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The Secretary
Senate Standing Committee on Rural and Regional Affairs and Transport
Parliament House
Canberra ACT 2600

By email: rrat.sen@aph.gov.au

9 September 2008

Humane Society International Submission to the Senate Standing Committee on Rural and Regional Affairs and Transport inquiry into water management in the Coorong and Lower Lakes.

Humane Society International (HSI) welcomes the opportunity to provide a submission to the Senate Standing Committee on Rural and Regional Affairs and Transport inquiry into water management in the Coorong and Lower Lakes. HSI is one of the world's largest conservation and animal welfare organisations, with over 10 million supporters worldwide and 40,000 in Australia, and works to achieve strong conservation outcomes both domestically and internationally, particularly through engagement with Government on national and international law and policy efforts.

Recognising the fragility of the Coorong and Lower Lakes ecosystems, HSI nominated these areas for listing as a critically endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act* earlier this year. This nomination has since been included on the Federal Government's Finalised Priority Assessment List, with an assessment completion date of 30th September 2011. As there have been warnings of an impending ecological collapse of the Coorong and Lower Lakes, from which this ecosystem will be unlikely to recover, HSI maintains that it requires an urgent comprehensive assessment and emergency listing, rather than a three year consideration period.

A copy of the nomination is attached for your information. It details the importance of the Coorong and Lower Lakes for numerous listed threatened species and habitats, and highlights the decimation of the ecosystem from decreasing water flows, increasing salinity and turbidity, and barrage installation.

Thank you for considering the views of Humane Society International. We hope you find the content of the nomination useful in your deliberations.

Yours sincerely,

Danielle Annese
Program Manager

Australian Government
Department of the Environment and Water Resources

Threatened Ecological Community Nomination Form - for listing or changing the status of an ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Nominator details Note: Nominator details are subject to the provision of the *Privacy Act 1988* and will not be divulged to third parties if advice regarding the nomination is sought from such parties	
1. Full name	
Danielle Annese	
2. Body, organisation or company name (if applicable)	
Humane Society International	
3. Contact details	
Email: danielle@hsi.org.au Phone: 02 99731728 Fax: 02 99731729	Postal Address: PO Box 439 Avalon NSW 2107
4. Declaration: I declare that the information in this nomination and its attachments is true and correct to the best of my knowledge.	
Signed (If available, please attach an electronic signature when submitting by email): [signed]	
5. Date signed	
31 March 2008	

Nominated Ecological Community - Summary of eligibility	
6. Name of Ecological Community	
Coorong and Lower Lakes (Lakes Alexandrina and Albert)	
7. Category for which the ecological community is nominated under the EPBC Act	
Current listing category ❑ Critically Endangered ❑ Endangered ❑ Vulnerable ✓ **Unlisted**	Proposed listing category ✓ **Critically Endangered** ❑ Endangered ❑ Vulnerable
8. Criteria that form the basis for this nomination	
❑ Criterion 1 – Decline in geographic distribution. ✓ **Criterion 2 – Small geographic distribution coupled with demonstrable threat.** ✓ **Criterion 3 – Loss or decline of functionally important species.** ✓ **Criterion 4 - Reduction in community integrity.** ❑ Criterion 5 - Rate of continuing detrimental change. ❑ Criterion 6 – Quantitative analysis showing probability of extinction.	

Important notes for completing this form

- Complete the form as far as possible. It is important for the Threatened Species Scientific Committee to have comprehensive information and the best case on which to judge an ecological community's eligibility against the EPBC Act criteria for listing (Attachment A).
- Nominations that do not meet the EPBC Amendment Regulations 2000 will not proceed. Division 7.2 of the EPBC Amendment Regulations at http://www.environment.gov.au/epbc/about specifies the required information for a nomination. If after research you find the information is not available, please state this under the relevant questions (as described in subregulation 7.05(3) of the EPBC Act Regulations).
- To ensure you have the most up to date information, it is recommended that you contact the relevant Natural Resource Management authority. For details see: www.nrm.gov.au.
- Keep in mind that the purpose of the questions is to help identify why the ecological community is eligible for listing in the nominated conservation category.
- The purpose of the form is to assist the Committee to gain an understanding of the ecological community. In that sense, it is important that you consider the full, national extent of an ecological community, not just its occurrence in specific areas or regions.
- The questions are separated into themes, which indirectly or directly relate to the criteria for listing. The Committee provides the following general description of what kind of information informs its judgements against the EPBC Act criteria for listing (Attachment A).
- For all facts and all information presented - identify your references and sources of information. Document the reasons and supportive data. Indicate the quality of facts/information and any uncertainty in the information. For example was it based on a peer-reviewed research publication or anecdote; or on observed data, an inference/extrapolation from the data, or a reasonable premise not yet supported by hard data?
- Personal communications - The opinion of appropriate scientific experts may also be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided at the end of this nomination.
- Confidential material – Identify any confidential material and explain the sensitivity.
- Tables – Can be included at the end of the form or prepared as separate electronic documents included as appendixes or attachments. Refer to tables in the relevant area of the text.
- Maps - If maps cannot be supplied electronically, please provide them in hardcopy.
- Cross-reference relevant areas of the nomination form where needed.

How to lodge your nomination

Completed nominations must be lodged either:

1. by email to: **epbc.nominations@environment.gov.au**

OR

2. by mail to: The Director
Ecological Communities Section
Department of The Environment and Water Resources
GPO Box 787
Canberra ACT 2601

Further information
The Threatened Species Scientific Committee has developed guidelines to assist nominators. The guidelines are attached to this form (Attachment A). They include the statutory criteria and guidelines for the 'critically endangered', 'endangered' and 'vulnerable' categories. The guidelines also include indicative thresholds, which may be used by the Committee to assess whether an ecological community is eligible for listing against the criteria prescribed by the EPBC Regulations. It should be noted that the Committee does not adhere strictly to these thresholds, but has regard to them when making judgements about ecological communities on a case-by-case basis. More detailed information on all categories for threatened ecological communities can be found in Section 182 of the EPBC Act and the statutory criteria can be found in Division 7.1 of the EPBC Regulations 2000. These are available at: **www.environment.gov.au/epbc/about/index.html** For questions regarding nominations contact: The Director Ecological Communities Section Department of The Environment and Water Resources GPO Box 787 Canberra ACT 2601 Telephone (02) 6274 2317 Fax (02) 6274 2214

Section 1 – Conservation Assessment

Information in this form is required for assessing ecological communities nominated as threatened under the EPBC Act. Provide answers in the space below each question. If no or insufficient information exists to answer a question, please indicate that no information available instead of leaving the space blank.

Conservation Theme

1. *The conservation theme for the assessment period commencing 1 October 2008 (for which nominations close 31 March 2008) is 'rivers, wetlands and groundwater dependent species and ecosystems of inland Australia'. How does this nomination relate to the Conservation Theme?*

The Coorong, Lakes Alexandrina and Albert (CLAA) form a natural connected wetland system, which is home to numerous wetland dependent species, some of which are classified as threatened under state and/or commonwealth legislation or protected under JAMBA/CAMBA agreements. The CLAA is included on the List of Wetlands of International Importance under the Ramsar convention and is classified as an inland wetland system within this directory.

Classification

By nominating a broader community, you will enable the Committee to consider the national extent and condition of the community and determine the limits of the listed ecological community.

2. *What is the name of the ecological community? Note any other names that have been used recently, including where different names apply to different jurisdictions.*
For example, is it known by separate names in different States or regions?

The name of the ecological community is 'The Coorong, Lakes Alexandrina and Albert'. At times, various agencies and stakeholders may refer to the community simply as 'The Coorong and Lower Lakes'. Although the three areas are connected and dependent upon each other, for the purpose of various reports, they may be referred to as separate entities.

3. *What authorities/surveys/studies support or use the name?*

All authorities/surveys/studies use the name 'Coorong, Lakes Alexandrina and Albert' or 'Coorong and Lower Lakes' when referring to this community.

Authorities that use the name include:

- Department of Environment and Heritage
- CSIRO
- National Heritage Trust
- SA National Parks and Wildlife

Studies that use the name include:

- Gilbertson, D.D. (1981). The Impact of Past and Present Land Use on a Major Coastal Barrier System. Applied Geography, 1, pp 97-119.
- Paton, D. (2000). Bird ecology in the Coorong and Lakes region, in Jensen, A., Good, M., Harvey, P., Tucker, P. & Long, M., River Murray Barrages Environmental Flows, report to Murray-Darling Basin Commission, Canberra, ACT, Wetlands Management Program, Department of Environment and Natural Resources, Adelaide, South Australia, pp. 35-42.
- Phillips, W. And Muller, K. (2006). Ecological Character of the Coorong, Lakes Alexandria and Albert Wetland of International Importance. South Australian Department for Environment and Heritage.

4. *How does the nominated ecological community relate to other communities that occur nearby or that may be similar to it? Does it intergrade with any other ecological communities and, if so, how wide*

are the intergradation zones? Please describe how you might distinguish the ecological community in areas where there is overlap.

There are a number of intricately related wetlands occurring within the larger CLAA ecological community. In all there are 23 unique wetland types ranging from freshwater lakes to estuarine environments. This series of lakes and lagoons are the culmination of the River Murray. The River Murray initially runs into Lake Alexandrina (76,000 ha), which in turn feeds Lake Albert (16,800 ha). Lake Alexandrina then drains through five channels that lead to either the Murray Mouth (and Southern Ocean) or into the Coorong Lagoons (47,700 ha) (Lamontagne et al, 2004) (Appendix 1).

Lakes Alexandrina and Albert are comprised of fresh to brackish/saline waters. Specific wetlands of Lake Alexandrina are: Tolderol, Mud Islands and Currency Creek Game Reserves. Overall, Lakes Alexandrina and Albert form a natural wetland system that connects with the Coorong – a shallow saline to hypersaline, 2-3km wide coastal lagoon system that parallels the coastline for more than 100km (Morelli, 1995; Lamontagne et al, 2004). The Coorong is separated from the Southern Ocean by a narrow sand dune peninsula (Younghusband Peninsula) (Morelli, 1995) (Appendix 1). The Coorong is divided into a Northern and a Southern Lagoon. The north western end of the Northern Lagoon is connected with Lake Alexandrina and Lake Albert, with associated shoreline marshes at the mouth of the River Murray (Morelli, 1995). A chain of shallow, ephemeral salt lakes and swampy mud flats lie at the southern end of the southern lagoon (Morelli, 1995).

This CLAA nomination covers the same area as the Ramsar site, within the Coorong Bioregion – *"35°40'S, 139°05'E; South east coast, located at the mouth of the River Murray, about 75km south east of the city of Adelaide. The site encompasses Lake Alexandrina 35°26'S, 139°12'E, including Tolderol and Mosquito Points, six main islands (Mundoo, Mud, Long, Hindmarsh, Tauwitchere, Salt Lagoon Island), lower reaches of Currency Creek and Finniss River; Lake Albert 35°38'S, 139°17'E, Narrung Narrows, the Coorong Lagoons, Lake Cantara and other ephemeral lakes"* (Morelli, 1995).

Legal Status

5. *What is its current conservation status under Australian State/Territory Government legislation?*

The CLAA is not currently listed under the EPBC Act 1999. The South Australian *National Parks and Wildlife* (NPW) *Act 1972* does not allow for the listing of threatened ecological communities.

6. *Does the ecological community provide a habitat for any listed threatened species? If so, please note whether the species are listed on State/Territory and/or national lists and the nature of its dependence on the ecological community.*

Table 1 comprises a list of threatened fauna and flora species recorded in the CLAA.

Table 1. Threatened species within the Coorong, Lakes Alexandrina and Albert listed under the *National Parks and Wildlife Act 1972* and the Commonwealth *Environment Protection and Biodiversity Conservation Act.*
CE = Critically Endangered; E = Endangered; V = Vulnerable; R = Rare.

Scientific Name	Common Name	SA NPW Act	EPBC listing
Neophema chrysogaster	Orange Bellied Parrot	E	CE
Stipiturus malachurus	SA Mt Lofty Ranges Emu Wren	E	E
Sterna albifrons	Little Tern	E	-
Thinornis rubricollis	Hooded Plover	V	-
Haliaeetus leucogaster	White-bellied Sea Eagle	E	-
Cereopsis novaehollandiae	Cape Barren Goose	R	-
Egretta garzetta	Little Egret	R	-
Botaurus poiciloptilus	Australasian Bittern	V	-
Biziura lobata	Musk Duck	R	-
Rostratula benghalensisis	Painted Snipe	V	-
Gallinago hardwickii	Latham's Snipe	R	-

Numenius madagascariensis	Eastern Curlew	V	-
Sterna nereis	Fairy Tern	E	-
Anas rhynchotis	Australasian Shoveler	R	-
Porzana tabuensis	Spotless Crake	R	-
Calidris melanotos	Pectoral Sandpiper	R	
Xenus cinereus	Terek Sandpiper	R	
Cladorhynchus leucocephalus	Banded Stilt	V	
Rattus lutreolus	Swamp Rat	R	-
Maccullochella peelii peelii	Murray Cod		V
Nannoperca obscura	Yarrah Pygmy Perch		V
Nannoperca australis	Southern Pygmy Perch		
Craterocephalus fluviatilis	Murray Hardyhead		V
Swainsona pyrophila	Yellow Swainson Pea	R	V
Correa Alba var. Pannosa	White Correa	R	-
Scaevola calendulacea	Dune Fanflower	V	-
Picris squarrosa	Squat Picris	R	-
Wurmbea latifolia ssp	Broad-leaf Nancy	V	-
Zoysia matrella	Manila Gras		-
Calandenia valida	Robust Spider Orchid	E	-
Pterostylis arenicola	Sandhill Greenhood	V	V
Thelymitra epipactoides	Metallic Sun Orchid	E	E

These listed fauna species depend on the habitat provided by the Coorong, Lakes Alexandrina and Albert for aspects of their daily and annual life-cycles, such as foraging, nesting, and provision of shelter.

Description

7. *List the main features that distinguish this ecological community from all other ecological communities?*
Characteristic features can be biological (e.g. species of plants and animals characteristic to the community; a type of vegetation structure), or associated non-biological landscape characteristics (e.g. soil type, habitat feature, hydrological feature). Please limit your answer to those features that are specific to the ecological community and can be used to distinguish it from other ecological communities.

The CLAA is a unique Australian wetlands system due to its mosaic of 23 different wetland types. These wetlands collectively provide a diverse array of habitats, which support a range of ecological communities and species (Phillips and Muller, 2006). In addition to providing habitat for a number of threatened species, the CLAA incorporates approximately 262.5 hectares of the critically endangered 'Swamps of the Fleurieu Peninsula', listed under the EPBC Act (Phillips and Muller, 2006). The nationally endangered Mount Lofty Ranges Southern Emu-wren relies on the Swamps of Fleurieu Peninsula for its survival.

The Coorong area supports the world's largest breeding colony of Australian Pelicans and is the only annual breeding site in South Australia (Morelli, 1995). The Coorong lagoons provide refuge from drought for many bird species when central or eastern Australian wetlands dry out.

The ephemeral salt lakes of the Coorong are highly productive ecosystems with great geological and biological significance. These lakes actively form unique associations of carbonate minerals and dolomite muds (Morelli, 1995). The ephemeral carbonate lakes are considered to be of national and international significance and the diversity of fauna found in the lakes is higher than that found in international examples of salt lakes (Morelli, 1995).

8. *Give a description of the biological components of the ecological community.*
For instance, what species of plants and animals commonly occur in the community; what is the typical vegetation structure (if relevant).

Sand dunes are dominated by grasslands of *Spinifex hirsutus* and coastal shrubland of *Acacia longifola var. Sophorae* and *Olearia axillaris*. The edges of the lagoons and ephemeral lakes support saltmarsh species such as *Sarcocornia quinqueflora, Sclerostegia arbuscula* and *Halosarcia* spp*.,* and tall shrublands of *Melaleuca halmaturorum*. Mallee communities are found on the mainland side of the lagoons and are dominated by *Eucalyptus diversifolia.* Freshwater soaks support closed sedgelands of *Typha angustifolia* and *Schoenoplectus pungen.* Extensive beds of aquatic plants, dominated by *Ruppia tuberosa, R. megacarpa* and the endemic macrophyte *Lamprothamnium populosum* occur in both the Northern and Southern Lagoons and in the ephemeral salt lakes (Morelli, 1995), however the *Ruppia* species have been declining at a rapid rate.

The CLAA supports numerous threatened species (see Q.6). More than 85 species of waterbirds have been recorded in the region, with 35 recorded in the Coorong (Carpenter, 1995). Many of the wading species are seasonal migrants to Australia that breed in Alaska, northern China and Siberia. The CLAA are particularly important for Red-necked stints, Sharp-tailed sandpipers and Curlew sandpipers. These species are protected under JAMBA and CAMBA agreements. Resident waders include stilts, avocets, plovers and oystercatchers (DEH, 2000). As stated in Q.7, Australian Pelicans utilise the Coorong as an annual breeding ground along with the Crested tern and Fairy tern (Paton, 2000). Lake Alexandrina is also an important breeding site for egrets, ibises, comorants and the Rufus night heron (DEH, 2000).

Mammals such as the Water Rat and Eastern Swamp Rat occur in the CLAA along with 10 species of Frogs and numerous reptiles, for example, the Eastern Tiger Snake, Brown Snake, Long-necked Turtle, Murray Turtle and various water Skinks (DEH, 2000). Sixty-five fish species have been recorded in the CLAA including 33 primarily marine species, 12 estuarine and 23 freshwater species. The lakes are dominated by native freshwater fish such as the Callop, Murray Cod, Bony Bream and various smaller species (DEH, 2000). Introduced aquatic species include the European Carp, Redfin Perch, the Mosquito Fish and the European Shore Crab (DEH, 2000).

9. *Give a description of the associated non-biological landscape characteristics or components of the ecological community.*
For instance, what is the typical landscape in which the community occurs; is it associated with a particular soil type; what major climatic variables drive the distribution of the ecological community.

The CLAA are *"located at the edge of the Padthaway Ridge, which has a shallow basement rock and is an uplifted area between the Murray Basin and The Gambier Embayment of the Otway Basis, which are deep sedimentary basins"* (Morelli, 1995). Soils are calcareous and sandy (Morelli, 1995).

Landforms in the area are described as consisting of *"parallel coastal dune systems, saline marshes, samphire, freshwater soaks and open water with a hypersaline area at the southern end"* (Morelli, 1995).

Mean average rainfall in the CLAA area ranges from 450-550mm, most of which falls between May and September (Morelli, 1995).

The CLAA receives water from four main sources:
- Exchange of water with the sea at the River Murray mouth
- Freshwater inflow from the River Murray
- Local rainfall, run-off and ground water inputs
- Inflows through Salt Creek (rare)

The major source of freshwater for the Coorong is the River Murray, and the ephemeral lakes are filled by rainfall when the unconfined aquifer rises above the lake beds in the wet winter months (Morelli, 1995). See Q.4 for flow pattern.

10. *Provide information on the ecological processes by which the components interact (where known).*

See Q.4.

11. *Does the ecological community show any consistent regional or other variation across its extent, such as differences in species composition or structure? If so, please describe these.*

In a wetland system, the types of species present are vastly dependent upon salinity levels. Due to the fact there are 23 different types of wetlands within the CLAA that experience differing salinity levels, species vary according to their own salinity thresholds and/or availability of suitable food in the varying salinity levels. Q.8 elaborates on variation of the species composition and structure across the nominated ecological community.

12. *Identify major studies on the ecological community.*

Gilbertson, D.D. (1981). The Impact of Past and Present Land Use on a Major Coastal Barrier System. Applied Geography, 1, pp 97-119.

Paton, D. (2000). Bird ecology in the Coorong and Lakes region, in Jensen, A., Good, M., Harvey, P., Tucker, P. & Long, M., River Murray Barrages Environmental Flows, report to Murray-Darling Basin Commission, Canberra, ACT, Wetlands Management Program, Department of Environment and Natural Resources, Adelaide, South Australia, pp. 35-42.

Phillips, W. & Muller, K. (2006). Ecological Character of the Coorong, Lakes Alexandria and Albert Wetland of International Importance. South Australian Department for Environment and Heritage.

Distribution

13. *Describe the national distribution in Australia. If possible, include appropriate bioregions (see Attachment A) where the ecological community occurs and attach a map showing its distribution.*

Although there are other wetland systems in Australia, the CLAA supports 23 different wetland types. It is therefore unique to Australia when considered as one system. Q.4 describes the exact location of the CLAA.

14. *What is the national distribution (in ha) for the ecological community? Identify whether any values represent extent of occurrence or area of occupancy (as described in Attachment B); explain how it was calculated and datasets used.*
a. What is the current distribution (in ha)?
b. What is the pre-European extent (in ha)?
c. What is the estimated percentage decline of the ecological community?
d. What data are there to indicate future changes in distribution will occur?

a. Collectively the CLAA covers approximately 140,500 hectares (Morelli, 1995), comprised of Lake Alexandrina (76,000 ha), Lake Albert (16,800 ha), and the Coorong (47,700 ha).

b. The estuarine ecosystem of the Coorong is presently supported along a 30km stretch from the Goolwa barrages to Pelican Point. This represents less than 25% of the original area. Changes to the lakes are also occurring but at a slower pace. Sediments and increasing salinity are having a negative impact on the lakes system due to lack of flows (Phillips and Muller, 2006).

Substantial vegetation clearing has occurred since European settlement; however extent percentage loss data is not available. See Q.20 for additional information on pre-European condition of the CLAA.

c. The estimated percentage decline of the estuarine ecosystem of the Coorong is 75%. An estimate percentage decline for the Lakes ecosystem is not available; however it is known that extensive clearing of surrounding vegetation has occurred, including tall woody vegetation (DEH, 2000).

d. Estimates of future loss in distribution are not available at this stage; however it is certain that the integrity of the CLAA will continue to decline without additional legal protection and commencement of additional conservation efforts.

15. *Is the ecological community considered to be naturally rare or restricted, based on its original (pre-European) distribution?*
An ecological community is considered to be naturally restricted if it has a pre-European area of occupancy that is less than 10 000 ha or a pre-European extent of occurrence that is less than 100 000 ha (refer to attachment A).

Although there has been substantial habitat decline, loss of ecological integrity appears to be the major immediate threat to the CLAA.

16. *What is the typical size (in ha) for a patch of the ecological community (if known)?* Explain how it was calculated and the datasets that are used. Relevant data includes the average patch size, the proportion of patches that are below 10 ha or 100 ha in size.

Not applicable.

17. *Quantify the percentage or area required for a patch to be considered viable.*
This refers to the minimum size of a remnant that can remain viable without active management. What would you consider is the smallest area for which a patch of the ecological community can be considered viable? It may be determined through the requirements for dominant native species, level of species diversity, or the nature of invasive weeds.

Not applicable.

Functionality

18. *Is the present distribution of the ecological community severely fragmented? If so, what are likely causes of fragmentation?*
Severely fragmented refers to the situation in which increased extinction risk to the ecological community results from most remnants being found in small and relatively isolated patches. These small patches may go extinct, with a reduced probability of decolonisation.

The different components of the CLAA must be intricately linked in order to function; however they have become separated to a large extent as a consequence of barrage operations.

19. *Has there been a loss or decline of functionally important species? If yes, which species are affected? How are they functionally important and to what extent have they declined?*
This refers to native species that are critically important in the processes that sustain or play a major role in the ecological community and whose removal has the potential to precipitate change in community structure or function sufficient to undermine the community's viability.

Submerged aquatic plant species such those of the genus *Ruppia* and *Lepilaena* are the keystone primary producers of the Coorong. These plants form the basis of the food chain for waders and waterfowl (Lamontagne et al, 2004; Phillips and Muller, 2006). *Ruppia* species have been lost from approximately 75% of their former habitat range and *Lepilaena* species have been lost from the Coorong all together. This dramatic and rapid decline is correlated with increasing salinity in the Coorong Lagoons, attributed to barrage operations that separate the freshwater of Lake Alexandrina from the more saline waters of the Coorong (Phillips and Muller, 2006). Under hypersaline conditions the *Ruppia* community disappears and phytoplankton and benthic algae take over as the primary producers. This alters the avian species able to feed within the Coorong due to the loss of aquatic plants and the resulting decline in fish species diversity (Lamontagne et al, 2004).

The barrages (five in total) operate on a 'fill and spill' basis, thereby preventing freshwater from reaching the Coorong Lagoons much of the time. Controlled barrage releases do occur, however they do not allow passage of sufficient freshwater. Sediment, nutrients, agrochemicals and organic matter are also released with the freshwater during barrage releases, which impact negatively on the Coorong (Phillips and Muller, 2006).

20. *Reduction in community integrity. Please describe any processes that have resulted in a reduction in integrity and the consequences of these processes e.g. loss of understorey. Include any available information on the rate of these changes.*
This recognizes that an ecological community can be threatened with extinction through on-going modifications that do not necessarily lead to total destruction of all elements of the community. Changes in integrity can be measured by comparison with a benchmark state that reflects as closely as possible the natural condition of the community with respect to the composition and arrangement of its abiotic and biotic elements and the processes that sustain them. Please provide a description of the benchmark state where available. For further information please refer to the Guidelines (Attachment A).

Since European settlement, exploitation of the natural resources of the Murray-Darling Basin has altered most of the catchment including the CLAA. Land clearing has accelerated erosion and therefore soil salinisation. The Murray-Darling catchment is relatively arid and as such is naturally exposed to irregular floods and lengthy periods of drought (DEH, 2000). Over millions of years, the flora and fauna of the area have evolved to cope well with these erratic climatic conditions (DEH, 2000). As a result of many years of river regulation and water diversion since European settlement, we are now seeing an accelerated negative impact on all aspects of the rivers ecosystems (DEH, 2000). Regulatory devices such as locks and barrages have created a series of pools along the river. This causes the permanent inundation of some wetlands while others are dry for extended periods of time (DEH, 2000).

At the time of European settlement, Lakes Alexandrina and Albert housed fresh and reliable water sources. By the late 1800s, alternative freshwater supplies had to be sourced for human, agricultural and industrial use due to increasing salinity levels (Phillips and Muller, 2004). At present, both lakes regularly exceed recommended salinity levels by significant amounts. As a result of the installation of intensive River Murray regulatory devices, the Lakes have become a much more steady state system which benefits fewer species of flora and fauna (DEH, 2000). *"Lake levels are a key determinant of all ecosystem components and processes. The current regime is counter-seasonal to the natural one and too static to support the full complement of the lakes' biota. Species reliant on variable water levels are under represented and are at risk of local extinction"* (DEH, 2000).

The barrage operations mentioned in Q.19 have a major impact on the integrity of the CLAA. The five barrages commenced operation at varying times between 1935 and the mid 1940s. As a consequence of the installation of these barrages, which supply water for agricultural and human use, the River Murray Mouth closed in 1981 for the first time since its formation some 7000 years ago. In October 2001, the Murray Mouth nearly closed again after 630 days of no barrage openings. The barrages keep the pool levels in the lakes artificially high, which is *"equivalent to an almost constant artificial flood with only rare drying out episodes of lake edge vegetation".* Flows into the lakes are too small to induce flow into the estuary (DEH, 2000), causing an almost permanent artificially induced drought (Edyvane et al, 1995). As mentioned in Q.19, this causes a change from saline to hypersaline conditions in the Coorong Lagoons through evaporation, which has resulted in the loss of natural keystone primary producers.

In general, the presence of barrages has caused the narrowing of the Murray Mouth. Dredging is now required year round as lack of flow through the estuary increases sand accumulation at the river mouth (Phillips and Muller, 2005; DEH, 2000). This means that the amount of sea water entering the Coorong is greater than that drained back to the sea on any tidal cycle (Phillips and Muller, 2004). Increased water levels cause inundation of mudflats, increased water temperature (which induces thermal stratification), and a decrease in dissolved oxygen to lethal levels (Phillips and Muller, 2004).

Extensive agricultural land borders the CLAA along with some urban development, and additional urban development is planned for the future (Phillips and Muller, 2006). Discharges from agricultural and urban activities to the land, water and air, impact directly on the ecological components and processes of the CLAA. These effects may be seen at the point of discharge or indirectly via atmospheric and hydro-geological processes (Phillips and Muller, 2006).

Gradual desalinisation of the Lakes commenced upon the introduction of barrages to the system. This has provided suitable conditions for the invasion of the exotic Water Couch *Paspalum distichum.* Water Couch has subsequently spread around the lake-shores. Irrigation practices on Narrung Peninsula and south of Miningie may have also encouraged the spread of this exotic species, which is impacting on the northern lagoon of the Coorong.

Associated with urban development and agricultural practices is the clearing of vegetation and subsequent invasion of exotic flora species. Clearing of native vegetation has occurred throughout the CLAA region and particularly around the edges of Lakes Alexandrina, Lake Albert and the Coorong Lagoons (DEH, 2000). For example, tall woody vegetation once existed in some areas of the lakes edges, however it has now been cleared leaving bird species less habitat for shelter and nesting sites. With decreasing natural vegetation, the area has become more windswept with increased wave action and re-suspension of silts, contributing to increased turbidity (DEH, 2000). In turn, increased turbidity affects light penetrating the water column thus negatively impacting upon the survival of photosynthesising aquatic plants – primary producers.

Average water residence time has generally increased in the lakes due to reduced inflows and outflows. This has led to increased rates of sedimentation (DEH, 2000). Wind induced mixing and wave action leads to re-suspension of these settled particles in the exposed lake environments, leading to highly turbid conditions (DEH, 2000). Knowledge of turbidity and sedimentation processes is poorly understood, however they are thought to be a major factor in the loss of ecological integrity (DEH, 2000).

Condition Classes

21. *The Committee recognises that ecological communities can exist in various condition states. In reaching its decision the Committee uses condition classes to determine the patches which are included or excluded from the listed ecological community (see www.environment.gov.au/epbc/publications/pubs/ecological-communities-listing-approach.pdf for details of the process of determining condition classes). What features do you consider to be most valuable for identifying a patch of the ecological community in good condition?*
Variables for establishing the condition class may include patch size, connectivity, native plant species diversity, overstorey foliage cover, understorey composition and cover and recognised faunal values.

Due to the nature of the CLAA, it is difficult to describe a single 'patch' of the ecological community. An area of the CLAA would be in good condition if salinity and turbidity measures were similar to those found at the time of European settlement, taking into consideration seasonal and climatic induced variations.

The freshwater sections of the ecological community would be in 'good condition' if keystone species are present, well represented and supporting native fish including juveniles.

Survey and Monitoring

22. *Has the ecological community been reasonably well surveyed? Provide an overview of surveys to date and the likelihood of its current known distribution and/or patch size being its actual distribution and/or population size. Where possible, please indicate areas that haven't been surveyed but may add to the information required in determining the community's overall viability and quality.*

When considering the mosaic of 23 wetland areas of the CLAA as one system, it is unique and the current known distribution is its actual distribution.

Is there an ongoing monitoring programme? If so, please describe the extent and length of the programme.

Ongoing monitoring of the Coorong Reserve is undertaken by the national parks. The CSIRO has begun monitoring of temperature, salinity, nutrient concentration, turbidity and phytoplankton production at inshore and offshore locations. This program is in conjuction with the University of Adelaide through the CLLAMMecology (Coorong Lower Lakes and Murray Mouth Ecology) Research Cluster and the Western Australian Centre for Water Research, and is funded by Land and Water Australia, CSIRO Flagship Collaboration Fund, and South Australia Water. The CSIRO monitoring program is part of the first large scale investigation of the role of the lower lakes as a food source for the Coorong and Murray Mouth.

The Living Murray Program (run by the Murray Darling Basin Commission – MDBC) has initiated monitoring as part of its projects. The Living Murray is Australia's most significant river restoration program, aiming to achieve a healthy working River Murray system for the benefit of all Australians. This includes returning water to the River's environment. This program focuses on the Murray as a whole; however the Coorong, Lower Lakes and Murray Mouth are one of the six targeted sites.

The Living Murray program was established in 2002 in response to evidence showing the declining health of the River Murray system. It is a partnership of the Australian, NSW, Victorian, South Australian and ACT governments.

Threats

23. *Identify past, current and future threats to the ecological community indicating whether they are actual or potential. For <u>each</u> threat, describe:*

a. *how and where it impacts on this ecological community?*
b. *what its effect has been so far (indicate whether it is known or suspected; provide supporting information/research; does the threat only affect certain patches)?*
c. *what is its expected effect in the future (is there supporting research/information; is the threat only suspected; does the threat only affect certain patches)?*

<u>Increased salinity</u>

a. See paragraph 3 of Question 20 for a description of how this occurs. In addition, high salinity levels reduce habitat availability for those communities requiring salinity levels less than that of sea water. At present, the Coorong is supported along a 30km stretch, which represents less than 25% of the original area, i.e. 75% of habitat availability has been lost (DEH, 2000).

b. The Coorong Lagoons are more saline than ever before in their 6,000 year history (DEH, 2000). The body of water as a whole has experienced salinity levels of 100ppt or more since the mid 1980s (DEH 2000). The two periods of highest recorded salinity readings coincided with the Murray mouth closure in 1981 and severe constriction in 2000. Both of these events resulted from a lack of barrage releases (Geddes, 2003). *Ruppia megacarpia* (keystone primary producer) has a salinity threshold of 4-46ppt and thus has been effectively lost from the Coorong. As well as being a key food item for birds, *Ruppia* species are eaten by small-mouthed Hardyhead fish and macro-invertebrates. Therefore, loss of *Ruppia* (estimated loss of range is 75% of former habitat) has subsequently led to a loss of small-mouthed Hardyhead fish and the wading birds that feed on them (DEH, 2000). Other estuarine keystone species of the genus *Leopilaena* have been lost from the Coorong altogether (DEH, 2000). A consequence of this loss, brine shrimp have dominated the south lagoon and south section of the north lagoon since 2005 (DEH, 2000). See also Q.20.

c. Gradually introducing fresh water to the system is the only way in which to lower salinity levels. Unless barrage operations are managed for higher ecological water flow this problem will worsen until the integrity of the system is lost all together.

<u>Increased turbidity</u>

a. Turbidity levels in Lakes Alexandrina and Albert have increased steadily since European settlement. This can be attributed to wind and water erosion in the catchment associated with vegetation clearing, river regulation and lakeshore erosion (DEH, 2000). Also, as a result of extensive river regulation the Darling River has become the main source of water entering South Australia (up from 35 – 58%) as opposed to River Murray water. Darling River water tends to be more turbid thereby causing an increase in turbidity in the lakes (lower Murray) (DEH, 2000). Excessive turbidity can restrict light entering the water column and thus limit survival of light dependent aquatic species such as the keystone *Ruppia* species, and increase algal growth. Reduced light levels may also affect catch success for sight feeding birds and fish.

b. As stated in Q.23a keystone species have dramatically declined in the CLAA. A decline in wader species has also been observed over the past 20 years (Gosbell and Christie 2005). In 2001 the total number of waders was 48,425 in comparison with 234,543 in 1982 (Gosbell and Christie,

2005). Although this number increased in 2002 and 2003 to 103,859 and 84,039 respectively, this still constitutes a concerning decline. (See also Q.20). There has also been a shift in diatom species assemblages from species preferring saline conditions to those that thrive in more turbid conditions (Haynes and Gell, 2005).

c. River regulation along with River Murray appears to be the cause of increased turbidity in the CLAA. Decrease in turbidity is not expected unless there is a change to the intensity of river regulation. There is a knowledge gap in our understanding of turbidity processes that must be rectified in order to accurately answer this question and address the known effects.

Decreased fish passage

a. The five barrages installed in the CLAA during the 1930s did not make any allowances for fish passage and have greatly impacted upon the connectivity of the system. Fish were unable to migrate to different sections of the CLAA in which they depend on at different times in their life cycle.

b. The barrage structures do not allow for fish passage, which has caused an almost complete loss of diadramous lampreys. Many other species such as the Mulloway are not observed by recreational fisherman in previously known/guaranteed locations (Phillips and Muller, 2004). The barrages have reduced the extent of the estuary to approximately 11% of its former size (DEH, 2000). Many fish species depend on this estuarine area to complete their life cycles and thus suffer greatly as a result.

c. Loss of fish species has already resulted from barrage operations and species loss is predicted to continue if fish passage is not improved. The decrease in bird species may also be attributed in part to the loss of certain fish species. At present two trial fish ladders are currently in operation and undergoing assessment as part of the Living Murray Program run by the Murray Darling Basin Commission.

Motorised recreational activities

a. The current level of human activity around the Coorong on weekends is sufficient to disrupt many of the bird species present (Paton et al, 2000). Of the activities tested by Paton et al (2000), powered water craft such as jet skies were the most disruptive to waterbirds.

b. It is not clear to what extent disturbance has affected birds, however use of powered craft is known to reduce foraging and feeding time of wading birds, which *"can force birds to seek, probably inferior, alternative feeding sites, and add to their daily energy expenditure"* (Paton et al, 2000). This level of disturbance for migratory waders *"can delay their conditioning prior to migration, delay their departure and influence their ability to establish the best breeding locations and therefore their reproductive success"* (Paton et al, 2000).

c. The level of human activity is predicted to increase significantly due to ongoing population growth around the CLAA (Paton et al, 2000). If bans are not placed on powered water craft, the disturbance to both resident and wading birds will increase.

24. *Catastrophic threats (if not included above) i.e. threats with a low predictability that are likely to severely affect the ecological community. Identify the threat, explain its likely impact and indicate the likelihood of it occurring (e.g. a drought/cyclone in the area every 100 years)*

Global warming

The narrowing of the Murray mouth as a result of barrage operations means that the amount of sea water entering the Coorong is greater than that drained back to the sea on any tidal cycle (Phillips and Muller, 2004). This issue could be greatly exacerbated by sea level rise.

Global warming is predicted to increase the rate of polar ice melting and therefore average sea levels.

25. *Identify and explain any additional biological characteristics particular to the community or species within that are threatening to its survival (e.g. Low genetic diversity)? Identify and explain any models addressing survival or particular features.*
a. How does it respond to disturbance?
b. How long does it take to regenerate and/or recover?

There are no known additional biological characteristics that are threatening its survival.

26. *Relative status of remnants within the community?*
How much of the community would you describe as in good condition, (i.e. Likely to persist into the long-term with minimal management?) Please describe how you would identify areas in good condition using one or a combination of indicators such as species richness, structure, remnant size, weed invasion etc.
How much of the community would you describe as in medium condition (i.e. Likely to persist into the long-term future with management?) Please describe how you would identify areas in medium condition using one or a combination of indicator such as species diversity, structure, remnant size, weed invasion etc.
How much of the community would you describe as in poor condition, (i.e. Unlikely to be recoverable with active management?) Please describe how you would identify area in poor condition using one or a combination of indicators such as species diversity, structure, remnant size, weed invasion etc.

As mentioned previously, the ecological integrity of the system is the major immediate concern. It is the loss of integrity (increased salinity/turbidity and altered flow regimes) of the system that is directly related to receding habitat. Therefore, unnatural hydrological issues must be addressed in order to prevent further habitat loss. It is unlikely that the community will persist with minimal management. See also Q.21.

Threat Abatement and Recovery

27. *Identify key management documentation available for the ecological community, e.g. recovery plans, conservation plans, threat abatement plans.*

- Coorong National Park Plan of Management
- Coorong, and Lakes Alexandrina and Albert Ramsar Management Plan
- 'No Species Loss' – A nature Conservation Strategy for South Australia 2007-2017
- The Living Murray Icon Site Environmental Management Plan

28. *Give an overview of how threats are being abated/could be abated and other recovery actions underway/proposed. Identify who is undertaking these activities and how successful the activities have been to date.*

The main ecological integrity issues for the CLAA appear to be a direct result of barrage installation. There is no choice other than to address the nature of these barrage operations. A multi-million dollar dredging operation has been embarked upon to maintain the river mouth, however this can only be a short term solution. The CLAA is strongly influence by water levels – a product of both freshwater inflows and tides, therefore keeping the Murray Mouth open with barrage releases as opposed to dredging should be a priority task for restoring the ecological integrity of the community (Phillips and Muller, 2004). An allocation of 2000 ML of water a day is required to maintain the Murray Mouth to the point where dredging can intermittently cease (Phillips and Muller, 2004). In addition, reinstatement of natural flow variations should occur, for example medium-sized floods of 20,000 – 80,000 ML/day are required at least once every five years, and flows over 100,000 ML/day are required at least every ten years in order to reset the system and assist in the restoration of ecological integrity (Phillips and Muller, 2004). Periods of no or low flow were extremely rare under natural conditions, therefore this must be prevented. The absence of barrage releases for 630 days, which ended in 2003, was predicted to have caused the widespread loss of keystone aquatic plant species (Phillips and Muller, 2004).

Two fish ladders are currently being trialed and assessed in the CLAA by the Murray-Darling Basin Commission as part of the Living Murray Program. The Coorong and Lower Lakes have been identified by the commission as an 'icon site' in need of monitoring and restoration. Upon identification of suitable fish ladder styles for individual sites, ladders should be installed as soon as possible and monitored on a regular basis.

One of the threats identified in Q.23 was the intensive recreational use of the CLAA by humans. Of particular concern is the use of recreational motorised craft. Policing the use of motorised recreational craft would be extremely difficult and not financially viable, therefore a total ban of these vehicles should be imposed.

29. *What portion of the current extent of the ecological community is protected in a reserve system? Which of these are actively managed? Give details including the name of the reserves, and the extent the ecological community is protected within these reserves.*

Only the Coorong Lagoons are currently protected in a reserve system as Coorong National Park, which incorporates an area of approximately 50,000 hectares. The entire CLAA is listed in the directory of Wetlands of International Significance under the Ramsar Convention.

Section 2 - Justification for this nomination

30. Provide data that demonstrates why the ecological community meets at least one of the following criteria for the nominated category of threat.
This data may already have been provided in previous sections. Please refer to the data again and demonstrate how it specifically meets at least one of the following criteria.

Criterion 2: Small geographic distribution coupled with demonstrable threat.

Many wetlands along the River Murray in South Australia have been drained, degraded or converted for other uses. The CLAA is therefore more isolated than ever before and particularly vulnerable to even small environmental events (DEH, 2000) or anthropogenic disturbances. If a local population of a species is decimated by an event, the nearest population may be too far away to assist in recolonisation, thus exacerbating the chances of extinction (Possingham, 1996).

The CLAA covers an area of only 140,000 hectares and is bordered in all directions by agricultural and degraded lands. The estuarine habitat of the Coorong Lagoons has already been reduced to 30% of its former range as a result of loss of ecological integrity.

The installation of barrages has caused dramatic increases in salinity and turbidity, which has led to loss of keystone primary producer species from 75% of their former range. The isolation of the CLAA is such that the system is unable to adequately cope with this change to maintain its ecological integrity.

Criterion 3: Loss or decline of functionally important species.

As stated in Question 19, a number of aquatic plant species are the keystone primary producers of the CLAA. To date, species of the genus *Lepilaena* have been lost from the Coorong altogether. *Ruppia megacarpia* has also been effectively lost from the Coorong (Q.23) and in general species from the genus *Ruppia* have been lost from 75% of their former range. All these species are considered functionally important species as they are key food items for numerous faunal species including macroinvertebrates, fish and birds.

As aquatic plants have declined, brine shrimp populations have increased. This has served to discourage birds and fish that feed on plants and encourage those that feed on shrimp. As a consequence, a reduction in the CLAA's natural values is occurring.

Criterion 4: Reduction in Community Integrity.

A major determinant of the ecological integrity of a wetland system is its salinity levels. Should these salinity levels fluctuate beyond normal variances, the integrity of the system will be compromised. Different species of flora and fauna possess different salinity thresholds, beyond which they are unable to survive. Salinity levels exceeding these thresholds can therefore change the species composition of

the wetland community resulting in a great loss of natural value. This has definitely occurred in the CLAA and is still occurring at present. Barrage operations in the CLAA have had a complicated yet obvious effect on the salinity levels within the entire system. For example, the Coorong Lagoons have changed from saline to hypersaline conditions with salinity levels exceeding 100ppt since 1981 (sea level salinity approx 35ppt). The salinity threshold of local functionally important species is 4-46 ppt, which explains their rapid decline mentioned above. Increased turbidity as a result of extensive river regulation also contributes to the loss of aquatic plants by limiting the amount of light that can penetrate the water column.

Section 3 – Recovery, Conservation, Protection

Additional information on legal status

31. *Does the ecological community have legal protection under other legislation or political agreements, i.e. State or Territory legislation?*

The Coorong is protected by the *National Parks and Wildlife Act 1972.* The CLAA as a whole is afforded protection under the Ramsar convention. A number of native species in the CLAA are protected under the EPBC Act (see Q.6) and a number of migratory bird species are listed in JAMBA/CAMBA agreements.

Additional information on distribution

32. *Give locations of sites for proposed management, preferably that have been identified in recovery plans. Are the sites considered to demonstrate those remnants of highest quality/most needing management/most under threat?*

The Coorong National Park is the main site for proposed management for the South Australian National Parks and Wildlife Service. The Murray-Darling Basin Commission is concentrating on the area of Wellington to the Coorong, incorporating all barrages and related operations. Proposed management objectives in the Ramsar Mangement Plan cover all aspects of the CLAA.

Conservation Advice

33. *Give details of recovery actions that are or could be carried out at the local and regional level. e.g. develop and implement management plan for the control of specific weed species (regional), undertake weeding of known sites (local).*

- At the local level, community groups and local councils can commence bush regeneration works (this has already been undertaken by some community groups - see Q.34), especially around the edges of lakes and lagoons to stabilise banks and dunes in order to reduce sedimentation and run off.
- Local land owners with remnant vegetation could be encouraged to take part in volunteer conservation agreements.
- Regional recovery plans must address river regulation upriver from the CLAA (some of this work is being done by the Murray-Darling Basin Commission).
- Barrage releases to be increased and fish ladders installed (this work has been commenced by the Murray-Darling Basin Commission).
- Ongoing research especially into issues such as turbidity processes that are poorly understood (some of this research is being completed by CSIRO in conjunction with Adelaide University; however it is unknown whether turbidity issues are on their investigation agenda).

Community Networks

34. *Is there an existing support network for the ecological community that facilitates recovery? e.g. an active landcare group, Conservation Management Network or funding.*

Apart from Local Governments, there are community groups that perform restoration and other activities in the CLAA. These include:

- Friends of the Coorong – bushcare work, fundraising, community education.
- Landcare
- River Murray Urban Users Committee

Survey Methods

35. *Describe methods for identifying the ecological community including when to conduct surveys (e.g. season, time of day, weather conditions); length, intensity and pattern of search effort; and limitations and expert acceptance; recommended methods; survey-effort guide.*

The CLAA comprises a mosaic of 23 different types of wetland characterised mainly by their differing levels of salinity and composed of a number of community types (See Questions 4 and 8). Identifying different wetlands within the overall ecological community may be achieved by salinity measures, however as stated throughout this nomination, salinity levels have dramatically changed with barrage operations.

As the health of the CLAA is dependent on water flows, the condition of the community varies according to the barrage operations, the state of the Murray Mouth and flooding regime. Therefore surveying at appropriate temporal and spatial scales would enable changes in flora and fauna abundance and community structure to be ascertained, and correlated with changing inundation patterns.

36. *Give details of the distinctiveness and detectability of the ecological community.*

As stated throughout this nomination. This CLAA nomination covers the same area as the Ramsar site, within the Coorong Bioregion – *"35°40'S, 139°05'E; South east coast, located at the mouth of the River Murray, about 75km south east of the city of Adelaide. The site encompasses Lake Alexandrina 35°26'S, 139°12'E, including Tolderol and Mosquito Points, six main islands (Mundoo, Mud, Long, Hindmarsh, Tauwitchere, Salt Lagoon Island), lower reaches of Currency Creek and Finniss River; Lake Albert 35°38'S, 139°17'E, Narrung Narrows, the Coorong Lagoons, Lake Cantara and other ephemeral lakes"* (Morelli, 1995).

Other

37. *Are there other aspects relating to the survival of this ecological community that you would like to address?*

There are no further aspects relating to the survival of this community.

Section 4 – References

Notes:

- The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below.
- Please provide copies of key documentation/references used in the nomination

38. *Reference list*

Carpenter, G. (1995). Birds of the Lower Murray region of South Australia, Proceedings of the Murray Mouth Biological Resource Assessment Workshop, South Australian Research and Development Institute.

DEH (2000). Coorong, and Lakes Alexandrina and Albert Ramsar management Plan. Department for Environment and Heritage, Government of South Australia, September.

Edyvane, K., Carvalho, P., Evans, K., Fotheringham, D., Kinlock, M. And McGlennon, D. (1996). Biological Resource Assessment of the Murray Mouth Estuary. South Australian Research and Development Institute.

Geddes, M. (2003). Survey to investigate the ecological health of the North and South Lagoons of the Coorong. June/July 2003, a report prepared for the Department for Environment and Heritage and the Department of Water, Land and Biodiversity Conservation, Adelaide.

Gilbertson, D.D. (1981). The Impact of Past and Present Land Use on a Major Coastal Barrier System. Applied Geography, 1, 97-119.

Gosbell, K. And Christie, M. (2005). Wader Surveys in the Coorong and S.E. Coastal Lakes. Australasian Wader Studies Group.

Lamontagne, S., McEwan, K., Webster, I., Ford, P., Leaney, F. And Walker, G. (2004). Coorong, Lower Lakes and Murray Mouth. Knowledge gaps and knowledge needs for delivering better ecological outcomes. Water for a Healthy Country National Research Flagship CSIRO: Canberra.

Morelli, J. (1995). A Directory of Important Wetlands in Australia- The Coorong, Lake Alexandrina & Lake Albert. South Australian Department of Environment and Natural Resources. http://www.environment.gov.au/cgi-bin/wetlands/report.pl. Accessed 20 March 2008.

Paton, D. (2000). Bird ecology in the Coorong and Lakes region, in Jensen, A., Good, M., Harvey, P., Tucker, P. & Long, M., River Murray Barrages Environmental Flows, report to Murray-Darling Basin Commission, Canberra, ACT, Wetlands Management Program, Department of Environment and Natural Resources, Adelaide, South Australia, pp. 35-42.

Paton, D., Ziembicki, M., Owen, P and Heddle, C. (2000). Disturbance distances for water birds and the management of human recreation with special reference to the Coorong region of South Australia. The Stilt: The Bulletin of the East Asian – Australiasian Flyway. 37 pp46-46.

Possingham, H. (1996). Biodiversity conservation after vegetation clearance controls. In From Conflict to Conservation: Native Vegetation Management in Australia. Department of Environment and Natural Resources, South Australia.

39. *Has this document been reviewed and/or have relevant experts been consulted? If so, indicate by whom.*

Due to the pressing nomination deadline, this nominated has not been reviewed.

Appendix 1: Map showing the boundary of the CLAA area (Phillips & Muller, 2004)