</p> <p>EVC=Swamp scrub (E); CMA=Corangamite; Bioreg=Warrnambool Plain; Plains sedgy woodland (D); CMA=Glenelg Hopkins; Bioreg=Dundas Tablelands; Coastal dune scrub (E); CMA=Port Phillip; Bioreg=Gippsland Plain; VH CLIMATE potential.</p> <p>'...commonly found as a weed of coastal flats, mine dumps and disturbed saline areas. Eliminate almost all other vegetation.' Major displacement of grasses/ground covers.</p>
Other sources	<p>High threat weed of the following eight EVCs: Estuarine Wetland, Brackish Sedgeland, Grey Clay Drainage-line Aggregate, Brackish Wetland Aggregate, Plains Grassy Wetland/Brackish Herbland Complex, Plains Saltmarsh, Brackish Lignum Swamp, Plains Grassy Wetland/Lignum Swamp Complex.</p> <p>A serious weed that is difficult to control (Sainty and Jacobs, 2003).</p>
Mechanism of impact	Dense growth overtops and displaces other vegetation
Summary of importance	High impact / High confidence
Hydrology	
VICWRA	'When growing in drains and watercourses, Spiny Rush restricts the flow of water which can result in serious flooding.'
Other sources	—
Mechanism of impact	Dense stems blocking water flow
Summary of importance	<p>Low impact / High confidence</p> <p>It is unlikely that the restricted flow that this species causes in drains and watercourses will alter natural wetland hydrology.</p>
Habitat, food or harbour for pests	
VICWRA	'It also provides an effective harbour for vermin, particularly rabbits, because dogs will not work in clumps of the weed and burrows cannot be ripped.'
Other sources	—
Mechanism of impact	Abundant and sharp spines provide protection for pest animals sheltering in the rush (note likely positive effect of this is native animals also shelter).
Summary of importance	<p>Medium impact / Medium confidence</p> <p>May provide harbour for native fauna as well as pest animals.</p>

A.1.5 *Juncus microcephalus*, Tiny-headed Rush

Fauna	
VICWRA	—
Other sources	<p><i>J. microcephalus</i> listed as a threat to the threatened Blue Mountains water skink (<i>Eulamprus leuraensis</i>) and giant dragonfly (<i>Petalura gigantea</i>) in NSW (NSW DPI and OEH, 2011).</p> <p>Listed as a weed threatening four priority habitats, corridors or wetlands (upland swamps; alluvial forests and wetlands; Blue Mountains western escarpment, Blue Mountains sedge swamps) (NSW DPI and OEH, 2011).</p> <p>Listed as a priority widespread weed impacting on biodiversity in the Hawkesbury–Nepean CMA region (NSW DPI and OEH, 2011).</p>
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	High impact / Medium confidence Invasion resulting in altered floristic community likely to have ecosystem impacts, with direct impacts recorded for several species and communities.
Flora	
VICWRA	—
Other sources	<p><i>J. microcephalus</i> listed as a threat to the threatened Smooth Bush-pea (<i>Pultenaea glabra</i>) in NSW (NSW DPI and OEH, 2011).</p> <p>Competition from <i>Juncus microcephalus</i> (along with other weeds) listed as a threat to the Listed as Critically Endangered <i>Grevillea brachystylis</i> subsp. <i>grandis</i> in Western Australia. It suppresses early plant growth by competing for soil moisture, nutrients and light (Department of the Environment, 2016).</p>
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. Not listed as threatening any wetland EVCs but it listed threatening two endangered plants.
Hydrology	
VICWRA	—
Other sources	It is a rapid coloniser of silt beds and riparian zones which leads to changes in water flow, increased erosion and sedimentation (Flora Base, 2016).
Mechanism of impact	Unlikely to occur.
Summary of importance	Low impact / High confidence
Wetland soils	
VICWRA	—
Other sources	It is a rapid coloniser of silt beds and riparian zones which leads to changes in water flow, increased erosion and sedimentation (Flora Base, 2016).
Mechanism of impact	Impact unlikely to occur.
Summary of importance	Low impact / High confidence

A.1.6 *Lilaea scilloides* (syn. *Triglochin scilloides*), Lilaea

Fauna	
VICWRA	—
Other sources	No environmental affects known (Romanowski, 2011).
Mechanism of impact	Unknown impact.
Summary of importance	Low impact / Low confidence Unknown impact.
Flora	
VICWRA	—
Other sources	High threat weed of the following 13 wetland EVCs: Lignum Swamp, Plains Grassy Wetland, Cane Grass Wetland, Aquatic Grassy Wetland, Cane Grass Wetland/Aquatic Herbland Complex, Cane Grass Wetland/Brackish Herbland Complex, Aquatic Herbland, Ephemeral Drainage-line Grassy Wetland, Plains Grassy Wetland/Aquatic Herbland Complex, Spike-sedge Wetland, Plains Grassy Wetland/Sedge-rich Wetland Complex, Plains Grassy Wetland/Spike-sedge Wetland Complex, Lava Plain Ephemeral Wetland
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	Medium impact / Low confidence No specific information available. Small stature and annual nature suggest the impact would be small, but large number of EVCs where it is considered a high threat indicate otherwise.
Hydrology	
VICWRA	—
Other sources	—
Mechanism of impact	—
Summary of importance	Low impact / Medium confidence Small stature of the plant not likely to impact hydrology

A.1.7 *Mentha pulegium*, Pennyroyal

Fauna	
VICWRA	—
Other sources	In other parts of the world <i>Mentha pulegium</i> is reported to form dense stands that crowd out native vegetation and reduce species richness. It is considered to be moderately invasive in wetlands in California, in south-western USA, and the flora of vernal pools in this region is thought to have been particularly impacted by the loss of habitat through the introduction of <i>Mentha pulegium</i> (Biosecurity Queensland, 2016).
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	Medium impact / Low confidence Impacts on wetland fauna documented in USA (described above), may cause similar problems in Victoria.
Flora	
VICWRA	—
Other sources	Pennyroyal is unlikely to be found in wetlands, only in damp ground in their vicinity. Primarily a weed of disturbed ground (Romanowski, 2011). Important agricultural weed (Parsons and Cutherbertson, 1992). It appears on several local and regional environmental weed lists in Victoria (e.g. in Knox city, the Goulburn Broken Catchment and the Angahook–Otways region) and has been recorded in conservation areas in Victoria and South Australia (Biosecurity Queensland, 2016). In other parts of the world <i>Mentha pulegium</i> is reported to form dense stands that crowd out native vegetation and reduce species richness. It is considered to be moderately invasive in wetlands in California, in south-western USA, and the flora of vernal pools in this region is thought to have been particularly impacted by the loss of habitat through the introduction of <i>Mentha pulegium</i> (Biosecurity Queensland, 2016).

Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	Medium impact / Low confidence Displacement of desirable flora likely to occur. Clearly invades moist areas but its impact is not well understood.

A.1.8 *Paspalum distichum*, Water Couch

Fauna	
VICWRA	—
Other sources	Water Couch is a minor habitat plant providing shelter for some migratory snipe and aquatic invertebrates, though these will shelter as readily in many other low-growing plants (Romanowski, 2011). Floating mats can be used by breeding water birds (Romanowski, 2011). 'Water Couch is a habitat and feeding area for diverse organisms from dragonfly larvae to herbivorous waterbirds (Hawking and New 2002, Middleton 1993, Middleton 1999); mosquito larvae (Greenway et al. 2003); as nocturnal foraging habitat for Latham's Snipe in wetlands near Newcastle in the Hunter Valley (Todd 2000); and is favoured by some fish species (Zampatti et al. 2006)' (from Roberts and Marston, 2011).
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	Low impact / Low confidence Although <i>P. distichum</i> invades wetland areas there is little evidence that it has a serious effect on fauna.
Flora	
VICWRA	—
Other sources	High threat weed of the following 26 EVCs: Floodplain Riparian Woodland, Swampy Riparian Woodland, Floodplain Wetland Aggregate, Red Gum Swamp, Aquatic Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland, Brackish Wetland Aggregate, Plains Grassy Wetland/Aquatic Herbland Complex, Plains Swampy Woodland/Lignum Swamp Complex, Rushy Riverine Swamp, Floodplain Grassy Wetland, Intermittent Swampy Woodland, Riverine Swamp Forest, Sedgy Riverine Forest/Riverine Swamp Forest Complex, Spike-sedge Wetland, Tall Marsh, Lignum Swampy Woodland, Brackish Grassland, Floodway Pond Herbland/Riverine Swamp Forest Complex, Estuarine Reedbed, Plains Grassy Wetland/Spike-sedge Wetland Complex, Plains Rushy Wetland, Plains Sedgy Wetland/Sedge Wetland Complex, Red Gum Swamp/Cane Grass Wetland Complex, Red Gum Swamp/Plains Rushy Wetland Complex. Smothers smaller species growing in shallow water (Romanowski, 2011).
Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	Medium impact / Low confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation. There are few reports quantifying or describing the impact of <i>P. distichum</i> on floristic composition.
Water quality	
VICWRA	—
Other sources	Water Couch forms very dense mats which usually senesce on drawdown, and persist as a dense 0.05 to 0.1 m thick dried-out organic layer on the wetland floor, unless grazed or fired. If these dried mats are flooded, they can result in very low oxygen levels (Roberts and Marston, 2011).
Mechanism of impact	Increased respiration resulting in water column anoxia.
Summary of importance	Medium impact / Low confidence Can contribute high levels of organic matter which decays and reduces DO upon wetland filling.

A.1.9 *Phalaris arundinacea*, Reed Canary-grass

Fauna	
VICWRA	—
Other sources	<p>'<i>Phalaris arundinacea</i> can form dense, persistent, monotypic stands in wetlands, moist meadows, and riparian areas that increase sedimentation, alter water circulation and ecosystem processes. These stands exclude and displace desirable native plants and animals. Areas invaded may be of little use to wildlife (Lavergne and Molofsky, 2006). Lyons (1998) states that it threatens many endangered species because its stands are shade tolerant and highly competitive despite relatively dry conditions' (From GISD, 2016). <i>P. arundinacea</i> foliage and seeds are palatable to water fowl, it is used for cover by prairie chickens, musk rats and fish (GISD, 2016).</p> <p>Both reed canary grass and common reed have invaded and formed large monospecific stands within some cleared floodplain areas subject to waterlogging of the Yellingbo Nature Conservation Reserve preventing wetland forest regeneration and restoration. The 'Sedge-rich <i>Eucalyptus camphora</i> swamp forests' at Yellingbo are listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988 (Turner 2003), and are of critical importance, being home to the last wild populations of the helmeted honeyeater and lowland Leadbeater's Possum (Pearce and Minchin, 2001; Harley and Lill, 2007) (from Greet et al. 2016).</p> <p>There was a positive association between reed canary grass and the abundance of 3 native amphibians in 62 natural and constructed urban and suburban ponds in Portland, Oregon. Experiments showed males preferred to call from reed canary grass, and there was a strong trend for females to lay eggs on the invasive grass compared to other plants offered. Tadpoles survivorship was 7 times higher survival in reed canary grass (Holzer and Lawler, 2015).</p>
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	<p>Medium impact / High confidence</p> <p>Invades wetlands altering habitat, leading to changes to fauna. Despite this, the changed habitat clearly provides valuable habitat, which can be utilised by native fauna.</p>
Flora	
VICWRA	—
Other sources	<p>High threat weed of the following two EVCs: Floodplain Wetland Aggregate, Wet Verge Sedgeland.</p> <p>'<i>Phalaris arundinacea</i> can form dense, persistent, monotypic stands ... These stands exclude and displace desirable native plants [which are] shade tolerant and highly competitive' (GISD, 2016).</p> <p>Both reed canary grass and common reed have invaded and formed large monospecific stands within some cleared floodplain areas subject to waterlogging of the Yellingbo Nature Conservation Reserve preventing wetland forest regeneration and restoration. The 'Sedge-rich <i>Eucalyptus camphora</i> swamp forests' at Yellingbo are listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988 (Turner 2003) (from Greet et al. 2016).</p>
Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	<p>Medium impact / High confidence</p> <p>Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.</p>
Hydrology	
VICWRA	—
Other sources	' <i>Phalaris arundinacea</i> can ... alter water circulation and ecosystem processes' (GISD, 2016).
Mechanism of impact	Dense stands restricting water movement.
Summary of importance	<p>Low impact / Low confidence</p> <p>It is not clear to what extent <i>P. arundinacea</i> can impact on water exchange in wetlands, and between areas.</p>

Wetland soils	
VICWRA	—
Other sources	'It constricts waterways and irrigation canals because it promotes silt deposition. Conversely, its colonies perched on the edges of incised watercourses may promote further erosion of soil beneath the dense mats of rhizomes by causing cutaways where water flows rapidly' (from GISD, 2016).
Mechanism of impact	Changes erosion and deposition dynamics.
Summary of importance	Low impact / Medium confidence These impacts relate to flowing water bodies, rather than wetlands.

A.2 Aquatic wetland weeds

A.2.1 *Aponogeton distachyos*, Cape Pond Lily, Water Hawthorn

Fauna	
VICWRA	—
Other sources	Dense Cape Pond Lily (<i>Aponogeton distachyos</i>) infestations can alter aquatic ecosystems and shade out the native submerged flora (Biosecurity Queensland, 2016).
Mechanism of impact	Floating foliage altering the habitat.
Summary of importance	Low impact / Medium confidence Although the floating foliage can alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna, it is doubtful whether the foliage is dense enough for these impacts to be serious. Further, the floating foliage does not seem to cover extensive areas. Because of this it is likely that the plant provides useful habitat.
Flora	
VICWRA	—
Other sources	High threat weed of the following four EVCs: Aquatic Grassy Wetland, Aquatic Herbland, Plains Grassy Wetland/Aquatic Herbland Complex, Sedge Wetland/Aquatic Herbland Complex. Dense Cape Pond Lily infestations can alter aquatic ecosystems and shade out the native submerged flora (Biosecurity Queensland, 2016). The potential to form dense communities may result in a serious reduction in vegetation diversity, though not leading to monoculture (Coffey and Clayton, 1988).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	Medium impact / Medium confidence Although the floating foliage can reduce light penetration (eliminating algae and other aquatic plants), it is doubtful whether the foliage is dense enough for these impacts to be serious. Further, the floating foliage does not seem to cover extensive areas.
Hydrology	
VICWRA	—
Other sources	<i>Aponogeton</i> can impede flow in slow moving streams (Coffey and Clayton, 1988) thus it could reduce lateral flow within and into wetlands.
Mechanism of impact	Dense stems and leaves impeding lateral water movement; dense foliage increasing evapotranspiration.
Summary of importance	Medium impact / Medium confidence The dense floating mat can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself it may reduce water holding capacity by increasing evapotranspiration and silt accumulation.
Water quality	
VICWRA	—
Other sources	Dense Cape Pond Lily infestations have the ability to change the physical and chemical characteristics of invaded lakes and waterways (Biosecurity Queensland, 2016). '...dense communities of this plant can lead to stagnation and poor water quality in shallow ponds and dams' (Coffey and Clayton, 1988).
Mechanism of impact	Purportedly the thick floating foliage can form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low dissolved oxygen.

Summary of importance	Medium impact / Medium confidence The floating foliage is probably not dense enough to have a large impact on dissolved oxygen in standing water as this species does not form mats as thick as some of the more troublesome weeds (e.g. Parrots Feather, Reed Sweetgrass).
Habitat, food or harbour for pests	
VICWRA	—
Other sources	Dense beds of aquatic plants have been associated with providing mosquito larvae habitat. However, this relationship varies between plant species and mosquito species so generalisations cannot be made (Webb, 2013). It is not clear how important this is for Cape Pond Lily.
Mechanism of impact	Mosquito habitat is provided in the still water areas among the floating mats.
Summary of importance	Low impact / Medium confidence It is not clear to what extent mosquito habitat is improved by Cape Pond Lily.

A.2.2 *Cabomba caroliniana*, Fanwort, Cabomba

Fauna	
VICWRA	This species is not documented as posing an additional risk to threatened fauna. 'Its ability to replace native aquatic plants, with the likely displacement of native fish and invertebrate populations, together with the ability to infest large areas of water, suggest that native aquatic life would be considerably endangered' (Mackey and Swarbrick, 1998). Reduction in habitat leading to reduced populations. The plant alters habitat leading to a reduction in population, but not extinction, of one or more species of threatened fauna. e.g. changes to shelter, food source, or causes isolation of spp. 'In regions where it is invasive, it is not clear whether native fish and invertebrates utilize it readily as a habitat' (Panetta, et al. 1998). Assume limited or no benefits.
Other sources	No difference in macro-invertebrate and zooplankton between <i>Cabomba</i> and native macrophytes in experimental mesocosms. Both <i>Cabomba</i> and native macrophytes had much richer communities than no macrophytes (Pakdel et al. 2016). Macroinvertebrates and <i>Paratya</i> shrimp commonly observed attached to and within <i>Cabomba</i> beds in Lake Benalla. Also, platypus noted actively feeding within the beds (author's observation). Dense stands of <i>Cabomba</i> have been reported to subsequently 'affect' native fauna, including platypus, water rats and Mary River cod (van Oosterhout, 2009). Sedimentation below dense beds can also alter habitat for bottom-dwelling organisms (van Oosterhout, 2009).
Mechanism of impact	Formation of dense beds altering the habitat.
Summary of importance	Low – Medium impact / Medium confidence Available data indicates that water column invertebrate fauna are not affected by <i>Cabomba</i> , relative to native macrophytes, while purported impacts on bottom-dwelling organisms, Mary River cod, platypus and water rats are reported without data.
Flora	
VICWRA	'It is extremely persistent and can establish a monoculture by excluding native plant species' (ARMCANZ, 2000). Moderate impact on recruitment of character species. Serious reduction in species diversity or forms dense monoculture. Stated to be 'extremely competitive' (Mackey, 1996). ' <i>Cabomba</i> is capable of rapid spread once it has been introduced in to a suitable water body. It was first reported from Lake MacDonald in April 1992, and by 1995 had invaded almost the whole of the lake's extensive littoral zone' (Panetta, et al. 1998). 'It is extremely persistent and can establish a monoculture by excluding native plant species' (ARMCANZ 2000). Monoculture within a specific layer.

Other sources	Where water is permanent and water level is stable, it forms dense monocultures in water from 0.5 m to >2 m deep, displacing submersed macrophytes (author pers. obs.). Under suitable environmental conditions it forms dense stands and crowds out previously well-established plants (GISD, 2016).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displacing native plants, where water regime allows (see above), therefore changing the character of the vegetation. Not weedy in wetlands with regular drying cycle.
Hydrology	
VICWRA	—
Other sources	Dense surface reaching beds may reduce water exchange with back water areas of wetlands (e.g. back waters and billabongs at Lake Nagambie; author pers. com.).
Mechanism of impact	Dense stems and foliage
Summary of importance	Low impact / High confidence The dense beds formed by <i>Cabomba</i> could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs (e.g. Lake Nagambie). Despite this, it is likely that wetlands would continue to function as valuable habitat.
Water quality	
VICWRA	'Oxygen depletion can occur when massive dieback and consequent decomposition occurs. In Queensland, <i>Cabomba</i> infestations may deleteriously affect water quality through increasing water colour' (Mackey and Swarbrick, 1998). High effect on dissolved oxygen levels.
Other sources	The dense surface reaching beds of <i>Cabomba</i> reduce vertical mixing of water, resulting in intensified temperature and dissolved oxygen gradients between the water surface and bottom of the wetland (stratification). Where infestations are dense this is likely to result in large diurnal fluctuations of dissolved oxygen and pH, as the plant produces water column oxygen during the day and consumes it at night. They also severely limit light penetration. In addition, the high biomass of beds produce a source of organic material that decays and further reduces dissolved oxygen (Author pers. obs.).
Mechanism of impact	Dense stems and foliage
Summary of importance	Medium impact / High confidence Dense beds reducing the capacity for gas exchange with the atmosphere, resulting in large diurnal fluctuations of dissolved oxygen and pH, and increased respiration rates associated with dieback. Although <i>Cabomba</i> forms thick stands that can deplete dissolved oxygen and light, native submersed plants can form similar densities e.g. <i>Valisneria australis</i> , <i>Potamogeton sulcatus</i> .
Wetland soils	
VICWRA	' <i>Cabomba</i> is found in ponds, ditches, small shallow lakes and slow flowing streams. If present in water storages, heavy infestations, because of the large volume of plant material, could cause water loss from overflow or seepage' (Mackey and Swarbrick 1998). Although water flow may not be significant, overflows may create some minor soil erosion. Can cause flooding therefore creating the potential for erosion to occur in the floodplain.
Other sources	It is possible that organic matter will accumulate under the dense stands, thus creating organic sediments in wetlands.
Mechanism of impact	Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulate organic matter.
Summary of importance	Low impact / High confidence Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests	
VICWRA	
Other sources	Dense beds of aquatic plants have been associated with providing mosquito larvae habitat. However, this relationship varies between plant species and mosquito species so generalisations cannot be made (Webb, 2013). It is not clear how important this is for Cabomba.
Mechanism of impact	Mosquito habitat may be provided in the still water areas among the surface reaching mats.
Summary of importance	Low impact / Low confidence It is not clear to what extent mosquito habitat is enhanced by <i>Cabomba</i> .

A.2.3 *Egeria densa*, Dense Waterweed

Fauna	
VICWRA	Reported to harbour different fish assemblages than those of native submerged macrophytes in the Hawkesbury–Nepean river system (Growth et al. 2003). Fish assemblages and invertebrate species are reported living amongst it, and can act as protection from predators (Duggan et al. 2001; Growth et al. 2003). Therefore, it provides an abundant food source for at least one species and it creates a habitat and shelters various species. However unknown specifically for native species.
Other sources	May provide a spawning site for native fish, readily eaten by herbivores (Romanowski, 2011), e.g. swans. Macroinvertebrates and paratya shrimp commonly observed attached to and within <i>Egeria</i> beds in Lake Mulwala (authors pers. obs.). Macro-invertebrate richness was higher in constructed wetlands dominated by native macrophytes than those dominated by invasive macrophytes (<i>Egeria</i> , along with two other species (<i>Elodea canadensis</i> and <i>Myriophyllum aquaticum</i>)) (Bryant et al. 2007)
Mechanism of impact	Formation of dense beds altering the habitat.
Summary of importance	Medium impact / Medium confidence Formation of dense beds has an impact on access to fauna (either physically or by altering oxygen levels, see section on water quality), with different fish assemblages and macroinvertebrate abundance reported from <i>Egeria</i> beds, relative to native macrophytes. Although this species can change aquatic fauna communities, the impact is probably not high considering aquatic fauna are found among <i>Egeria</i> beds.
Flora	
VICWRA	Can form monospecific stands. Produces many small white male flowers covering the surface (Coffey and Clayton, 1988). Forms thick mat of intertwining stems below the surface (Parsons and Cuthbertson, 2001). Forms dense growths- hence one of the common names – ‘Dense Waterweed’ (Parsons and Cuthbertson, 1992). Reported displacing native submerged macrophytes (Roberts et al. 1999). Serious reduction in species diversity or forms dense monoculture. EVC= Shallow Freshwater Marsh (E); CMA= Corangamite; Bioreg= Otway Plain; VH CLIMATE potential. Can form monospecific stands (Coffey and Clayton, 1988). Reported displacing native submerged macrophytes (Roberts et al. 1999)
Other sources	Where water is permanent and water level is stable, it forms dense monocultures in water from 0.5 m to >2 m deep, displacing native submerged macrophytes (author pers. obs.).
Mechanism of impact	Dense habit crowding out native species; competitiveness.

Summary of importance	High impact / High confidence Dense perennial monocultures displace native plants, where water regime allows (see above), therefore changing the character of the vegetation. Not weedy in wetlands with regular drying cycle.
Hydrology	
VICWRA	An attached submerged species preferring slow moving water, reported to seriously retard flow (Parsons and Cuthbertson, 2001). Can act as a semi permeable dam, slowing flow and increasing stream depth (Champion and Tanner, 2000). During times of high flow can cause flooding (DiTomas and Healey, 2003).
Other sources	Dense surface reaching beds may reduce water exchange with back water areas of wetlands.
Mechanism of impact	Dense stems and foliage reducing lateral water movement
Summary of importance	Low impact / High confidence The dense beds formed by <i>Egeria</i> could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs (e.g. Lake Mulwala). Despite this, it is likely that wetlands would continue to function as valuable habitat.
Water quality	
VICWRA	Can help to stabilise shallow systems, by reducing wave action and stabilising sediment. However, when the species builds up to high biomass levels, the system can collapse. Benthic anoxia leads to death of large proportions of the <i>Egeria</i> . This can cause the wetland to switch to one that has turbid water and is dominated by phytoplankton (Champion, 2002). Not stated to cause algal blooms (Champion, 1995; J. Weiss, pers. obs.);
Other sources	Dense beds stabilise sediment and compete with phytoplankton for nutrients, so can be associated with improved water quality. The dense surface reaching beds of <i>Egeria</i> reduce vertical mixing of water, resulting in intensified temperature and dissolved oxygen gradients between the water surface and bottom of the wetland (stratification). Where infestations are dense this is likely to result in large diurnal fluctuations of dissolved oxygen and pH, as the plant produces water column oxygen during the day and consumes it at night. They also severely limit light penetration. In addition, the high biomass of beds produce a source of organic material that decays and further reduces dissolved oxygen (Author pers. obs.). <i>E. densa</i> forms dense mono-specific stands that restrict water movement, trap sediment, and cause fluctuations in water quality (GISD, 2016).
Mechanism of impact	Dense beds reducing the capacity for gas exchange with the atmosphere and increased respiration rates associated with dieback.
Summary of importance	Medium impact / High confidence Dense beds reducing the capacity for gas exchange with the atmosphere resulting in large diurnal fluctuations in water quality, increased respiration rates associated with dieback.
Wetland soils	
VICWRA	During times of high flow can cause flooding and therefore increase the chance of erosion (DiTomas and Healy, 2003).
Other sources	It is possible that organic matter will accumulate under the dense stands, thus creating organic sediments in wetlands.
Mechanism of impact	Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter.
Summary of importance	Low impact / High confidence Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.

Habitat, food or harbour for pests	
VICWRA	
Other sources	Dense beds of aquatic plants have been associated with providing mosquito larvae habitat. However, this relationship varies between plant species and mosquito species so generalisations cannot be made (Webb, 2013). It is not clear how important this is for <i>Egeria</i> .
Mechanism of impact	Mosquito habitat may be provided in the still water areas among the surface reaching mats.
Summary of importance	Low impact / Low confidence It is not clear to what extent mosquito habitat is improved by <i>Egeria</i> .

A.2.4 *Elodea canadensis*, Canadian Pondweed, Elodea

Fauna

VICWRA	—
Other sources	May provide a spawning site for native fish, readily eaten by herbivores, e.g. swans (Romanowski, 2011). Macroinvertebrate richness was higher in constructed wetlands dominated by native macrophytes than those dominated by invasive macrophytes (<i>Egeria</i> , along with two other species (<i>Elodea canadensis</i> and <i>Myriophyllum aquaticum</i>)) (Bryant et al. 2007). In its native habitat of North America, it provides habitat for aquatic invertebrates, fish and amphibians and is a food source for waterfowl, beavers and muskrats (GISD, 2016).
Mechanism of impact	Formation of dense beds altering the habitat.
Summary of importance	Medium impact / Low confidence There is little information available but, due to their similar growth form, though less robust, it is likely that <i>Elodea</i> will have similar impacts to <i>Egeria</i> and <i>Cabomba</i> , except <i>Elodea</i> does not grow as densely as these species so may have a reduced impact. Regardless, <i>Elodea</i> is not weedy in wetlands with fluctuating water levels (see flora, below).

Flora

VICWRA	—
Other sources	Where water is permanent and water level is stable, it forms dense monocultures in water from 0.5 m to >2 m deep, displacing native submersed macrophytes (author pers. obs.). Not recognised as a high threat to any EVCs. This waterweed can have a general negative impact on the functioning of the aquatic ecosystem and it will outcompete native aquatic plants (GISD, 2016). Forms dense monospecific stands (Parsons and Cuthbertson, 2001). Displaces native submersed species in lakes (Bowmer et al. 1995).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displace native submersed plants, where water regime allows (see above), therefore changing the character of the vegetation. However, it is not weedy in wetlands with a regular drying cycle.

Hydrology

VICWRA	An attached submersed species preferring slow moving water, reported to seriously retard flow (Parsons and Cuthbertson, 2001).
Other sources	Dense surface reaching beds may reduce water exchange with back water areas of wetlands
Mechanism of impact	Dense beds reducing lateral water movement
Summary of importance	Low impact / High confidence The dense beds formed by <i>Elodea</i> could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs. Despite this, it is likely that wetlands would continue to function as valuable habitat for native aquatic fauna. Further, it is not weedy in wetlands with a regular drying cycle.

Water quality	
VICWRA	—
Other sources	Dense beds stabilise sediment and compete with phytoplankton for nutrients, so can be associated with improved water quality. The dense surface reaching beds reduce light, temperature and oxygen in the water column, which may have follow on impacts to fish (Parsons and Cuthbertson, 2001) and, presumably other fauna. Where infestations are dense this is likely to result in large diurnal fluctuations of dissolved oxygen and pH, as the plant produces oxygen in the water column during the day and consumes it at night.
Mechanism of impact	Dense beds reducing the capacity for gas exchange with the atmosphere and increased respiration rates associated with dieback.
Summary of importance	Medium impact / High confidence Dense beds reducing the capacity for gas exchange with the atmosphere resulting in large diurnal fluctuations in water quality, increased respiration rates associated with dieback.

Wetland soils	
VICWRA	—
Other sources	It is possible that organic matter will accumulate under the dense stands, thus creating organic sediments in wetlands.
Mechanism of impact	Dense stands may change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulating organic matter.
Summary of importance	Low impact / High confidence Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly.

Habitat, food or harbour for pests	
VICWRA	—
Other sources	Dense beds of aquatic plants have been associated with providing mosquito larvae habitat. However, this relationship varies between plant species and mosquito species so generalisations cannot be made (Webb, 2013). It is not clear how important this is for <i>Elodea</i> .
Mechanism of impact	Mosquito habitat is provided in the still water areas among the surface reaching mats.
Summary of importance	Low impact / High confidence It is not clear to what extent mosquito habitat is improved by <i>Elodea</i> .

A.2.5 *Hydrocleys nymphoides*, Water Poppy

Fauna

VICWRA	It can completely choke streams, shallow ponds and lake margins, excluding native species (BioSec NZ, 2008). It is an aggressive coloniser of streams, ponds, farm dams and lake margins (Coffey and Clayton, 1988).
Other sources	—
Mechanism of impact	Dense floating foliage alters habitat.
Summary of importance	High impact / Medium confidence

Dense mats floating over the water surface alter habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna.

Flora

VICWRA	It can completely choke streams, shallow ponds and lake margins, excluding native species. (BioSec NZ, 2008). It is an aggressive coloniser of streams, ponds, farm dams and lake margins (Coffey and Clayton, 1988). <i>H. nymphoides</i> forms mats which exclude all other aquatic flora.
Other sources	—
Mechanism of impact	Dense floating foliage crowding out native species; competitiveness.

Summary of importance	High impact / Medium confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.
Hydrology	
VICWRA	It will out-compete native species by completely choking waterways (ARC, 2007), causing flooding (EWRC, 2008; BioSec NZ, 2008). Dominant aquatic species capable of forming mats that restrict in-stream water flow.
Other sources	
Mechanism of impact	Dense stems and floating foliage reducing lateral water movement
Summary of importance	Low impact / High confidence Dense stems and floating foliage may reduce water exchange with back water areas of wetlands. The dense stands could form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water.
Water quality	
VICWRA	Vegetative spread blocks access to waterways and degrades water quality (ARC 2004).
Other sources	
Mechanism of impact	Thick mats which form a barrier to gas exchange with the atmosphere and produce high levels of decaying organic material.
Summary of importance	Medium impact / High confidence Low dissolved oxygen likely to occur with high biomass in standing water. This species does not form mats as thick as some of the more troublesome weeds (e.g. Parrots Feather, Reed Sweetgrass).

A.2.6 *Ludwigia palustris*, Marsh Ludwigia, Swamp Ludwigia, Red Ludwigia

Fauna

VICWRA

Other sources	Has the potential to form floating mats and has the same smothering effect as the weediest floating plants (Romanowski 2011). This species has escaped cultivation as an aquatic ornamental and become a weed of permanent freshwater wetlands, waterways and riparian areas (Biosecurity Queensland, 2016).
Mechanism of impact	Dense floating foliage on land and floating over water crowding out native species alters habitat.
Summary of importance	Low impact / Low confidence Has the potential to form monocultures and floating mats that crowd out other plants and alter the habitat by reducing gas exchange (thus creating anoxia), light penetration (eliminating algae and other aquatic plants) and physical access to the water for fauna. Not as robust as typical weeds that cause these impacts.

Flora

VICWRA

Other sources	'In Victoria... it is a highly invasive weed of riparian shrublands in the Northern Inland Slopes bioregion and a weed of wetlands along the lower Broken River' (Biosecurity Queensland, 2016). In the USA and South Africa, two countries where it is regarded as being native, Marsh Ludwigia (<i>Ludwigia palustris</i>) competes with other native aquatic vegetation and can obstruct water flow (Biosecurity Queensland, 2016). Has the potential to form floating mats and have the same smothering effect as the weediest floating plants (Romanowski, 2011). This species has escaped cultivation as an aquatic ornamental and become a weed of permanent freshwater wetlands, waterways and riparian areas (Biosecurity Queensland, 2016).
Mechanism of impact	Dense foliage on land and floating over water crowding out native species; competitiveness.
Summary of importance	Medium impact / Medium confidence Has the potential to form monocultures and floating mats that crowd out other plants, therefore changing the character of the vegetation. Not as robust as typical weeds that cause these impacts.

Hydrology	
VICWRA	
Other sources	In the USA and South Africa, two countries where it is regarded as being native, Marsh Ludwigia (<i>Ludwigia palustris</i>) competes with other native aquatic vegetation and can obstruct water flow (Biosecurity Queensland, 2016).
Mechanism of impact	Dense stems and floating foliage reducing lateral water movement
Summary of importance	Low impact / Medium confidence Although it can obstruct water flow it is unlikely to have an effect on wetland hydrology because its growth habit is similar to other native plants (e.g. <i>Ludwigia peploides</i> , <i>Cotula coronopifolia</i> , <i>Ranunculus</i> spp.).

A.2.7 *Myriophyllum aquaticum*, Parrots Feather, Parrotfeather, Brazilian Milfoil

Fauna	
VICWRA	[Effects on fauna] through exclusion of other aquatic plants and algae, invasion by <i>M. aquaticum</i> can alter ecosystem dynamics by altering the base of the food web (Bossard, Randell and Hoshovsky, 2000). Can cause animals to drown (Henderson and Cilliers, 2002).
Other sources	Forms infestations that are too dense for fauna to access. Reduces dissolved oxygen and impacts aquatic fauna– see impact on water quality. Infestations can alter aquatic ecosystems by shading out the algae in the water column that serve as the basis of the aquatic food web (GISD, 2016). Macroinvertebrate richness was higher in constructed wetlands dominated by native macrophytes than those dominated by invasive macrophytes (<i>Myriophyllum aquaticum</i> , along with two other species (<i>Elodea canadensis</i> and <i>Egeria densa</i>)) (Bryant et al. 2007).
Mechanism of impact	Dense mats floating over the water surface alter habitat.
Summary of importance	High impact / High confidence Perennial monocultures of extremely dense stems form floating rafts that reduce water quality (anoxia), light penetration and physical access to the water for fauna.
Flora	
VICWRA	Can [impact on habitat structure] for dense stands to the exclusion of native aquatics and even shade out algae (Bossard et al. 2000; Weber, 2003). No specific evidence reported [of effect on threatened flora], presumed from major displacement of all native species reported in Weber (2003), there would be displacement of threatened species. EVC= Lignum Wetland (V); CMA= North Central; Bioreg= Victorian Riverina; EVC= Swampy Riparian Woodland (D); CMA= East Gippsland; Bioreg= Highlands-Southern Fall; VH CLIMATE potential. EVC= Riverine Swamp Forest (LC); CMA= North Central; Bioreg= Victorian Riverina; VH CLIMATE potential. Can form dense stands to the exclusion of native aquatics and even shade out algae (Bossard et al. 2000; Weber, 2003). Can move into marshy areas adjacent to aquatic populations (Bossard et al. 2000). Unknown to what extent the species impacts on vegetation in these areas, presume some minor displacement of native species.
Other sources	Where water regime is stable, or where water is present most of the time, it forms dense monocultures, displacing small to medium native plants growing in the shallow water zone and reducing species diversity (author pers. obs.). 'The ability of <i>M. aquaticum</i> rhizomes to completely colonise moist or fully submerged sediments also affects colonisation by native taxa' (Toomey, unpublished MS). High threat weed of the following five EVCs: Aquatic Grassy Wetland, Aquatic Sedgeland, Billabong Wetland Aggregate, Aquatic Herbland, Sedge Wetland/Aquatic Herbland Complex.
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Perennial monocultures of extremely dense stems form floating rafts that displace native plants, therefore changing the character of the vegetation.

Hydrology	
VICWRA	The plant can form free floating mats, be attached and submerged or emergent and is reported to severely impede water flow.
Other sources	—
Mechanism of impact	Dense stems and floating rafts of vegetation.
Summary of importance	Low impact / Medium confidence The floating mats formed by Parrots Feather can form an obstruction to flow into and out of wetlands, particularly where artificial control structures are used to manage water. Within the wetland itself parrots feather is unlikely to impact hydrology.
Water quality	
VICWRA	Reduces light and water flow (Weber, 2003), therefore has the potential to alter temperature and dissolved oxygen. Unknown to what extent.
Other sources	The floating mats formed by Parrots Feather form a thick barrier between the atmosphere and water, eliminating gas exchange and light. Without water exchange this would reduce dissolved oxygen considerably. In addition, the high biomass of floating mats produce a source of organic material that decays and further reduces dissolved oxygen (Author pers. obs.). 'Dense stands...deplete oxygen concentrations in the water column ... and increase rates of water loss from water bodies via transpiration' (Toomey et al. unpublished MS).
Mechanism of impact	It can seriously change the physical and chemical characteristics of lakes and streams (GISD, 2016). Thick mats which form a barrier to oxygen exchange with the atmosphere and produce high levels of decaying organic material, both resulting in low dissolved oxygen.
Summary of importance	High impact / High confidence The impact of low dissolved oxygen can be high in standing water.
Wetland soils	
VICWRA	Can cause flooding, therefore creating the potential for erosion to occur on the floodplain.
Other sources	It is possible that organic matter will accumulate under the dense mats, thus creating organic sediments in wetlands. 'Dense stands restrict stream flow, increase the deposition of sediment and organic matter' (Toomey and Boon, unpublished MS).
Mechanism of impact	Dense infestations change flow patterns and thus erosion and deposition dynamics. Dense infestations accumulate organic matter.
Summary of importance	Low impact / Low confidence Build-up of organic material is only likely to occur in wetlands with permanent water. During dry periods that occur in most natural wetlands, this organic material will decay quickly. Impacts of changed flow dynamics on erosion and deposition is not clear.
Habitat, food or harbour for pests	
VICWRA	Provides habitat for mosquitos (Bossard et al. 2000).
Other sources	'Dense accumulations of shoots and leaves in the water column provide habitat for mosquito larvae, since predation by fish is much decreased among the tangled plant material' (Toomey, unpublished MS). Provides choice mosquito larvae habitat (GISD, 2016).
Mechanism of impact	Mosquito habitat is provided in the still water areas among the floating mats.
Summary of importance	High impact / Low confidence It appears that Parrots Feather improves mosquito habitat.

A.2.8 *Nasturtium officinale*, Watercress

Fauna	
VICWRA	—
Other sources	—
Mechanism of impact	—
Summary of importance	Low impact / High confidence Unknown impacts documented or suggested.
Flora	
VICWRA	—
Other sources	High threat weed of the following two EVCs: Swampy Riparian Woodland, Alkaline Basaltic Wetland Aggregate. Common aquatic weed of lowland creeks and drains, mostly in southern Victoria (AVH, 2014). Listed as a priority widespread weed in Central West CMA region (NSW) for 'riparian' and 'watercourse' vegetation communities (NSW DPI and OEH, 2011).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	Low impact / High confidence Although it appears on several lists of environmental weeds its impacts are not documented and it appears to be an innocuous weed.

A.2.9 *Sagittaria platyphylla*, Sagittaria, Delta Arrowhead

Fauna	
VICWRA	'Has a negative impact on native species and on the integrity of natural waterways, such as the waterways of the Barmah-Millewa forest, where it has been recorded' (GMW). Large populations obstruct the movement of wildlife and fish (Sagliocco and Bruzese, 2005). May reduce habitat and have a minor effect on native fauna.
Other sources	Evidence of high use by snakes and frogs in dense infestations (author, pers. obs.). Genus known to be a food source for water fowl (seed and tubers). Spoonbills have been observed feeding on the plant (Parson and Cuthberston, 1992).
Mechanism of impact	Dense stems alters habitat.
Summary of importance	Low impact / Low confidence May form infestations that are too dense for fauna to access but no clear documented evidence of its negative impact on a particular fauna taxon. This species seems to have a beneficial effect on some fauna as well as negative effects.
Flora	
VICWRA	'...it is very abundant in suitable years, sometimes forming vast beds' (Kaul, 1985). Can displace native water plants which occupy the same habitat (ESC, 2005). Able to form monocultures displacing all species within a layer.'
Other sources	'Threatens native aquatic flora and fauna by invading shallow water bodies, where it competes with native species and reduces plant biodiversity However, quantitative data demonstrating such impacts are lacking. The endangered Lower Murray Ecological Community, iconic wetland areas of Barmah and Gunbower Forests, and northern RAMSAR sites such as the Kerang wetlands and Chowilla flood plain are at risk from invasions by <i>S. platyphylla</i> ' (Adair et al. 2012). Where water regime is stable, or where water is present most of the time, it forms dense monocultures, displacing small to medium native plants growing in the shallow water zone and reducing species diversity (author, pers. obs.). High threat weed of the following six EVCs: Red Gum Swamp, Aquatic Herbland, Rushy Riverine Swamp, Floodplain Grassy Wetland, Spike-sedge Wetland, Floodway Pond Herbland/Riverine Swamp Forest Complex.
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displace native plants, therefore changing the character of the vegetation.

Hydrology	
VICWRA	‘Sagittaria forms extensive infestations in shallow waterways, seriously restricting water flow and increasing sedimentation, thus aggravating flooding.’ (BPRC, 2004). An emergent aquatic, firmly rooted. ‘Dense infestations block channels and drainage ditches’ (Parsons and Cuthbertson, 1992). ‘Arrowhead can severely retard and completely choke water flow in irrigation channels’ (Gunasekera and Krake, 2001). Serious impacts to both surface and subsurface water flow.
Other sources	Forms extensive infestations in shallow waterways, where it can seriously restrict water flow, increase sedimentation, and aggravate flooding (GISD, 2016).
Mechanism of impact	Dense stems restrict water flow.
Summary of importance	Medium impact / Medium confidence This certainly occurs and they would be greater for <i>Sagittaria</i> , because of its very dense growth habit, than many (but not all) native species. However, it is unclear how large they are and therefore the magnitude of the impact.
Water quality	
VICWRA	‘Decaying plant material contributes to water pollution and sedimentation and may also increase the risk of algal bloom and microbial activity’ (Sagliocco and Bruzesse, 2005). Likely to cause noticeable but minor effects on dissolved oxygen.
Other sources	—
Mechanism of impact	High biomass produces high levels of organic matter.
Summary of importance	Low impact / Medium confidence The impact of low dissolved oxygen is likely to be small because its leaves are vertical so a mat over the water surface does not form. It is unlikely to occur at a rate greater than what would occur around many species of native vegetation.
Wetland soils	
VICWRA	In New Zealand, it ‘forms extensive infestations in shallow waterways, seriously restricting water flow and increasing sedimentation, thus aggravating flooding’ (BPRC, 2004). Increased chance of flooding would create the potential for large-scale soil movement with minor off-site implications.
Other sources	—
Mechanism of impact	Dense stems slowing water flow and increasing sedimentation.
Summary of importance	Low impact / Medium confidence Impact of sedimentation may not be as great in natural wetlands, which are the focus of this project, particularly ephemeral ones. Further, wetlands are natural deposition zones anyway.
Habitat, food or harbour for pests	
VICWRA	Carp have been observed feeding on the plant and dense infestations may also provide harbor for them (Parsons and Cuthbertson, 1992).
Other sources	—
Mechanism of impact	Provision of habitat
Summary of importance	Low impact / High confidence Although carp are found in <i>Sagittaria</i> beds there is no evidence that the plant provides a benefit over and above any other aquatic habitat (e.g. among other emergent plants or areas of water without emergent plants).

A.3 Saltmarsh wetland weeds

A.3.1 *Limonium hyblaenum*, Sea Lavender, Sicilian Sea Lavender

Fauna	
VICWRA	—
Other sources	Invades saltmarsh, resulting in total exclusion of other plants, prevents regeneration, reduces biodiversity, changes ecosystem functions, threat to RAMSAR wetlands, threat to orange-bellied parrot habitat, catastrophic invader of upper coastal saltmarsh (Adair, undated).
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	High impact / Medium confidence Floristic community structure changes, resulting in altered habitat for fauna.
Flora	
VICWRA	—
Other sources	Invades saltmarsh, resulting in total exclusion of other plants, prevents regeneration, reduces biodiversity, change ecosystem functions, threat to RAMSAR wetlands, threat to orange-bellied parrot habitat, catastrophic invader of upper coastal saltmarsh (Adair, undated). In Victoria, it can survive periodic tidal inundation and can invade and suppress native coastal salt marsh vegetation (Parsons, 2013). Both in the salt spray zone of rocky coastlines and in saltmarshes, it is clearly a rapidly emerging weed, serious enough to be a major ecosystem transformer (Parsons, 2013). High threat weed of the EVC: Riverine Chenopod Woodland
Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	High impact / Medium confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.

A.3.2 *Spartina* spp., Cord Grass, Rice Grass

Fauna	
VICWRA	—
Other sources	Alters or reduces biodiversity by altering or reducing biodiversity by invading mudflats, converting them to saltwater meadows, which few indigenous animals have any use for (Romanowski, 2011). Its invasion and spread leads to the loss of feeding habitat for wildfowl and waders (GISD, 2016). '...alteration of native and commercial food webs and productivity (direct impacts to macrofaunal communities with potential for reduced diversity and biomass of higher trophic levels).' '...loss of rearing habitat for fish.' ' displacement of migratory and wader birds in infested estuaries due to reduction in prey density and extent of foraging ground.' '...conversion of marine habitats into <i>Spartina</i> monocultures' (Kershaw and McMahon, 2016). 'Introduction and spread of <i>Spartina</i> to Victorian estuarine environments' is listed under the <i>Victorian Flora and Fauna Guarantee Act 1988</i> as a Potentially Threatening Process (http://www.depi.vic.gov.au/environment-and-wildlife/threatened-species-and-communities/flora-and-fauna-guarantee-act-1988)
Mechanism of impact	Altered habitat
Summary of importance	High impact / High confidence Competition with, and subsequent displacement of, native saltmarsh species

Flora	
VICWRA	—
Other sources	Fast growing competitor of indigenous saltmarsh plants (Romanowski, 2011). Its invasion and spread leads to exclusion of native plant species (GISD, 2016). High threat weed of the following five EVCs: Coastal Saltmarsh Aggregate, Estuarine Wetland, Mangrove Shrubland, Sea-grass Meadow, Wet Saltmarsh Herbland. 'competitive exclusion of indigenous plant species (including local dominants such as <i>Sarcocornia quinqueflora</i> ssp. <i>quinqueflora</i> and <i>Avicennia marina</i> ssp. <i>australasica</i>)' (Kershaw and McMahon, 2016).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Formation of dense swards in areas otherwise absent of dense vegetation (intertidal mud flat) results in altered ecosystem function (sedimentation rates, biomass accumulation, water quality, fauna use i.e. waders, benthos, fish).
Hydrology	
VICWRA	
Other sources	Modifies hydrodynamic and sediment dynamics in water ways (Kershaw and McMahon, 2016; Shepard, 2011).
Mechanism of impact	Dense habit and subsequent sediment accretion.
Summary of importance	High impact / High confidence Dense stems and subsequent sediment accretion modify estuary hydrodynamics
Wetland soils	
VICWRA	
Other sources	Dense habit and rhizomes increase sedimentation rates resulting in changes to shoreline profile (e.g. elevating shorelines resulting in saltmarsh islands, intertidal terraces and changes to flow dynamics) (Kershaw and McMahon, 2016; Shepard, 2011). It destroys amenity values such as sandy beaches (Tamar Valley Weed Strategy, http://www.weeds.asn.au/tasmanian-weeds/view-by-common-name/rice-grass/).
Mechanism of impact	Dense stem and rhizomes changing sediment accretion.
Summary of importance	High impact / Medium confidence Dense stems and rhizomes accelerate sediment accretion, elevating shorelines resulting in saltmarsh islands, intertidal terraces and changes to flow dynamics.

A.4 Fringing or marginal wetland weeds

A.4.1 *Gymnocoronis spilanthoides*, Senegal Tea

Fauna	
VICWRA	Grows very quickly, rapidly covers water bodies with floating mat, excluding other plants and the animals that rely on them (CRC for Australian Weed Management, 2003). The plant alters habitat leading to a reduction in population, but not extinction, of one or more species of threatened fauna.
Other sources	Will invade and degrade natural wetlands, competing strongly with slower growing native plants and affecting wetland birds and other animals dependent upon them (GISD, 2016).
Mechanism of impact	Dense infestations altering the habitat.
Summary of importance	Medium impact / Medium confidence Dense infestations alter the floristic composition, thus changing the habitat for fauna.
Flora	
VICWRA	Impedes growth of native plant species (Weber, 2003). 'Can rapidly cover water bodies with a floating mat, excluding other plants' (CRC for Australian Weed Management, 2003). Can form self-sustaining monocultures (Parsons and Cuthbertson, 2001). Serious reduction in species diversity or forms monoculture.
Other sources	It can quickly take over wetlands and detract from their environmental value (GISD, 2016). Will invade and degrade natural wetlands, competing strongly with slower growing native plants and affecting wetland birds and other animals dependent upon them (GISD, 2016).
Mechanism of impact	Dense habit crowding out native species; competitiveness.
Summary of importance	High impact / High confidence Dense infestations forming monoculture outcompeting and displacing native flora in wet and moist environments.
Hydrology	
VICWRA	'In New Zealand, it has caused flooding by blocking streams and drainage channels.... The effects of flooding are made much worse because infestations block drainage channels' (CRC for Australian Weed Management, 2003). Increases surface area and therefore evaporation, water loss through flooding.
Other sources	—
Mechanism of impact	Dense growths obstruct lateral water movement and may increase evapotranspiration.
Summary of importance	Medium impact / Medium confidence Dense growths obstruct lateral water movement and could obstruct flow into and out of wetlands, particularly where artificial control structures are used to manage water, or prevent water exchange to back water areas and billabongs. Despite this, it is likely that wetlands would continue to function as valuable habitat. May increase evapotranspiration, thus reducing water volume in wetlands.
Water quality	
VICWRA	Water quality may decline if large amounts of Senegal Tea plant die off and rot under water (CRC for Australian Weed Management, 2003). Noticeable but minor effects in either dissolved oxygen or light levels. The high growth rate can help prevent the growth of algae because the plant absorbs a great number of nutrients from the water (Tropica Aquarium Plants, 2001).
Other sources	—
Mechanism of impact	Die back of dense growths increasing respiration and reducing oxygen, dense growth reducing light.
Summary of importance	Medium impact / Medium confidence The magnitude of these impacts is not likely to be significantly greater than native species.

A.4.2 *Nassella hyalina*, Cane Needle-grass

Fauna	
VICWRA	In Argentina, it is only of intermediate feed value. Where it replaces better quality native grasses, it would reduce the quality of fodder overall. Minor negative affect on food source for fauna.
Other sources	—
Mechanism of impact	Reduced food value for grazers
Summary of importance	Low impact / Medium confidence Provision of forage for fauna is not an important value of wetlands.
Flora	
VICWRA	EVC=Grassy Woodland (E); CMA=Corangamite; Bioreg=Victorian Volcanic Plain; VH CLIMATE potential. The literature suggests that cane needle grass is not as competitive as the related Chilean needle grass or serrated tussock. However, its presence will displace other more desirable native grass species. Where it occurs north west of Melbourne it forms part of a mixed vegetation community. 'Stipoid grasses generally invade plant communities which are already highly degraded,...and evidence suggests that there is a drop in biodiversity in stipoid grass-dominated grasslands.' (McLaren et al. 1998). Minor displacement of some dominant spp. It appears unlikely to occur, or have any significant impact, in medium and low value EVCs across the southern areas of Victoria.
Other sources	High threat weed of the following two EVCs: Plains Grassy Wetland/Aquatic Herbland Complex, Lava Plain Ephemeral Wetland
Mechanism of impact	Displacement of native species
Summary of importance	Low It is unlikely that <i>N. hyalina</i> will result in significant displacement of true wetland plants. Invasion is likely to be the symptom of prolonged drying.
Habitat, food or harbour for pests	
VICWRA	Slender, tufted grass. Unlikely to provide harbour to pest animals (CRC, 2003).
Other sources	—
Mechanism of impact	—
Summary of importance	Low impact / Medium confidence

A.4.3 *Phalaris aquatica*, Toowoomba Canary Grass, phalaris

Fauna	
VICWRA	—
Other sources	Although a common weed of drains and poorly drained places, it is primarily a weed of disturbed ground and rarely becomes a problem in natural wetlands (Romanowski, 2011). Once established, <i>P. aquatica</i> has deleterious impacts on native plant and animal diversity and can alter ecosystem function (Williams et al. undated).
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	Medium impact / Low confidence Scant information on the impacts of <i>P. aquatica</i> on wetland fauna. Invasion resulting in altered floristic community likely to have ecosystem impacts, although restricted to dryer areas of wetlands.
Flora	
VICWRA	—
Other sources	High threat weed of the following 29 EVCs: Brackish Sedgeland, Floodplain Riparian Woodland, Swampy Riparian Woodland, Grey Clay Drainage-line Aggregate, Plains Grassy Wetland, Cane Grass Wetland, Red Gum Swamp, Billabong Wetland Aggregate, Brackish Herbland, Cane Grass Wetland/Aquatic Herbland Complex, Plains Swampy Woodland, Brackish Wetland Aggregate, Freshwater Lignum Shrubland, Ephemeral Drainage-line Grassy Wetland, Plains Grassy Wetland/Aquatic Herbland Complex, Plains Swampy Woodland/Lignum Swamp Complex, Sedgy Riverine Forest, Wet Verge Sedgeland, Brackish

	<p>Grassland, Swampy Woodland, Brackish Lignum Swamp, Freshwater Lignum – Cane Grass Swamp, Herb-rich Gilgai Wetland, Plains Grassy Wetland/Sedge-rich Wetland Complex, Plains Rushy Wetland, Lava Plain Ephemeral Wetland, Coastal Ephemeral Wetland, Plains Sedgy Wetland/Sedge Wetland Complex, Plains Grassy Wetland/Lignum Swamp Complex.</p> <p>Phalaris is invasive in disturbed areas, native grasslands, grassy woodlands and forests. Although seedlings may be slow to establish, mature plants, if not managed, can form a monoculture of rank unpalatable material which may exclude the ground flora and impede overstorey recruitment (FFICRC, 2011).</p> <p>Once established, <i>P. aquatica</i> has deleterious impacts on native plant and animal diversity and can alter ecosystem function (Williams et al. undated).</p>
Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	<p>High impact / High confidence</p> <p>Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation, although restricted to dryer areas of wetlands.</p> <p>Published data on impacts lacking but large number of wetland EVCs which it threatens indicates an important impact.</p>

A.4.4 *Phyla canescens*, Fog-fruit, Lippia

Fauna	
VICWRA	<p>Earl (2003) lists 14 threatened flora species listed under the federal EPBC Act, including <i>Echinochloa inundata</i> within the Macquarie Marshes, that are known to occur in the distribution of Lippia, and that may be adversely impacted. Earl (2003) also states that ‘any species that occurs in wetlands, along riparian zones or on floodplains which are affected by Lippia could be regarded as potentially threatened because of the extent of the modification of the habitat...’. However, Lippias direct impact on these species has not been officially assessed (Leigh and Walton, 2004). ‘...the loss of wildlife habitat has been observed in the Macquarie Marshes, including the reduced availability of waterbird nesting sites as a result of the conversion of Water Couch communities to lippa (Leigh and Walton, 2004)’</p>
Other sources (all cited in Leigh and Walton, 2004)	<p>Lippia competes effectively with other plants for moisture due to its deep and extensive root system. As a result, Lippia is able to completely dominate ground layer vegetation. It has even been known to dominate in areas previously covered by robust and weedy grasses such as Johnson’s grass (<i>Sorghum halepense</i>) (G Dight 2003, pers. comm., February).</p> <p>Native herb and grassland communities have been displaced as ephemeral wetland, and riparian plant communities in the Macquarie, Gwydir and Condamine valleys have become heavily infested with Lippia (McCosker, 1994). It is also considered a serious threat to the natural integrity of the flood-prone Darling Downs grassy communities due to this competitive ability (Fensham, 1998).</p> <p>The ability of Lippia to effectively dry out soil profiles has been postulated as having negative effects on the establishment of eucalypt seedlings, such as the river red gums (<i>Eucalyptus camaldulensis</i>), along the Condamine River (Richardson, 1994).</p>
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	<p>High impact / High confidence</p> <p>Floristic community structure changes completely, resulting in a low growing monoculture with no structure for fauna.</p>
Flora	
VICWRA	<p>As a very low growing prostrate herb its ability to completely displace ground layer vegetation (Leigh and Walton 2004), as well as affect the regeneration of woody species, such as the eucalypts, <i>E. coolabah</i> and <i>E. camaldulensis</i>, and the large shrub <i>Muehlenbeckia cunninghamii</i> (Earl, 2003),</p> <p>There are many communities threatened by the presence of Lippia (Earl 2003). It is able to completely dominate ground layer vegetation (Leigh & Walton 2004) forming monocultures, and is considered a major threat to riparian and associated ecosystems (Julien et al. 2004).</p>
Other sources	<p>High threat weed of the following nine EVCs: Lignum Swamp, Grassy Riverine Forest, Red Gum Swamp, Intermittent Swampy Woodland, Riverine Swamp Forest, Sedgy Riverine Forest/Riverine Swamp Forest Complex, Intermittent Swampy Woodland/Riverine Grassy Woodland Complex, Lignum Swampy Woodland, Plains Grassy Wetland/Lignum Swamp Complex.</p>

Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	High impact / High confidence Dense perennial monocultures displacing native plants, therefore changing the character of the vegetation.
Hydrology	
VICWRA	—
Other sources	Lippia was introduced in some areas as a soil stabiliser. It was thought that the root biomass and dense foliage would provide a barrier to streambank erosion, but the opposite is true. Due to its massive taproot system, Lippia has the ability to draw moisture from very deep in the soil profile. Instead of streambanks being stabilised, they slump and collapse as a result of the soil being dried out to several metres (Lippia Management Manual, QMDC, undated). The spreading nature and deep rooting system of Lippia are some of the main concerns with this plant (Leigh and Walton, 2004). Lippia has a deep root system that dries out floodplain clay soils. This is said to contrast to native perennial grasses which have an extensive but fine fibrous root system. As a result of drying out caused by Lippia, soils crack which can cause stream bank instability in areas overtaken by this plant, especially if no other vegetation, particularly tree cover, is present (Leigh and Walton, 2004).
Mechanism of impact	Deep root system and high transpiration rate reduces soil moisture.
Summary of importance	Medium impact / Medium confidence Based on its described behavior in stream banks it is likely to severely reduce wetland soil moisture during wetland dry phase.
Water quality	
VICWRA	Increased soil erosion, caused by Lippia, could result in increased nutrient loading and stream water turbidity, which may contribute to an increase in algal blooms and eutrophication (Lucy et al. 1995).
Other sources	—
Mechanism of impact	Increasing erosion of stream banks (via drying and cracking of soil leading to increased slumping)
Summary of importance	Medium impact / Medium confidence Indirectly reduces wetland water quality by increasing erosion in streams that flow into wetlands.
Wetland soils	
VICWRA	Riverbanks overtaken by Lippia often become extremely unstable with a greatly increased incidence of subsistence of sections of bank into the river (Lucy et al. 1995), and 'as well as being locally damaging, this has severe implications in terms of downstream water quality and movement of soil (Julien, 2005).
Other sources	Lippia was introduced in some areas as a soil stabiliser. It was thought that the root biomass and dense foliage would provide a barrier to streambank erosion, but the opposite is true. Because of its massive taproot system, Lippia has the ability to draw moisture from very deep in the soil profile. Instead of streambanks being stabilised, they slump and collapse as a result of the soil being dried out to several metres (Lippia Management Manual, QMDC). Soils crack as a result of drying out caused by the Lippia root system, which can cause stream bank instability in areas overtaken by this plant, especially if no other vegetation, particularly tree cover, is present (Leigh and Walton, 2004).
Mechanism of impact	Increasing erosion of stream banks (via drying and cracking of soil leading to increased slumping).
Summary of importance	Medium impact / Medium confidence Growth destabilises stream banks, increasing erosion and suspended sediment load in streams, probably increasing the siltation rate in receiving wetlands.

A.4.5 *Salix cinerea*, Grey Sallow, Grey Willow, Pussy Willow

Fauna	
VICWRA	<p>In Yellingbo State Fauna Reserve ‘willow species have the potential to seriously degrade, or even destroy in the longer-term, the habitat of the...highly localised, endemic, endangered...Helmeted honeyeater and the...endangered...Leadbeater’s Possum which are dependent on riparian vegetation for their survival. <i>Eucalyptus camphora</i>, which provides nectar in winter, is the principal habitat component for the Helmeted honeyeater and willows could easily overtop this small tree and prevent its recruitment. The most serious willow [at this site] is <i>S. cinerea</i>’ (Ladson et al. 1997).</p> <p><i>S. cinerea</i> seriously threatens the nationally significant alpine bogs and fens in Victoria (eg. Bogong High Plains) and the Red Gum floodplain vegetation in the Lower Owens Heritage River (ARMCANZ, 2001).</p> <p>All willows are capable of invading riparian zones and reducing the habitat available to vertebrates. For example, the rare Broad-toothed Rat that favours drainage-line vegetation (Ladson et al. 1997).</p> <p>Intense shading decreases primary production in waterways, impacting on invertebrates and fish (Ladson et al. 1997).</p> <p>Reduce indigenous vegetation which would otherwise provide habitat (especially tree hollows) and pollen and nectar food sources (Ladson et al. 1997).</p> <p>‘Dense shade and mat-forming willow roots suppress and kill indigenous understorey [which is] important habitat for insects, birds and mammals. Bare banks beneath willows provide little protection for frogs, water rats, snakes, lizards and other fauna. Willows do not provide nectar for native birds...Willows also have few hollows, important habitat for over half of our woodland birds and mammals’ (Purtle et al. 2001b).</p>
Other sources	<p>Forms dense stands in shallow water or on dry land, displacing native plant species and reducing biodiversity (Sainty and Jacobs, 2003).</p> <p>‘...their seedlings can establish thickets on exposed wet sediments and they can invade shallow water by the layering of branches and toppling of over mature, live stems. At this point, extensive displacement of native vegetation with loss of biodiversity’ occurs (GISD, 2016).</p> <p>The underwater roots of this species can modify the banks, and in shallow streams, cover the ground, eliminating niches for organisms needing shelter in hollows. And because this species is exotic it has become a poor link in the food chain for native organisms (GISD, 2016).</p>
Mechanism of impact	Dense growth alters habitat.
Summary of importance	<p>High impact / High confidence</p> <p>Dense thickets change the ecological character of the wetlands and reduce suitability for native fauna.</p>
Flora	
VICWRA	<p>All Victorian waterbodies are assumed to be high value EVCs. ‘Stands are mostly monocultures excluding 97% of sunlight and most other species’ (Cremer, 1999). Capable of forming monocultures displacing all species within a layer.</p> <p><i>S. cinerea</i> is spreading, often forming dense thickets. Often forms dominant vegetation in swampy habitats (Webb, Sykes & Garnock-Jones, 1988).</p> <p>‘The sedge-rich <i>Eucalyptus camphora</i> Swamp Community, a dominant swamp vegetation of the Reserve, is also listed under the <i>Flora and Fauna Guarantee Act 1988</i>. This community type is very rare...one species is of state significance and 55 are of regional significance. Willows could easily overtop [<i>E. camphora</i>] and prevent its recruitment...The most serious willow [at this site] is <i>S. cinerea</i>’ (Ladson et al. 1997).</p>
Other sources	<p>High threat weed of the following eight EVCs: Montane Riparian Thicket, Riparian Thicket, Montane Sedgeland, Floodplain Wetland Aggregate, Alpine Heath Peatland, Forest Creekline Sedge Swamp, Tall Marsh, Alpine Hummock Peatland.</p> <p>Forms dense stands in shallow water or on dry land, displacing native plant species and reducing biodiversity (Sainty and Jacobs, 2003).</p> <p>‘...their seedlings can establish thickets on exposed wet sediments and they can invade shallow water by the layering of branches and toppling of over mature, live stems. At this point, extensive displacement of native vegetation with loss of biodiversity. <i>S. cinerea</i> also produce dense shade during the growing season eliminating most native terrestrial plants growing beneath and inhibiting aquatic plants’ (GISD, 2016).</p>

Mechanism of impact	Dense monocultures and competitiveness.
Summary of importance	High impact / High confidence Forms dense thickets which change the floristic composition of the wetlands and riparian areas in which they grow.
Hydrology	
VICWRA	<i>S. cinerea</i> is a thicket forming species that is especially adapted to waterlogging (Cremer, 1999) that may encroach into streams, trapping silt and reducing channel capacity (Purtle et al. 2001b).
Other sources	Evapotranspiration rates very high (Romanowski, 2011).
Mechanism of impact	High rates of high evapotranspiration
Summary of importance	Medium impact / Medium confidence Results in increased evapotranspiration, possibly reducing volume and duration of inundation of wetlands. Impacts on stream flow irrelevant to wetland focus of this project.
Water quality	
VICWRA	As deciduous plants (Carr, 1996), all shrub and tree willows have mass autumn leaf fall, which leads to decreased oxygen levels (Ladson et al. 1997). Intense shading by willows, which tend to have more dense canopies than native species, decreases water temperature (Ladson et al. 1997).
Other sources	Reductions in the quantity and quality of water can occur because of the diversion of floodwaters and erosion of floodplains (GISD, 2016). Because of the deciduous nature of <i>S. cinerea</i> leaf inputs to streams are largely restricted to autumn, with consequent anaerobic decay in stagnant waters (GISD, 2016).
Mechanism of impact	Changed leaf fall and canopy density altering light and oxygen in water.
Summary of importance	Medium impact / High confidence Increased leaf fall during a short autumn period increasing microbial decay (respiration), increased shade reducing light, increased erosion resulting in muddy water during floods. Note: reduced water temperature through shading can be of benefit. Note: most of the impacts above relate to flowing water courses, not wetlands.
Wetland soils	
VICWRA	'Willows encroaching into the center of streams interrupt the flow of water which results in stream flows being directed into watercourse banks, causing erosion. In severe cases, willows can create complete blockages, causing the stream to change course (Purtle, 2001b). <i>S. cinerea</i> is a thicket forming species that is especially adapted to waterlogging (Cremer, 1999) that may encroach into streams, trapping silt and reducing channel capacity (Purtle et al. 2001b).
Other sources	Diversion of floodwaters and erosion of floodplains (GISD, 2016).
Mechanism of impact	The dense stems changing flow and sediment dynamics.
Summary of importance	Low impact / High confidence The impacts above relate to flowing water courses, not wetlands.
Habitat, food or harbour for pests	
VICWRA	'...thicket-forming species that might harbour foxes and rabbits include: <i>S. cinerea</i> ' (Cremer, 2001)
Other sources	—
Mechanism of impact	May provide habitat for foxes and rabbits.
Summary of importance	Low impact / Medium confidence Not well documented

A.4.6 *Salix* spp., Willows

Fauna	
VICWRA	<p>'Studies have shown major reductions in numbers and diversity of invertebrates, fish and indigenous plants along watercourses dominated by willows. This is because willows provide a totally different, and much poorer living environment than the local natural system.'</p> <p>All willows are capable of invading riparian zones and reducing the habitat available to vertebrates. For example, the rare Broad-toothed Rat that favours drainage-line vegetation (Ladson et al. 1997).</p> <p>Intense shading decreases primary production in waterways, impacting on invertebrates and fish (Ladson et al. 1997). Reduce indigenous vegetation which would otherwise provide habitat (especially tree hollows) and pollen and nectar food sources (Ladson et al. 1997).</p> <p>'Dense shade and mat-forming willow roots suppress and kill indigenous understorey [which is] important habitat for insects, birds and mammals. Bare banks beneath willows provide little protection for frogs, water rats, snakes, lizards and other fauna. Willows do not provide nectar for native birds...Willows also have few hollows, important habitat for over half of our woodland birds and mammals' (Purtle et al. 2001b).</p> <p>See also Section 0 for impacts of <i>Salix cinerea</i>.</p>
Other sources	—
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	High impact / High confidence Dense monocultures change the ecological character of the wetlands and reduce suitability for native fauna.
Flora	
VICWRA	<p>'Willows compete vigorously for space, water and nutrients eliminating virtually all indigenous vegetation within an infestation.' One of the worst weeds of temperate Australian streams and wetlands. Displaces species within different layers.</p> <p>'The sedge-rich <i>Eucalyptus camphora</i> Swamp Community, a dominant swamp vegetation of the Reserve, is also listed under the <i>Flora and Fauna Guarantee Act 1988</i>. This community type is very rare...one species is of state significance and 55 are of regional significance. Willows could easily overtop [<i>E. camphora</i>] and prevent its recruitment...The most serious willow [at this site] is <i>S. cinerea</i>' (Ladson et al. 1997).</p>
Other sources	High threat weed of the following two EVCs: Floodplain Wetland Aggregate, Tall Marsh
Mechanism of impact	Dense smothering monocultures and competitiveness.
Summary of importance	High impact / High confidence Forms dense monocultures which change the floristic composition of the wetlands and riparian areas in which they grow.
Hydrology	
VICWRA	<p>'Willows colonise...stream beds. Impacts include blockage/obstruction, avulsion, increased erosion and sedimentation and increased flooding.'</p> <p>Species able to grow in streambeds can have serious impacts both to surface and subsurface water flow.</p> <p>'Fibrous willow roots and dense willow foliage trap large amounts of silt which can decrease channel capacity, exacerbate flooding and change flood patterns. Willow roots can grow out into the stream, trapping silt and layering new roots over old roots, building up the streambed and creating a broad shallow stream' (Purtle et al., 2001b).</p>
Other sources	Evapotranspiration rates very high (Romanowski, 2011).
Mechanism of impact	High rates of high evapotranspiration.
Summary of importance	High impact / Medium confidence Results in increased evapotranspiration, possibly reducing volume and duration of inundation of wetlands. Impacts on stream flow not considered important to the 'in-wetland' focus of this project.

Water quality	
VICWRA	Water quality is affected by the creation of anoxic conditions produced during the breakdown of the massed autumn leaf fall. '...light levels and temperatures are drastically reduced under their dense shade, compromising the in-stream habitat of aquatic invertebrates and vertebrates.' Changes to light, temperature and oxygen levels.
Other sources	—
Mechanism of impact	Changed leaf fall and canopy density altering light and oxygen in water.
Summary of importance	Medium impact / High confidence Increased leaf fall during a short autumn period increasing microbial decay (respiration), increased shade reducing light.
Wetland soils	
VICWRA	Originally planted to provide stream bank stabilisation, the long term impact of willows has been to change watercourse behaviour, '...with impacts on erosion, silt movement and flooding patterns. Willows encroaching into the centre of streams interrupt the flow of water which results in stream flows being directed into watercourse banks, causing erosion.'
Other sources	—
Mechanism of impact	Changed erosion and sediment deposition patterns.
Summary of importance	Low impact / High confidence The impacts above relate to flowing water courses, not wetlands.

A.5 Bogs and moss beds, mud herbs

A.5.1 *Juncus effusus*, Soft Rush

Fauna	
VICWRA	—
Other sources	<i>J. effusus</i> is capable of forming closed swards (DSE, 2009).
Mechanism of impact	Dense smothering growth altering the habitat.
Summary of importance	Medium impact / Low confidence No direct impacts recorded, but formation of dense swards is likely to result in altered floristic community and thus have ecosystem impacts.
Flora	
VICWRA	—
Other sources	<i>J. effusus</i> is capable of forming closed swards, thus listed as a potentially threatening process for the threatened Dwarf sedge (<i>Carex paupera</i>) (DSE, 2009). High threat weed of the following six wetland EVCs: Montane Sedgeland, Alpine Fen, Sub-alpine Wet Heathland, Alpine Heath Peatland, Sub-alpine Wet Sedgeland, Alpine Hummock Peatland.
Mechanism of impact	Dense habit and competitiveness.
Summary of importance	Medium impact / Low confidence Closed perennial swards likely to displace native plants, therefore changing the character of the vegetation.

A.5.2 *Xanthium strumarium* spp. agg., Noogoora Burr species aggregate

Fauna	
VICWRA	'An extensive root system and rapid growth rate make these plants strong competitors.' 'Noogoora Burr can form very dense patches... Californian burr occurs in thick patches, and occasionally in large dense stands.' Reduces food source for native fauna (Parsons and Cuthbertson, 2001)
Other sources	This weed has a major impact on agriculture but information about its impact on fauna is scarce. 'Noogoora Burr forms dense thickets which exclude the majority of understorey plants. Due to the spread along water courses, wetland plant biodiversity is threatened by Noogoora Burr infestation. Noogoora Burr replaces the Cane Grass in which Purple-crowned Fairy-wrens nest. Fairy-wrens will feed in Noogoora Burr while its lush greenery provides shelter, but they avoid it once it shrivels and turns brown. If Noogoora Burr continues to spread, this weed could also affect a wider range of threatened species (Anonymous, 2011).
Mechanism of impact	Dense growth altering the habitat.
Summary of importance	Medium impact / Medium confidence Unknown impacts on wetland fauna documented, likely to be problematic only during dry periods.
Flora	
VICWRA	EVC=Creekline grassy woodland (E); CMA=North Central; Bioreg=Victorian Riverina; EVC=Riverine grassy woodland (D); CMA=Goulburn Broken; Bioreg=Murray Fans; VH CLIMATE potential. It occurs along flood-prone areas of the Murray River and its tributaries. 'Thick burr patches in pasture eliminate almost all other species.' Prefers unshaded situations. Major impact on grasses/forbs. EVC=Riparian forest (LC); CMA=West Gippsland; Bioreg=Highlands – Southern Fall; L CLIMATE potential. Prefers unshaded situations. Likely CLIMATE potential and forest situation would limit impact.
Other sources	High threat weed of the following five wetland EVCs (including <i>Xanthium</i> spp.): Grassy Riverine Forest, Floodway Pond Herbland, Grassy Riverine Forest/Floodway Pond Herbland Complex, Grassy Riverine Forest/Riverine Swamp Forest Complex, Riverine Ephemeral Wetland.

Mechanism of impact	Dense habit and competitiveness.
Summary of importance	High impact / Medium confidence Displacement of desirable flora likely to occur only during dry periods.
Habitat, food or harbour for pests	
VICWRA	The seeds and seedlings of both species are poisonous. Not known as a food source to pests or to provide harbour.
Other sources	—
Mechanism of impact	Poisoning of wetland fauna unlikely to occur.
Summary of importance	Low impact / Low confidence Plant is poisonous to browsers but unlikely to be important for wetland species

