## Appendix A: Australian Ramsar Management Principles (EPBC Act, 1999)

The Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (see section 1) seeks to encourage the preparation of management plans for Ramsar sites in Australia and that such plans comply with the Australian Ramsar Management Principles. These principles are presented below.

A management plan for a declared Ramsar wetland should:

(a) describe its ecological character; and,

(b) state the characteristics that make it a wetland of international importance under the Ramsar Convention; and

(c) state what must be done to maintain its ecological character; and

(d) promote its conservation and sustainable use for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem; and

(e) state mechanisms to deal with the impacts of actions that individually or cumulatively endanger its ecological character, including risks arising from:

(i) physical loss, modification or encroachment on the wetland; or

(ii) loss of biodiversity; or

(iii) pollution and nutrient input; or

(iv) changes to water regimes; or

(v) utilisation of resources; or

(vi) introduction of invasive species; and

(f) state whether the wetland needs restoration or rehabilitation; and

(g) if restoration or rehabilitation is needed — explain how the plan provides for restoration or rehabilitation; and

(h) provide for continuing monitoring and reporting on the state of its ecological character; and

(i) be based on an integrated catchment management approach; and

(j) include adequate processes for public consultation on the elements of the plan; and

(k) be reviewed at intervals of not more than 7 years.

# Appendix B: Ecosystem services of the Coorong and Lakes Ramsar site

The following is based on the definition of ecosystem services as promoted by the *Millenium Ecosystem Assessment*, and as now endorsed for use under the Ramsar Convention through Resolution IX.1 of the 9th Conference of the Contracting in November 2005.

| Ecosystem service | Details | Source |
|---|---|---|
| **Provisioning services** | | |
| Wetland products | Water source for irrigators (horticulture, viticulture) | 1 |
| | Drinking water supply (Augmentation of Adelaide's water supply) | 1 |
| | Commercial and recreational fisheries | 1 |
| | Commercial cockle industry | 1 |
| | Grazing | 1 |
| **Regulating services** | | |
| Maintenance of hydrological stability | Flood mitigation | 2,3 |
| | Groundwater interactions | 2 |
| Water purification | Removal and dilution of wastewaters from irrigation areas, urban areas and septic tanks | Ex |
| Coastal shoreline and river bank stabilisation | Reduce impacts of wind and wave action and currents | Ex |
| | Prevent erosion by holding sediments with plant roots | Ex |
| Sediment and nutrient retention | Flood retardation and sediment and nutrient deposition | Ex |
| Local climate regulation | Local climate stabilisation, particularly in relation to rainfall and temperature | KG |
| Climate change mitigation | Sequestering of carbon | KG |
| Biological control of pests and diseases | Support of predators of agricultural pests (for example ibis feeding on grasshoppers) | Ex |
| **Cultural services** | | |
| Recreation and tourism | Boating and water-skiing | 1 |
| | Fishing (see above also) | 1 |
| | Bird watching and sightseeing | 1 |
| | Swimming, picnicking and camping | 3 |
| Cultural values | Aesthetics, amenity | Ex |
| | Cultural and spiritual significance for the Ngarrindjeri people | Ex |
| | Educational and research site | Ex |
| **Supporting services** | | |
| Food web support | Nutrient cycling | KG |
| | Primary ecosystem production | Ex |
| Ecological values (as presented in the draft revised Ramsar Information Sheet – see Appendix C) | Representative of a unique ecosystem (globally, nationally and regionally) | 2 |
| | Supports a large variety of ecological communities | 3 |
| | Supports a number of globally and nationally threatened species and communities | 2 |
| | Supports a high diversity of species and assemblages important for conserving biodiversity at the bioregional scale | 3 |
| | Supports animal taxa at critical stages of their lifecycle and during drought | 2,3 |
| | Supports significant numbers and diversity of wetland-dependent birds, including migratory species listed under the JAMBA and CAMBA agreements. | 2,3 |
| | Supports significant numbers and diversity of native fish, including migratory species. | 2,3 |

**Sources:**
1= management plan for the site;
2 = Ramsar Information Sheet (See Appendix C);
3 = Asset Plan (DWLBC, 2005);
Ex = Expert opinion – recognition that the services occurs at the site but may not have been actually listed in a key document;
KG = Knowledge gap – see below.

# Appendix C: (Draft Revised) Information Sheet on Ramsar Wetlands (RIS)

| | |
|---|---|
| **1. Name and address of the compiler(s) of this form:** | South Australia Department of Environment and Heritage. Contact: Tim Wilson, Senior Ramsar Officer, Coorong and Lower Lakes Regional Conservation, South East, Department for Environment and Heritage,<br>Telephone: +61 8 8555 0296<br>Email: wilson.timj@saugov.sa.gov.au |
| **2. Date this sheet was completed/updated:** | Site designated 1 November 1985<br>RIS update March 2006 |
| **3. Country:** | Australia |
| **4. Name of Ramsar site:** | The Coorong, and Lakes Alexandrina and Albert Wetland, South Australia |
| **5. Map of the site included ?** | |
| **5a) hardcopy** | a) Yes |
| **5b) digital (electronic) format** | b) Yes |
| **6. Geographical coordinates:** | Latitude: (approx.) 35 degrees 18'S to 36 degrees 33'S.; Longitude: (approx.) 138 degrees 46'E to 139 degrees 50'E. |
| **7. General location:** | The mouth of the River Murray, South Australia. |
| **8. Elevation:** | Sea level |
| **9. Area:** | 140,500 ha. (approx.) |
| **10. Overview:** | The Coorong is a long, shallow brackish to hypersaline lagoon more than 100 km in length that is separated from the Southern Ocean by a narrow sand dune peninsula. The Lakes Alexandrina and Albert form the mouth of the River Murray and are comprised of fresh to brackish/saline waters. Wetlands specifically included are:<br>Lake Alexandrina including Tolderol, Mud Islands and Currency Creek Game Reserves, otherwise mainly Crown Lands. 76,000 ha.<br>Lake Albert. Mainly Crown Lands. 16,800 ha.<br>Coorong - mainly covering Coorong National Park and Game Reserve, otherwise mainly Crown Lands. 47,700 ha.<br>The site is one of Australia's icon wetlands and biodiversity 'hot-spot' supporting critically endangered, endangered, threatened and vulnerable species and ecological communities. It is also supports extensive and diverse waterbird, fish and plant assemblages; reliant on its complex mosaic of wetland types.<br>The area is a popular recreational site, while also supporting a range of commercial activities related to tourism and commercial fishing most notably.<br>The Ngarrindjeri Indigenous people have a long association with the Coorong and Lakes and the site has great cultural significance for them. They retain these close links with the wetland and its biodiversity through these cultural links. |

**11. Ramsar site criteria met by the site:**
The site qualifies as a Ramsar site against the following criteria (as provided in full below along with justification for their application in each case):

**Note: at the time this site was designated (in 1985) the two fish-related criteria 7 and 8 (see below) did not exist. This revision of the RIS has been able to establish that the site clearly qualifies against both these criteria as well. Further, in November 2005 at Ramsar's 9th Conference an additional criterion was added, as follows:**

Criterion 9:
A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

At this time it is not possible to confirm that the site also qualifies against this additional criterion. It is possible that it does for some of the native fish species found within the site, but there is insufficient population data for these species at present to be able to make such a conclusion.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|

| **12. Justification of the criteria selected under 11 above:** | |
|---|---|
| Criteria for designating Wetlands of International Importance | Justification |
| **Criterion 1:** A wetland should be considered internationally important if it contains a representative, rare or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region. | The Coorong and Lower Lakes represent a unique wetland system comprising a natural wetland system with associated shoreline marshes at the mouth of the River Murray connected with the Coorong - a long, narrow wetland complex extending from the Murray Mouth to parallel coastal dunes and consisting of saline marshes, samphire, freshwater soaks and open water with a hypersaline area at the southern end. The full range of wetland types is described in section 17. This shows the presence of 23 different wetland tyypes spread across the marine/coastal, inland waters and human-made categories. |
| **Criterion 2:** A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities. | The site partially supports one critically endangered ecological community plus populations of a number of internationally or nationally threatened species included in the global 'red list' of the World Conservation Union (IUCN) or listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).<br>Full details are given in Attachment 1. In summary:<br>Lying partly within the Ramsar-listed area are the 'Swamps of the Fleurieu Peninsula'; a critically endangered ecological community under the EPBC Act. These swamps are habitat (in part) of the endangered Mount Lofty Ranges Southern Emu-Wren. Notable among the species listed in Attachment 1 are the following fauna:<br>**Some of the notable species under this criterion are:**<br>Fauna: Orange-bellied Parrot, Mount Lofty Ranges Southern Emu Wren, Southern Bell Frog, Yarra Pygmy Perch, Murray Cod and Murray Hardyhead,.<br>Flora: 6 wetland-dependent species, including, Silver Daisy-bush, Fat-leaf Wattle and Osborn's Eyebright. |
| **Criterion 3**: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region. | In addition to the above-referred to species and ecological community of note, the Coorong and Lower Lakes Ramsar site also supports a large number of taxa and communities of biodiversity significance. These are detailed in Attachment 2.<br>The vegetation association of Smooth Cutting Grasses (*Gahnia spp.)* has been provisionally listed as a threatened ecosystem within the agricultural district of South Australia. In addition there are the following of note; 5 waterbird species, 20 fish species and 1 plant species. |
| **Criterion 4:** A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions. | Attachment 3 sets out the details of those species that qualify the site under this criterion. It includes the following:<br>Fish: 20 species in addition to the 20 listed under criterion 3, these including a number of migratory or diadromous species;<br>Birds: 49 species including 25 migratory waterbird birds listed under the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA respectively) plus many resident species that breed within the site or rely on it for refuge during times of drought. |
| **Criterion 5**: A wetland should be considered internationally important if it regularly supports 20,000 of more waterbirds. | This site supports well in excess of 20,000 waterbirds, at times reaching populations estimated at between 10 and 20 times greater. The significant species that comprise this large waterbird community include the 51 species listed under criterion 4 and 16 listed under criterion 6. In addition, there are a further 13 species of note as listed in Attachment 4. |
| **Criterion 6:** A wetland should be considered | There are 16 species that have been regularly recorded in |

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| internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird. | numbers exceeding the 1% level (see Attachment 5). Among these are the following; two grebe species, the Cape Barren Goose, Sharp-tailed and Curlew Sandpipers, three species of plover, the Banded Stilt, Red-necked Avocet and the Fairy Tern. |
| **Criterion 7:** A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity. | The Coorong and Lower Lakes are considered significant for 49 fish species. Taken collectively they qualify the site under this criterion because of their biodiversity and biodisparity. The transitional environment from fresh to marine waters makes this site a unique habitat for fish species. The full list of these species can be found in Attachment 1, 2 and 3 plus Table 6. |
| **Criterion 8:** A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend. | As indicated above the site is important for 49 marine, freshwater and diadromous fish species. Of these, all but 6 are considered reliant on the ecosystem in the ways specified under this criterion. |

| **13. Biogeography:** | |
|---|---|
| **13a) Biogeographic region:** | Murray-Darling Depression and Naracoorte Coastal Plain. |
| **13b) Biogeographic regionalisation scheme:** | Interim Biogeographic Regionalisation of Australia (IBRA) Version 5.1. Department of Environment and Heritage, Canberra. |
| **14. Physical features of the site:** | The Lakes Alexandrina and Albert form a semi-natural wetland system with associated shoreline marshes at the mouth of the River Murray and are connected with the Coorong - a long, narrow wetland complex extending from the Murray Mouth to parallel coastal dunes and consisting of saline marshes, samphire, freshwater soaks and open water with a hypersaline area at the southern end. |
| **15. Physical features of the catchment area** | The Coorong and Lower Lakes are located at the downstream end of the Murray-Darling system; Australia's largest river basin. The River Murray terminates at the Southern Ocean in South Australia, where it passes through Lakes Alexandrina and Albert, the Murray estuary, the Coorong and Murray Mouth. |
| **16. Hydrological values:** | The Coorong and Lower Lakes receive local runoff and rainfall plus inflows at the northern end of the system from the River Murray. In addition there are groundwater inputs and inflows into the South Lagoon from the Upper South East drainage scheme via Salt Creek.<br>The Lower Lakes are separated from the Murray Mouth and Coorong by a system of barrages. They were constructed between 1935 and 1940 to provide fresh water for irrigation, stock and domestic purposes (MDBC 2004d). Recently, fishways were installed on Goolwa and Tauwitchere barrages to enable fish passage between the Lower Lakes and the Murray Mouth/Coorong. |

**17. Wetland types:**

**a) presence:**
The Ramsar site contains those wetland types shown in the table below.

**b) dominance:**
Based on the calculated area of each type, the dominant types within each of the marine/coastal, inland and human-made categories are shaded.

**Note: This represents the breakdown of types and their respective areas for 2005, not 1985 when the site was listed.**

| **Marine/Coastal Wetlands** | **Area (ha)** |
|---|---|
| A -- **Permanent shallow marine waters** in most cases less than six metres deep at low tide; includes sea bays and straits. | 50 |
| D -- **Rocky marine shores**; includes rocky offshore islands, sea cliffs. | 788* |
| E -- **Sand, shingle or pebble shores**; includes sand bars, spits and sandy islets; includes dune systems and humid dune slacks. | 1,020# |
| F -- **Estuarine waters**; permanent water of estuaries and estuarine systems of deltas. | 2,200 |

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| G -- **Intertidal mud, sand or salt flats**. | 3,142 |
| H -- **Intertidal marshes**; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes. | 536 |
| I -- **Intertidal forested wetlands**; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests. | 4 |
| J -- **Coastal brackish/saline lagoons**; brackish to saline lagoons with at least one relatively narrow connection to the sea. | 10,128 |
| K -- **Coastal freshwater lagoons**; includes freshwater delta lagoons. | 41 |
| **Inland Wetlands** | |
| M -- **Permanent rivers/streams/creeks**; includes waterfalls. | 221 |
| N -- **Seasonal/intermittent/irregular rivers/streams/creeks**. | 200 |
| O -- **Permanent freshwater lakes** (over 8 ha); includes large oxbow lakes. | 79,480 |
| P -- **Seasonal/intermittent freshwater lakes** (over 8 ha); includes floodplain lakes. | 120 |
| R -- **Seasonal/intermittent saline/brackish/alkaline lakes and flats**. | 1,729 |
| Ss -- **Seasonal/intermittent saline/brackish/alkaline marshes/pools**. | 1,274 |
| Tp -- **Permanent freshwater marshes/pools**; ponds (below 8 ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season. | 4,474 |
| Ts -- **Seasonal/intermittent freshwater marshes/pools** on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes. | 1,037 |
| W -- **Shrub-dominated wetlands**; shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on inorganic soils. | 4,875 |
| Xf -- **Freshwater, tree-dominated wetlands**; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils. | 1,470 |
| Y -- **Freshwater springs; oases**. | <10 |
| **Human-made wetlands** | |
| 4 -- **Seasonally flooded agricultural land** (including intensively managed or grazed wet meadow or pasture). | 1,235 |
| 6 -- **Water storage areas**; reservoirs/barrages/dams/impoundments (generally over 8 ha). | 1 |
| 9 -- **Canals and drainage channels, ditches**. | 44 |

Notes:
Types not found in the system have been deleted from the table.
* = includes 165 ha from Lake Alexandrina a freshwater part of the system.
# = includes 6 ha from Lake Alexandrina and 1 ha from Lake Albert; freshwater parts of the system
The total area of wetland types is approximately 114,100 hectares. The balance of the Ramsar site (approx 26,400 hectares)is comprised of terrestrial habitat which is not classified by the Ramsar Convention.

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| **18. General ecological features:** | **The Coorong**<br>The Coorong is a 140 km long expanse of water, separated from the Southern Ocean by a narrow coastal dune barrier. It forms part of the extensive wetland system of the Lower Murray, which covers a total area of 660 km$^2$ (AWE 2003). In addition to local runoff and rainfall, the Coorong receives inflows at its northern extremity from the River Murray, groundwater inputs and inflows into the South Lagoon from the Upper South East drainage scheme via Salt Creek.<br>The Coorong is the only estuarine area within the River Murray system. It can be divided into three distinct components based on different salinity patterns - the Murray estuary, the Northern Lagoon and the Southern Lagoon<br>A key feature of the Coorong is the salinity gradient, which increases with distance from the Mouth. Salinity in the Coorong changes from estuarine in the Murray estuary, influenced by freshwater flows over the barrages, to hypersaline in the Southern Lagoon.<br>**Murray estuary**<br>The Murray estuary includes the area around the Murray Mouth from the Goolwa barrage to Pelican Point and encapsulates the Goolwa, Coorong and Mundoo channels. The area is naturally estuarine, but salinity levels fluctuate |

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| | widely due to barrage-regulated flow. The lagoon environment, which includes habitats such as exposed mudflats, *Ruppia megacarpa* beds and shallow waters, provides important foraging grounds for many wader species.<br><br>**North Lagoon**<br>The North Lagoon is characterised by similar conditions as the Murray estuary, with barrage releases controlling salinity. The salinity gradient increases southwards along the North Lagoon, which extends from Pelican Point to Parnka Point, where it reduces to a small bottleneck that separates it from the South Lagoon.<br>**South Lagoon**<br>South of Parnka Point, the South Lagoon extends past Salt Creek where it becomes a series of predominantly hypersaline ephemeral lagoons. The South Lagoon varies from estuarine to hypersaline. The 'natural' salinity of the Coorong is currently under debate, as it is believed that the Coorong is more saline now than prior to river regulation (for example, Geddes and Hall 1990).<br>Salinities are affected by flow over the barrages and Upper South East Drainage inflows. During times of low freshwater flow, salinity levels in the lagoon become two to three times that of seawater. Water levels, quality and temperature in the South Lagoon are influenced by tidal exchange and River Murray flows into the Northern Lagoon (EconSearch 2004a).<br>**Murray Mouth**<br>The Murray Mouth is a tidal inlet restricted by the accumulation of dune material on the flanking spits of Sir Richard Peninsula and Younghusband Peninsula. It is located in a high-energy environment and is extremely dynamic. The location, size and shape of the Mouth and the adjacent estuary are dictated by a combination of river flows, tidal flows and ocean and coastal processes (Harvey 2002).<br>Large volumes of sand are continually being moved through the Mouth by daily tides. The capacity of the tides to transport sand is dependent on two main factors – tidal velocity and wind/wave action in the immediate vicinity of the Mouth. Tidal velocity is determined by the tidal range, flow over the barrages and the existing water level in the estuary. Even small river flows counteracting the incoming tide may result in a significant reduction in the consequent sediment load in the Mouth region (Harvey 2002).<br>**Lakes Alexandrina and Albert**<br>Prior to European settlement, the Lower Lakes were predominantly fresh, with river water discharging to the sea and keeping the Murray Mouth clear. Saltwater intrusions into the Lake environment were not common until after 1900 when significant water resource development had occurred in the River Murray system (Sim & Muller 2004). Short-lived intrusions of saltwater would occur during periods of low flow down river resulting in a lower lake level; however it appears that only small areas of the Lakes, around the Mouth and channels, were affected.<br>The Lower Lakes system would have offered a mosaic of fresh, brackish, saline and hypersaline fringing wetland systems that interconnected across time and space (MDBC 2004c)." (DWLBC, 2005))<br>**Tributary wetlands**<br>The lower reaches of Finniss River, Tookayerta Creek and Currency Creek lie within the Ramsar site. The terminal reaches of the Finniss River and Tookayerta Creek are structurally diverse and thus support dense and diverse wetland flora, ranging from red gum and reed lined channels to broader swamps with a full complement of wetland floral assemblages below Tuckers Ford on the Finniss River. |
| **19. Noteworthy flora** | "Submerged aquatic vegetation in the Coorong is dependent on the salinity and water regime. Main species found in the Coorong include *Ruppia tuberosa* (tuberous tassel), *Ruppia megacarpa* (large-fruit tassel), *Lamprothamnium papulosum* (musk grass or stonewort), *Lepilaena* (long-fruit water mat), *Cladophora* and *Zostera* (seagrasses) (Oborne 2003). *Ruppia* is a very important species in the food chain, particularly for waders and water birds. *R. megacarpa* is found in the North Lagoon and is a seed bearing perennial plant requiring permanent water cover. *R. tuberosa* is found in the South Lagoon and is an annual plant which survives by producing seeds and turions through spring and summer, a key food source for waders and water birds (Oborne 2003).<br>Submerged vegetation in the South Lagoon is characterised by extensive areas |

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| | of *Ruppia tuberosa, Lepilaena* and *Lamprothamnion* (EconSearch 2004a). However, these areas have greatly declined in extent and quality. These submerged plants are a critical component of the habitat as they provide a source of detritus for benthic communities and architecture for juvenile fish, invertebrate and biofilm habitat.<br>**Lower Lakes**<br>Submerged aquatic plant communities were once extensive in the lakes system and included species such as ribbon weed (*Vallisneria Americana*), lax-marshflower (*Villarsia reniformis*), water ribbons (*Triglochin procerum*), swamp lily (*Ottelia ovalifolia*), pondweeds (*Potamogeton* spp) and milfoils (*Myriophyllum* spp).<br>Sections of the near shore environment around Lake Albert have extensive, highly significant *Phragmites australis* and *Typha domingensis* reed beds which provide excellent sheltered habitat for a range of fish and other vertebrate species, as well as long-term rookery sites for ibis, spoonbill and cormorants (EconSearch 2004a).<br>Saline wetlands have also fringed the lakes since pre-European times, but now only exist along a limited area of lakeshore. These areas supported saline-adapted plant communities such as samphire shrubland, an important feeding habitat for migratory waders, waterfowl, and water birds (EconSearch 2004a). In good condition, they support diverse faunal assemblages, and several areas of seasonally inundated swamp paperbark (*Melaleuca halmaturorum)*.<br>Fresh wetland areas would have received significant fresh water inputs from Eastern Mount Lofty Ranges streams, localised runoff or from infrequent, but extensive, flooding of the River Murray and would have supported a range of submerged and emergent freshwater plant communities." (DWLBC, 2005) |
| **20. Noteworthy fauna** | See Attachments 1-6. |
| **21. Social & cultural values** | The area is valued for its conservation - scenic attributes and is used for outdoor recreational pursuits including: wildlife observation and studies and recreational fishing and hunting. Professional fishing occurs both along the beach and in parts of the wetland complex. The area, and particularly the Coorong, is noted for its extensive Aboriginal (traditional and archaeological), historic and geological sites. The Ngarrindjeri people continue to have a close association with the area. Note: some of the northern islands within the Coorong lagoon are not part of the Coorong National Park but are reserved for use by Ngarrindjeri people.<br>"The Ngarrindjeri are culturally and spiritually part of the Lower Murray, Lakes and Coorong region, and the Ngarrindjeri lands are crucial for the survival of the Ngarrindjeri people. The fish, birds and other living things are the Ngartjis (totems) of the Ngarrindjeri people, with which they have a strong spiritual connection and a responsibility to protect. This totemic relationship is deeply embedded in Ngarrindjeri culture and spirituality, and provides a unique perspective on Ramsar values and the maintenance of habitats (NRWG 1998)." (DWLBC, 2005). |
| **22. Land tenure/ownership** | |
| **22a) site:** | The area is mostly Crown Land (water) and National Park and Game Reserves. Lakes Alexandrina and Albert are surrounded mainly by private property. |
| **22b) surrounding area:** | The Coorong is surrounded by National Park and Freehold Land. The Lakes and Tributaries are surrounded by Crown Land and Freehold land |
| **23. Current land (including water) use** | |
| **23a) within the Ramsar site:** | Conservation, recreation: camping, boating, duck hunting (not over entire area; in game reserve only), water storage and extraction, grazing and cropping, urban/residential development |
| **23b) surrounding area or catchment:** | Grazing and light farming in adjacent areas. Most of the edge of Lakes Alexandrina and Albert is used for farming, with tourist development in several areas. Development is otherwise restricted under the State Planning and other Acts and most of the area is in its natural state. |
| **24. Factors (past, present or potential) adversely affecting the site's ecological character** | |
| **24(a) at the site:** | "Studies over time indicate that the environmental health of the Asset has greatly declined. Geddes (2003) found that the biodiversity and productivity of the Coorong was at an historical low point. A comparison with the flora and fauna collected in the 1980s showed that the distribution and abundances of a |

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| | variety of species was greatly reduced. Populations had decreased in numbers and retreated to small, more favourable areas, especially around the Murray Mouth. Geddes' survey showed the poorest biodiversity and abundance record for the South Lagoon.<br>Loss of the natural flow regime has had a huge impact. The natural longitudinal salinity gradient of the lagoons is now absent, reflecting the long period of limited exchange of water with barrage inflows and high evaporation in the South Lagoon. Geddes concludes that persistently high salinities probably represent a historically high salinity regime in the South Lagoon.<br>A dramatic decline in the number of water birds utilising the Asset has been observed over the last twenty years (AWE 2003). There is also evidence of declines in native fish populations (MDBC 2004c)." (DWLBC, 2005) |
| **24(b) around the site:** | Activities around the site include agriculture and urban developments while up-stream water diversions are having a significna t detrimental im;act on the site. |
| **25. Conservation measures taken:** | The Coorong is reserved as a National Park. A management plan is in place and this is to be revised in late 2005. |
| **26. Conservation measures proposed but not yet implemented:** | SA DEH to provide advice. |
| **27. Current scientific research and facilities:** | SA DEH to provide advice. |
| **28. Current conservation education:** | SA DEH to provide advice. |
| **29. Current recreation and tourism:** | The wetlands and adjoining areas are used for outdoor recreation and research purposes. It is estimated that the area under the park reserve receives in excess of 200,000 visitor days per year and activities include: boating, fishing, camping, walking and wildlife observation. Access to important wetland sites - particularly waterbird breeding areas - is restricted. |
| **30. Jurisdiction:** | |
| **31. Management authority:** | The SA Department for Environment and Heritage is the management authority responsible for the Ramsar site, however there are several other organistions that directly play a major role in the management of the site, these include: the Murray Darling Conservation Basin Commission, SA Department for Water Land and Biodiversity, Primary Industries and Resources SA, Environment Erotection Authority River Murray and South East NRM Boards, SA Water, three local government organisations, Planning SA, and the Australian Government Department of the Environment and Heritage |
| **32. Bibliographical references:** | SA DEH to provide advice. |

## Attachment 1:

### Ecological communities and species that qualify against criterion 2

**Decision rules applied:**

1. Wetland-dependent/related ecological communities or species listed under the EPBC Act 1999 as critically endangered, endangered and vulnerable, and/or,

2. Wetland-dependent/related species listed as critically endangered, endangered or vulnerable under the IUCN Red Lists but not rare or other lesser IUCN categories.

Note: communities and species that qualify under this criterion automatically qualify under criterion 3 also. See Table 2.

**Ecological communities**

**Swamps of the Fleurieu Peninsula**
The listing of the swamps of the Fleurieu Peninsula as a critically endangered ecological community under the EPBC Act is notable in this context as this area and the Ramsar site partially overlap. This same area (in part) provides habitat for the Mount Lofty Ranges Southern Emu-Wren for further details.

### Plant taxa

| Common name | Scientific name | Ramsar criteria | Status - National | Status - IUCN | Status – SA |
|---|---|---|---|---|---|
| **Family Asteraceae** | | | | | |
| Silver Daisy-bush | *Olearia pannosa ssp. pannosa* | 2,3 | V | | V |
| George's Groundsel | *Senecio georgianus var. georgianus* | 2,3 | V | | E |
| **Family Mimosaceae** | | | | | |
| Yellow Swainson-pea | *Swainsona pyrophila* | 2,3 | V | | R |
| **Family Orchidaceae** | | | | | |
| Sandhill Greenhood | *Pterostylis arenicola* | 2,3 | V | | V |
| Metallic Sun-orchid | *Thelymitra epipactoides* | 2,3 | E | | E |
| **Family Proteaceae** | | | | | |
| Scarlet Grevillea | *Grevillea treueriana* | 2,3 | V | | V |

### Animal taxa

| Common name | Scientific name | Ramsar criteria | Status - National | Status - IUCN | Status – SA |
|---|---|---|---|---|---|
| **Amphibians** | | | | | |
| Southern Bell Frog | *Litoria raniformis* | 2,3,4 | V | E | V |

| **Fish** | | | | | |
|---|---|---|---|---|---|
| **Hardyheads or Silversides – Family Atherinidae** | | | | | |
| Murray hardyhead | *Craterocephalus fluviatilis* | 2,3,4,7,8 | V | E | C |
| Yarra pygmy perch | *Nannoperca obscura* | 2,3,4,7,8 | V | V | P,C |
| Murray cod | *Maccullochella peelii peelii* | 2,3,7,8 | V | | |

| | | | | | |
|---|---|---|---|---|---|
| **Pipefishes & seahorses – Family Syngnathidae** | | | | | |
| Big-bellied seahorse | *Hippocampus abdominalis* | 2,3,7 | | V | |
| **Grunters – Family Terapontidae** | | | | | |
| Silver perch | *Bidyanus bidyanus* | 2,3,4,7,8 | | V | P,C |

| | | | | | |
|---|---|---|---|---|---|
| **Birds** | | | | | |
| **Herons, Egrets, Bitterns – Family *Ardeidae*** | | | | | |
| Australasian Bittern | *Botaurus poiciloptilus* | 2,3 | | E | V |
| **Parrots – Family *Psittacidae*** | | | | | |
| Orange-bellied Parrot | *Neophema chrysogaster* | 2,3,4 | E | CE | E |
| **Fairy-wrens – Family *Maluridae*** | | | | | |
| Mount Lofty Ranges Southern Emu-wren & | *Stipiturus malachurus intermedius* | 2,3,4 | E | E | E |

**Key:**
**Conservation status:**
**National:** E – Endangered, V – Vulnerable under the *EPBC Act 1999*.
**IUCN:** CE = Critically endangered, Endangered, V – Vulnerable in the IUCN Red list
**State:** P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (refer: http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status)
JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement

**Notes:**
& = This species is found in association with the swamps of the Fleurieu Peninsula, a critically endangered ecological community under the EPBC Act (see above).

Frog data comes from the Wetlands Baseline Survey, 2004. Southern Bell Frogs recorded at Tolderol survey site only.

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## Attachment 2:

### Ecological communities and species that qualify against criterion 3

**Decision rules applied:**

1. Wetland-dependent/related ecological communities and species that qualify under criterion 2 also automatically qualify under this criterion. These communities and species are not shown below – see Table 1.

2. Wetland-dependent/related plant species that are:
(a) listed as vulnerable or endangered (but not rare) under SA legislation, and/or
(b) listed as threatened, vulnerable or endangered regionally for the Southern Lofty botanical region (SL) or Murray botanical region(MU) of SA.

3. Native fish species that are listed at the State level as P – protected under the *Fisheries Act 1982* or C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*.

**Ecological communities**

**Vegetation association of *Gahnia spp.***
"The Department for Environment and Heritage has compiled a provisional list of threatened ecosystems. The vegetation association of *Gahnia filum* is identified as a vulnerable ecosystem within the agricultural district of South Australia. This ecosystem is described as a sedgeland located in

drainage lines and depressions, the distribution of intact remnants within the agricultural district is largely contained in a number of small areas within NPWSA Reserves. This is an ecosystem that historically has suffered severe degradation from drainage, increased salinity (can tolerate a certain level) and grazing. There is little regeneration evident across the agricultural districts (DEH 2001). The Coorong and Lower Lakes Habitat Database has been queried to display records of *Gahnia filum* to be included within the Core Habitat Zone. Approximately 471 hectares are identified with distribution along the northern shoreline of the Finniss River and the Western shoreline of Lake Alexandrina (50ha), scattered remnants occur throughout the Lower Lakes. Within the Coorong National Park, good remnants remain south of Parnka Point comprising of approximately 421 hectares." (Seaman, draft report 2005)

**Plant taxa**

| Common name | Scientific name | Ramsar criteria | Status – SA | Status regionally |
|---|---|---|---|---|
| **See Table 1 also** | | | | |
| **Family Goodeniaceae** | | | | |
| Dune Fanflower | *Scaevola calendulacea* | 3 | V | |

**Animal taxa**

| Common name | Scientific name | Ramsar criteria | Status - National | Status - IUCN | Status – SA |
|---|---|---|---|---|---|
| **See Table 1 also.** | | | | | |
| **Fish** | | | | | |
| **Glassfishes – Family Ambassidae** | | | | | |
| Chanda perch (Olive perchlet, Agassiz's glassfish) | *Ambassis agassizii* | 3,4,7,8 | | | P,C |
| **Freshwater eels – Family Anguillidae** | | | | | |
| Short-finned eel | *Anguilla australis* | 3,4,7 | | | C |
| **Hardyheads or Silversides – Family Atherinidae** | | | | | |
| Fly-specked hardyhead | *Craterocephalus stercusmuscarum fulvus* | 3,4,7,8 | | | C |
| **Gudgeons – Family Eleotrididae** | | | | | |
| Purple-spotted gudgeon | *Mogurnda adspersa* | 3,4,7,8 | | | P,C |
| Dwarf flathead gudgeon | *Philypnodon* sp. | 3,4,7,8 | | | C |
| Western carp gudgeon | *Hypseleotris klunzingeri* | 3,4,7,8 | | | C |
| Murray Darling carp gudgeon | *Hypseleotris* sp. | 3,4,7,8 | | | C |
| **Freshwater blackfishes - Family Gadopsidae** | | | | | |
| River blackfish | *Gadopsis marmoratus* | 3,4,7,8 | | | P,C |
| **Galaxids or Native minnows – Family Galaxidae** | | | | | |
| Climbing galaxias | *Galaxias brevipinnis* | 3,4,7,8 | | | C |
| Mountain galaxias | *Galaxias olidus* | 3,4,7,8 | | | C |
| **Pouched lampreys – Family Geotriidae** | | | | | |
| Pouched lamprey | *Geotria australis* | 3,4,7,8 | | | C |
| **Gobies – Family Gobiidae** | | | | | |
| Bridled goby | *Acentrogobius* | 3#4,7,8 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | *bifrenatus* | | | | |
| Tamar goby | *Afurcagobius tamarensis* | 3#,4,7,8 | | | |
| Western blue spot (Swan River) goby | *Pseudogobius olorum* | 3#,4,7,8 | | | |
| Lagoon goby | *Tasmanogobius lasti* | 3#,4,7,8 | | | |
| **Shorthead lampreys – Family Mordaciidae** | | | | | |
| Shortheaded lamprey | *Mordacia mordax* | 3,4,7,8 | | | C |
| **Freshwater basses and cods – Family Percichthyidae** | | | | | |
| Southern pygmy perch | *Nannoperca australis* | 3,4,7,8 | | | P,C |
| Estuary perch | *Macquaria colonorum* | 3,4,7,8 | | | C |
| **Eel-tailed catfishes – Family Plotosidae** | | | | | |
| Freshwater eel-tailed catfish | *Tandanus tandanus* | 3,4,7,8 | | | P |
| **Congollis – Family Pseudaphritidae** | | | | | |
| Congolli (Tupong) | *Pseudaphritis urvillii* | 3,4,7,8 | | | C |

| **Birds** | | | | | |
|---|---|---|---|---|---|
| **Rails, Crakes, Swamphens, Coot – Family Rallidae** | | | | | |
| Lewin's Rail | *Rallus pectoralis* | 3 | | | V |
| **Curlews, Sandpipers, Snipes, Godwits, Phalaropes – Family *Scolopacidae*** | | | | | |
| Latham's Snipe | *Gallinago hardwickii* | 3,4 | J/CAMBA CMS | | V |
| Eastern curlew | *Numenius madagascariensis* | 3,4,5.3 | J/CAMBA CMS | | V |
| **Lapwings, Plovers, Dotterels – Family Charadriidae** | | | | | |
| Hooded Plover | *Charadrius rubricollis* | 3,4,5.3,6 | CMS | | V |
| **Gulls, Terns etc – Family Laridae** | | | | | |
| Little Tern | *Sterna albifrons* | 3,4 | J/CAMBA | | V |

**Key:**
**Conservation status:** E = Endangered, V = Vulnerable, T = Threatened
**State:** P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (refer: http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status)
JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement, CMS = Convention on Migratory Species

**Notes:**
* = see above re this species and Department for Environment and Heritage compilation of a provisional list of threatened ecosystems.
# = Gobies considered significant as this is the only location where they are found in the Murray-Darling Basin.

For this criterion, "A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region"

for freshwater species the appropriate biogeographic unit is the Murray-Darling Basin (Hammer M. P. and Walker K. F. (2004).

for marine species the appropriate biogeographic unit is the Flindersian bioregion.

## Attachment 3:

### Species that qualify against criterion 4

**Decision rules applied:**

1. Supports native fish species at critical stages in their lifecycle or offers refuge.
   All diadromous species qualify;
   Estuarine species that spawn or have large populations qualify;
   Species for which critical life stages are supported; such as, any freshwater taxa that spawn/recruit in the wetland qualify.

2. Supports birds species at critical stages in their lifecycle or offers refuge.
   All JAMBA or CAMBA-listed migratory birds are included, since it is assumed the habitat provided by the site will be important pre- and post-migration. Convention on Migratory Species (CMS) listing on its own is ignored unless the species is within Annex I (Endangered species) of CMS.
   Species that are migratory but not JAMBA or CAMBA listed can also be considered if they use the site at important stages of migration, and they also qualify against either criterion 5 or 6.
   Species for which the site is considered important as a refuge during times of drought and which also qualify against either criterion 5 or 6.
   Species that breed at the site on a regular basis (3 years in 5 on average) and which also qualify against either criterion 5 or 6.

**Significant fish**

| Common name | Scientific name | Ramsar criteria | Status - national | IUCN status | Status-SA |
|---|---|---|---|---|---|
| **Hardyheads or Silversides – Family Atherinidae** | | | | | |
| Small-mouthed hardyhead | *Atherinosoma microstoma* | 4,7,8 | | | |
| **Herrings –Family Clupeidae** | | | | | |
| Sandy sprat | *Hyperlophus vittatus* | 4,7,8 | | | |
| Bony bream | *Nematalosa erebi* | 4,7,8 | | | |
| Blue sprat | *Spratelloides robustus* | 4,7,8 | | | |
| **Gudgeons – Family Eleotrididae** | | | | | |
| Flathead gudgeon | *Philypnodon grandiceps* | 4,7,8 | | | |
| Midgley's carp gudgeon | *Hypseleotris* sp. | 4,7,8 | | | |
| Hybrid carp gudgeon (e.g. Lakes carp gudgeon) | *Hypseleotris* spp. | 4,7,8 | | | |
| **Galaxids or Native minnows – Family Galaxidae** | | | | | |
| Common galaxias | *Galaxias maculatus* | 4,7,8 | | | |
| **Halfbeaks - Family Hemiramhidae** | | | | | |
| River garfish | *Hyporhamphus regularis* | 4,7,8 | | | |
| **Rainbowfishes – Family Melanotaeniidae** | | | | | |
| Murray (Crimson-spotted) rainbowfish | *Melanotaenia fluviatilis* | 4,7,8 | | | |
| **Grey mullets - Family Mugilidae** | | | | | |
| Yellow-eye mullet | *Aldrichetta forsteri* | 4,7,8 | | | |
| Jumping mullet | *Liza argentea* | 4,7,8 | | | |
| **Freshwater basses and cods – Family Percichthyidae** | | | | | |
| Golden perch | *Macquaria ambigua ambigua* | 4,7,8 | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Righteye flounders - Family Rhombosoleinae** | | | | | |
| Greenback flounder | *Rhombosolea tapirina* | 4,7,8 | | | |
| **Smelts – Family Retropinnidae** | | | | | |
| Australian smelt | *Retropinna semoni* | 4,7,8 | | | |
| **Drums - Family Sciaenidae** | | | | | |
| Mulloway | *Argyrosomus hololepidotus* | 4,7,8 | | | |
| **Scorpion fishes – Family Tetrarogidae** | | | | | |
| South Australian Cobbler | *Gymnapistes marmoratus* | 4,7,8 | | | |
| **Breams – Family Sparidae** | | | | | |
| Black bream | *Acanthopagrus butcheri* | 4,7,8 | | | |
| **Grunters – Family Terapontidae** | | | | | |
| Striped perch | *Helotes sexlineatus* | 4,7,8 | | | |
| **Pufferfishes– Family Tetraodontidae** | | | | | |
| Smooth toadfish | *Tetractenos glaber* | 4,7,8 | | | |

## Significant birds

| Common name | Scientific name | Ramsar criteria | Status - national | Status IUCN @ | J/CAMBA or CMS | Status-SA |
|---|---|---|---|---|---|---|
| **Pelicans - Family Pelecanidae** | | | | | | |
| Australian Pelican | *Pelecanus conspicillatus* | 4, 5.1, 5.2, 5.3 | | | | |
| **Darters - Family Anhingidae** | | | | | | |
| Australian Darter | *Anhinga melanogaster* | 4? | | | | |
| **Cormorants – Family Phalacrocoracidae** | | | | | | |
| Little Pied Cormorant | *Phalacrocorax melanoleucos* | 4 | | | | |
| Pied Cormorant | *Phalacrocorax varius* | 4 | | | | |
| Little Black Cormorant | *Phalacrocorax sulcirostris* | 4, 5.1, 5.2 | | | | |
| Great Black Cormorant | *Phalacrocorax carbo* | 4, 5.1, 5.2 | | | | |
| **Geese, Swans and Ducks – Family Anatidae** | | | | | | |
| Australasian Shoveler | *Anas rhynchotis* | 4 | | | CMS | R |
| Australian Shelduck | *Tadorna tadornoides* | 4, 5.1, 5.2, 5.3 | | | CMS | |
| **Rails, Crakes, Swamphens, Coot – Family Rallidae** | | | | | | |
| Dusky Moorhen | *Gallinula tenebrosa* | 4 | | | | |
| Purple Swamphen | *Porphyrio porphyrio* | 4, 5.3 | | | | |
| **Herons, Egrets, Bitterns – Family Ardeidae** | | | | | | |
| Little Egret | *Ardea garzetta* | 4 | | | | |
| Cattle Egret | *Ardea ibis* | 4 | | | | |
| Great Egret | *Ardea alba* | 4 | | | J/CAMBA | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rufous Night Heron | *Nyctocorax caledonicus* | 4, 5.3 | | | | |
| **Ibises, Spoonbills – Family Threskiornidae** | | | | | | |
| Glossy Ibis | *Plegadis falcinellus* | 4 | | | CAMBA | R |
| Straw-necked Ibis | *Threskiornis spincollis* | 4, 5.1 | | | | |
| Royal Spoonbill | *Platalea regia* | 4, 5.3 | | | | |
| Yellow-billed Spoonbill | *Platalea flavipes* | 4, 5.3 | | | | |
| **Curlews, Sandpipers, Snipes, Godwits, Phalaropes – Family Scolopacidae** | | | | | | |
| Sharp-tailed sandpiper | *Calidris acuminata* | 4,5.3,6 | | | J/CAMBA CMS | |
| Curlew Sandpiper | *Calidris ferruginea* | 4,5.3,6 | | | J/CAMBA CMS | |
| Common sandpiper | *Tringa hypoleucos* | 4 | | | J/CAMBA CMS | |
| Marsh Sandpiper | *Tringa stagnatilis* | 4 | | | CAMBA CMS | |
| Terek Sandpiper | *Xenus cinereus* (*Tringa terek*) | 4 | | | J/CAMBA CMS | |
| Pectoral Sandpiper | *Calidris melanotos* | 4 | | | JAMBA CMS | |
| Red-necked Stint | *Calidris ruficollis* | 4,5.3,6 | | | J/CAMBA CMS | |
| Sanderling | *Crocethia alba* | 4,6 | | | J/CAMBA CMS | |
| Common Greenshank | *Tringa nebularia* | 4,5.3,6 | | | J/CAMBA CMS | |
| Red-necked Pharalope | *Phalaropus lobatus* | 4 | | | J/CAMBA CMS | |
| Bar-tailed godwit | *Limosa lapponica* | 4 | | | J/CAMBA CMS | |
| Black-tailed godwit | *Limosa limosa* | 4, 5.3 | | | J/CAMBA CMS | |
| Great Knot | *Calidris tenuirostris* | 4 | | | J/CAMBA CMS | |
| Red Knot | *Calidris canutus* | 4 | | | J/CAMBA CMS | |
| Grey-tailed Tattler | *Tringa brevipes* | 4 | | | J/CAMBA CMS | |
| Wandering Tattler | *Tringa incana* | 4 | | | JAMBA CMS | |
| Ruddy turnstone | *Arenaria interpres* | 4 | | | J/CAMBA CMS | |
| Ruff | *Philomachus pugnax* | 4 | | | J/CAMBA CMS | |
| **Oystercatchers – Family Haematopodidae** | | | | | | |
| Pied Oystercatcher | *Haematopus* | 4,5.3,6 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *longirostris* | | | | | |
| **Lapwings, Plovers, Dotterels – Family Charadriidae** | | | | | | |
| Pacific Golden Plover | *Pluvialis fulva* | 4,5.3,6 | | | CMS | |
| Grey Plover | *Pluvialis squatarola* | 4 | | | J/CAMBA CMS | |
| Pacific Golden Plover | *Pluvialis fulva* | 4 | | | J/CAMBA CMS | |
| Lesser Sand Plover | *Charadrius mongolus* | 4 | | | CMS | |
| Oriental Plover | *Charadrius veredus* | 4 | | | CMS | |
| Double-banded Plover | *Charadrius bicinctus* | 4 | | | CMS | |
| **Gulls, Terns etc – Family Laridae** | | | | | | |
| Crested Tern | *Sterna bergii* | 4,5.1,5.2 | | | JAMBA | |
| Caspian Tern | *Hydropogne tschegrava* (*Hydroprogne caspia*) | 4,5.3,6 | | | CAMBA | |
| Pacific Gull | *Larus pacificus* | 4? | | | | |
| **Old World Warblers – Family Sylviidae** | | | | | | |
| Great (Oriental) Reed-Warbler | *Acrocephalus arundinaceus* | 4 | | | CAMBA | |
| Little Grassbird | *Megalurus gramineus* | 4 | | | | |
| Golden-headed Cisticola | *Cisticola exilis* | 4? | | | | |

The order used follows that of *Field Guide to the Birds of Australia*, 6th Edition by Simpson and Day, 1999
**Key:**
**Conservation status:**
**National:** E – Endangered, V – Vulnerable under the *EPBC Act 1999*.
**IUCN:** CE = Critically endangered, Endangered, V – Vulnerable in the IUCN Red list
**State:** P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (refer: http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status)
JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement

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# Attachment 4:

## Species that qualify against criterion 5

### Decision rules applied:

Ramsar criterion 5 specifies that the site qualifies for Ramsar listing if it "...regularly supports 20,000 of more waterbirds.". At the time of listing (1985) the site regularly supported in excess of 200,000 waterbirds and so qualifying against this criterion was unquestioned. However, within the context of describing the ecological character of site this simple recognition of total number of waterbirds was considered too superficial and more specific sub-criteria were developed to help better understand the composition and ecological roles of the waterbird community of the Coorong and Lower Lakes Ramsar site. These sub-criteria are detailed below along with advice on how they have been applied.

Note: waterbird species that qualify against either criteria 4 or 6 and considered to automatically qualify against this criterion also and so are not shown in the table below.

**Sub-Criterion 5.1: The species is a prominent component of the overall waterbird community in the Coorong and Lower Lakes Ramsar site.**

A species can be listed under this sub-category if it represents a numerical contribution equivalent to at least 5% of the aquatic bird community.

1. Since the waterbird communities of the Coorong and Lower Lakes Ramsar site typically contain greater than 20,000 birds during the summer months (but possibly less than this number in winter), in applying this sub-criterion, species were included that regularly (at least 3 in 5 years on average) accounted for at least 1,000 individuals (5% of 20,000), irrespective of season, OR,

2. Where data were limited to only a portion of the Coorong or Lower Lakes site, all species that regularly (at least 3 in 5 years on average) accounted for 5% of the counts in that location were included.

**Sub-Criterion 5.2: The species is a prominent component in ONE of the distinctive waterbird communities in the Coorong and Lower Lakes Ramsar site.**

One of the most important features of the overall waterbird community of the Coorong and Lower Lakes Ramsar site is that it consists of a series of distinct communities determined primarily by the various water regimes (fresh, estuarine, hypermarine) and ecological factors (mix of open water, protected riparian areas etc).

For the purpose of documenting the ecological character of this Ramsar site, six wetland components have been identified from a geographic/ecological perspective; namely, the South Lagoon, North Lagoon, Murray Mouth and estuary; Lake Albert, Lake Alexandrina and the tributaries of all waters that enter Lake Alexandrina. Several of the waterbird communities found in these components regularly consist of more than 20,000 birds and so would in their own right qualify under Ramsar criterion 5. Therefore, this sub-criterion allows for the recognition of those species that represent on a regular basis (at least 3 out of 5 years on average), either in a numerical or through biomass contribution, the equivalent of at least 5% of the waterbird community in the relevant system component (namely, South Lagoon, North Lagoon, Murray Mouth and estuary; Lake Albert, Lake Alexandrina and the tributaries of all waters that enter Lake Alexandrina). The decision rules applied here were the same as above.

**Sub-Criterion 5.3: The species occupies a unique or prominent foraging niche or represents a key trophic position in the aquatic bird communities of the Coorong and Lower Lakes Ramsar site.**

This sub-criterion acknowledges the importance of the diversity and range of ecological roles within the waterbird communities of the Coorong and Lower Lakes Ramsar site. Applying similar logic to that used to apply Ramsar criterion 7 for this project (see Significant Fish Table), species that forage in different ways on the same resources (e.g. Red-necked Avocet versus Banded Stilt; pelicans versus terns versus cormorants versus grebes versus Greenshanks versus herons all feed on fish but use different strategies to hunt them) or on different resources (e.g. the various Terns; Fairy, Whiskered, Caspian, Crested) or in different parts of the water column should have at least one representative species listed to capture the full ecological character and breadth of the waterbird communities.

| Common name | Scientific name | Ramsar criteria | Status - national | Status IUCN @ | J/CAMBA or CMS | Status-SA |
|---|---|---|---|---|---|---|
| Note: waterbird species that qualify against either criteria 4 or 6 and considered to automatically qualify against this criterion also and so are not shown in the table below. | | | | | | |
| **Geese, Swans and Ducks – Family Anatidae** | | | | | | |
| Black swan | *Cygnus atratus* | 5.1, 5.3 | | | CMS | |
| Musk Duck | *Biziura lobata* | 5.3 | | | CMS | R |

| | | | | | | |
|---|---|---|---|---|---|---|
| Grey Teal | *Anas gracilis* | 5.1, 5.2, 5.3 | | | CMS | |
| Chestnut Teal | *Anas castanea* | 5.1, 5.2, 5.3 | | | CMS | |
| **Rails, Crakes, Swamphens, Coot – Family Rallidae** | | | | | | |
| Spotless Crake | *Porzana tabuensis* | 5.3 | | | | |
| **Herons, Egrets, Bitterns – Family *Ardeidae*** | | | | | | |
| White faced Heron | *Ardea navaehollandiae* | 5.3 | | | | |
| **Ibises, Spoonbills – Family Threskiornidae** | | | | | | |
| Australian White Ibis | *Threskiornis molucca* | 5.3? | | | | |
| **Oystercatchers – Family Haematopodidae** | | | | | | |
| Sooty Oystercatcher | *Haematopus fuliginosa* | 5.3 | | | | |
| **Lapwings, Plovers, Dotterels – Family Charadriidae** | | | | | | |
| Masked Lapwing | *Vanellus miles* | 5.3 | | | CMS | |
| Red-kneed Dotterel | *Erthrogonys cinctus* | 5.3 | | | CMS | |
| **Stilts, Avocets – Family Recurvirostridae** | | | | | | |
| Black-winged Stilt | *Himantopus himantopus* | 5.3 | | | CMS | |
| **Gulls, Terns etc – Family Laridae** | | | | | | |
| Whiskered Tern | *Chlidonias hybridus* | 5.1,5.2,5.3 | | | | |
| Silver Gull | *Larus navaehollandiae* | 5.1,5.2,5.3 | | | | |

**Key:**
**Conservation status:**
**National:** E – Endangered, V – Vulnerable under the *EPBC Act 1999*.
**IUCN:** CE = Critically endangered, Endangered, V – Vulnerable in the IUCN Red list
**State:** P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (refer: http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status)
JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement

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## Attachment 5:

### Waterbirds that qualify against criterion 6

**Decision rules applied:**

1% levels taken from Waterbird Polulation Estimates (Third edition, 2002) by Wetlands International which maintains these figures as reference of applying this Ramsar criterion.

1. Species that regularly (see below) exceed the 1% population level. Where possible the assessment has been based on surveys conducted around the time the site was Ramsar listed (1985). For some species more recent data has been used.

| Common name | Scientific name | Ramsar criteria | Status - national | Status IUCN | J/CAMBA or CMS | Status-SA |
|---|---|---|---|---|---|---|
| **Grebes – Family Podicipedidae** | | | | | | |
| Great Crested Grebe | *Podiceps cristatus* | 5.3, 6 | | | | R |
| Hoary-headed Grebe | *Podiceps poliocephalus* | 5.1, 5.2, 5.3, 6 | | | | |
| **Geese, Swans and Ducks – Family Anatidae** | | | | | | |
| Cape Barren Goose | *Cereopsis novaehollandiae* | 6 | | | CMS | R |
| **Curlews, Sandpipers, Snipes, Godwits, Phalaropes – Family Scolopacidae** | | | | | | |
| Sharp-tailed sandpiper | *Calidris acuminata* | 4,5.3,6 | | | J/CAMBA CMS | |
| Curlew Sandpiper | *Calidris ferruginea* | 4,5.3,6 | | | J/CAMBA CMS | |
| Red-necked Stint | *Calidris ruficollis* | 4,5.3,6 | | | J/CAMBA CMS | |
| Sanderling | *Crocethia alba* | 4,6 | | | J/CAMBA CMS | |
| Common Greenshank | *Tringa nebularia* | 4,5.3,6 | | | J/CAMBA CMS | |
| **Oystercatchers – Family Haematopodidae** | | | | | | |
| Pied Oystercatcher | *Haematopus longirostris* | 4,5.3,6 | | | | |
| **Lapwings, Plovers, Dotterels – Family Charadriidae** | | | | | | |
| Hooded Plover | *Charadrius rubricollis* | 3,4,5.3,6 | | | CMS | V |
| Red-capped Plover | *Charadrius ruficapillus* | 5.3,6 | | | CMS | |
| Pacific Golden Plover | *Pluvialis fulva* | 4,5.3,6 | | | CMS | |
| **Stilts, Avocets – Family Recurvirostridae** | | | | | | |
| Banded Stilt | *Cladorhynchus leucocephalus* | 5.3,6 | | | CMS | |
| Red-necked Avocet | *Recurvirostra novaehollandiae* | 5.3,6 | | | CMS | |
| **Gulls, Terns etc – Family Laridae** | | | | | | |
| Fairy Tern | *Sterna nereis* | 3,4,5.1, 5.2, 5.3,6 | | | | V |
| Caspian Tern | *Hydropogne tschegrava* (*Hydroprogne caspia*) | 4,5.3,6 | | | CAMBA | |

**Key:**
**Conservation status:**
**National:** E – Endangered, V – Vulnerable under the *EPBC Act 1999*.
**IUCN:** CE = Critically endangered, Endangered, V – Vulnerable in the IUCN Red list
JAMBA = Japan-Australia Migratory Bird Agreement, CAMBA = China-Australia Migratory Bird Agreement

**Notes:**
Those hose species that regularly use (see below) the site in numbers representing 1% or more of the estimated flyway or sub-species population.

"Regularly is defined in the Ramsar guidance as follows:

(i) the requisite number of birds is known to have occurred in two thirds of the seasons for which adequate data are available, the total number of seasons being not less than three; or

(ii) the mean of the maxima of those seasons in which the site is internationally important, taken over at least five years, amounts to the required level (means based on three or four years may be quoted in provisional assessments only)." See Ramsar Wise Use 'toolkit' Handbook 7 (page 39 for further clarification).

The data used to establish the 1% flyway population level are as given by Wetlands International (http://www.wetlands.org/IWC/WPEnote.htm)

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## Attachment 6:

### Species that qualify against criteria 7 and 8

**Criterion 7**: This criterion allows for the recognition of species that are representative of wetland benefits and/or values, and thereby contribute to global biodiversity. The guidelines associated with this criterion are less than definitive and in general focus on the issues of biodiversity and biodisparity within the overall fish community found within the Ramsar site. In the absence of more specific guidance the following decision rules have applied here:

**Decision rules:**

any species that qualified against criteria 2, 3 or 4 automatically qualify here also.
species that contribute significantly to diversity within the fish community; such as through morphological body forms (large top order predators, omnivores through to small microphagic carnivores) or representative of a wide array of diverse families and classes etc. qualified.
species with a wide diversity of ecological roles, such as in the interface of fresh and marine environments (overlap between fresh, estuarine and marine life history strategies) qualified.
Endemic species qualify; genetically distinct subpopulations for Yarra and Southern pygmy perch occur n the Ramsar site. Other species likely to display similar patterns once research is undertaken include Estuary perch, Smelt, gudgeon and River blackfish.

Note: native fish species that qualify against criteria 2, 3, or 4 automatically qualify against this criterion also and so are not shown in the table below. See the relevant tables for these species.

**Criterion 8**

**Decision rules:**

Supports fish through providing important sources of food, spawning ground, nursery and/or migration path. Rules applied here:

any species that qualified against criterion 4 automatically qualifies here also;
any species that spawn in the Ramsar area qualify;
any species that use the area as a nursery qualify;
any species that use the area as part of a migration pathway qualify.

**Species omitted:**
Species were omitted if the Ramsar site is not considered an 'important' location, that is, they don't breed there or are unlikely to be resident species.

| Common name | Scientific name | Ramsar criteria | Status - national | IUCN status | Status- SA |
|---|---|---|---|---|---|
| Note: native fish species that qualify against criteria 2, 3, or 4 automatically qualify against this criterion also and so are not shown in the table below. See the relevant tables for these species. | | | | | |
| **Leptoscopids- Family Leptoscopidae** | | | | | |
| Sand fish | *Crapatalus arenarius lasti* | 7 | | | |
| **Goblin shark – Family Mitsukurinidae** | | | | | |
| Goblin shark | *Mitsukurina owstoni* | 7 | | | |
| **Pufferfishes– Family Tetraodontidae** | | | | | |
| Prickly toadfish | *Contusus brevicaudus* | 7 | | | |
| Richardson's toadfish | *Tetractenos hamiltoni* | 7 | | | |

**Key:**
**Conservation status:**
**IUCN:** E – Endangered in the IUCN Red list, V- Vulnerable in the IUCN Red list
**National:** V – vulnerable under the *EPBC Act 1999*.
**State:** P – protected under the *Fisheries Act 1982*, C – provisional State conservation concern under the *draft Threatened Species Schedule NPWSA*. (refer: http://www.environment.sa.gov.au/biodiversity/latest_news.html#review_of_status)

# Appendix D. Obligate freshwater fish - Summary of spawning, larval and juvenile characteristics (SKM, 2003)

## Extracts from MDBC report *Habitat requirements of native fish of the Murray-Darling Basin (SKM, 2003)*

*[note: as a review-style project the SKM report presents information from previous studies in parts of the Murray-Darling Basin. Care should be exercised in applying it to the Coorong and Lower Lakes Ramsar site]*

## Summary of spawning characteristics

| | | Pre-spawning behaviour | | | | | Spawning behaviour | | | Post-spawning behaviour | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Scientific Name | Common Name | Migration | | | | Other | Season | Induction | Site | Migration | Parental care |
| | | Migrate | Direction | Season | Induction | | | | | | |
| *Ambassis agassizii* | Olive Perchlet | Not recorded | | | | | Spring-summer | Rise in water level | Macrophytes | Not recorded | Not recorded |
| *Craterocephalus stercusmuscarum* | Fly-specked Hardyhead | Not recorded | | | | | Prolonged over spring-summer | Water temperature >23°C | Rock, weedy areas, crevices or rocky beds | Not recorded | Unlikely due to prolonged spawning |
| *Craterocephalus fluviatilis* | Murray Hardyhead | Not recorded | | | | | Spring-summer | - | Macrophytes | Not recorded | Unlikely |
| *Nematalosa erebi* | Bony Herring | No | | | | | Spring-summer | Increasing flows? | Shallow backwaters during floods | Not recorded | No |
| *Mogurnda adspersa* | Southern Purple-spotted Gudgeon | No | | | | | Spring-summer | Increasing day length & water temperature >18° | Hard substrates | No | Males guard & fan eggs |
| *Philypnodon sp.1* | Dwarf Flathead Gudgeon | Not recorded | | | | | - | Variation in temp. | Hard surfaces | No | Males guard & fan eggs |
| *Hypseleotris spp.* | Carp Gudgeon | Not recorded | | | | Males territorial & develop lump on head during spawning | Spring-summer | Low flows | Shallow backwaters, macrophytes, woody debris | No | Males guard & fan eggs |
| *Gadopsis marmoratus* | River Blackfish | No | | | | | Late spring-summer | Increasing water temperature >16° | In hollow snags or spaces between boulders | No | Males guard eggs/larvae |
| *Galaxias olidus* | Mountain Galaxias | Possible | Short upstream movement | | | | Winter-summer | - | Riffle cobbles | Downstream | No |
| *Melanotaenia fluviatilis* | Murray-Darling Rainbowfish | No | | | | | Spring-summer | Warming of flooded backwaters & during low flow periods | Macrophytes | No | No |

| | | Pre-spawning behaviour | | | | | Spawning behaviour | | | Post-spawning behaviour | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Migration** | | | | | | | | | |
| *Nannoperca australis* | Southern Pygmy Perch | No | | | | Males territorial during breeding | Late winter-spring | Temp <15° | Scattered over bed & macrophytes in still waters | No | No |
| *Nannoperca obscura* | Yarra Pygmy Perch | Not recorded | | | | | Spring | - | - | Not recorded | - |
| *Maccullochella peelii peelii* | Murray Cod | Yes – some individuals (facultative migration) | Upstream | Late winter-spring | Increasing flows, change in temperature | | Spring-summer | Increasing water temperatures, flow & day length | Hard substrates & inside hollow LWD | Return downstream in migrating populations but males also guard eggs | Males guard & fan eggs |
| *Macquaria ambigua* | Golden Perch | Facultative migration | Upstream | Spring-summer | Increasing flows | | Spring-summer | Increasing flow & water temperatures >23° | Water column near surface | Gradual downstream dispersal | No |
| *Tandanus tandanus* | Freshwater Catfish | No | | | | | Spring-summer | > 24° for nest building | Nest in shallows on sand/gravel substrate | No | Both sexes guard & fan eggs |
| *Bidyanus bidyanus* | Silver Perch | Yes | Long upstream migration | Spring-summer | Increasing flows and behind flood peak | Move through fishways during daylight- | Spring-summer | Increasing flow? | Water column near surface | Return | No |
| *Retropinna semoni* | Australian Smelt | Movement not associated with spawning | | | | | Spring | Increase in temperature | Macrophytes | No | No |
| *Philypnodon grandiceps* | Flathead Gudgeon | Not recorded | | | | | Spring-summer | - | Hard substrates | No | Males guard & fan eggs |

- Data deficient

## Summary of larval and juvenile characteristics

| Scientific Name | Common Name | Movement | Habitat | Water quality tolerance | | | | Other |
|---|---|---|---|---|---|---|---|---|
| | | | | Temperature | | Salinity | Dissolved oxygen | |
| | | | | Low | High | | | |
| *Ambassis agassizii* | Olive Perchlet | Large scale movement not recorded | - | - | - | - | - | |
| *Craterocephalus fluviatilis* | Murray Hardyhead | Large scale movement not recorded | Slow flowing littoral zones of lakes and weir pools | - | - | <48,000 mg/l | - | |
| *Craterocephalus stercusmuscarum* | Fly-specked Hardyhead | Large scale movement not recorded | - | <23.5°C | 36°C | - | - | |
| *Nematalosa erebi* | Bony Herring | Larvae drift with flood waters | Floodplains, creeks and weir pools | - | - | - | - | Winter kills occur in low temperatures |
| *Mogurnda adspersa* | Southern Purple-spotted Gudgeon | Large scale movement not recorded | - | - | - | - | - | |
| *Philypnodon sp.1* | Dwarf Flathead Gudgeon | - | - | - | - | - | - | |
| *Hypseleotris spp.* | Carp Gudgeon | Dispersal migration | Shallow ponded habitats | - | - | - | - | |
| *Gadopsis marmoratus* | River Blackfish | No | Silt/detrital substrate | - | - | <6000 mg/l | - | |
| *Galaxias olidus* | Mountain Galaxias | Downstream dispersal of juveniles | Form loose shoals in pools | - | - | - | - | Forms loose shoals |
| *Melanotaenia fluviatilis* | Murray-Darling Rainbowfish | No | Shaded backwaters and still littoral habitats | 18°C | 28°C | <12,000 mg/l | - | |
| *Nannoperca australis* | Southern Pygmy Perch | Large scale movement not recorded | Shallow still waters amongst macrophytes | - | - | - | - | |
| *Nannoperca obscura* | Yarra Pygmy Perch | Large scale movement not recorded | Shallow still waters amongst macrophytes | - | - | Brackish waters | - | |
| *Maccullochella peelii peelii* | Murray Cod | Proportion of larvae drift downstream at night close to bed | Benthic habitats in main channel, not recorded from floodplain habitats | - | - | <10,000-14,000 mg/l | - | |
| *Macquaria ambigua* | Golden Perch | Eggs & larvae swept downstream; juveniles may move back upstream during increased flows | Range of habitats including amongst LWD, slow flowing water, deep water, main channel, anabranches and floodplain habitats | 4°C | 37°C | <8270 mg/l | Prefer high DO | Larvae rarely sampled but require large numbers of zooplankton for survival |
| *Tandanus tandanus* | Freshwater Catfish | Large scale movement not recorded | - | - | - | - | - | Form loose schools |
| *Bidyanus bidyanus* | Silver Perch | Larvae swept downstream but juveniles actively move upstream or downstream during increased flows in spring and summer | Backwaters and floodplain areas rich in zooplankton | 2°C | 37°C | <24,600 mg/l | - | |
| *Retropinna semoni* | Australian Smelt | Upstream dispersal movement in spring and summer during increased flow | Backwaters and still littoral habitats in main channel and billabongs | - | - | <2800 mg/l | - | |
| *Philypnodon grandiceps* | Flathead Gudgeon | Observed in drift (facultative) | Slow flowing backwaters, pools and littoral zones | - | - | - | - | |

- Data deficient

# Appendix E. Diadromous fish - Summary of spawning, larval and juvenile characteristics (SKM, 2003)

**Extracts from MDBC report *Habitat requirements of native fish of the Murray-Darling Basin* (SKM, 2003)**
[note: as a review-style project the SKM report presents information from previous studies in parts of the Murray-Darling Basin. Care should be exercised in applying it to the Coorong and Lower Lakes Ramsar site]

## Summary of spawning characteristics

| | | Pre-spawning behaviour | | | | | Spawning behaviour | | | Post-spawning behaviour | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Scientific Name | Common Name | Migration | | | | Other | Season | Induction | Site | Migration | Parental care |
| | | Migrate | Direction | Season | Induction | | | | | | |
| *Anguilla australis* | Short-finned Eel | Yes | Downstream to sea | Spring and summer | Moon phase, increase in water temperature, increase floodwaters. | | Spring-summer | Specific temperature and pressure | Sea | Adults presumably die | No |
| *Galaxias brevipinnis* | Climbing Galaxias | No | | | | | Autumn-early winter | Increasing flows | Damp substrates adjacent to stream | No | No |
| *Galaxias maculatus* | Common Galaxias | Yes | Downstream to estuaries | Summer-autumn | Full or new moon | | Autumn-winter | High tides | Bank vegetation on estuary margins | Spent adults die | No |
| Geotria australis | Pouched Lamprey | Yes | Upstream from sea | Spring-summer | | Migrate at night | Spring-summer | - | Headwaters, nest in sandy/muddy backwaters | Spent adults die | No |
| *Mordacia mordax* | Short-Headed Lamprey | Yes | Upstream from sea | Spring-summer | Increasing water temperature, decreasing flows | | Spring-summer | - | Depressions in soft substrates | Spent adults die | - |
| *Macquaria colonorum* | Estuary Perch | Yes | Downstream to estuary | Late winter-summer | | | Spring-summer | Delayed by cold temp. | Estuarine macrophytes | Presumably return upstream | - |
| *Pseudaphritis urvilli* | Tupong | Yes | Downstream to estuaries | Autumn-winter | Increased river flow | | Late autumn-early summer | - | Weedy estuaries | Return upstream? | - |

- Data deficient

## Summary of larval and juvenile characteristics (SKM, 2003)

| Scientific Name | Common Name | Movement | Habitat | Water quality tolerance | | | | Other |
|---|---|---|---|---|---|---|---|---|
| | | | | Temperature | | Salinity | Dissolved oxygen | |
| | | | | Low | High | | | |
| *Anguilla australis* | Short-finned Eel | Upstream from sea at night during spring and summer | Larvae drift at sea and enter rivers as glass eels | - | - | - | - | Can climb damp walls and travel over damp ground |
| *Galaxias brevipinnis* | Climbing Galaxias | Swept to sea as larvae (coastal populations); swept downstream into lakes as larvae (inland populations); return to freshwater as juveniles (coastal populations) | At sea for a few months before returning to freshwater. | - | - | - | - | |
| *Galaxias maculatus* | Common Galaxias | Larvae swept to sea | Submerged vegetation in shallow lake margins and river mouths | - | - | >6000 mg/l | LC50 <1 mg/l | Shoals |
| *Geotria australis* | Pouched Lamprey | Migrate downstream to sea to mature, return to freshwater after 18 months | Ammocetes prefer shaded silty areas in slow water | - | 28°C | - | Adapted to low DO | Burrows |
| *Mordacia mordax* | Short-headed Lamprey | Migrate downstream to sea over late winter-spring with high flows | Mud and silt along river edges | - | - | - | - | Burrows |
| *Macquaria colonorum* | Estuary Perch | Large scale movement not recorded | - | - | - | - | - | |
| *Pseudaphritis urvilli* | Tupong | Upstream from estuaries in spring & summer when ~9 months old | Estuaries until 9 months old | - | - | - | - | |

- Data deficient

# Appendix F: Glossary and abbreviations

From: *Upper South East Drainage and Flood Management Program Glossary*, or *The Murray Mouth Exploring the implications of closure or restricted flow*, July 2002

| **Glossary** | |
|---|---|
| Aeolian | erosion and deposition of sediments by wind-blown movement |
| Anadromous | fish species that spawn in freshwater environments but use estuaries and/or the sea for larval, juvenile and/or adult phases of their life cycle. |
| Angiosperm | a flowering plant. |
| Anoxia | lack of oxygen. |
| Australian Height Datum | the measure of elevation above mean sea level. The AHD is the official datum used in Australia and is used to measure the water level in the Lower Lakes. |
| Benthic | species that thrive on the bottom of a water body, ie benthic algae can thrive on the bottom of lakes. |
| Biomass | the amount of living material in a unit area or volume, usually expressed as mass or weight. |
| Brackish | water that has a salinity of 2500 – 5000 EC; between that of fresh and estuarine. |
| Catchment | the area of land drained by a river and its tributaries. |
| Catadromous | fish species that spawn at sea but use freshwater catchment areas during the juvenile and sub-adult life stages. |
| Collodial particles | suspended within a liquid - not dissolved. |
| Cue | a term used for a flow that triggers an ecological event, such as fish spawning. |
| Crustaceans | belonging to the Crustacea, a phylum of (chiefly aquatic) arthropod animals, including the lobsters, prawns, crabs, barnacles, slaters, etc., commonly having the body covered with a hard exoskeleton or carapace. |
| Cyanobacteria | aquatic bacteria that can photosynthesize. |
| Detritus | disintegrated or eroded material that accumulates at the bottom of a water body. |
| Diurnal | having a 24 hour or daily cycle; ie a diurnal tide occurs each day. |
| Driver | a process that influences how an ecological system operates. |
| Density | stratification *see* stratification. |
| Depauperate | species-poor. |
| Ebb tide | receding tide. |
| Entitlement Flow | the amount of water in the River Murray that NSW and Victoria must allow to flow to South Australia under the Murray-Darling Basin Agreement. South Australia's Entitlement Flow is 1850GL. |
| Estuarine | water that has a salinity of 12 000 – 60 000 EC; between that of fresh and marine. |
| Estuarine Migrant | fish species of marine origin that usually reside in estuaries as juveniles and adults but often have a marine larval phase. |
| Estuarine Resident | fish species of marine origin that reside in estuaries and can complete their entire lifecycle within these systems. |
| Freshwater Migrant | freshwater fish species that are often recorded in estuaries retreating into catchment rivers when conditions become unfavourable. |
| Freshwater Straggler | freshwater fish species that sometimes enter estuaries when conditions are favourable. |
| Endangered s | species that are threatened with extinction. |
| Euryhaline | species that have a wide tolerance to salinity. |
| Eutrophic | having water high in nutrients. |
| Family | a scientific order of taxonomy which contains genera,or genus. |

| | |
|---|---|
| Flocculate | collect into lumps or tufts. |
| Freshwater | obligate sp. species that are virtually always found in freshwater environments. |
| Hydrograph | a mathematical curve depicting the changes in flow or water level over a given time period. |
| Hypermarine | ocean water with very high salinity. |
| Hypersaline | water that is extremely saline, and sometimes referred to as twice that of seawater. Greater than 115 000EC. |
| Land retirement | the process of changing the way in which land is used in order to rehabilitate it. |
| Lever | an option or tool for the management of environmental flows. |
| Littoral | the edge or shallow area of a water body. |
| Macrofauna | animals large enough to be seen with the naked eye. |
| Macroinvertebrate | invertebrates visible to the naked eye, such as insect larvae. |
| Macrophytes | water plant that is not algae, and may be either floating or rooted. |
| Maintain | to keep the condition of the asset in its current state. This is used if the condition is healthy, but may be appropriate if the condition is declining and there is no way of improving it. |
| Marine | water that is highly saline, and salinity of around 60000EC (salinities between estuarine and hypersaline). |
| Marine Migrant | marine species that make extensive use of estuaries during juvenile and/or adult life stages. |
| Marine Straggler | marine species where only a small proportion of the overall population make use of estuaries. |
| Median flow | the flow that occurs in the most number of years. |
| Morphospecies | species that are given an informal code or number instead of actual species names, when they cannot be formally identified. |
| Neap | tide a tide that occurs when the difference between high and low tide is least; the lowest level of high tide. Neap tides occur twice a month, in the first and third quarters of the moon. |
| Nutrients | any substance which has nutritious qualities – that is, which nourishes or promotes growth. |
| Pathogen | disease producing organism. |
| Prograded | built out; a term that refers to areas of lake edge where elevated water levels have caused erosion of the sediment underneath the clay topsoil, resulting in a 'shelf''. |
| Propagules | any vegetative portions of a plant, such as a bud or other offshoot, that aid in dispersal of the species and from which a new individual may develop. |
| Restore | move the condition of the asset back to its natural condition. |
| Resuspension | when sediment or other matter becomes suspended in water once it has settled to the bottom of a water body. |
| Rehabilitate | move the condition of the resource to some better condition, but which is lower than or different to natural. This may be to a reference condition (a specified level of health that is acceptable) or to some predetermined target (ie. a specified salinity). |
| Saline intrusion | often referred to as a 'salt wedge', it is the intrusion of dense saline water from the sea below the fresher water in the river. |
| Shoal | a sandy elevation on the bottom of a body of water, a sandbank or sandbar. |
| Seiche | water oscillations in a water body caused by wind or other resonance. Wind seiche in the Lower Lakes can cause lake edge erosion if water levels are adequate. |
| Semi-diurnal | having a 12 hour or half-daily cycle; ie a semi-diurnal tide occurs once every 12 hours. |
| Stratification | a natural feature of water bodies characterised by a vertical gradient in density, caused by differential heating of the water surface and/or |

| | |
|---|---|
| | differences in salinity. |
| Surcharge | to fill a water body to a pre-determined level to accommodate for extractions and other losses. For example, the Lower Lakes are surcharged to 0.85m prior to the irrigation season, allowing enough storage to cover irrigation extractions, domestic use and evaporative losses. |
| Taxa | a grouping of organisms given a formal taxonomic name such as species, genus, family, etc. |
| Tidal prism | the volume of water that passes in and out of an inlet during a tidal cycle. |
| Turbidity | the murkiness of water caused by suspended sediment. |
| Turion | an underground bud or shoot from which an aerial stem arises; in this case for *Ruppia* species, the turions of which are an important food source for wading birds |

| **Abbreviations** | |
|---|---|
| AHD | Australian Height Datum |
| Asset Plan | Asset Environmental Management Plan for the Lower Lakes, Coorong and Murray Mouth (DLWBC, 2005) |
| AWSG | Australasian Wader Studies Groups, of Birds Australia |
| CAMBA | China-Australian Migratory Migratory Bird Agreement |
| CMS | Convention on Migratory Species |
| DSE | Victoria's Department of Sustainability and Environment |
| EPBC ACT | Commonwealth *Environment Protection and Biodiversity Act 1999* |
| GL | Gigalitres - one thousand million litres |
| ha | hectares |
| JAMBA | Japan-Australian Migratory Migratory Bird Agreement |
| MDB | Murray-Darling Basin |
| MDBC | Murray-Darling Basin Commission |
| ML | Megalitres - one million litres |
| MLRSEW | Mount Lofty Ranges Southern Emu-Wren |
| PAR | Photosynthetically active radiation |
| RES | Regional Ecosystem Services (the project team leading the development of this report) |
| RIS | Ramsar Information Sheet |
| SA DEH | South Australian Department of Environment and Heritage |
| USEDS | Upper South East Drainage Scheme |

# Appendix G: Salinity conversion details

From: DWLBC, 2005, Lower Lakes, Coorong and Murray Mouth Asset Environmental Management Plan (draft), report prepared for the Murray-Darling Basin Commission, Canberra (Appendix G)

**Salinity definitions**

| Definitions | mg/L, ppm | EC, uS/cm | mS/cm, dS/m | gpg |
|---|---|---|---|---|
| **FRESH – potable water** | 0 –1500 | 0 – 2500 | 0 – 25 | 0 – 105.63 |
| **BRACKISH** | 1501 – 3000 | 2501 – 5000 | 25.01 – 50 | 105.70 – 211.26 |
| **SEMI SALINE – often referred to as moderately saline** | 3001 – 7000 | 5001 – 11666 | 50.01 – 116.66 | 211.34 – 492.96 |
| **ESTUARINE** | 7001 – 34999 | 11667 – 58332 | 116.67 – 583.32 | 493.03 – 2468.70 |
| **MARINE (sea water)** | 35000 | 58333 | 583.33 | 2464.80 |
| **HYPERMARINE**– g**reater than marine** | 35001 – 69999 | 58335 – 116665 | 583.35 - 1166.65 | 2464.90 – 4929.50 |
| **HYPERSALINE** | > 70000 | > 116666 | > 1166.66 | > 4929.60 |

**Units and symbols**

| Unit | Symbol |
|---|---|
| grain per (imperial) gallon | gpg |
| Electrical Conductivity Unit | EC |
| = micro-Siemen per cm | uS/cm |
| deci-Siemen per metre | dS/m |
| = milli-Siemen per cm | mS/cm |
| parts per million | ppm |
| = milli-gram per Litre | mg/L |

mS/cm X 100 = uS/cm  uS/cm X 0.6 = ppm  ppm ÷ 14.2 = gpg

**Conversions:** 1 ppt = approx. 1,667 EC and conversely 1,000 EC = approx. 0.64 ppt.

# Appendix H: Water quality data for Lakes Alexandrina and Albert and three of the tributaries

Data and map supplied by the EPA of South Australia, courtesy of Peter Goonan and Peter Christy.

## Lake Alexandrina

| Year | Salinity (EC) | | NTU | |
|---|---|---|---|---|
| | Average (no. of sample dates) | Range | Average (no. of sample dates) | Range |
| Site 1 (see locality map attached) | | | | |
| 1996 | 610 (n=10) | 340-852 | 77 (n=8) | 7-130 (400)* |
| 1997 | 545 (n=12) | 303-1070 | 59 (n=12) | 36-73 |
| 1998 | 979 (n=8) | 742-970 | 31.2 (n=8) | 18-47 |
| Site 2 (see locality map attached) | | | | |
| 1996 | 608 (n=10) | 291-840 | 74.4 (n=8) | 8-160 (360)* |
| 1997 | 632 (n=12) | 319-1210 | 48.1 (n=12) | 23-82 |
| 1998 | 942 (n=8) | 726-1300 | 32 (n=8) | 16-94 |
| Site 3 (see locality map attached) | | | | |
| 1996 | 562 (n=10) | 258-821 | 81.5 (n=8) | 4-210 (480)* |
| 1997 | 519 (n=11) | 314-659 | 68 (n=12) | 49-90 |
| 1998 | 877 (n=8) | 719-936 | 28.2 (n=8) | 14-54 |
| Site 4 (see locality map attached) | | | | |
| 1996 | 578 (n=10) | 232-823 | 51.6 (n=8) | 10-140 (380)* |
| 1997 | 530 (n=12) | 315-699 | 60.2 (n=12) | 39-91 |
| 1998 | 868 (n=8) | 735-929 | 29.4 (n=8) | 12-51 |
| Site 5 (see locality map attached) | | | | |
| 1996 | 568 (n=11) | 223-856 | 91.5 (n=9) | 7.5-130 (400)* |
| 1997 | 537 (n=12) | 265-754 | 49.4 (n=12) | 17-90 |
| 1998 | 840 (n=8) | 792-927 | 36.5 (n=8) | 16-58 |
| Site: Goolwa barrage - upstream | | | | |
| 1999 | 1895 (n=7) | 879-4670 | 29.1 (n=7) | 10.2-91.5 |
| 2000 | 1977 (n=10) | 521-2410 | 23.5 (n=10) | 7.9-55.4 |
| 2001 | 1205 (n=12) | 448-2460 | 24.9 (n=12) | 5.2-52.4 |
| 2002 | 2877 (n=12) | 1420-6690 | 13.9 (n=12) | 2.5-43.1 |
| 2003 | 3894 (n=11) | 1386-8460 | 12.5 (n=11) | 8.8-20 |
| 2004 | 2332 (n=11) | 1526-4160 | 17.3 (n=11) | 11.7-22.8 |
| 2005 | 2299 (n=10) | 1611-3541 | 15.1 (n=10) | 7.6-23.1 |
| Site: Poltalloch Plains | | | | |
| 1999 | 645 (n=7) | 527-722 | 86.3 (n=7) | 40-185 |
| 2000 | 748 (n=12) | 424-888 | 53.5 (n=12) | 16.8-120 |
| 2001 | 595 (n=12) | 384-678 | 66.3 (n=12) | 19.5-137 |
| 2002 | 956 (n=12) | 810-1213 | 59.3 (n=12) | 17.2-114 |
| 2003 | 1228 (n=11) | 1028-1340 | 31.8 (n=11) | 15.5-62.8 |
| 2004 | 1259 (n=11) | 1150-1380 | 32.9 (n=11) | 16.2-51.9 |
| 2005 | 1315 (n=10) | 1109-1664 | 44.6 (n=10) | 16.8-102 |
| Site: Milang | | | | |
| 1971 | 505 (n=12) | 397-611 | - | - |
| 1972 | 587 (n=12) | 411-846 | - | - |
| 1973 | 960 (n=9) | 446-1075 | - | - |
| 1974 | 451 (n=12) | 274-707 | - | - |
| 1975 | 553 (n=12) | 269-1260 | - | - |
| 1976 | 493 (n=12) | 312-737 | - | - |

| | | | | |
|---|---|---|---|---|
| 1977 | 810 (n=12) | 591-1000 | - | - |
| 1978 | 853 (n=14) | 544-1160 | - | - |
| 1979 | 647 (n=22) | 487-866 | - | - |
| 1980 | 860 (n=22) | 656-1122 | - | - |
| 1981 | 1100 (n=47) | 372-1447 | - | - |
| 1982 | 724 (n=49) | 436-1163 | - | - |
| 1983 | 1102 (n=53) | 450-1410 | 116 (n=50) | 14-390 |
| 1984 | 540 (n=52) | 363-674 | 201.3 (n=52) | 144-320 |
| 1985 | 660 (n=51) | 379-943 | 122.1(n=52) | 72-195 |
| 1986 | 943 (n=53) | 502-1340 | 82.8 (n=53) | 32-198 |
| 1987 | 629 (n=49) | 509-983 | 103.5 (n=51) | 57-172 |
| 1988 | 805 (n=51) | 504-1350 | 74.8 (n=52) | 16-192 |
| 1989 | 622 (n=49) | 380-838 | 77.5 (n=51) | 24-138 |
| 1990 | 569 (n=52) | 314-984 | 83.1 (n=53) | 14-182 |
| 1991 | 713 (n=49) | 394-1440 | 50.5 (n=46) | 5.3-320 |
| 1992 | 727 (n=51) | 491-1005 | 66.6 (n=52) | 25-153 |
| 1993 | 448 (n=52) | 362-696 | 59.7 (n=52) | 16-172 |
| 1994 | 613 (n=52) | 329-920 | 34.9 (n=52) | 15-78 |
| 1995 | 914 (n=52) | 565-1190 | 53.6 (n=51) | 4-180 |
| 1996 | 666 (n=53) | 320-882 | 72.2 (n=53) | 12-220 |
| 1997 | 501 (n=52) | 293-715 | 51.2 (n=52) | 26-110 |
| 1998 | 891 (n=54) | 682-1010 | 38.8 (n=54) | 12.9-120 |
| 1999 | 676 (n=22) | 527-720 | 48.8 (n=22) | 0.31-97 |
| 2000 | 782 (n=12) | 591-855 | 33.8 (n=12) | 8.1-86.3 |
| 2001 | 564 (n=12) | 455-690 | 49.2 (n=12) | 29-81.5 |
| 2002 | 903 (n=12) | 773-1073 | 44.5 (n=12) | 16.3-80.6 |
| 2003 | 1193 (n=11) | 467-1442 | 47.3 (n=11) | 17.2-88.1 |
| 2004 | 1285 (n=11) | 1183-1483 | 37.4 (n=11) | 20.2-58 |
| 2005 | 1364 (n=10) | 1250-1427 | 33.5 (n=10) | 11.9-52.8 |

* the very high readings at these sites were in February 1996 as shown in brackets above. For all four sites the January reading was also very high (390 at Site 1, 390 at Site 2, 460 at Site 3, 450 at Site 4 and 350 at Site 5 ). These numbers have not been included in the calculation of averages.

## Lake Albert

| Year | Salinity (EC) | | NTU | |
|---|---|---|---|---|
| | Average (no. of sample dates) | Range | Average (no. of sample dates) | Range |
| Site 1 (see locality map attached) | | | | |
| 1996 | 1415 (n=10) | 1270-1580 | 36.5 (n=10) | 9-66 (320*) |
| 1997 | 1116 (n=12) | 532-1440 | 50.8 (n=12) | 25-74 |
| 1998 | 1315 (n=8) | 1220-1440 | 59.1(n=8) | 24-63 |
| Site 2 (see locality map attached) | | | | |
| 1996 | 1466 (n=12) | 1350-1650 | 39.5 (n=12) | 9-66 (320)* |
| 1997 | 1080 (n=12) | 466-1280 | 42.8 (n=12) | 18-70 |
| 1998 | 1378 (n=8) | 904-1740 | 48 (n=8) | 29-70 |
| Site 3 (see locality map attached) | | | | |
| 1996 | 1821 (n=11) | 1270-1560 | 38.8 (n=9) | 9-56 (360*) |
| 1997 | 1146 (n=12) | 1070-1230 | 43.3 (n=12) | 20-80 |
| 1998 | 1386 (n=8) | 1260-1460 | 52.2 (n=8) | 33-87 |
| Site: 8kms south west of Meningie | | | | |
| 1985 | 2920 (n=2) | 2840-3000 | | |
| 1986 | 2445 (n=2) | 2300-2590 | 70 (n=1) | - |
| 1987 | 2025 (n=4) | 1650-2280 | 48 (n=4) | 12-72 |
| 1988 | 1195 (n=4) | 1890-2090 | 43 (n=4) | 31-63 |
| 1989 | 2017 (n=3) | 1900-2130 | 70.7 (n=3) | 29-130 |
| 1990 | 1921 (n=3) | 1850-1983 | 23.7 (n=3) | 5.2-38 |
| 1991 | 1702.5 (n=2) | 1660-1745 | 13.9 (n=2) | 12.8-15 |
| 1992 | 2365 (n=2) | 2250-2480 | 19 (n=2) | 18-20 |
| 1993 | 1939 (n=1) | - | 14 (n=1) | - |
| 1994 | 1773 (n=1) | - | 18 (n=1) | - |
| Site: Meningie | | | | |
| 1999 | 1567 (n=7) | 1240-1570 | 54.2(n=67) | 30. 3-77.7 (234.5#) |
| 2000 | 1503 (n=12) | 1294-1609 | 61.2 (n=12) | 27.9-101 |
| 2001 | 1718 (n=12) | 1119-1643 | 50.4 (n=12) | 16-125 |
| 2002 | 1601 (n=12) | 1365-2143 | 50.4 (n=12) | 27-81.7 |
| 2003 | 1810 (n=11) | 1575-2298 | 35.7 (n=11) | 25.7-45.7 |
| 2004 | 2232 (n=10) | 1834-2204 | 55.7 (n=10) | 27.5-124 |
| 2005 | 2094 (n=10) | 1920-2279 | 63.2 (n=10) | 35.5-127 |

* the very high readings at these sites were in February 1996 as shown in brackets above. For all three sites the January reading was also very high (210 at Site 1, 175 at Site 2, 110 at Site 3). These numbers have not been included in the mean calculation.

# very high reading taken in September 1999 and excluded from calculation of averages.

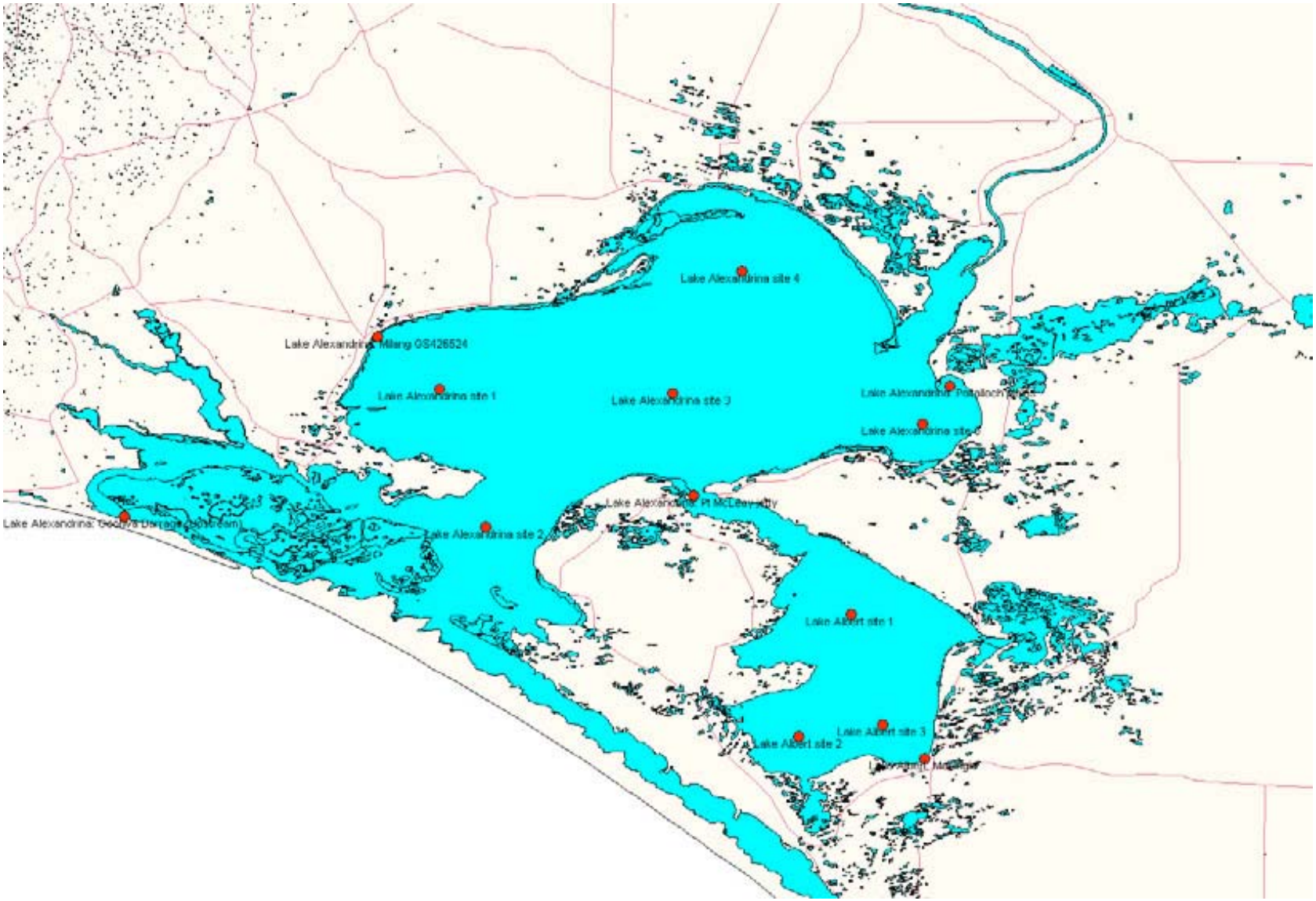
## Tributaries

### Salinity:

| Sites | Average uS/cm (EC) | Range | Sampling dates |
|---|---|---|---|
| Currency Creek (Near Higgins) | | | |
| Jan '72-Jan '76 | 2,539 | 482 - 7,600 | n =103 |
| Feb '85 – Aug '93 | 2,407 | 423 – 7,320 | n = 40 |
| Finniss River (4 km East of Yundi) | | | |
| Apr '70 – Jan '76 | 1,183 | 381 – 2,551 | n =113 |
| Jan '00 – Oct '05 | 1,351 | 575 – 3,301 | n = 67 |
| Bremer River (near Hartley) | | | |
| May '73 – Dec '76 | 2,552 | 635 – 5,294 | n = 37 |
| Mar '00 – Oct '05 | 3,164 | 997 – 8,380 | n = 55 |
| Bremer River (Wanstead Road) | | | |
| May '03 – Oct '05 | 5,070 | 981 – 11,410 | n = 27 |

### Turbidity:

| Sites | Average NTU | Range | Sampling dates |
|---|---|---|---|
| Currency Creek (Near Higgins) | | | |
| Jan '72-Jan '76 | 12.1 | 2 – 31 | n = 36 |
| Feb '85 – Aug '93 | 17.4 | 1.2 - 47 | n = 32 |
| Finniss River (4 km East of Yundi) | | | |
| Feb '73 – Jan '76 | 15.6 | 5 - 47 | n = 38 |
| Jan '00 – Oct '05 | 7.9 | 2.2 – 34.1 | n = 67 |
| Bremer River (near Hartley) | | | |
| Jul '79 – Nov '87 | 8.9 | 0.6 - 46 | n = 31 |
| Mar '00 – Oct '05 | 10.4 | 2.2 – 44.8 (one reading of 110 excluded) | n = 55 |
| Bremer River (Wanstead Road) | | | |
| May '03 – Oct '05 | 10.4 | 0.8 – 65.4 (one reading of 115 excluded) | n = 25 |




Locality map for water quality recording. Courtesy: Peter Christy (SA EPA)

**Appendix I:** **Modelled average monthly flow in the River Murray; three scenarios**