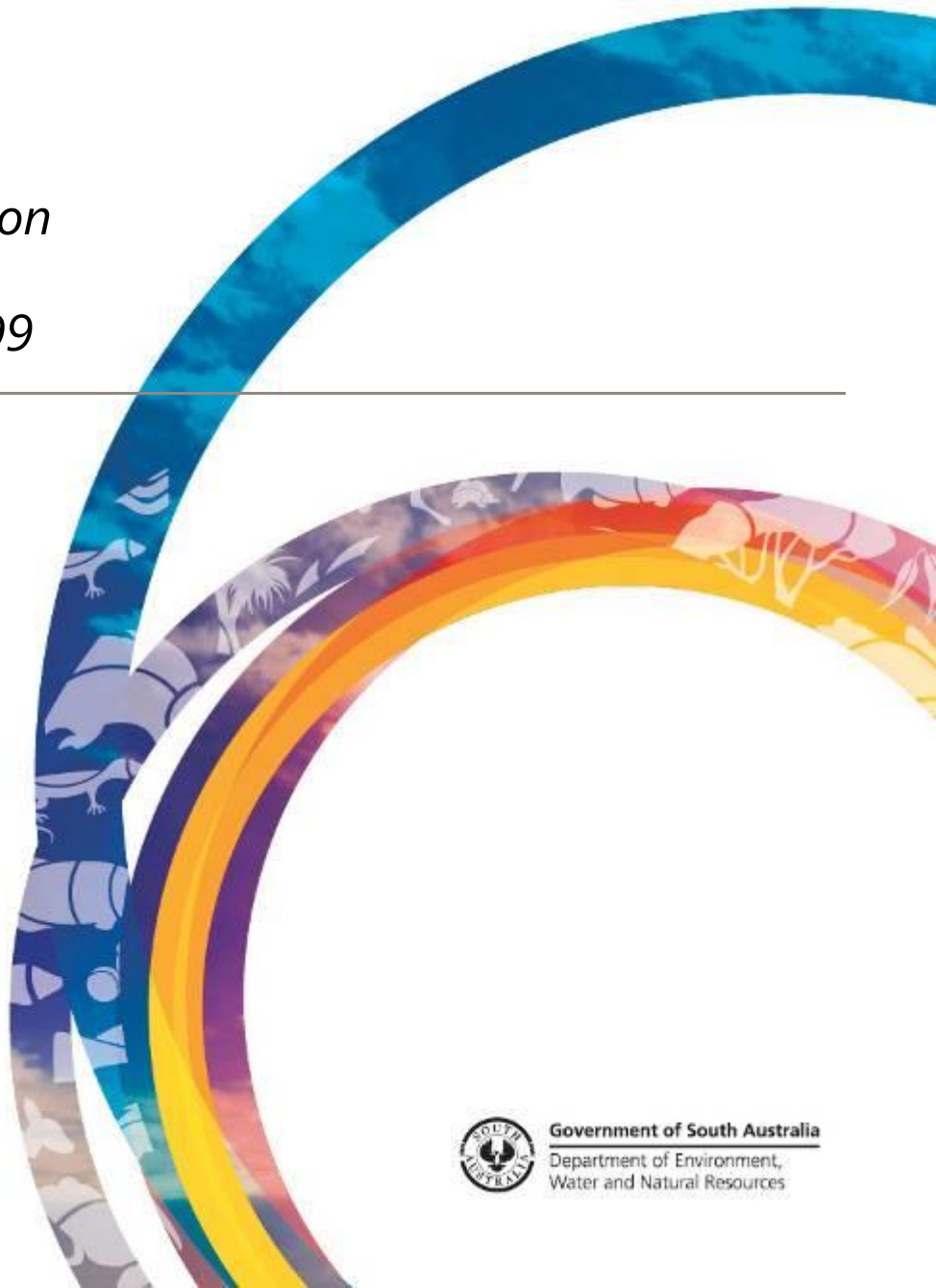
MURRAY FUTURES: COORONG, LOWER LAKES & MURRAY MOUTH RECOVERY PROJECT

SOUTH EAST FLOWS RESTORATION PROJECT

Referral under the *Environment Protection and Biodiversity Conservation Act 1999*



Government of South Australia
Department of Environment, Water and Natural Resources

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Executive Summary

The Coorong is a large coastal lagoon situated at the mouth of the River Murray. Separated to the Southern Ocean by the Younghusband Peninsula, a Holocene barrier dune, the Coorong stretches for 140 km in a south-easterly direction from the Murray Mouth and terminates in the Upper South East region of South Australia. Recognised internationally for the spectacular abundance and diversity of waterbirds it regularly supports, the Coorong forms an important component of the Ramsar-listed *Coorong and Lakes Alexandrina and Albert* Wetland of International Importance.

The Upper South East (USE) is a biologically rich, yet highly modified landscape. Broad scale land clearance and the construction of an extensive drainage network has altered the wetland dominated landscape in favour of agricultural production. The USE drainage network collects and diverts slow-moving surface and ground water across natural dunal barriers to the Southern Ocean and Coorong South Lagoon. It has reduced flooding, lowered saline watertables and, subsequently, resulted in significant agricultural productivity gains. However, this development has come at the cost of substantial local wetland habitat and the natural flow of water north towards the Coorong.

The recent Murray-Darling Basin (MDB) drought of 2006 to 2010 had a profound impact on the ecological health of the Coorong and Lakes Alexandrina and Albert Wetland of International Importance. Reduced River Murray flows into Lakes Alexandrina and Albert (the Lower Lakes) dramatically reduced water levels, resulting in significant habitat degradation and reducing all capacity to release flows over the barrages that separate Lake Alexandrina from the Murray Mouth and Coorong.

Flows over the barrages are a key driver of the Coorong's hydrological regime and resultant ecological character, raising water levels and freshening salinities. The only other source of freshwater flow into the Coorong is from the Upper South East, a relatively small volume of seasonal flows discharged from the Morella Basin via Salt Creek into the Coorong South Lagoon.

Years without significant flows over the barrages, supplemented only by the relatively minor flows from the South East, resulted in low water levels and extreme hypersaline conditions in the Coorong South Lagoon. Subsequently the Coorong South Lagoon ecosystem collapsed. Keystone aquatic plant species *Ruppia tuberosa* was lost, important small-bodied fish species withdrew to the North Lagoon and Murray Mouth, and the once healthy, highly productive ecosystem was replaced by a predominantly desolate waterbody which supported only the proliferation of brine shrimp.

Since 2010, significant flows over the barrages have restored salinity within the ranges required to support the key biota that represent a healthy Coorong South Lagoon. However,

the ecosystem has been slow to respond, demonstrating the long-term nature of impacts associated with periods of low River Murray flows and hypersalinity.

The South East Flows Restoration Project (SEFRP) is one of 19 management actions being implemented by the Coorong Lower Lakes and Murray Mouth (CLLMM) Recovery Project, funded by the Australian Government's Sustainable Rural Water Use and Infrastructure Program, and delivered through South Australia's *Murray Futures* Program. The CLLMM Recovery Project supports the CLLMM Long Term Plan, which aims to secure a future for the region as a healthy, productive and resilient wetland system of international importance.

The SEFRP aims to:

(1) divert additional relatively fresh water from the Upper South-East Drainage System to the Coorong South Lagoon to assist in managing salinity during periods when River Murray flows are insufficient to maintain the Coorong's health, thus building resilience and supporting a healthy ecosystem; and,

(2) provide additional environmental benefits by increasing flow through *en route* wetlands in the Upper South East.

To achieve its aims, the SEFRP will modify and link elements of the South East Drainage Network, using a combination of widened existing drains (totalling approximately 81 kilometres) and newly constructed drains (totalling approximately 12 kilometres) to deliver, on average, up to 26.5 GL of additional water to the Coorong South Lagoon per year. This water, which otherwise flows to sea via the Blackford Drain, will assist in managing salinity in the Coorong South Lagoon within the target management ranges for a healthy ecosystem (60g/L to 100 g/L) and reducing the risk of widespread ecological degradation in periods of reduced River Murray flows. In addition, at times when the Coorong does not require all of the available water, the infrastructure will allow for the delivery of increased flows into the Taratap wetlands and Tilley Swamp watercourse *en route* to the Coorong.

The CLLMM site, due to its listing as a Ramsar wetland of International Importance, and many threatened and migratory species that inhabit both it and the Upper South East region are protected under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999***.**

An EPBC Act Protected Matters Report of the project area dated 10 November 2014 (Appendix 1) identified the following matters of National Environmental Significance (DEWNR has considered updates to the status of protected matters since this time):

- One Wetland of International Importance – *Coorong, and Lakes Alexandrina and Albert*;

- Three listed threatened ecological communities - Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions, Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains, and Subtropical and Temperate Coastal Saltmarsh (a fourth was identified, however its listing was disallowed under the act);
- 54 listed threatened species (two species with revised status were included after this date); and,
- 57 listed migratory species.

The South Australian government has undertaken a detailed assessment of potential impacts to the identified matters of National Environmental Significance. This assessment concludes that it is unlikely that the SEFRP will result in any significant adverse impacts upon matters of National Environmental Significance; determining that:

- No significant adverse impact to the ecological character of the Ramsar site is expected as a result of the project;
- Threatened ecological communities identified in the Protected Matters Report are unlikely to occur in the project area or are unlikely to be influenced by the project;
- While the SEFRP footprint provides suitable habitat for some threatened and migratory species, through field flora and fauna surveys combined with detailed desktop analysis of recorded presence and habitat preferences, no significant impacts on any threatened or migratory species are considered likely as a result of the project.

Potential construction and operational impacts will be managed through mitigation measures including:

- Implementing a construction Environmental Management Plan which includes water quality monitoring and processes for managing potential impacts to flora and fauna;
- Actively promoting the regeneration of vegetation cleared within the construction corridor.
- 'Management Principles' for operations under the South East Drainage Network Management Strategy that consider any risks to receiving environments and mitigation strategies, which will be integrated with the development of the CLLMM Site Operations Manual and management objectives of the Coorong;

Without the proposed action, the ecological values of the Coorong South Lagoon will remain at a higher risk of ecological decline during periods of protracted low River Murray flows, such as the recent MDB 'Millennium' drought.

1. Summary of proposed action

1.1 Short Description

The South East Flows Restoration Project (SEFRP) is designed to provide significant long-term environmental outcomes for:

(1) the Coorong South Lagoon by helping to maintain salinity between the target management ranges of 60 g/L and 100 g/L in order to ensure that the lethal effects of high salinity on the ecosystem are mitigated during periods of low barrage outflows; and

(2) the Tilley Swamp and Taratap (*"en route"*) wetlands through the provision of additional flows.

The project involves widening approximately 81 km of existing drains (the Tilley Swamp and Taratap drains), and constructing approximately 12 km of new drains to connect the Taratap Drain to the existing Blackford Drain. The SEFRP channel capacity will range between 1,100 ML/day and 600 ML/day and will have the capacity to deliver, on average, an additional 26.5 GL (56.2 GL total) of water to the Coorong South Lagoon per year.

1.2 Latitude and Longitude

Table 1 shows the latitude and longitude of the project area used to develop a protected matters search of matters of national environmental significance listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

Table 1: Latitude and longitude of the project area used to develop a protected matters search

Longitude	Latitude
139.397	-35.903
139.433	-35.882
139.822	-36.095
140.425	-36.821
139.841	-36.821
139.863	-36.727
139.398	-35.903

1.3 Locality and property description

The SEFRP construction footprint extends 93 km southwards (upstream) from the proposed outfall of the drain into the Coorong South Lagoon at Salt Creek (part of the Coorong National Park), to the Blackford Drain. It follows the existing Tilley Swamp and Taratap drains (81 km).

Approximately 12 km of new drain will be constructed to connect into the Blackford Drain (Figure 1).

The closest major township to the project area is Kingston SE, located approximately 15 km south of the Blackford Drain, at the southern extent of the project area. Salt Creek, at the northern extent of the project area, is located approximately 160 km south east of Adelaide.

A more detailed description of the project area is provided in Section 2.2.

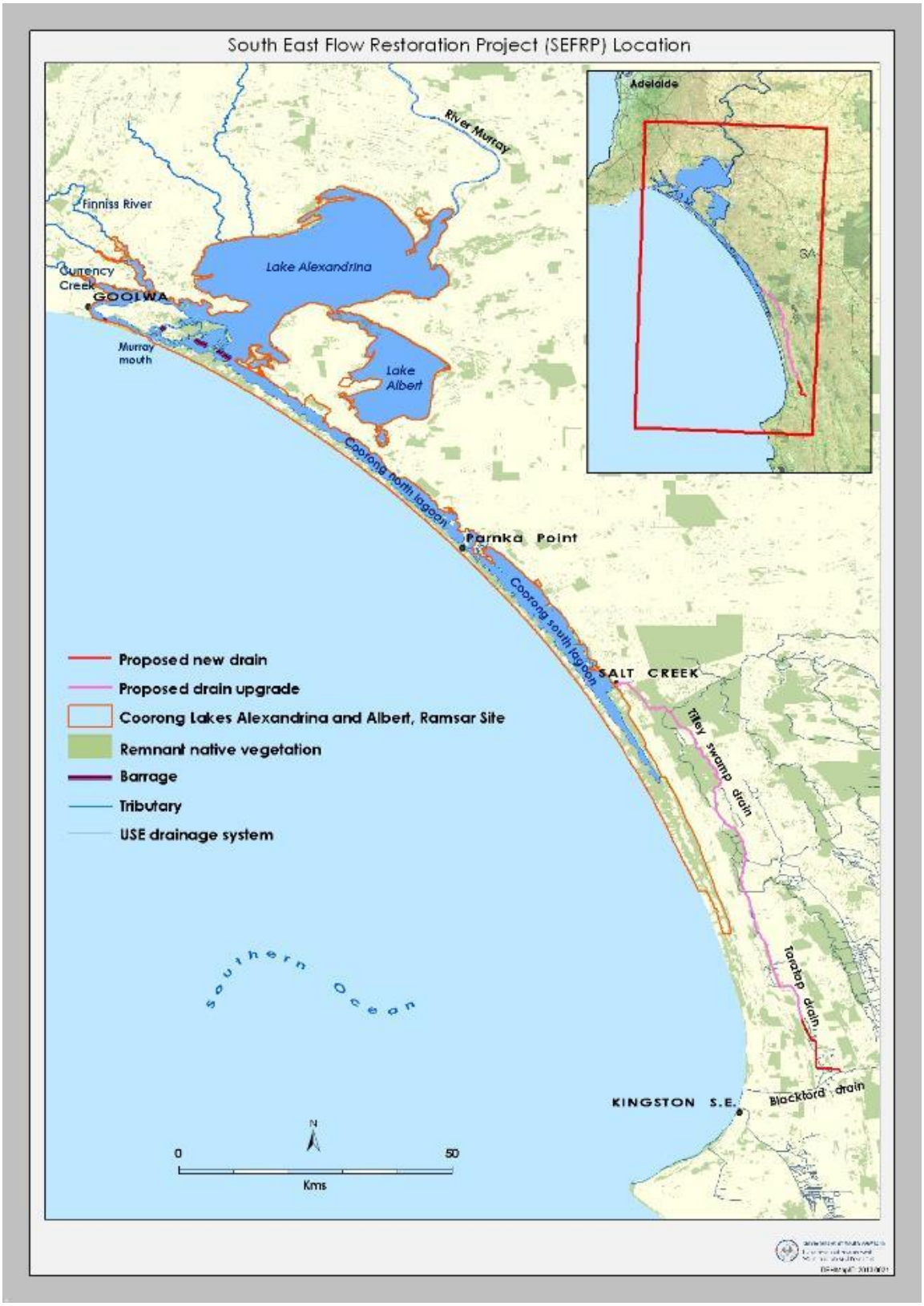

Figure 1: SEFRP location

1.4 Size of the development footprint or work area (hectares)

The approximate footprint of the project channel corridor is 1018 hectares. This has been estimated using channel concept designs, and applies a maximum 100 m channel width footprint. This will be subject to refinements during the finalisation of detailed design, estimated to be complete in the first half of 2016.

1.5 Street address of the site

Not applicable.

1.6 Lot description

Lot numbers and title descriptions within the development footprint have been determined based on concept designs (

Table 2). The exact size of the footprint is being finalised through detailed project design.

Table 2: Lot numbers and location of land affected by the SEFRP.

No.	PARCEL_ID	No.	PARCEL_ID
Salt Creek Outlet to Safari Rd		**Henry Creek Rd to Taratap Road**	
1	D60360 Q5	21	F204320 Q91
2	D60360 Q6	22	F52889 Q12
3	D60360 Q7	23	F52287 Q96
4	D59184 Q214	24	F52880 Q93
5	D59184 Q213	25	F52896 Q191
Safari Rd to Petherick Road		26	F52876 Q98
6	D62716 Q250	27	F52876 Q99
7	D62716 Q251	28	F52876 Q101
8	D59179 Q218	29	F209671 Q94
9	D59179 Q219	**Taratap Rd Blackford Drain offtake**	
10	D59183 Q220	30	H430300 S139
11	D59183 Q221	31	H430300 S11
12	D59181 Q223	32	D75434 A4
13	D59181 Q222	33	H430300 S71
14	D59181 Q224	34	H430800 S62
15	D59181 Q225	35	F52870 Q103
16	D59182 Q228	36	H430700 S559
17	D59182 Q227	37	H430700 S481
18	D72258 A100	38	H431200 S60
Petherick Road to Henry Creek Road		39	F48398 A10
19	D59180 Q231	40	H431200 S69
20	D72255 A500	41	H431200 S77

1.7 Local Government Area and Council contact (if known)

- Relevant local government councils include the Kingston District Council; and
- Coorong District Council.

1.8 Timeframe

A 75 week period has been estimated for construction of the SEFRP channel, including upgrading approximately 81 km the existing drainage system, and constructing approximately 12 km of new drain. Construction is likely to commence in late 2016, and the project is expected to be completed by June 2018.

1.9 Alternatives to proposed action

Alternatives to the proposed action include a “do-nothing” scenario and the previously considered South Lagoon Salinity Reduction Scheme. Both options have been discounted as neither option is considered an appropriate response to the environmental problems associated with the Coorong South Lagoon. These alternatives to the proposed action are described in more detail in Section 2.2.

1.10 Alternative timeframes etc

No alternative timeframes, locations or activities are proposed. Alternative alignment options considered during preliminary project investigations were determined to be unfeasible and were not pursued. The *Deed of Variation to the Project Schedule for the South Australian Priority Project SA – 07: Coorong, Lower Lakes and Murray Mouth Recovery Project* requires the project to be completed within specified timeframes.

1.11 State assessment

Compliance with a number of Commonwealth and State legislative processes will be required for the proposed action to proceed. These include:

- *Water Act 2007* (Cth)
- *Native Title Act 1993* (Cth)
- *Aboriginal Heritage Act 1988* (SA)
- *Crown Land Management Act 2009 (SA)*
- *Development Act 1993 (SA) (exemption applies)*
- *Environment Protection Act 1993* (SA)
- *Highways Act 1929 (SA)*
- *Local Government Act 1999 (SA)*
- *National Parks and Wildlife Act 1972* (SA)
- *Native Vegetation Act 1991* (SA) *(exemption applies)*
- *River Murray Act 2003* (SA)

Federal and State approvals and assessments are discussed in more detail in Section 2.4.

1.12 Component of larger action

The SEFRP exists as a “stand alone” project aimed at managing salinity levels in the Coorong South Lagoon in order to maintain a healthy ecosystem, and improving the health of en route wetlands. Further information regarding the context of the SEFRP is provided in Section 2.7.

1.13 Related actions/proposals

On 18 February 2009, a funding agreement was signed under the Commonwealth-South Australian Water Management Partnership Agreement for South Australia to undertake studies, initial works, and consultations required to develop a long-term plan for the CLLMM region.

The Long-Term Plan was developed in stages, and included significant consultation and input from the community, scientists, industry and government. The plan was publicly released on 4 June 2010 by the then Minister for Climate Change, Energy Efficiency and Water, Senator the Hon Penny Wong, and the then South Australian Minister for Water, the Hon Paul Caica MP.

The goal of the Long-Term Plan (*Securing the Future: A long-term plan for the Coorong, Lower Lakes and Murray Mouth*) is for the region to be a healthy, productive and resilient wetland system that maintains its international importance.

The Plan outlines priority actions to prevent irreversible ecological damage to the region and to address social and economic problems through an adaptive approach to management. Achieving the outcomes of the Long-Term Plan directly supports the economic, cultural and social wellbeing of regional communities. Working in partnership with the Traditional Owners of the site, as well as the regional community, is critical to the successful development and implementation of the Plan.

In order to address the environmental risks resulting from very low inflows to the CLLMM region, a set of emergency and early works actions were implemented while the Long-Term Plan was being developed. These actions included the construction of the Clayton and Currency Creek temporary flow regulators, and the *South Australian Priority Project SA-03 – Early Works for the Water for the Future, Enduring Response for the Coorong and Lower Lakes* (Early Works Priority Project), implemented from February 2009 to June 2011. Announced on 18 May 2011, the *Coorong, Lower Lakes and Murray Mouth Recovery Project* enables funding of up to $137 million to be provided to deliver a suite of management actions from 1 July 2011 to 30 June 2016.

The CLLMM Recovery Project consists of 19 management actions which contribute to one or more of the following outcomes:

a) Improve the ecological features of the CLLMM site to deliver a healthy and resilient wetland;
b) The CLLMM ecosystem can adapt to a variable climate and variable water levels;
c) The environmental values that give the Coorong, Lower Lakes and Murray Mouth wetland its international significance are protected;
d) The CLLMM site maintains salinity gradients close to historic trends and an open Murray Mouth;
e) The culture of the traditional owners, the Ngarrindjeri, is preserved and promoted through partnerships and involvement in projects;
f) The local communities that depend on the health of the site are supported with a view to improving their resilience; and
g) Capacity, knowledge and understanding are increased across communities.

The SEFRP is one of the 19 management actions being delivered under the CLLMM Recovery Project. These include:

- The Vegetation Program (comprised of seven individual management actions)
- Construction of Fishways
- Critical Fish Habitat
- South Lagoon Salinity Reduction Scheme
- Ruppia Translocation
- Monitoring and Adaptive Management Framework
- Managing Acid Sulfate Soils
- Research Priorities
- Community Engagement and Communications
- Ngarrindjeri Partnerships
- Meningie Wetland
- Lake Albert Scoping Study.

The 19 management actions of the CLLMM Recovery Project are related by their common outcome of contributing to managing the CLLMM site for ecological health, and supporting the implementation and objectives of the Long-Term Plan for the region.

The Ruppia Translocation project, in particular, focuses on addressing the ecological health of the Coorong South Lagoon through the restoration of *Ruppia tuberosa*, an aquatic plant. *Ruppia tuberosa* is an important part of the ecology of the Coorong South Lagoon, providing necessary food resources and habitat for many bird and fish species. *Ruppia tuberosa* was

once widespread throughout the Coorong South Lagoon; however, the recent drought of 2006 to 2010 led to the significant decline of the species in the Coorong South Lagoon.

The SEFRP is also related to the following EPBC Act referrals for management actions in the CLLMM region and South East of South Australia:

- EPBC 2010/5526 Department of Environment and Heritage (South Australia) / Natural resources management / Coorong National Park / SA / Coorong South Lagoon Salinity Reduction Strategy: Pumping Scheme

  The purpose of this action was to lower salinity levels in the Coorong South Lagoon. The action was also developed as part of the CLLMM Recovery Project, and proposed to construct a temporary pipeline from the Coorong South Lagoon to the Southern Ocean, across the Young Husband Peninsula, in order to pump hypersaline water from the Coorong South Lagoon. This action has been withdrawn and is discussed in more detail in Section 2.2.2.

- EPBC 2007/3223 South Australian Department of Water, Land and Biodiversity Conservation / Water management and use / The Coorong / SA / Water capture to restore wetlands and restore environmental flows to the Upper South East of SA

  This action involved connecting low-lying interdunal watercourses at two locations (downstream of Bool Lagoon and Drain M immediately upstream of the Callendale Regulator) in order to capture surface water to restore the health of valuable wetlands and watercourses in the Upper South East. The action was a component of works known as the Upper South East Drainage System.

1.14 Australian Government funding

Up to $137 million funding from the Australian Government has been secured for the South Australian Department of Environment, Water and Natural Resources (DEWNR) to deliver the CLLMM Recovery Project.

The CLLMM Recovery Project comprises compliant management actions, currently being delivered, and compliant but conditional management actions, which require management triggers to be met prior to funding being approved and the management action being delivered. Funding for the SEFRP was conditional upon the submission, and Australian Government approval of a fully-costed proposal for the project.

A business case for the South East Flows Restoration Project was developed and submitted to the Australian Government on 26 April 2013 for consideration. On 12 June 2014, the South East Flows Restoration Project was jointly announced by the Parliamentary Secretary to the

Minister for the Environment, Senator the Honorable Simon Birmingham and the Minister for Environment and Sustainability, the Honorable Ian Hunter (MLC).

1.15 Great Barrier Reef Marine Park

The proposed action is not within the Great Barrier Reef Marine Park.

2. Detailed description of proposed action

2.1 Description of proposed action

2.1.1 Context of the Proposed Action

2.1.1.1 Coorong, Lower Lakes and Murray Mouth Region

The CLLMM region forms an important Australian wetland system, with significant regional, state, national and international values.

In 1985, the Coorong, and Lakes Alexandrina and Albert site was designated as a Wetland of International Importance under the *Convention on Wetlands of International Importance especially as Waterfowl Habitat* (Ramsar Convention). The site satisfied at least eight of the nine criteria for listing when the Ecological Character Description for the Coorong, Lakes Alexandrina and Albert Wetland of International Importance was completed in 2006.

The Coorong, a large coastal lagoon complex situated at the mouth of the River Murray, forms an important component of the Ramsar-listed wetland. The Coorong stretches for 140 km in a south-easterly direction, and is separated from the Southern Ocean by the Younghusband Peninsula, a Holocene barrier dune. The Coorong consists of two main lagoons, the North Lagoon and the South Lagoon, separated by a narrowing of the waterbody at Parnka Point. The South Lagoon is the larger of the two with a total surface area of approximately 110 km^2 when at capacity, compared to 85 km^2 for the North Lagoon.

The Coorong ecosystem is recognised nationally and internationally for the spectacular abundance and diversity of waterbirds it regularly supports (Kingsford *et al.* 2009, Rogers and Paton 2009). Abundances of certain waterbird species can, at times, represent up to 10 per cent of the global population (Paton 2010). These include species protected under Commonwealth legislation (EPBC Act) and international agreements (JAMBA, CAMBA, ROKAMBA) due to their migratory and/or threatened status. The abundance and diversity of waterbirds combined with the permanence of water in the Coorong during drought reflects the importance of this wetland as a drought refuge and its critical role in supporting waterbird populations nationally and internationally (Paton 2010). The annual waterbird survey of the Icon Sites of the Murray-Darling Basin (MDB) (which surveys Icon Sites under the Australian Government's *The Living Murray* initiative, including the Lower Lakes, Coorong and Murray Mouth Icon Site) regularly shows the Coorong and Lower Lakes supporting a large proportion of the MDB's waterbirds. For example, in the drought years of 2007, 2008 and 2009, the site supported 92 per cent, 96 per cent and 95 per cent respectively of total waterbird abundance across all MDB Icon Sites, as well as high species richness (Kingsford and Porter 2008, Kingsford and Porter 2009, Kingsford and Porter 2010). Within the Coorong and Lower Lakes

site, the Coorong supported 61 per cent, 44 per cent and 79 per cent of the waterbirds counted in those years respectively.

The Coorong receives inflows from a number of sources including:

- the River Murray via the Lower Lakes (Lakes Alexandrina and Albert) through five barrages that separate the lakes from the Southern Ocean and Coorong;
- the South East via Salt Creek and the South East Drainage System;
- the Southern Ocean via the Murray Mouth;
- groundwater;
- precipitation; and,
- local runoff.

Inflows from these sources have been severely impacted by River Murray regulation, construction of drains in the Upper South East, extended drought and modified land use. Outflows from the Coorong are solely through the Murray Mouth to the Southern Ocean.

Drivers of Ecological Character in the Coorong

Salinity, water level and Murray Mouth openness are important drivers of the Coorong's Ecological Character (Phillips and Muller 2006; Higham 2012).

Salinity has been demonstrated to influence key biota, including; the abundance and distribution of fish (Brookes *et al*. 2009), the aquatic plant *Ruppia tuberosa* (Rogers and Paton 2009), macroinvertebrates in the Coorong (Rolston and Dittmann 2009), and indirectly through food availability for waterbirds (Rogers and Paton 2009). Importantly, due to the terminal location of the South Lagoon, the natural export of salt through the Murray Mouth occurs at a very slow rate.

Driven primarily by tidal regimes and barrage outflows, water levels in the Coorong influence the structure of submerged aquatic plant communities (Rogers and Paton 2009), and macroinvertebrate distribution and abundance (Rolston and Dittmann 2009). Seasonal water level variation is also important in inundating and exposing mudflats which provide important feeding habitat and food sources for migratory wading birds (Rogers and Paton 2009). Water levels also affect water mixing processes along the Coorong and therefore salinity (Webster 2007).

The 'openness' of the Murray Mouth has been demonstrated to interact with water levels by the way it moderates sea level variations from Encounter Bay into the Coorong, longitudinal (along the Coorong) mixing and therefore salinity (Webster 2007).

Effects of drought

The lack of flows into the Coorong Lagoons during the period of 2006 to 2010 lowered water levels, exposing large areas of shoreline and led to a significant increase in the salinity gradient of the region. In early 2010, the Coorong South Lagoon recorded extreme hypersaline conditions (175 g/L), five times the salinity of seawater (~35 g/L). Estuarine habitat effectively disappeared during this time, and hydrological connectivity was lost between the Lower Lakes and Coorong, impacting on diadromous and estuarine fish species, and estuarine macroinvertebrates.

During this time, connectivity with the Southern Ocean was only maintained through dredging of the Murray Mouth. The Murray Mouth region went from an estuarine environment to a marine embayment, and salinities in the North and South Lagoons increased dramatically. The aquatic plant *Ruppia tuberosa* was previously common in the Coorong South Lagoon, but disappeared during the drought.

During this period the Murray Mouth region represented the lowest salinities in the Coorong. It acted as a refuge habitat for many macroinvertebrate, fish and bird species as conditions in both the Coorong South Lagoon and much of the Coorong North Lagoon were unfavourable and resulted in species distributions contracting northwards.

High salinities in the South Lagoon saw the proliferation of brine shrimp, as well as a significant decline in Small-mouthed hardyhead fish (a saline-tolerant fish species previously common in the region) and Chironomid larvae (the sexual propagules of *Ruppia tuberosa* that has essentially disappeared from the Coorong South Lagoon), which were previously abundant in the region. Bird numbers have declined substantially over the past 25 years, particularly during the recent drought period due to poor quality foraging habitat caused by a lack of food resources and prolonged low water levels.

Environmental response to increased flows over the barrages

The Millennium Drought ended with significant flooding throughout the Murray-Darling Basin. Following 42 consecutive months without flow, barrage flows recommenced in September 2010 and a period of high barrage flows ensued, returning to more typical barrage flows by late 2012. The return of barrage flows has had a generally positive affect upon the two key drivers of the Coorong ecosystem; water level and salinity. During the summer of 2010/11 high barrage flows caused Coorong water levels to remain elevated, which rendered the Coorong less favourable for wading waterbirds than typically. However, these conditions helped export

salt from the Coorong South Lagoon that had accumulated during the drought. Both salinity and water levels in the South Lagoon have since returned to within or close to the target range.

Consistent with scientific understanding of the system (e.g. Brookes *et al.* 2009) the Coorong ecosystem has responded positively to improved salinity and water levels. The distribution and abundance of the important aquatic plant *Ruppia tuberosa* has improved dramatically (DEWNR 2014). This plant, which is central to the ecology of the Coorong South Lagoon, was eliminated from the South Lagoon during the Millennium Drought due to excessive salinity and unfavourable water levels caused by the absence of adequate barrage flows in spring (Paton 2010). *Ruppia* has now re-established over much, although not all, of its former extent within the South Lagoon. However, it's seedbank is yet to return to pre-drought status (DEWNR 2014).

Macroinvertebrate samples in Coorong mudflats show signs of post-drought recovery of the wetland - based on increasing numbers of species and increasing abundances of individuals at sites throughout the Murray Mouth and into the northern South Lagoon (DEWNR 2014). Encouragingly, in January 2014 increased species numbers were recorded around Hells Gate, where the South and North Lagoon meet, and in the North Lagoon. For example, the small bivalve *Arthritica helmsi*, which was very abundant before the drought, has continued to recolonise the mudflats. The vertical distribution of macroinvertebrates has also improved, with more species and high abundances in the deeper sediment layers at several sites. Experts anticipate that further promotion of environmental watering will that lead to resident macroinvertebrate communities more dominated by species that are larger in size.

In 2008/09, at the height of the Millennium Drought's ecological impact upon the Coorong, the only fish species present in the South Lagoon was the high salinity tolerant small-mouthed hardyhead (*Atherinosoma microstoma*) (Ye *et al.* 2009). Its abundance was extremely low compared to pre-drought levels, and very few juvenile fish were present. By 2013/14 small-mouthed hardyhead abundance and population demographics had improved dramatically and several other fish species had returned to the South Lagoon, including black bream (*Acanthopagrus bucheri*), yelloweye mullet (*Aldrichetta forsteri*), congolli (*Pseudaphritis urvillii*) and bony herring (*Nematolosa erebi*). Anecdotal reports from commercial fisherman confirmed this improvement, with commercial fishing occurring in spring 2013 in the vicinity of Salt Creek for the first time since the 1970s (G. Hera-Singh, pers. Comm., June 2014). Multiple lines of evidence indicated the fish community in the Murray Estuary and Coorong Lagoons improved after receiving elevated freshwater discharge in 2010/11 and low-moderate flows in the subsequent years. All the indices investigated showed positive responses to flow discharge. The fish community in the Murray Estuary was first to show these responses, whilst there was a lagged response of one–two years from the fish community in both North and South Lagoons (Livore *et al*, 2013).

Over 66,000 waterbirds from 44 species were recorded in January 2014 in the Coorong South Lagoon during the annual waterbird census (Paton and Bailey 2014b). This represents a marked improvement to waterbird abundance compared to the drought years. Total waterbird counts for the South Lagoon in the summers of 2007 and 2009 were 9,512 and 35,317 respectively (Kingsford and Porter 2008, Kingsford and Porter 2010). However, waterbird abundance remains supressed compared to 1985, the year the Coorong and Lower Lakes were listed as a wetland of international importance. In that year 160,000 waterbirds were counted in the Coorong South Lagoon (Paton 2010).

In summary, the resumption of inflows of 2010 – 2012 have dramatically improved both the abiotic conditions and the abundance, diversity and geographic extent of biota within the Coorong. However, complete recovery is yet to occur, with several measures of Coorong health remaining indicative of degradation. By most measures, the Coorong remains degraded compared to its 1985 reference condition.

2.1.1.2 Upper South East Region, South Australia

The South East of South Australia is a biologically rich area due to varied topography and hydrological conditions (Foulkes and Heard 2003), albeit a highly modified landscape. The entire region covers approximately 28,000 square kilometres and supports a population of 64,000 people (SENRM Board 2010).

Broad scale land clearing and an extensive drainage network have converted what was once a wetland dominated landscape into agricultural production on a vast scale. These activities have altered the hydrological regime of regional wetlands. It has been estimated that since European settlement, wetlands of the region have been reduced by 93 percent and, of the remaining wetland area, only 10 percent is considered ‘intact’ (Harding 2007). Intact native vegetation is mostly located in areas of low agricultural value or in conservation areas (Foulkes and Heard 2003). Seasonally inundated sedge and shrub-dominated floodplains (i.e. Gahnia spp. Sedgelands) have been the most affected, with less than 5 percent of this wetland type remaining (Harding 2007).

The South East Drainage System

The South East drainage system consists of over 2,500 km of constructed drainage channels that direct surface- and groundwater to sea or, in the case of the northern catchment, into the Coorong via Salt Creek (Figure 2). The drainage system has developed continuously from the early days of European colonisation of the region in the 1860s through to the present day. Major drainage infrastructure was constructed in the 1950s and 60s (the Anderson Scheme) and from 1997 to 2010 (the Upper South East Dryland Salinity and Flood Management

Program). The management objectives of the drainage system are to prevent the inundation of agricultural land, counter dryland salinity (in the northern catchment) and provide water to wetlands. The northern catchment of the drainage system assists with salinity management in the Coorong South Lagoon by discharging fresh-brackish water to the Coorong via the natural outlet at Salt Creek. Other, more southerly outlets of the drainage system, for example the Blackford Drain, Kingston Main Drain, Drain L and Drain M, discharge to sea.

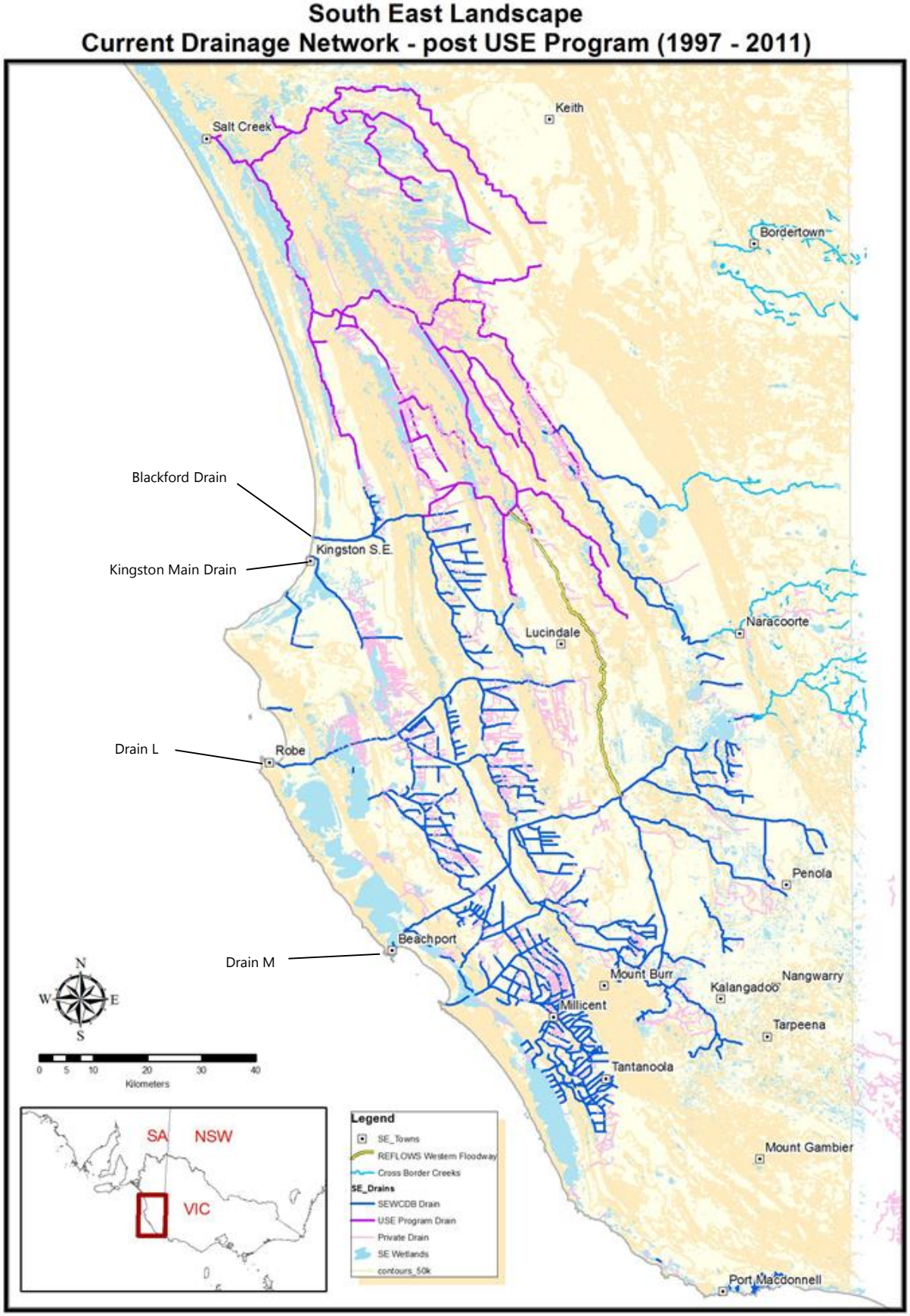

Figure 2: Map of the current South East Drainage System

Blackford Catchment Area

The existing Salt Creek catchment (Figure 3**Error! Reference source not found.**) covers pproximately 570,000 ha and has a median annual discharge at Salt Creek of 29.7 GL (AWE 2012). However, flows generated in the far eastern and southern areas of the catchment 'fill and spill' through a number of wetlands prior to reaching the Coorong, thus most flow that reaches the Coorong is generated from the western part of the catchment.

The Blackford Drain catchment upstream of the proposed SEFRP offtake weir (Figure 3) is much smaller, covering 68,387 ha. However, there are no wetlands through which the watercourse flows, and subsequently limited 'losses'. Thus, even though the catchment area is much smaller, modelling indicates that the addition of this catchment to the existing Salt Creek catchment can add a median of 26.5 GL, increasing median Salt Creek flows into the Coorong to 56.2 GL (AWE 2012).

Land use in the area to be added to the Salt Creek catchment under the SEFRP is similar to that in the existing Salt Creek catchment (Table 3). The dominant land use is grazing, representing 78% and 70% of catchment area respectively. Nature conservation, i.e. protected remnant native vegetation, comprises the second largest area of each catchment, 13.6 and 11.2% respectively. All other land uses cover a similar area of each catchment. Thus, when the additional catchment is added to the existing Salt Creek catchment, the proportion of different land uses in the combined catchment will be very similar. This is anticipated to cause little change to the water quality generated from the combined catchment, and issue explored in detail by the water quality risk assessment undertaken for the project (Wilson *et al*. 2016) (see Section 3.1.3.2).

Table 3: Comparison of land use in the existing and SEFRP additional Salt Creek catchments.

Land Use	**SEFRP additional Salt Creek catchment**	**Existing Salt Creek catchment**
Drainage channels	569 ha (0.8%)	2,908 ha (0.5%)
Cropping and horticulture	1,750 ha (2.6%)	30,076 ha (5.3%)
Grazing	53,331 ha (78%)	397,518 ha (69.9%)
Lakes and wetlands	572 ha (0.8%)	7,782 ha (1.4%)
Mining	2 ha (0.003%)	87 ha (0.02%)
Nature conservation (native vegetation)	9,274 ha (13.6%)	63,650 ha (11.2%)

Land Use	SEFRP additional Salt Creek catchment	Existing Salt Creek catchment
Plantation forestry	206 ha (0.3%)	10,778 ha (1.9%)
Other	2,683 ha (3.9%)	56,040 ha (9.9%)
TOTAL	68,387 ha	568,839 ha

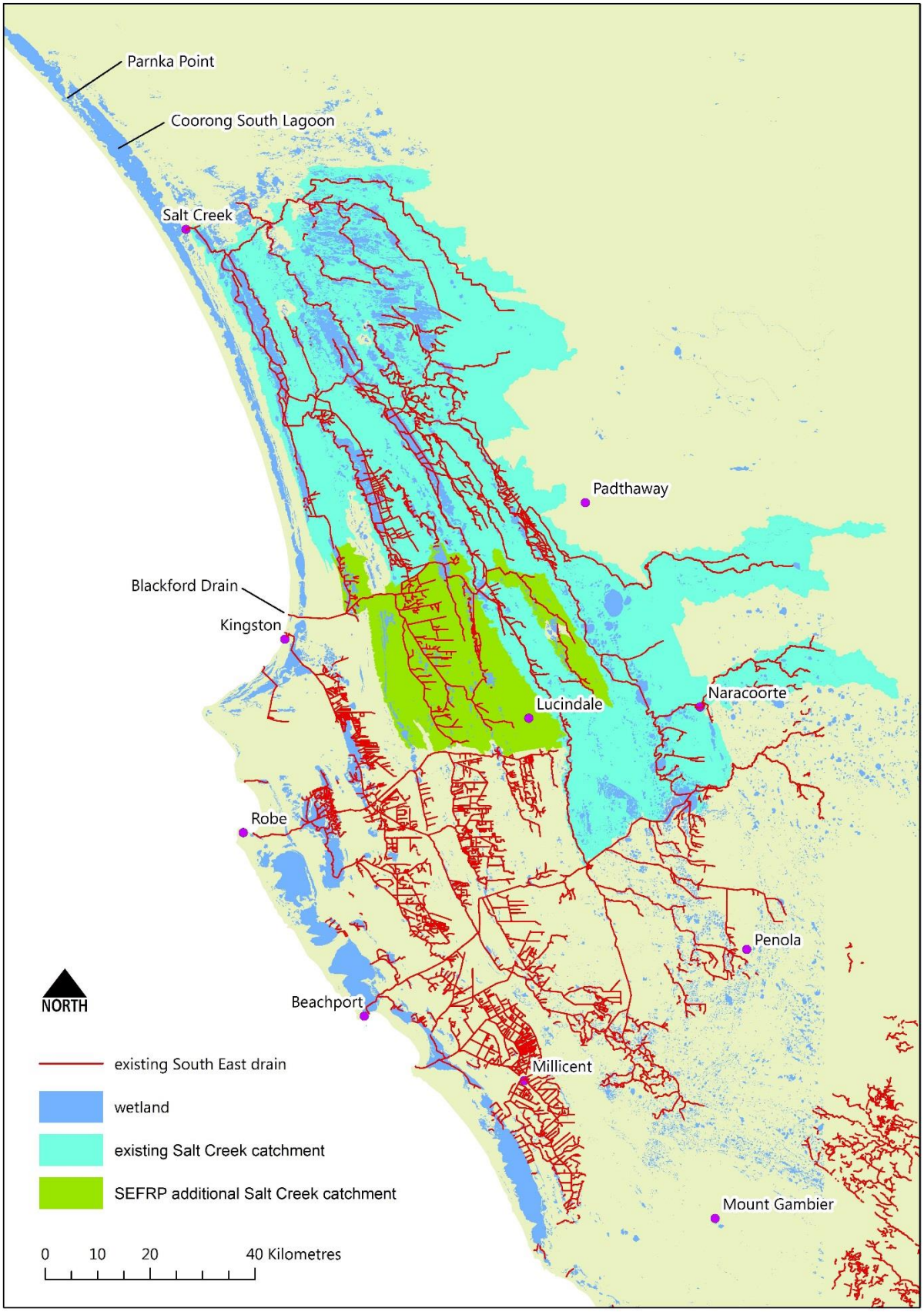

Figure 3: The South East drainage system showing the existing Salt Creek catchment and the additional catchment to be added under the SEFRP.

2.1.1.3 SEFRP (Taratap and Tilley Swamp) Flow Path

Figure 4 shows the SEFRP proposed alignment, as well as the location of the Taratap wetlands, Tilley Swamp watercourse and Morella basin *en route* to the Coorong.

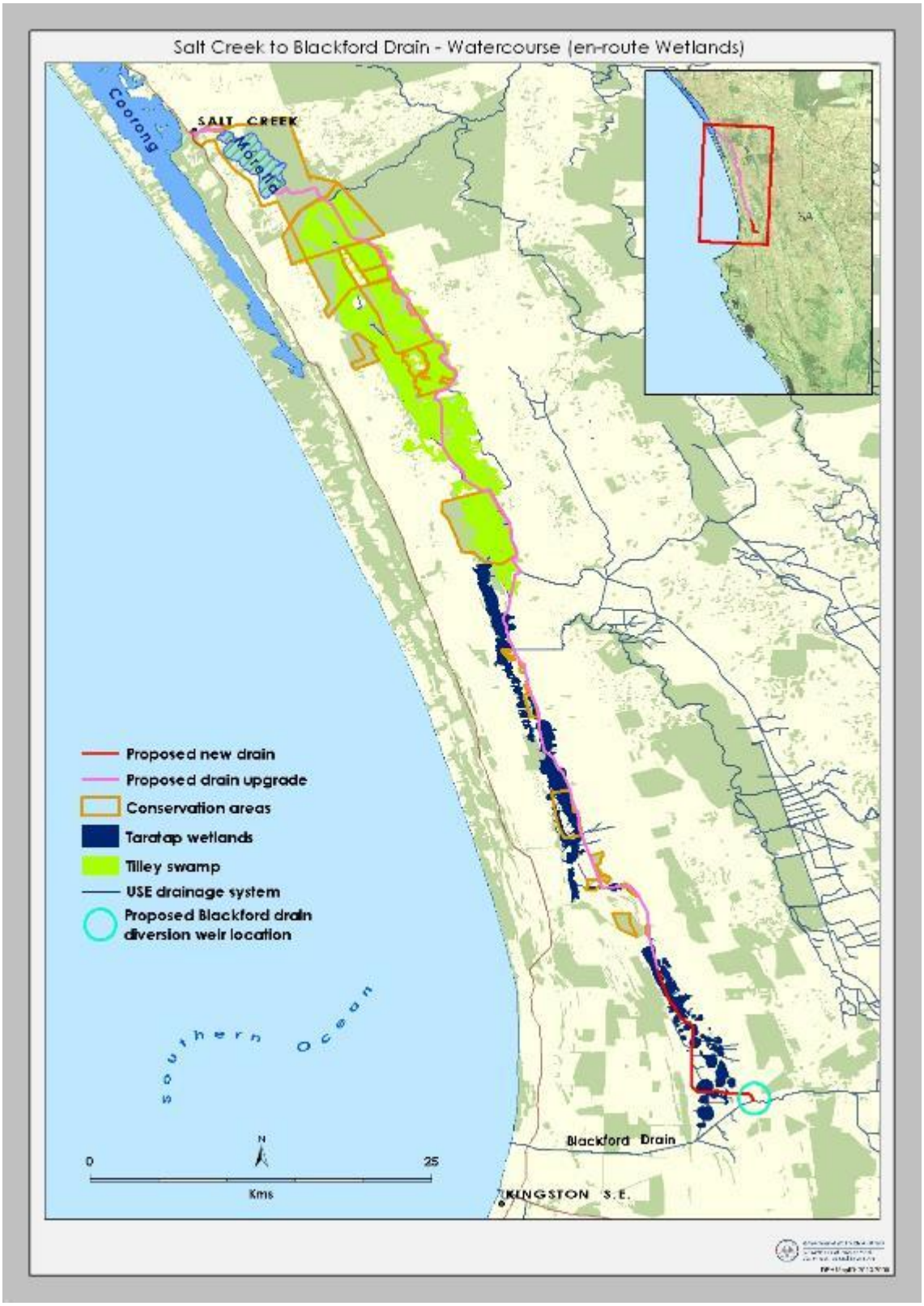

Figure 4: SEFRP flow path alignment and *en route* wetlands

Land Use

The two dominant land uses in the area of the proposed action are grazing (57 percent of the total South East region) and native vegetation (20 percent of the total South East region) (SE NRM Board 2009). Some cropping occurs on the Taratap Flats adjacent to the SEFRP channel alignment. Perennial horticulture, forestry and urban land uses are largely absent from the area of the proposed action.

Hydrology

Historically, watercourse flow in the South East of South Australia moved from South to North, along broad flats between north-westerly aligned, parallel, dune ranges (Harding 2007). There were few clearly defined creeks in the region, with surface flows generally slow moving and occurring over broad, shallowly inundated flats. It has been estimated that, prior to drainage, 45 percent of South East region was subject to inundation either permanently or seasonally (Harding 2007). In wet years, surface water that flowed northwards provided freshening flows to the Coorong South Lagoon via Tilley Swamp and Salt Creek. Flow paths terminating at Salt Creek had their headwaters as far south as the Mt Burr area, 175 km from Salt Creek. The Southern Ephemeral Lakes, which extend south-east from the southernmost end of the Coorong, may also have formed a flow path to the Coorong. Commencing in 1863, water diversion and drainage schemes have changed the hydrological patterns of the region and generally reduced surface water flooding (Harding 2007). The drainage system has short-circuited the natural north-west direction of flows towards the Coorong, channelling water more directly to sea via the large, arterial drains including the Blackford Drain, Drain L and Drain M. As a whole, the South East drainage system comprises 2589 km of drains and floodways and over 1940 structures such as bridges, culverts, inlets, sea outlet structures and regulators.

Taratap and Tilley Swamp '*en route*' wetlands

Wetland habitats in the Tilley Swamp (Figure 5) and Taratap (Figure 6) areas are important environmental assets in the project area. These wetlands are typically brackish, with salinities ranging between approximately 3,000 to 15,000 EC. Wetland vegetation reflects the brackish water quality and water regime of shallow, seasonal inundation. Vegetation types include open areas alternatively supporting submerged aquatic plants when inundated and herblands when exposed. Peripheral to the deeper areas, *Gahnia filum* sedgelands and *Melaleuca halmaturorum* shrublands are dominant (Stewart *et al.* 1998, Milne and Squire 2001, Dickson

et al. 2013). Notably, the wetlands of the Taratap and Tilley Swamp areas support many of the species that also utilise the more saline, permanent aquatic habitat of the Coorong. For example, a variety of waterbird species that utilise the Coorong South Lagoon for foraging do not breed there (Paton, 2010). The Taratap and Tilley Swamp wetlands provide breeding habitat for many of these species and thus are complementary to the Coorong and ecologically integrated with it at the landscape scale.

Figure 5: Tilley Swamp (M De Jong)

Figure 6: Taratap Wetlands (M De Jong)

The Taratap wetlands comprise approximately 1400 ha of seasonally inundated wetland habitat along the lowest lying, western edge of the Taratap Flats. Most of the Taratap wetland area is managed for conservation by private landholders, while land use on the Taratap Flats to the east is primarily grazing, with some limited cropping. The existing Taratap Drain delineates the boundary between the Taratap wetlands to the west and the Taratap Flats to the east. The drain features weirs and regulators that permit its flows to be diverted into the Taratap wetlands when salinity in the drain is below the threshold value of 7500 EC. Additionally, local runoff from the eastern side of the Taratap flats is diverted directly into the Taratap wetlands via under- and over-passes across the Taratap drain. This local runoff is typically much fresher than the 7500 EC threshold. However, the combined volume of local runoff plus diversions from the Taratap drain is rarely sufficient to completely fill the Taratap wetlands. In below average rainfall years the Taratap wetlands can remain dry. The SEFRP thus represents an opportunity to increase the frequency of complete filling of the Taratap wetlands. Analysis of flow and salinity data for the Blackford Drain indicates that a sufficient quantity of suitably fresh water is available most years.

Approximately half way along the proposed SEFRP alignment, the Henry Creek Drain adjoins the existing drain from the east. At this confluence the name of the north-south flowing drain changes. South (upstream) of this location the drain is known as the Taratap Drain. North (downstream) of this location the rain is called the Tilley Swamp Drain. Existing salinity thresholds for diversion into wetlands change at Henry Creek from 7500 EC upstream to 10,000 EC downstream.

Tilley Swamp Conservation Park is located 7 km downstream of the Henry Creek confluence. Infrastructure at Petherick Road permits the diversion of water from Tilley Swamp Drain into Tilley Swamp Conservation Park. Such diversions occur in most years. The Conservation Park is 1515 ha in size and conserves *Gahnia filum* sedgelands, *Melaleuca halmaturorum* shrublands, *Eucalyptus fasciculosa* woodlands and *Allocasuarina verticillata* woodlands.

North (downstream) of Tilley Swamp Conservation Park are cleared and grazed from east to west. The Tilley Swamp Drain flows northwards through the approximate centre of the Tilley Swamp flat, however its capacity is insufficient to contain the inflows it regularly receives from upstream and in most winters water spills from the drain, inundating surrounding agricultural land.

North of Cantara Road the Tilley Swamp Drain is located on the eastern, more elevated side of the Tilley Swamp flat. The drain passes through an extensive area of native vegetation, with *Melalauca halmaturorum* shrubland generally abutting the drain on both sides. The Tilley Swamp Watercourse lies to the west, consisting of approximately 5,100 ha of largely undisturbed wetland habitat on private land. There is no existing infrastructure in place to enable the diversion of water from the Tilley Swamp Drain into the Tilley Swamp Watercourse and the management priority of prevention of inundation of some low lying agricultural land is an obstacle to such diversion were the infrastructure in place.

Morella Basin

Morella Basin (Figure 7) is a large (860 ha) brackish wetland that serves as the terminus for the Upper South East Drainage Network, prior to release into the Coorong South Lagoon via Salt Creek. Morella Basin has been free from grazing since 2000, and the buffering area revegetated since 2001. In 2005, Morella Basin and surrounding areas were proclaimed as Martin Washpool Conservation Park. It is now permanently inundated and provides important summer refuge for waterbirds, including threatened and migratory species, and habitat that is fresher and complementary to the Coorong (Everingham and Kawalec 2009). Releases of water from Morella Basin into the Coorong South Lagoon via Salt Creek are controlled by the Morella Outlet Regulator. Water levels in Morella have an influence upon the effectiveness of the drainage service provided by the Tilley Swamp Drain to agricultural land up to 30 km upstream. Water levels in Morella are managed to (DFW 2011):

- Maintain the drainage service to agricultural land upstream;
- Maintain the ecological values of Morella itself; and
- Optimise the ecological benefits for the Coorong South Lagoon of water releases.

The SEFRP will not change these management principles. It will simply provide additional water, when required, the help meet ecological objectives.

Figure 7: Morella Basin (M De Jong)

2.1.2 Purpose of the proposed action

The SEFRP aims to:

(1) divert additional relatively fresh water from the Upper South-East Drainage System to the Coorong to assist in managing salinity in the Coorong South Lagoon during periods of low River Murray flows, thus building resilience and supporting a healthy ecosystem; and

(2) provide additional environmental benefits by increasing flow through *en route* wetlands in the Upper South East.

2.1.2.1 Managing salinity in the South Lagoon

The ecological health of the Coorong South Lagoon is largely dependent upon flows delivered over the barrages from the River Murray. The recent drought of 2006 to 2010 demonstrated the fragility of this relationship and the consequences when insufficient water reaches the Coorong. In particular, the drought demonstrated that the Coorong South Lagoon is particularly susceptible to significant increases in salinity levels during periods of reduced barrage outflows, causing environmental degradation. Further, water quality monitoring has indicated

that environmental conditions in the Coorong South Lagoon are slow to improve when barrage outflows return (i.e. salinity levels do not immediately reset upon return of flows).

Hydrodynamic modelling of the Coorong which considered inputs from the ocean, barrage outflows and Upper South East Drainage Network was undertaken in 2012 (Webster 2012 and BMT WBM, 2012). The modelling showed that salinities and water levels in the Coorong South Lagoon were largely driven by barrage outflows, seasonal sea level changes, and local meteorological conditions (wind, net evaporation)(Webster, 2005).

The provision of additional water from the South East drainage system (provided by the SEFRP channel) can potentially be effective at preventing the highest salinities that are most likely to cause ecological damage in the Coorong South Lagoon, especially if these flows coincide with periods of low barrage outflow (Lester, *et al*., 2011). Thus, there is positive ecological benefit to the Coorong South Lagoon from additional fresh water entering the Coorong via the SEFRP, promoting ecosystem health, productivity and resilience in-line with the goal of the CLLMM Recovery Project.

2.1.2.2 Salinity target values and threshold to support Coorong biota

An ecologically healthy Coorong South Lagoon requires the ongoing maintenance of both salinity and water level within their management target ranges. Studies to date (Lester *et al.* 2011 and Lester *et al.* 2012) indicate that the delivery of water from the South East drainage will have a greater impact on salinity than water levels, with water levels remaining largely constant regardless of the volume delivered from the South East (Lester *et al.* 2012). As such, the SEFRP has been developed to specifically address the other key driver affecting ecological health in the Coorong namely, salinity.

The salinity of the Coorong generally increases with increasing distance from the Murray Mouth, but varies over time, mainly in response to barrage outflows from the Murray-Darling Basin (MDBC 2006). The salinity variation – forming estuarine, marine and hypermarine habitats – supports diverse ecological communities (Brookes *et al.* 2009) and therefore has ecological significance.

The salinity management target range to support a healthy ecosystem in the Coorong South Lagoon is between 60 g/L and a maximum of 100 g/L (i.e. less than three times seawater salinity). Keeping salinity below 100 g/L supports an ecosystem optimal for its distinct waterbird community by supporting the insect component of the macroinvertebrate community (chironomids), Small-mouthed hardyhead (*Atherinosoma microstoma*), a food species for piscivorous birds such as fairy terns (*Sternula nereis nereis*), and *Ruppia tuberosa* growth and reproduction (Higham, 2012). The target minimum salinity of ~60 g/L has been selected so as

not to favour an undesirable competitor species, filamentous green algae *Ulva sp.* (CLLAMMecology Research Cluster, 2008).

Lester *et al*. (2011) developed a linked suite of species and assemblages for the Coorong, Lake Alexandrina and Lake Albert site as part of a process to determine the environmental water requirements for a healthy and resilient Wetland of International Importance (Ramsar Convention). Through this work, a broader evidentiary base for determination of upper maximum target salinity for the Coorong South Lagoon that would support key indicator biota was identified, including *Ruppia tuberosa*, Small-mouthed hardyhead and chironomids.

This enables the consideration of important sub-lethal impacts and determination of thresholds. The identified lethal maximum and preferred maximum target salinities for Coorong South Lagoon biotic indicators are listed in Table 4.

Table 4: Lethal and preferred maximum target salinities for biotic indicators.

Ruppia tuberosa	Lethal Maximum	~230 g L-1	(Brock, 1982)
Small-mouthed hardyhead	Lethal Maximum	~108 g L-1	(Lui, 1969)
Chironomids	Lethal Maximum	~100 g L-1	(Kokkinn, 1986)
Ruppia tuberosa	Preferred Maximum	~110 g L-1	(Paton, 2010)
Small-mouthed hardyhead	Preferred Maximum	~94 g L-1	(Molsher *et al.* 1994)
Chironomids	Preferred Maximum	~90 g L-1	(Geddes and Butler 1994)

Additionally, growth, flowering, seed set, and turion growth in *Ruppia tuberosa* is severely curtailed at salinities above 120 g/L (Paton and Bailey 2010).

2.1.2.3 SEFRP yield to the Coorong

Modelling suggests the proposed action will deliver an average of 26.5 GL/year (median historic climate) of additional water per year to the Coorong South Lagoon (including *en route* wetlands) (Table 5).

Table 5: SEFRP yields to the Coorong South Lagoon (historic climate) (source: AWE 2012).

Staging	SERFP reach	Median Yield to Coorong (GL/year)

Existing	Existing Drainage Network (EDN)	29.7
SEFRP	Blackford Connection	26.5
Total	EDN + Blackford	56.2

The annual exceedance curve of the proposed action yield to the Coorong (historic climate) is shown in Figure 8. The proposed action curve (EDN + BF) indicates that, in combination with the existing drainage system, it has ability to deliver up to 14 GL in 90 percent of years, up to 25 GL in 75 percent of years, and up to 56 GL in 50 percent of years. In addition, at the wetter end of the spectrum, up to 97 GL could be delivered to the Coorong South Lagoon in 10 percent of years.

This is in contrast to the existing drainage network (EDN) whereby less than 10 GL is provided in 90 percent of years, approximately 17 GL in 75 percent of years, and approximately 30 GL in 50 percent of years. At the wetter end of the spectrum, currently less than 50 GL is delivered to the Coorong South Lagoon in 10 percent of years. However, infrastructure constraints would prevent this volume of water from being delivered without significant inundation of private land.

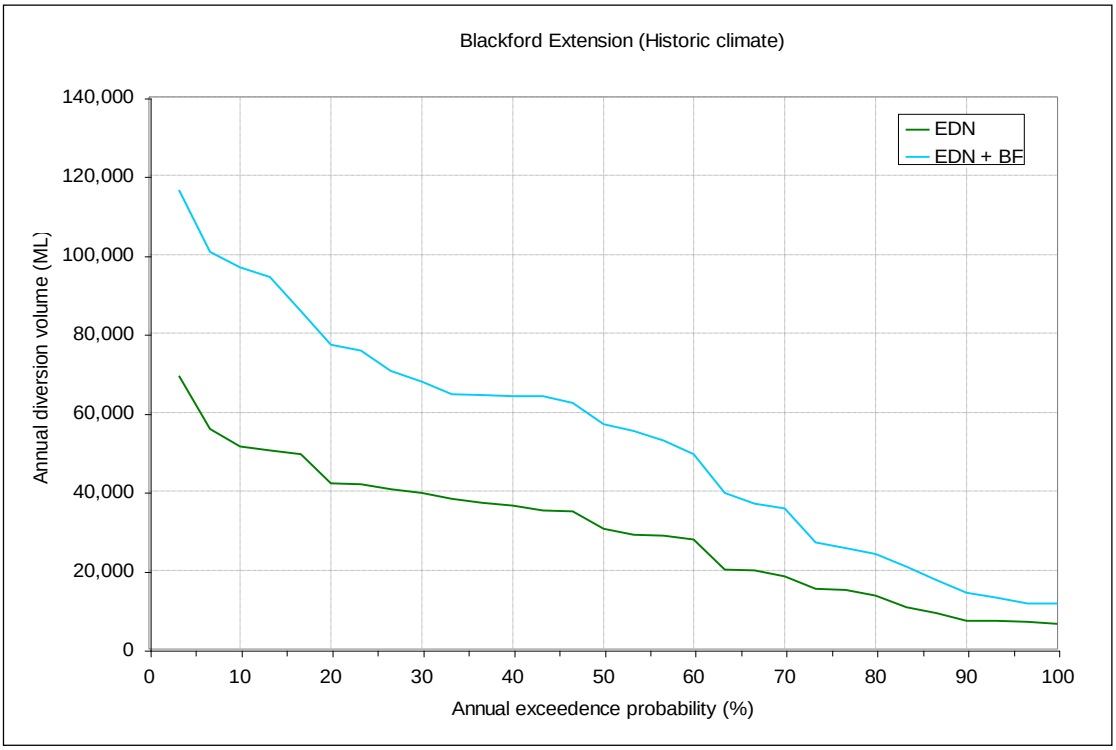

Figure 8: Annual exceedance curves for the SEFRP (historic climate).

The proposed action is represented by the light blue line, i.e. the existing drainage system plus Blackford Drain (EDN+BF) (source: AWE 2012).

A total median annual yield to the Coorong of up to 56.2 GL/year (Table 5) will assist in maintaining Coorong salinities predominantly within the management target range of 60 g/L to 100 g/L, particularly in periods of low River Murray Flows (Lester *et al*. 2012).

The proposed action will almost double the minimum yield to the Coorong (currently 7 GL). Larger volumes are likely to be provided during periods of low MDB inflows, which will assist to mitigate the risk of exceeding salinity threshold levels in the Coorong South Lagoon.

2.1.2.4 Additional flows to *en route* wetlands

The existing Taratap and Tilley Swamp Drains feature infrastructure that enables drain water to be diverted into the Taratap wetlands and Tilley Swamp Conservation Park. Under the SEFRP this infrastructure and capability will be retained and upgraded. These *en route* wetlands, located on both private and public land, are managed for conservation. As discussed in Section 2.1.1.3, these are important environmental assets in the project area with values to be protected and, where possible, enhanced.

It is likely that regional scale changes to hydrology have led to a drying trend for these wetland areas, with complete filling currently only occurring infrequently, approximately 1 year in 5. In response, the vegetation in these wetlands is showing evidence of "terrestrialisation" (Dickson *et al*. 2013), that is the displacement of aquatic flora with terrestrial flora. This type of impact can occur in response to reduced frequency and/or duration of inundation.

The SEFRP provides an opportunity to increase the frequency that the Taratap and Tilley Swamp Conservation Park wetlands are filled. By diverting the waters of the Blackford Drain through the Taratap and Tilley Swamp Drains, the SEFRP will increase the volume of suitably fresh water available for diversion into these *en route* wetlands. It is anticipated this will provide ecological benefits such as the halting or reversal of the process of terrestrialisation and increased abundances of water dependent fauna such as waterbirds, frogs and fish.

The objective of the project is to maximise the benefits to *en route* wetlands when the Coorong does not require all available flow. However, the extent to which the project can be designed and operated to inundate privately held land within these wetland areas is subject to ongoing consultation with the relevant landowners. This consultation is required to be finalised ahead of finalising detailed design in order for the design to include relevant ancillary works to retain the integrity of infrastructure located within these areas, as well as reduced capacity requirements within the drain through these sections.

2.1.3 Elements of the proposed action

The SEFRP will use a combination of widened existing drains and newly constructed drains to divert additional water from the Upper South East to the Coorong South Lagoon (Figure 9).

The proposed action consists of the upgrade to the existing Tilley Swamp and Taratap drains, and the construction of a section of new drain connecting the Blackford Drain to the Taratap Drain.

Ongoing negotiations with relevant private landowners regarding the inundation of private land within the Tilley Swamp Water Course will inform the final design, and the extent of work required to retain the integrity of infrastructure located within these areas.

Operation of the SEFRP channel, including flow volumes and timing, will be subject to 'Management Principles' developed under the South East Drainage Network Management Strategy to govern operations of the SEFRP channel and subsequent decision framework (see Section 2.1.6.2). Through these mechanisms, operation of the SEFRP channel will take into account a number of management considerations, including the volume of flows over the barrages and potential en route wetland benefits.

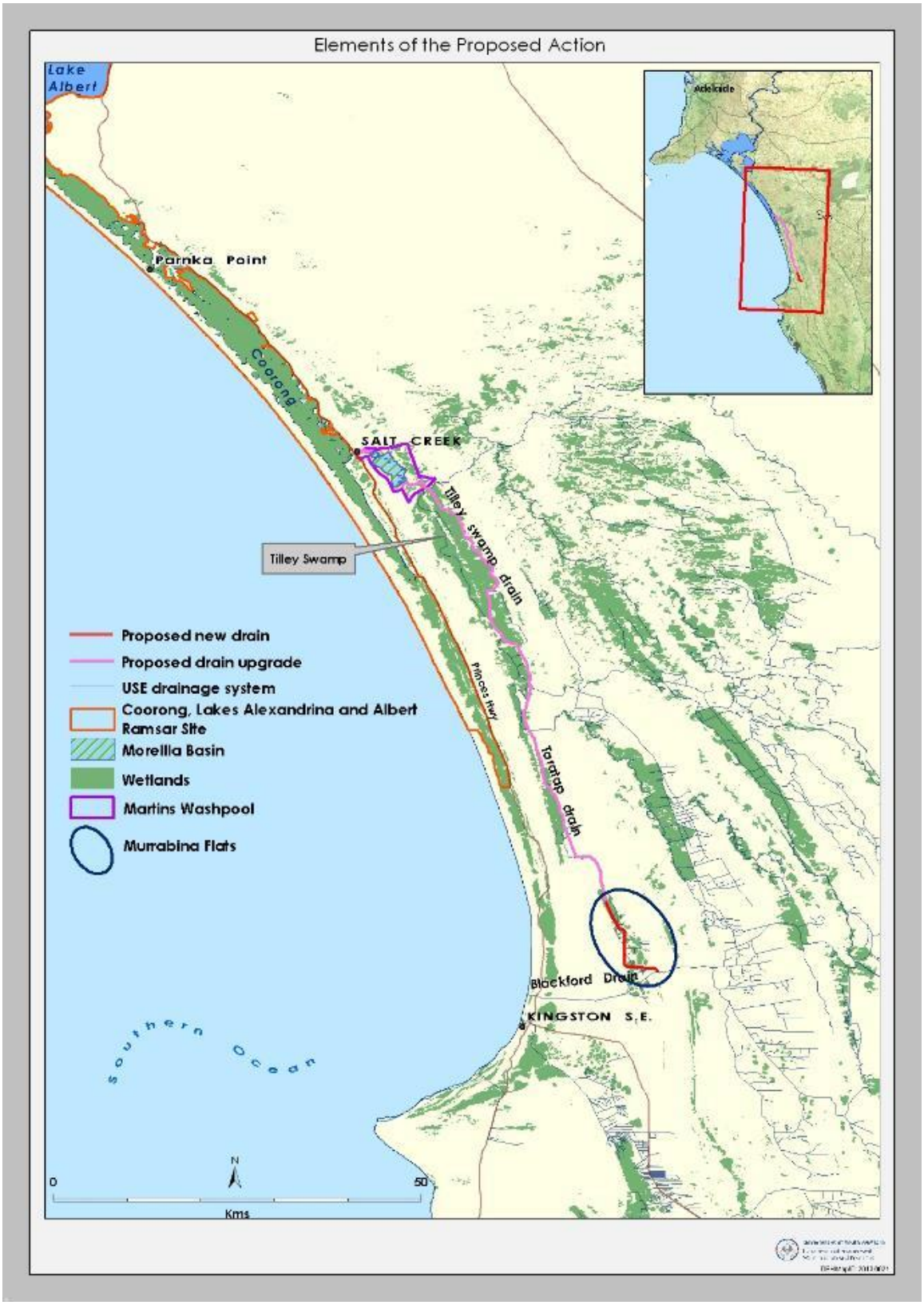

Figure 9: Elements of proposed action

Salt Creek to Blackford Drain

The proposed SEFRP channel extends 93 km southwards along an alignment from the outfall (Figure 10) into the Coorong South Lagoon at Salt Creek to the Blackford Drain. Salt Creek is a natural channel of approximately 7 m width at the point it enters the Coorong South Lagoon.

Figure 10: Salt Creek outfall, facing the Coorong South Lagoon (R. Seaman)

From the Salt Creek outfall, the proposed drain:

- Passes under the Princes Highway and along Salt Creek with minimal channel modifications
- Follows the existing channel through Morella Basin, without modification
- Follows along the existing Tilley Swamp and Taratap drains (80.7 km) with increased channel width to obtain the required capacity;
- Crosses the Murrabinna Flats to the Blackford Drain in a new channel along the western side; and,
- Connects to the Blackford Drain at the 'Blackford weir'.

The proposed action will upgrade 81km of existing drainage infrastructure between Salt Creek and the Blackford Drain.

2.1.4 Construction details

A 75 week construction period (over two years to account for encountering a wet winter) is proposed to enable completion by June 2018.

Key elements of the construction of the SEFRP include detailed design, construction and installation of associated infrastructure such as crossings, regulators, fencing and local drainage. Approximately 3 million m^3 of excavation is required for construction of the SEFRP.

This section provides a high-level overview of the construction details of the SEFRP.

Channel design details

In the preliminary design of the SEFRP channel, consideration has been given to maintaining the existing drainage of the landscape through which it flows. The preliminary design has aimed to keep the water surface below ground level where reasonably and practically possible. Where this could not be achieved, flows in the channel will be contained by levees. Catch drains will be provided to deal with drainage from the local catchment.

Flow capacity

In order to deliver additional volumes of water to the Coorong South Lagoon through the SEFRP, the flow capacity of the existing drainage system (Taratap Drain and Tilley Swamp Drain) will be increased. This will be done by expanding the width of the existing drainage corridor and introducing approximately 12 kilometres of new channel. Generally, existing drains will not be deepened, but widened to increase flow capacity.

The SEFRP will involve excavation to widen the Tilley Swamp and Taratap drains along approximately 72 km of the existing alignment. The existing Tilley Swamp and Taratap drains have an average corridor width of approximately 30 - 40 metres, with a drain base width from 2 to 10 metres. Only small local drains currently exist between the southernmost end of the Taratap Drain and the Blackford Drain. The proposed Salt Creek to Blackford corridor will average a width of 80 to 100 metres, with a drain base width of 15 to 35 metres.

Table 4 summarises the flow capacity of the SEFRP channel. The table compares the flow capacity of the proposed SEFRP channel to the flow capacity of the existing drainage system, and also includes a comparison of the existing and proposed channel base widths. The distances are described as chainages (ch) in metres measured from the downstream end of flows (Salt Creek – Coorong South Lagoon outfall).

Table 6: Summary of flow capacity for the SEFRP channel

Chainage (m)	Section	Flow Capacity (ML/day)		Base Width (m)		Comments
		Existing	SEFRP	Existing	SEFRP[1]	
0 - 8700	Salt Creek Outfall (CSL) – Morella Basin inlet	1,000	1,000	5-20	5-20	***Existing***: Ch 0-1500 – Natural Creek 10->20 m Ch 1500-3100 – 5-11 m (Some natural but min 5 m required at times) Ch 3100-8700 Morella Basin – no works required ***SEFRP***: No Change
8700 - 12600	Morella Basin inlet – Martin Washpool inlet	520	600	7.5-12	15	
12600 - 39000	Martin Washpool inlet - to Cantara Road	130	600	2-3	<15	
39000 - 47100	Cantara Road – S-Bend junction	130	600-1100	2-6	15-20	**SEFRP:** Variable widths to suit a number of diversion scenarios. 1100 ML/day commences at S-Bend Drain junction to accommodate additional inflows from approximately 300 km of drains.
47100 - 53100	S-Bend junction – Henry Creek Road (start Taratap Drain)	130	730	3	20	
53100 - 63000	Taratap Drain	90	690	4 - 6	20	***Existing***: Ch 53100-58600 – 4 m Ch 58600-63000 – 6 m
63000 - 72500	Taratap Drain - Taratap Road	45	645	6	20-35	***SEFRP***: Ch 63000-68400 – 20 m Ch 68400-72300 – 35 m Ch 72300-72500 – 20 m
72500 - 80700	Taratap Drain - end	30	630	2	20	

80700 - 93400	Murabinna Flats	-	600	-	15-25	***Existing***: Some local drains but new drains required ***SEFRP***: Ch 80700-88100 – 15 m Ch 88100-93400 – 25 m

Notes: 1. Variable channel widths result from changes in gradient – a steeper gradient through a section requires less cross-section and therefore less base width.

Drain invert

The drain invert refers to the vertical alignment (depth) of the proposed SEFRP channel. The following principles were applied in finalising concept design of the drain invert of the channel:

- where there is an existing drain, the drain invert was maintained in most cases, and the width increased to provide the required additional capacity
- where there was no existing drain, the invert was determined based on consideration of:
    - the upstream and downstream inverts of existing drains
    - a preference to balance cut and fill volumes for construction of channel levees
    - the width of the flow path corridor
    - topographic features.

There were some exceptions to the above principles, where the hydraulics of the system require the invert of existing drains to be lowered.

In the final invert, groundwater interception and potential drawdown of the water table was assessed to minimise any adverse effects upon soil moisture retention and wetting up of the profile to maintain runoff potential for local surface water flows for nearby wetlands. Groundwater gains to, and losses from, the SEFRP channel were estimated using a methodology commissioned for the project (Morgan *et al*. 2011).This methodology was applied to the hydrological modelling used to estimate water yield to the Coorong and the components of loss and gain for water *en route* (KBR 2015). This modelling determined that groundwater gains to, and losses from, the SEFRP channel are negligible (Figure 11), while acknowledging that they cannot be predicted with a high degree of confidence (KBR 2015).

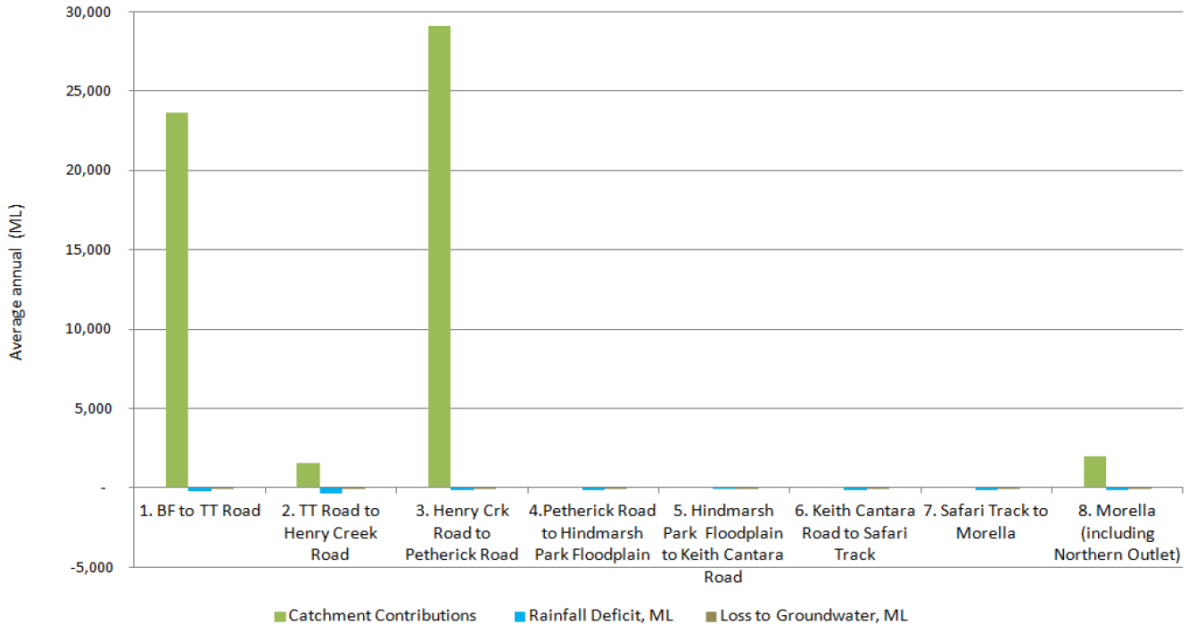

Figure 11: Modelled components of loss and gain from the SEFRP channel (8 sections) between the Blackford Drain (BF) and Morella Basin. Note loss groundwater is negligible in all 8 sections. Catchment contributions refers to inflows from tributary drains (source: KBR 2015).

Cross-sections

The channel cross-sections vary depending on the requirements for levees on one or both sides and the specific requirements of each reach. A number of typical cross-sections have been applied along the alignment. The two most common are shown in Figure 12 and Figure 13. Figure 12 illustrates contained flow (above ground) with a catch drain to deal with local drainage and Figure 13 for below ground flow. In the detailed design phase, levee batter slopes may be varied according to local conditions or landholder requirements.

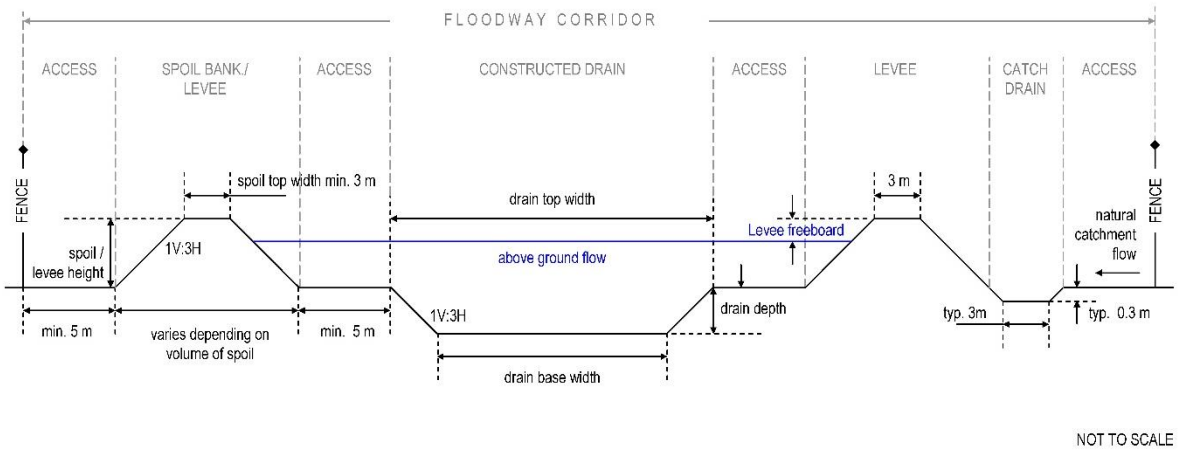

Figure 12: Channel cross-section for contained, above ground flow

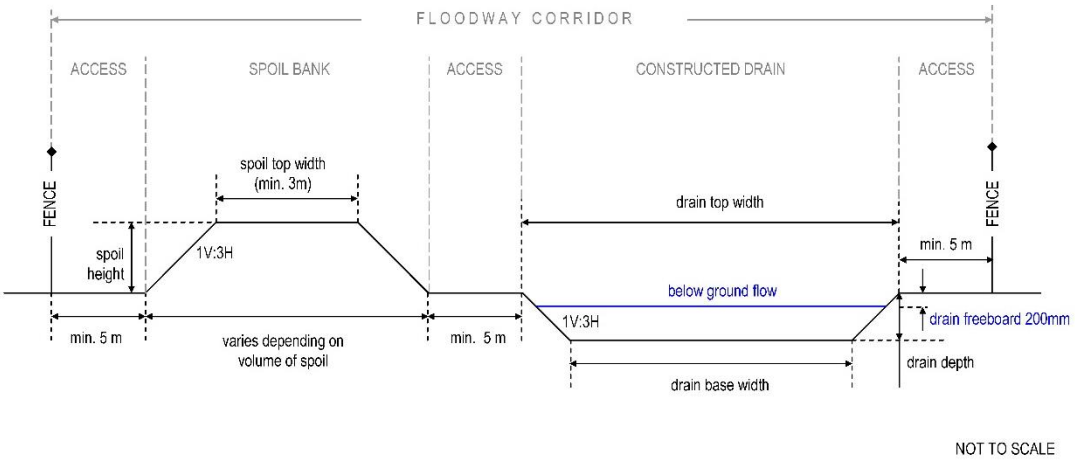

Figure 13: Channel cross-section for below ground flow

Associated infrastructure

Crossings

There are numerous existing and new crossings affected by the SEFRP that have been categorised as follows:

- Fauna crossings (Figure 14) – 30 m wide crossings designed to facilitate the movement of fauna species between native vegetation patches on either side of the drain. These fauna crossings will be maintained and upgraded as required.

- Water cross over structures – includes two locations that have been identified along the existing Taratap alignment where there are currently siphon structures to convey water from the eastern side of the channel to the west. These structures will be replaced by ‘at grade’ water crossings.
- Occupational crossings – on-farm crossings generally used by landholders to cross the channel.

  Occupational crossings have been placed at existing crossing locations and where there are obvious tracks intersecting the proposed alignment. In the absence of these features, allowance has been made for one crossing per title, as identified on the cadastral database, with a maximum spacing of 2 km between crossings. The assumed locations of the occupational crossings are indicative only, and will be confirmed following landholder consultation during the detailed design phase
- Road crossings (sealed and unsealed) – where the proposed channel intersects an existing public road reserve as identified in the cadastral database.

  Where practicable, effort will be made to maintain design water surface levels in the vicinity of road crossings at a suitable freeboard below road level. Where this cannot be achieved and peak water levels are expected to be above ground, the road will be reconstructed at a higher level to provide necessary freeboard.
- Regulator and weirs – typically pipes with drop boards, which are designed to control flows along the alignment.

Figure 14: Tilley Swamp drain fauna crossing (R. Seaman)

A summary of the crossings along the proposed SEFRP channel is contained in Table 7.

Table 7: Summary of crossings along the channel

Type	Existing crossings	New crossings	Total
Sealed Road	2	-	2
Unsealed Road	4	-	4
Occupational	24	9	33
Fauna	4	-	4
Regulator/weir	8	6	14
Other	4	2	6

Regulators

The SEFRP will include the installation of two types of regulators:

- A 'major' regulator on Blackford Drain which will divert water which currently flows out to sea at Kingston to the Coorong South Lagoon via the proposed SEFRP channel.
- 'minor' or 'other' regulators on the channel to enable control of diversions and to allow diversion of water elsewhere in the system (e.g. into *en route* wetlands).

Major regulator

A major regulator structure will be required at the location of the existing 'Blackford weir' in the Blackford Drain, to hold up water and enable diversion northwards along the proposed SEFRP channel. The existing 'Blackford weir' creates a permanent weir pool upstream. The proposed regulator has been designed to maintain the character of the weir pool during periods of low or no flow.

The final details of the major regulator will be determined during the detailed design phase.

Minor regulators

Minor regulators will be installed as part of the SEFRP including:

- Lateral diversion regulator at the Blackford regulator to prevent or permit diversions when required. It is assumed that no water level control is required as this function will be performed by the main regulator in the Blackford Drain.
- Minor regulator structures such as those installed on the existing Tilley Swamp and Taratap drains to enable water to be diverted into *en route* wetlands. These structures are fitted to the culvert upstream headwall at a crossing point.

- Morella outfall regulator (Figure 15) and fish passage - the existing regulator structure at the Morella outlet will be upgraded from 800 ML/d to 1,000 ML/d capacity. As part of the upgrade, a fishway will also be constructed to facilitate upstream fish movement around this structure under variable flow conditions. Unrestricted fish passage between the Coorong and the South East drainage system allows Morella Basin and other upstream sites to act as a drought refuge when conditions in the Coorong are unfavourable.
- Salt Creek to Coorong South Lagoon outfall regulator and fish passage - at this location a low (approx. 0.5 m) permanent weir currently exists to maintain target water levels in Salt Creek immediately upstream of the Coorong. As part of the SEFRP this weir will be restructured with removable boards so that high flow rates (up to 1,000 ML/d) can be passed without causing an undesirable backwater effect that could inundate the Princes Highway and Salt Creek township. As part of the restructure, a fishway will be incorporated to facilitate upstream fish movement around this structure when it is in the closed position, during low and medium flows. Target species include congolli, Small-mouthed hardyhead and flathead gudgeon.

Figure 15: Morella Basin regulator (outlet to Salt Creek) (R. Seaman)

Fencing

Much of the existing Tilley Swamp Drain and Taratap Drain is fenced to exclude stock and restrict public access. Generally, sections of drain which traverse agricultural land are fenced and those through native vegetation are not, unless there is a property boundary. The SEFRP

channel will be fenced in a consistent manner with existing fencing (i.e. fenced on agricultural land or where there is a land boundary).

The SEFRP channel will cross a large number of existing fences including internal paddock fences and boundary fences. Where new longitudinal fencing is constructed, internal fences will terminate at the junction with the new fence; only boundary fences will span the channel. In sections where there is no longitudinal fencing, internal fencing will span the channel.

In addition, there are many locations where internal paddock fences join existing longitudinal fences on one side of the channel. These will be cut and repaired during the works.

It is estimated that 120 km of longitudinal fencing, 52 boundary/internal cross fences and an additional 49 repairs to existing fences will be required.

Local drainage

A range of local drainage issues will be addressed in the detailed design of the SEFRP channel. In particular, where flow in the channel is above the natural surface level and continuous levees are required on both sides of the drain, catch drains will be required to manage drainage flows from the local catchment.

During the concept design phase no detailed assessment of catch drain location or size was undertaken. However, during the detailed design phase an assessment will be made to determine how these catch drains operate and locations where they may be required (both the eastern and western sides of the channel). At this stage it is assumed that catch drains will be constructed where levees are used for flow containment. Catch drains will be placed only on the eastern side of the channel, as local drainage flows are generally from east to west across the flats.

Farm drainage inlets are required to allow local catchment flows to enter the channel or drain. Farm drain inlets are assumed to be required:

- where channel flows are above ground, contained by levees, a pipe will penetrate the levees to allow drainage of local surface water once hydraulic conditions within the drain permit.
- where the channel intersects an existing local drain. It has been assumed that all local drains terminate prior to their junction with the channel and are connected to the channel via a pipe. This reduces the possibility of bank erosion at the junction and allows vehicles to cross the local drains.

All farm drainage inlets will be fitted with flap gates to prevent back-flow out of the channel.

The location of farm drainage inlets has been determined by inspection of the detailed survey, aerial photographs and GIS drainage layers. Where no local drains exist it has been assumed that penetrations will be placed through levees at 500 m intervals.

It is estimated that 36 km of catch drains and 71 farm drainage inlets will be required.

Water cross-over structures

There are a number of locations along the existing Taratap Drain where structures are in place to allow local surface water from the east to cross over the drain and flow into the Taratap watercourse to the west. At some of these locations water is taken across the drain at crossing points in pipes co-located in the crossing formation. In three locations siphons have been placed under the drain.

Seven existing water cross-over structures at occupational crossings, and three additional water cross-over structures (not at crossings) will be retained.

Where cross-over locations coincide with occupational crossings it has been assumed that the current arrangement of pipes located within the crossing formation will be retained. Where the locations of the cross-over do not coincide with crossings (at the existing siphon locations) it has been assumed that a surface drainage structure (2 m wide) will be constructed. These will not be vehicular crossings.

2.1.5 Environmental Management

The purposes of the Environmental Management Program of the SEFRP are to:

- Ensure that identified ecological risks associated with the construction and future operation phases of the project are avoided, minimised or mitigated;
- Enable the future assessment of the project against its ecological objectives; and
- Enable the future real-time operation of new water management infrastructure under an adaptive management approach.

Native Vegetation Clearance Assessment

Most of the project footprint is on cleared agricultural land. However, the widening of existing drains in the Taratap and Tilley Swamp areas will involve some unavoidable clearance of native vegetation. During the concept design phase, all reasonable efforts were made to minimise clearance of native vegetation. Where potential high construction costs and long-term maintenance issues (such as where the potential erosion of excavated or constructed

slopes is high) were apparent, the design was developed to be physically practical, which makes some native vegetation clearance unavoidable. Every attempt will be made to reduce the area of native vegetation clearance during further landholder consultation, detailed design and refinement of construction methods.

Table 8 provides a clearance estimate based on the maximum potential corridor width currently being considered by the project through detailed design. The final clearance requirements could be considerably less (>50% if upgrades downstream of Cantara Rd are at the lower of the required range i.e. 600 ML/day). This figure will be finalised upon the completion of negotiations with private landowners regarding the use of the natural watercourse in preference over in channel flow.

Table 8: Preliminary clearance estimates for different vegetation types within the proposed SEFRP construction footprint.

Vegetation type[1]	**Worst Case Clearance (ha)**
Melaleuca halmaturorum regrowth on existing spoil mounds	19.50
Allocasuarina verticillata ± *Melaleuca lanceolata* open woodland	0.43
Eucalyptus camaldulensis ssp. *camaldulensis* woodland	1.53
Eucalyptus diversifolia mallee (open understorey)	3.78
Eucalyptus diversifolia mallee (shrubby understorey)	12.56
Eucalyptus fasciculosa/Eucalyptus leucoxylon open woodland	1.96
Eucalyptus fasciculosa/Eucalyptus leucoxylon open woodland over pasture	0.58
Gahnia filum sedgeland ± *Atriplex paludosa*	2.98
Gahnia filum sedgeland ± *Melaleuca halmaturorum*	50.94
Gahnia trifida sedgeland ± *Melaleuca brevifolia*	16.23
Melaleuca brevifolia closed shrubland	15.99
Melaleuca halmaturorum shrubland to tall shrubland	120.83
Samolus repens/Wilsonia backhousei herbland ± *Melaleuca halmaturorum*	8.04
Tecticornia sp. low open shrubland	31.55
TOTAL	**286.90**

[1]As defined by Jacobs, 2015.

A Native Vegetation Management Plan is being developed for the construction and post-construction phases in accordance with the *Native Vegetation Regulations 2003* (SA) –

Regulation 5(1)(zl) to ensure native vegetation is conserved and enhanced post-construction of the channel.

Subject to the requirements of the Native Vegetation Management Plan, techniques for promoting the regeneration of native vegetation in recently cleared areas, where appropriate, will be employed. Techniques involving the re-spreading of topsoil, containing the native seedbank, and mulched native vegetation over exposed ground have proved successful for previous channel construction works in the South East. The regeneration of native flora will be actively promoted in all areas except the channel, access tracks and fence lines.

Transport of construction machinery will only be permitted through areas of native vegetation that are directly affected by construction.

Threatened Flora and Fauna Field Assessment

In combination with the Native Vegetation Clearance Assessment, an on-ground survey of the construction corridor has been undertaken by Jacobs to assess the potential presence of any threatened flora and fauna. These include species listed as rare, threatened and/or migratory under both state (*National Parks and Wildlife Act 1972*) and Commonwealth (*Environment Protection and Biodiversity Protection Act 1999*) legislation.

Knowledge of the precise locations of these species or their habitat within the construction corridor has informed the assessment of whether the project is likely to result in a significant impact on any matters of NES, as well as any strategies to avoid or minimise any potential impacts.

The likelihood of occurrence of identified rare, threatened and migratory species within the different sub-areas of the project is discussed in detail in Section 3.1.5.

Baseline Ecosystem Monitoring

One of the objectives of the SEFRP is to improve the condition of *en route* wetlands. Baseline ecosystem monitoring of *en route* wetlands will provide quantitative information to enable the future assessment of the project against this objective. Such information will also inform the future adaptive management of the drainage system in the Taratap and Tilley Swamp areas.

Previous work dating back to the late 1990s describes the vegetation and biota of the Taratap and Tilley Swamp area (e.g. Stewart *et al.* 1998, Telfer *et al.* 2000, Milne and Squire 2001, Hammer 2002, DEH 2003b, Bachmann *et al.* 2005) providing useful, quantitative baseline ecological information. Additionally, work commissioned during the feasibility phase of the SEFRP (Dickson *et al.* 2013) established quantitative monitoring sites for vegetation, frogs,

fish and waterbirds in the Taratap wetlands and re-assessed existing vegetation monitoring sites in Tilley Swamp Conservation Park.

Using the methodology of Dickson *et al*. (2013), additional sites will be established within *en route* wetlands to broaden the geographic coverage of baseline monitoring. Additionally, some existing sites will be resurveyed for particular biota (e.g. waterbirds) that are highly variable in abundance from year to year to increase confidence in baseline estimates of abundance.

Jacobs (2015) assessed the type and condition of vegetation at a number of sites within the project area using the BushRAT quantitative assessment methodology (DEWNR 2013). Several of these sites are ideally located to assess future changes to *en route* wetland and watercourse vegetation following implementation of the SEFRP, providing an additional, complementary assessment to that of Dickson *et al*. (2013).

Information obtained from existing ecosystem monitoring programs in the Coorong South Lagoon (including through the CLLMM Recovery Project and The Living Murray Program) will be used as baseline data to measure ecological outcomes for the Coorong South Lagoon as a result of the SEFRP. These existing programs cover a range of biota including *Ruppia tuberosa*, waterbirds, fish and invertebrates.

Water Quality Risk Management

The water quality risks to the Coorong presented by the SEFRP have been assessed in detail and determined to be low and/or readily avoided (Wilson et al. 2016) (see Section 3.1.3.2). To manage water quality risks the Environmental Management Program includes:

- Monitoring of water quality in drains during construction to ensure compliance with water quality regulations (compliance monitoring);
- Monitoring of water quality in the Coorong during Morella release events to better understand the influence of South East inflows upon water quality in the Coorong (Coorong water quality monitoring); and
- Monitoring of water quality in drains within and upstream of the SEFRP project area to better understand how water quality changes throughout the catchment both geographically, through time and in response to management (catchment water quality monitoring).

Compliance monitoring will focus on the construction period and the location of construction activities, which will change as construction progresses. Water quality in the drain will be monitored regularly both upstream and downstream of the construction zone. Parameters to be monitored will be dictated by the water quality regulations that apply but are likely to include turbidity, dissolved oxygen, pH, salinity and nutrients.

The monitoring of water quality in Coorong prior to, during and following releases of water from Morella Basin has been undertaken in 2013 - 2015 and will continue during the life of the project. Key parameters of interest include the various species of nitrogen and phosphorous, dissolved oxygen, organic carbon, chlorophyll and salinity. Analysis of data collected to date has been undertaken (Mosely 2015) and has informed the water quality risk assessment undertaken for the SEFRP (Wilson *et al*. 2016). Further data collection and analysis will inform the operation of SEFRP/South East drainage system infrastructure with a view to maximise ecological benefits for the Coorong and avoid water quality risks.

Catchment water quality monitoring will occur at various times and locations throughout the project area and beyond. The intention is to characterise the catchment in relation to key water quality parameters including nitrogen, phosphorous, organic carbon, pH and salinity. The information obtained will help guide the operational rules of SEFRP/South East drainage system infrastructure with a view to avoiding water quality risks to *en route* wetlands and the Coorong.

Hydrological Monitoring

Hydrological monitoring stations currently exist throughout the South East drainage system to monitor flow rates, water levels and water quality (basic water quality parameters include salinity, dissolved oxygen and pH) and thereby inform operations. Much of the existing hydrological monitoring infrastructure is telemetered, with live web-based data available to enable a rapid operational response to issues and opportunities as they arise. In addition to the basic water quality parameters, some monitoring stations feature composite samplers which enable the collection of water samples at specific times and/or frequencies for more detailed water quality analysis.

The construction of the SEFRP will disturb four existing hydrological monitoring stations in the Salt Creek to Blackford Drain area. The SEFRP will reinstate all four stations to accommodate the expanded channel widths. An additional four new hydrological monitoring stations are planned to manage the expanded system, including the addition of two composite samplers.

2.1.6 Management and operations

The State of South Australia is responsible for managing the existing South East Drainage System, which includes existing drains (such as Tilley Swamp, Taratap and Blackford), wetlands and environmental assets through the South Eastern Water Conservation and Drainage (SEWCD) Board. While DEWNR is delivering the project in agreement with the SEWCD Board under a Memorandum of Administrative Arrangement (MoAA), the SEWCD

Board will ultimately be the relevant managing authority once construction of the under SEFRP is completed.

The SEWCD Board is responsible for managing the drainage system to meet multiple objectives including protecting infrastructure from flooding, providing water for the environment, and protecting and enhancing agricultural lands, in accordance with the current South East Drainage Network Management Strategy (which incorporates the previous Upper South East Drainage Network Management Strategy (DFW 2011). It is also responsible for general drainage maintenance (e.g. repair and cleaning of the entire 2589 km of drainage system across the South East), and the operation of regulating structures to manage water flows.

In the future, the South East Natural Resource Management (SE NRM) Board will be responsible for setting the strategic direction for the management of water in the drainage system, wetlands and watercourses through the preparation of a new South East Drainage and Wetland Management Strategy. This strategy is currently in the early stages of preparation.

The new Strategy will provide guidance and direction to:

- The SEWCD Board on the management of water in the drainage system, including flow management objectives and performance standards within an adaptive management framework; and
- Other persons or bodies (which may include the Board) to whom responsibility for the management of wetlands and watercourses is assigned.

The South East Drainage and Wetland Strategy will complement the SE NRM Board's regional Natural Resource Management (NRM) Plan and be consistent with the State NRM Plan. The new strategy's role is seen to be complementary to the Board's role under the NRM Act for water resource planning and management. The management principles for operation developed through the SEFRP will be immediately aligned to the existing South East Drainage Network Management Strategy, to be incorporated in the new South East Drainage and Wetland Strategy as it is developed.

2.1.6.1 Current operating procedures

The current drains that will form part of the SEFRP channel have two main operational decision points *en route* to the Salt Creek outfall. These points include the Morella Basin, which acts as

a detention basin, holding back water prior to its release into the Coorong via Salt Creek; and a number of diversion points that allow water to be diverted through the wetlands *en route*.

Operation of the Morella Basin

Morella Basin (Figure 16) is currently operated as a detention basin which has significant environmental value in its own right. However, during late winter and spring the rate of outflow generally equates to the rate of inflow. Surcharging the water height of Morella is currently not practical because of flooding impacts on upstream properties. As springtime flows recede, water levels can be maintained or increased to allow either the maintenance of Morella Basin habitat values or facilitate a summer release of water into the Coorong South Lagoon, at a time when evaporation losses are highest.

Figure 16: Morella Basin (R. Seaman)

Diversion to *en route* wetlands

Opportunities to divert water out of the existing Taratap and Tilley Swamp Drains and into *en route* wetlands arise when salinity levels within the drains fall below the management target threshold of 7,500 µS.cm−1. Since 2006, diversions to *en route* wetlands along the Taratap Drain have occurred every year, except for 2011. In the Tilley Swamp Conservation Park, diversions have occurred in all years since 2008. Areas between Tilley Swamp Conservation Park and Martin Washpool Conservation Park have remained dry during this period. The total

volume of diversions is not measured, however, the recipient wetlands, which have a total combined full-supply volume of approximately 11.5 GL, have not completely filled during this period and local runoff contributes significantly to the wetlands.

2.1.6.2 Future operating procedures

The operation of the SEFRP infrastructure will be integrated with the SEWCD Board's current Drainage Network Management Strategy and the supporting adaptive flows management systems (noting this will be incorporated into the NRM Board's South East Drainage and Wetland Strategy as it is developed). The current Strategy has four themes:

- Theme 1 - Supporting sustainable agricultural business and the regional economy
- Theme 2 - Protecting and enhancing the region's biodiversity assets
- Theme 3 - Sustainable surface and groundwater management
- Theme 4 - Effective and efficient governance.

'Management Principles' will be developed under the Drainage Network Management Strategy to govern operations of the SEFRP channel. The Management Principles will list the 'Critical Control Points' and 'Priorities' that guide operational decision making. These priorities will flow into a Decision Support System which supports real-time operations within the Network.

SEFRP will not, of itself, result in changes to the Management Principles and Priorities of the existing Drainage Network infrastructure upstream of the Blackford drain diversion point.

Separately, the CLLMM Recovery Project will be developing a CLLMM Site Operations Manual. The Site Operations Manual will contain a module on SEFRP Operations, which will be cross-referenced with the Drainage Network Management Strategy Management Principles to coordinate outcomes for the Coorong South Lagoon.

Management Principles for the SEFRP

The project will work with key community, SEWCD Board and regional NRM Board stakeholders in developing Management Principles, under the current Drainage Network Management Strategy, that will govern water management in the SEFRP channel. In the future, these principles, and subsequent water management along the SEFRP channel, will support and be informed by the Drainage and Wetland Management Strategy for the South East region, which is being developed by the SE NRM Board.

An adaptive management approach will be taken in supporting SEFRP channel operational decision making. Management Principles within the Drainage Network Management Strategy

and the CLLMM Site Operations Manual will be integrated to achieve the project objective of supporting a healthy Coorong South Lagoon.

The following principles will be considered in the development of the SEFRP channel Management Principles that guide operations:

1. the capacity for the SEFRP channel to accept flow without over-topping and flooding adjacent agricultural land;
2. the salinity level within the Coorong South Lagoon (current and predicted accounting for predicted barrage flows), i.e. the Coorong's requirement for water from the South East drainage system;
3. flow rates in the Blackford Drain;
4. active storage and available storage capacity within *en route* wetlands;
5. salinity of water in the SEFRP channel and the salinity thresholds of *en route* wetlands; and,
6. other water quality issues of relevance to *en route* wetlands and the Coorong.

The amount of water diverted from the SEFRP channel into *en route* wetlands will vary from year to year according to the timing, quality and volume of flows to the Blackford Drain, and the water needs of the Coorong South Lagoon. Conservatively, diversions to *en route* wetlands are anticipated to increase, markedly in some years, for example when the Coorong's requirement is low, and rainfall in the South East is high. Diversion volumes will be guided by the Management Principles for the SEFRP developed under the Drainage Network Management Strategy.

2.2 Alternatives to taking the proposed action

The proposed action is considered important to assist in maintaining salinity levels between the target management ranges of 60 g/L to 100g/L in the Coorong South Lagoon, particularly during periods of low barrage flows. Maintaining salinity levels below 100g/L will ensure that the lethal effects of high salinity on the ecosystem are mitigated during periods of low barrage outflows, thus building system resilience.

2.2.1 Do nothing scenario

Under a 'do nothing' scenario, the Coorong South Lagoon would remain exposed to a higher risk of significant ecological decline during periods of low River Murray flows over the barrages, due to elevated salinity. Keystone species *Ruppia tuberosa* stocks and all of the

species that depend upon it as a source of habitat and food will decline rapidly if salinity levels exceed its tolerance level. This is a likely scenario whenever there are prolonged low flows over the barrages, e.g. during times of drought.

2.2.2 South Lagoon Salinity Reduction Strategy (Pumping Scheme)

The CLLMM Recovery Project included two inter-related 'Restoring the Coorong' management actions that aim to reset and support salinity levels more appropriate for reinstating the ecological health of the Coorong - the South Lagoon Salinity Reduction Scheme (SLSRS) and the SEFRP.

The SLSRS was referred under the EPBC Act in 2010 (EPBC 2009/5526) – see Section 1.13. The project proposed the construction of a pumping station and pipeline across the Younghusband Peninsula to pump hypersaline water into the Southern Ocean. The primary outcome of the project was to reduce hypersalinity and improve water quality in the Coorong South Lagoon, thereby enhancing the ecological recovery of the Coorong South Lagoon and supporting the tolerance levels of key species (*Ruppia tuberosa*, chironomids and Small-mouthed hardyhead). The SLSRS would act as a short term 'reset' for salinity. However, it provided limited long-term benefit.

The South Australian government formally withdrew the SLSRS on 26 April 2013 as it was considered more feasible and environmentally beneficial in the long-term to proceed with the SEFRP than the SLSRS. This was based on data and modelling which indicated that following the provision of environmental water in 2012-13, the risk of salinities exceeding 100 g/L in 2012-13 were very low, regardless of future local climatic conditions. This reduces the likelihood that salinities in 2014-15 will exceed the 120 g/L that would necessitate consideration of implementing the SLSRS within the life of the CLLMM Recovery Project.

2.3 Alternative locations, timeframes or activities that form part of the referred action

No alternative time frames, locations or activities form part of this referred action.

2.4 Context, planning framework and state/local government requirements

As described in Section 1.13, the SEFRP is one of 19 management actions under the CLLMM Recovery Project which aims to contribute to managing the CLLMM site for ecological health and supports the implementation and objectives of the long-term plan. The purpose of the

long-term plan is to provide a clear direction of the future management of the CLLMM region as a healthy, productive and resilient Wetland of International Importance.

The SEFRP will contribute to the achievement of the following targets under the South Australian Strategic Plan 2011:

- T69 – Lose no species: lose no native species as a result of human impacts
- T71 – Marine Biodiversity: maintain the health and diversity of South Australia's unique marine environments
- T77 – River Murray – Salinity: South Australia maintains a positive balance on the Murray Darling Basin Authority Salinity Register.

A brief description of key Commonwealth and State legislation is provided in Sections 2.4.1 and 2.4.2. Section 2.4.3 outlines other relevant agreements and policies.

2.4.1 Legislative framework

The legislative framework for delivery of the proposed action and ongoing operation of the SEFRP channel is as follows:

South Eastern Water Conservation and Drainage Act 1992 (SA)

The *South Eastern Water Conservation and Drainage Act 1992* (SA) (SEWCD Act) provides for the conservation and management of water and the prevention of flooding of rural land in the South East of South Australia. It also established the SEWCD Board.

Through a MoAA with DEWNR, certain powers of the SEWCD Board will be utilised in order to deliver the SEFRP, particularly in relation to acquiring an interest in land and undertaking works.

The SEFRP will be recognised in the Board's Management Plan as the SEWCD Board must not, except with the approval of the Minister, undertake any works that are not contemplated by the Board's approved Management Plan.

Securing interests in land for the SEFRP channel corridor are to be undertaken in accordance with the SEWCDB Act which includes the capacity to enable provisions of the Land Acquisition Act 1969 (SA).

Provision to secure interests beyond the corridor, where required, will be undertaken by negotiation and documented in individual management agreements between landholders and the SEWCD Board.

DEWNR is working collaboratively with the SEWCD Board. The SEWCD Board are also represented at all levels of the SEFRP governance arrangements.

All assets constructed under the SEFRP will be operated and maintained by the SEWCD Board under the administrative objectives associated with the SEWCD Act (and inter-related Acts).

Upper South East Dryland Salinity and Flood Management Act 2002 (SA)

The *Upper South East Dryland Salinity and Flood Management Act 2002* (SA) (USE Act) expired on 18 December 2012. This Act provided for the protection and improvement of the environment and agricultural production in the Upper South East through the conservation and management of water across the landscape.

Upon its expiration, all operational and management requirements for the drainage system delivered under the USE Act were vested in the SEWCD Board, to be managed under the SEWCD Act.

Specific provisions of the USE Act continue to apply - the Upper South East Drainage Network Management Strategy is required to continue and is binding on the SEWCD Board. This strategy is linked to certain objectives of the *Natural Resources Management Act 2004* (SA), including an updated South East Drainage Network Management Strategy currently in early development, the *Environment Protection Act 1993* (SA) and the *River Murray Act 2003* (SA).

The proposed action will include widening an existing drainage corridor constructed under the USE Act.

2.4.2 Commonwealth legislative compliance requirements

Water Act 2007 (Cth) and Murray-Darling Basin Agreement

The *Water Act 2007* provides for the management of the MDB and other matters of national interest with respect to water and water information.

The *Water Act 2007* establishes a range of mechanisms to support the sustainable management of water resources in Australia, in particular the MDB. Principally, the Murray-Darling Basin Authority (MDBA) is required to develop a strategic plan (the Basin Plan) for management of water resources in the MDB. Under Division 1 of the Act, the Basin Plan is required so as to give effect to Australia's obligations under the Ramsar Convention, and other international environmental agreements such as the United Nations Convention on Biological Diversity or migratory bird agreements.

The adoption and implementation of the Basin Plan gives effect to the *Water Act 2007* through delivery of environmental water to the CLLMM site by establishing environmental water entitlements, and by reducing the level of water available for human use in the MDB.

Under section 18E of the *Water Act 2007*, the MDBA has the functions, powers and duties which are expressed to be conferred on it by the MDB Agreement. Clause 49 of the Agreement provides that MDBA must be informed of certain proposals which may significantly affect the flow, use, control or quality of any water in the River Murray in South Australia.

While the proposed action does not, in itself, physically reside within the borders of the MDB, the intent is to support the provision of fresh water flows into that environment via the Coorong at Salt Creek. The MDBA has been involved in negotiations surrounding the proposed action and the South Australian government will comply with any obligations under the Act.

Native Title Act 1993 **(Cth)**

Native title is the communal, group or individual rights and interests of Aboriginal peoples or Torres Strait Islanders in relation to land or waters, where:

- the rights and interests are possessed under the traditional laws acknowledged, and the traditional customs observed, by the Aboriginal peoples or Torres Strait Islanders
- the Aboriginal peoples or Torres Strait Islanders, by those laws and customs, have a connection with the land or waters
- the rights and interests are recognised by the common law of Australia.

The *Native Title Act 1993* (Cth) provides a process through which native title can be lodged and assessed. The Act also requires that native title claim groups are notified of future acts that may affect the land or waters over which native title is claimed. Pursuant to section 24KA, relevant native title claim groups will be notified prior to on-ground works commencing.

The South Australian government has determined that Native Title has been extinguished over all areas affected by the SEFRP, and subsequently, there is no requirement for notification, comment or consent under the Native Title Act.

2.4.3 State legislative compliance requirements

Aboriginal Heritage Act 1988 **(SA)**

The *Aboriginal Heritage Act 1988* (SA) provides for the protection and preservation of Aboriginal heritage. Section 23 of the Act provides that a person must not, without the authority of the Minister, damage, disturb, interfere with or remove any Aboriginal sites, objects or remains.

The SEFRP area encompasses several groups of Traditional Owners, including the Ngarrindjeri of the Lower Lakes and Coorong region, and the Meintangk, Potaruwutij, Tatiara/Ngarkat and Tanganekald peoples of the South East region. The proposed action will

be undertaken in accordance with the AH Act and will include engagement with Traditional Owners to support the processes under the Act.

DEWNR has applied to the Minister for Aboriginal Affairs and Reconciliation seeking an authorisation under section 23 of the Act. This application is being progressed in conjunction with discussions with Traditional Owners. A pre-construction heritage survey report will be developed by Traditional Owners and will form the basis for the AH Act consultation.

Environment Protection Act 1993 (SA)

The *Environment Protection Act 1993* (SA) provides for the protection of the environment. The objects of the Act include coordinating action to minimise or avoid environmental harm, and ensuring effective environmental protection, restoration or enhancement. The Act creates a general environmental duty (section 25) for persons not to undertake an activity that pollutes or might pollute the environment, unless taking all reasonable and practical measures to prevent or minimise any resultant harm. Several significant offences exist for causing environmental harm. The Act also provides environment protection policies relating to water quality, noise and air quality that will need to be complied with in the conduct of the project.

The Act also provides a set of environment protection policies which relate to water quality, noise and air quality. Of particular relevance to the SEFRP is the *Environment Protection (Water Quality) Policy 2003* which sets out water quality criteria for the protection of waters within South Australia.

DEWNR has a history of working with the South Australian Environment Protection Authority (SA EPA) to ensure that projects are compliant with the Act and regulations. DEWNR will continue to work with the SA EPA on the SEFRP to ensure compliance during implementation of the proposed action.

National Parks and Wildlife Act 1972 (SA)

The *National Parks and Wildlife Act 1972* (SA) (NPW Act) provides a framework for reserves to be established and managed, and provides for the conservation of wildlife in a natural environment. The Act is administered by DEWNR.

Under the Act and associated regulations, the written permission of the Director, National Parks and Wildlife is required to enter and use a National Park for specified purposes, to dig or disturb soil, to use vehicles or boats, or to use generators.

Implementation of the SEFRP will involve on-ground works in the Coorong National Park, the Martin Washpool Conservation Park, and the Tilley Swamp Conservation Park. On-ground works, specifically vehicle use and digging, being undertaken in the Coorong National Park, Martin Washpool Conservation Park, and Tilley Swamp Conservation Park will require approval under the Act.

Native Vegetation Act 1991 (SA)

The *Native Vegetation Act 1991* (SA) serves to conserve, protect and enhance native vegetation in the State and, in particular, remnant native vegetation, in order to prevent further reduction of biological diversity and degradation of the land and its soil; and loss of quantity and quality of native vegetation in the State; and loss of critical habitat. The Act is administered by DEWNR.

Clearance of native vegetation will be required where the footprint of the existing drain is being widened. An exemption for clearance of native vegetation is available for the proposed action under Part 2 of the *Native Vegetation Regulations 2003* (SA). In accordance with this exemption, a native vegetation management plan will be prepared and approved by the Native Vegetation Council. Liaison with native vegetation officers will be maintained as management plans are being progressed to ensure that they are to the satisfaction of the Native Vegetation Council.

Natural Resources Management Act 2004 (SA)

The *Natural Resources Management Act 2004* (SA) provides for the promotion of sustainable and integrated management of the State's natural resources and for the protection of those resources. The Act seeks to protect biological diversity; provide for the sustainable use of water resources; prevent the impacts of pest plants and animals; and give consideration to Aboriginal Heritage. The Act is administered by DEWNR and the Natural Resource Management (NRM) Boards.

The Act also establishes NRM regions, each of which has an NRM Board. Of specific relevance to this project are the South East Natural Resources Management region and the South Australian MDB Natural Resources Management (SA MDB NRM) region.

The proposed action will be undertaken in accordance with the duties established by the Act. Engagement with the relevant NRM regions has commenced and will continue throughout the life of the proposed action.

River Murray Act 2003 (SA)

The *River Murray Act 2003* (SA) provides for the protection and enhancement of the River Murray and related areas and ecosystems. Objectives, collectively known as the Objectives for a Healthy River Murray, are defined under section 7 of the Act and include river health, environmental flow, water quality and human dimension objectives.

Under the *River Murray Act 2003*, the River Murray is recognised as an important feature of the economic, cultural, social and environmental landscape for South Australians. The definition of the River Murray under the Act is broad, and the potential scope for use of the Act

is wide. The *River Murray Act Implementation Strategy* outlines, in broad terms, how the Minister for the River Murray intends the Act to be utilised. The Act is administered by DEWNR.

Part of the proposed action is situated within the River Murray Floodplain Protection Area designated by the Act (through Regulation). Through integration with other legislation, the objectives of this Act will be considered in assessments under other State legislation.

2.4.4 Agreements and Policies

Living Murray Icon Site Management Plan (Inter-Governmental)

The Lower Lakes, Coorong and Murray Mouth (LLCMM) Icon Site is one of six Living Murray Icon Sites selected for their high ecological, cultural, recreational, heritage and economic values. The *Living Murray* program is one of Australia's most significant river restoration programs, aiming to achieve a healthy working Murray River system for the benefit of all Australians. It includes returning water to the river's environment. The Living Murray program is a partnership of the South Australian and Australian governments, coordinated by the MDBA.

The *Lower Lakes, Coorong and Murray Mouth Environmental Water Management Plan*, an updated water management plan for the LLCCMM icon site was published in July 2014 (MDBA 2014a). The purpose of the Environmental Water Management Plan (EWMP) is to define the environmental water needs for the LLCMM, based on the volumes and flow regimes required to achieve the ecological objectives and targets of the icon site.

The environmental water management plan identifies how to deliver and manage environmental flows at this site. The plan establishes three main ecological objectives and sets ecological targets for particular species and areas requiring action to achieve the objectives. The three broad ecological objectives to improve the condition of the LLCCMM icon site are an open Murray Mouth, enhanced migratory bird habitat, and more frequent estuarine fish recruitment. In order to achieve these objectives, 16 LLCMM-specific ecological and physical targets have been developed to quantify changes in the condition of the site.

The plan also includes flow targets, description of required management activities in the LLCMM icon site under each water availability scenario, and proposed operating regime to optimise ecological outcomes. The outcomes of the proposed action are consistent with the objectives of the plan.

Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder (CEWH), an independent statutory position established by the *Water Act 2007*, manages Commonwealth environmental water holdings

and is supported by the Commonwealth Environmental Water Office, a division of the Australian Government's Department of the Environment.

Commonwealth environmental water is acquired in order to protect and restore environmental assets within the MDB. The CEWH identified specific environmental objectives for the Coorong, and Lakes Alexandrina and Albert Wetland of International Importance in its *Framework for Determining Environmental Water Use* (May 2013), including the requirement to maintain an open Murray Mouth at times and for durations that ensure the Coorong's water quality, particularly salinity, is within the tolerance of the Coorong ecosystem's resilience.

In addition, the *Commonwealth environmental water use options 2013-14: Lower Murray-Darling Region* notes the potential for environmental water to be used to in the 'River Murray from Euston to Lower Lakes and Coorong' site to produce environmental outcomes, including: reducing salinity, maintaining wetland refuges, and maintaining hydrological connectivity between the River Murray channel, Lower Lakes and the Coorong. This will, in turn, support the condition of aquatic vegetation such as *Ruppia* in the Coorong, and the condition and distribution of native fish.

MDBA Basin Annual Environmental Watering Priority

The MDBA has recognised the importance of the CLLMM region in the 2014-15 *Basin Annual Environmental Watering Priority* (MDBA 2014b) which aims to enable the recovery of *Ruppia* in the Coorong by providing appropriate flows into the Coorong, and improve Lake Albert water quality through the maintenance of connection between Lake Alexandrina and Lake Albert. This priority also aims to provide suitable water levels and conditions in the Coorong to support waterbirds and native fish lifecycles.

The *2014-15 Basin Annual Environmental Priorities* identifies a number of watering priorities to support ecosystem functions and the continued maintenance of a mosaic of refuge habitats. This includes to '*improve riparian, littoral and aquatic vegetation (e.g. Ruppia tuberosa) and native fish populations by increasing ecosystem connectivity through coordinating water delivery in the River Murray system'*.

Other relevant agreements and policies

Additional international and Australian agreements and policies that may be relevant to the proposed action are as follows:

- As a signatory to the Ramsar Convention, the Commonwealth of Australia is required to nominate wetlands of international importance and ensure the wise use of all wetlands.

The EPBC Act establishes a framework for managing Ramsar wetlands in accordance with the Ramsar Convention, guided by Australian Ramsar management principles.

- The United Nations Convention on Biological Diversity came into force on 29 December 1993. The main objectives of the convention are:
  - The conservation of biological diversity
  - The sustainable use of the components of biological diversity
  - The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

  In line with Article 6 of the convention, the Australian Government has produced the *Australia's Biodiversity Conservation Strategy 2010-2030*. The strategy provides guidance for management and protection of Australia's plants, animals and ecosystems over the next 20 years. The Australian Government's EPBC Act has regard to these principles. This Act has direct relevance for the management of the CLLMM region and is discussed in more detail below.

  The Commonwealth of Australia is a signatory to three bilateral migratory bird agreements:

  - China-Australia Migratory Birds Agreement (CAMBA) 1986
  - Japan-Australia Migratory Birds Agreement (JAMBA) 1974
  - Republic of Korea-Australia Migratory Bird Agreement (RoKAMBA) 2007.

  These agreements provide a formal framework for cooperation between countries on efforts to conserve migratory birds of the East Asian – Australasian Flyway. Each of these agreements provide for the protection of migratory birds from take or trade, except under limited circumstances; the protection and conservation of habitats; the exchange of information; and building cooperative relationship.

  Collectively the SEFRP area, Coorong South Lagoon and wetlands of the South East, are known to support 27 migratory bird species listed under one or more of these agreements.

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

No single overarching environmental impact assessment is required for the SEFRP at a State level. However, as discussed in Section 2.4, the potential impact associated with particular

aspects of the proposed action is required to be assessed under a number of State laws which have an emphasis on protecting the State's natural resources, including:

- *Environment Protection Act 1993* (SA)
- *National Parks and Wildlife Act 1972* (SA)
- *Natural Resources Management Act 2004* (SA)
- *Native Vegetation Act 1991* (SA)
- *River Murray Act 2003* (SA).

2.6 Public consultation (including with Indigenous stakeholders)

Public consultation and community engagement is considered to be a fundamental aspect of the success of the SEFRP. Public consultation for the proposed action has drawn on the experiences and lessons of the Upper South East Dryland Salinity and Flood Management Program, the REFLOWS Project and the CLLMM Recovery Project.

The following key stakeholders have been identified for the SEFRP:

- Australian and South Australian government agencies – including Natural Resource Management regions
- SENRM Board and SA-MDB NRM Board
- SEWCD Board
- Traditional Owners – including the Ngarrindjeri of the Lower Lakes and Coorong region, and the Meintangk, Potaruwutij, Tatiara/Ngarkat and Tanganekald peoples of the South East region
- Affected landholders – landholders along the proposed SEFRP channel
- Regional community – including local government, Local Action Planning associations, and local industry
- Wetland management groups.

2.6.1 Stakeholder engagement

Stakeholder engagement commenced during the feasibility investigation stage of the proposed action. Preliminary activities included public information sessions to provide the community with details of the proposed action, and presentations to local councils impacted by the proposed action. Consultation was held with:

- the SE NRM Board, SEWCD Board,
- South East Local Government Association,
- Primary Producers South Australia (formerly South Australian Farmers Federation),
- Conservation Council South Australia,
- South East Consultative Committee,
- CLLMM Community Advisory Panel (CAP),
- South East Aboriginal Focus Group,
- Ngarrindjeri Regional Authority (NRA); and,
- south east community members and alignment landholders.

Current project delivery is supported by the SEFRP Communications and Community Engagement Strategy, based on the SA Government "Better Together" Principles of Engagement and in line with DEWNR's Community Engagement Framework.

The main objectives of this strategy are to:

- Ensure the citizens of the South East and broader community understand the scope and benefits of the South East Flows Restoration Project and are clear on the influence the community has over the project through the SENRM Board, the SEWCD Board and the Coorong CAP.
- Ensure that engagement with the directly affected landholders on any element of the project is consistent and their influence is known, understood and realised.
- Ensure the aspirations of the Traditional Owners are considered and accommodated where possible within project scope.

In accordance with the Better Together framework, the following strategies guide engagement across all project elements to achieve the overarching objectives.

- Inform: Communicate regularly and consistently to the broader community during project initiation and implementation.
- Consult: Engage with the directly affected landholders to assist them understand their influence over the project and negotiate mutually beneficial outcomes.
- Collaborate: Establish and maintain community governance arrangements for the duration of the project which facilitates opportunities for the SE regional community to provide input to the project.
- Collaborate: Work directly with the Traditional Owners via the South East Aboriginal Focus Group (SEAFP) and the Ngarrindjeri Regional Authority (NRA) to ensure cultural

heritage and Traditional Owners interests are considered and accommodate where possible within project scope.

Throughout delivery, the project will be:

- Supporting liaison between relevant community structures (SEWCD Board, SE NRM Board, NRA, SEAFG and CLLMM CAP) to highlight synergies and realise opportunities for increased communication and collaboration;
- Delivering of communication materials (factsheets, media releases, newsletters, website) and events (information sessions, field days) to provide a regular flow of information to the broader community regarding the scope, benefits and progress of the project.
- Undertaking direct landholder engagement in all project delivery elements (design and survey, environmental management, cultural heritage program, land acquisition and construction).
- Undertaking direct Traditional Owner engagement in project delivery elements (design and survey, environmental management, cultural heritage program and construction).
- Undertaking community engagement in project governance through establishment and support of the South East Flows Restoration Project Steering Committee and its supporting community representative advisory groups (Design and Environment Advisory Group and Community Engagement Advisory Group).

2.6.2 Traditional Owner engagement

Traditional Owner engagement has been a critical component of the feasibility investigations for the SEFRP. The state government has discussed the proposed action with the NRA and South East Aboriginal Focus Group (SEAFG), including the Murrapeena Heritage Committee, since 2008.

The SEFRP offers a range of direct and indirect opportunities for Traditional Owner participation and engagement. Direct opportunities include heritage survey, heritage monitoring and advice on culturally appropriate operations at *en route* wetlands and the Coorong. Indirect opportunities will be available subject to South Australian government's procurement processes.

Figure 17 demonstrates the engagement and consultation components of the SEFRP with Traditional Owners and Aboriginal peoples.

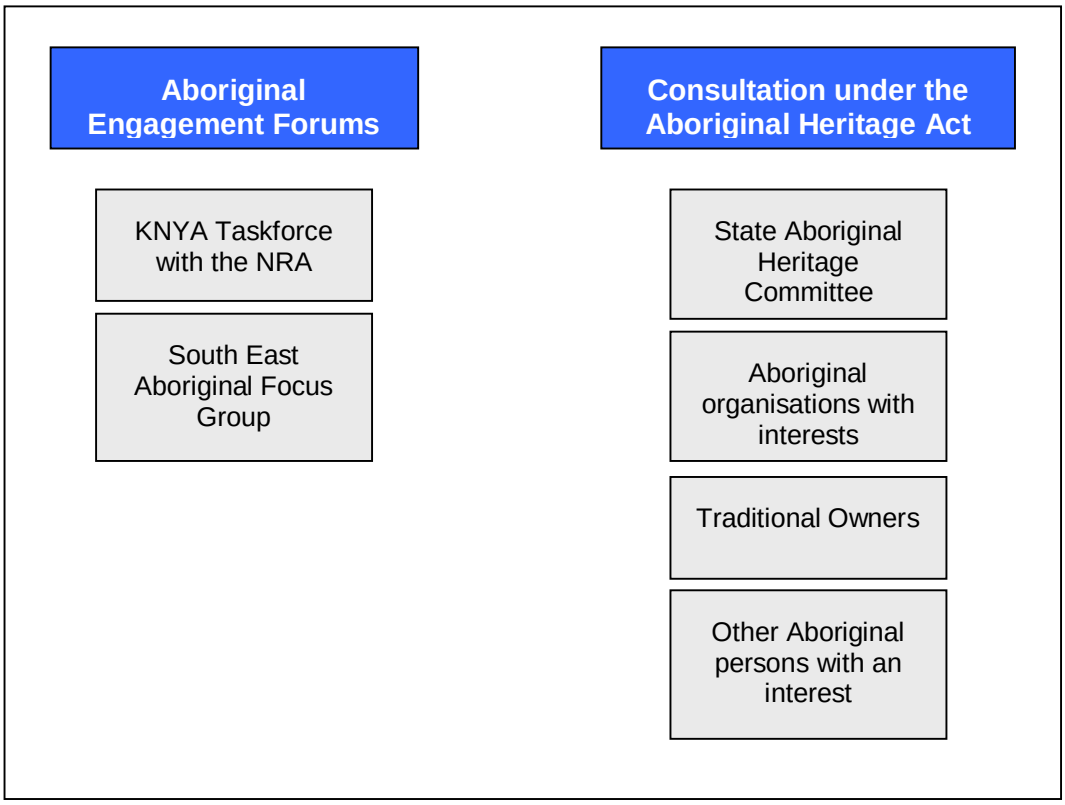

Figure 17: Diagram demonstrating engagement and consultation components of the SEFRP with Traditional Owners and Aboriginal peoples.

In 2008, the NRA, SEAFG, and Murrapeena Heritage Committee requested that the NRA's Research, Policy and Planning Unit (NRA RPPU), based at Flinders University, support them in clarifying their position on the SEFRP to government. The SA MDB NRM Board, on behalf of the former Department of Water, Land and Biodiversity Conservation (DWLBC), contracted the NRA RPPU to develop an Aboriginal nation position paper on the project. The NRA RPPU's report (Hemming and Rigney 2008), attached at Appendix 4, provided in principle support for the projects fundamental intention to redirect water back through historical flow-paths to the Coorong (Kurangk).

More recently, both the NRA and the SEAFG have prepared position papers on the SEFRP which reiterate their support of the project.

Currently DEWNR is engaging both NRA and SEAFG in pre-construction cultural heritage survey of the proposed SEFRP alignment. Heritage report outcomes are being incorporated where appropriate into the Detailed Design process as well as the Contractor's Cultural Heritage and Environmental Management Plan requirements. Both these activities seek to ensure that appropriate cultural heritage risk management processes are in place. Cultural heritage inductions are also planned for the success contractors.

DEWNR is also preparing Traditional Owner engagement in more specific project design elements, including Salt Creek fish passage and the development of the SEFRP Operations Manual.

2.7 A staged development or component of a larger project

2.7.1 CLLMM Recovery Project

As described in Section 1.13, the SEFRP is a component of the CLLMM Recovery Project. The SEFRP is the only action proposed under the CLLMM Recovery Project that aims to address the ecological health of the Coorong South Lagoon by providing additional freshwater inflows into the lagoon. The proposed action is considered necessary to help maintain salinity levels in the Coorong South Lagoon between the management targets of 60 g/L and 100 g/L in order to ensure that the lethal effects of high salinity on the ecosystem is mitigated during periods of low barrage outflows.

2.7.2 Potential for future projects

During the investigations stage of the SEFRP, a variety of channel alignments and geographic extents were explored.

Several options were considered south of the Blackford Drain, including a new channel along the Reedy Creek Flats or an extension of the Blackford Drain through to the Avenue Flat drains. Both of these options were designed to access surplus water from Drain L, K and possibly M which is currently discharged into the ocean. Due to stakeholder concerns, funding constraints and the need for further community consultation, these elements are not part of the SEFRP.

3. Description of environment and likely impacts

Section 3 describes the matters of national environmental significance (NES) identified in the EPBC Act Protected Matters Report (PMR) dated 10 November 2014 (Appendix 1), and assesses any likely adverse impacts to these matters of NES as a result of the SEFRP.

- Sections 3.1.1 and 3.1.2 discuss impacts to World and National Heritage Places, noting that no places exist within the SEFR project area;
- Section 3.1.3 describes the Coorong, and Lakes Alexandrina and Albert Wetland of International Importance (identified as the only Wetland of International Importance that may occur in or relate to the SEFR project area), and assesses likely impacts to the ecological character of the site;
- Section 3.1.4 describes listed threatened ecological communities identified in the PMR, including an assessment of the likelihood of occurrence within the SEFR project, and an assessment of likely impacts to the threatened ecological communities identified as likely to occur within the SEFR project area;
- Section 3.1.5 discusses listed threatened and migratory species identified in the PMR, including an assessment of the likelihood of occurrence within the SEFR project area, and an assessment of likely impacts to the species which have been determined as likely to occur within the SEFR project area; and
- Sections 3.1.6, 3.1.7, and 3.1.8 which addresses likely impacts to the South East Commonwealth Marine Area, Commonwealth Land, and the Great Barrier Reef Marine Park, noting that the SEFRP does not fall within any of these areas.

Section 3.3 considers the 'Other Important Features of the Environment' which focuses on the South East region of South Australia, where construction of the SEFRP is proposed.

3.1 Matters of national environmental significance

3.1.1 World Heritage Places

The proposal will not impact on any World Heritage places. The closest listed World Heritage place is situated over 200 km away - Australian Fossil Mammal Site (Naracoorte).

3.1.2 National Heritage Places

The proposal will not impact on any National Heritage places. The closest listed National Heritage place is situated in Adelaide, over 150 km away – South Australian Old and New Parliament Houses.

There are four State Heritage places located within the SEFRP area:

- Magrath (sometimes McGrath) Flat Homestead, including Dwelling, Stables, Smithy, Shearers' Quarters and Woolshed, Princes Highway (SHP 12303)
- Chinamans Well, Coorong National Park (SHP 10253)
- Cantara Homestead, Coorong National Park (SHP 10572)
- Blackford Reserve including three cottages, Princes Highway (SHP 26328)

The SEFRP will not impact on the abovementioned State Heritage Places.

3.1.3 Wetlands of International Importance (declared Ramsar Wetlands)

There is one Wetland of International Importance (declared Ramsar Wetland) identified in the Protected Matters Report; namely the Coorong and Lakes Alexandrina and Albert Ramsar site.

The South Australian government acknowledges Bool and Hacks Lagoons Wetland of International Importance located in the South East of South Australia (upstream of the SEFRP area). The Bool and Hacks Lagoons site is located upstream of the SEFRP area and thus the environmental water requirements of the site are met prior to water being delivered to lower parts of the system. As such, the Bool and Hacks Lagoons Wetland of International Importance is not considered as part of this referral.

3.1.3.1 Coorong and Lakes Alexandrina and Albert Ramsar Site Description

The Coorong and Lakes Alexandrina and Albert Ramsar site (the Ramsar site), listed in 1985, is approximately 85 km south east (direct line) of Adelaide and covers an area of 140,500 ha. The site encompasses:

- Lake Alexandrina and Lake Albert (the Lower Lakes) (including land, tributaries and wetlands connected to the lakes and the islands in the lakes); and
- The Coorong (including all land and water in the Coorong National Park, the Younghusband Peninsula, and Ocean Beach to the low water mark).

In 2000, the site qualified under Ramsar criteria 1 to 6. However, further assessment has identified that the site also qualifies against Criteria 7 and 8 (Phillips and Muller 2006). The criteria for Ramsar qualification are listed in Appendix 6, *Information Sheet on Ramsar Wetlands (RIS)*.

In December 2006, the South Australian government notified the Ramsar Secretariat of changes in the ecological character of the Ramsar site (in accordance with Article 3.2 of the Ramsar Convention (UNESCO 1994)) as a result of low inflows at the time. The Ecological Character Description (ECD) for the site was provided which detailed the 1985 listing condition of the site, and concluded that the site had been declining for at least 20-30 years prior to its

listing (Phillips and Muller, 2006). The recent drought of 2006 to 2010 exacerbated the decline, resulting in the condition of the site being identified as an issue of concern in the Australian Government's national report (2008), submitted to the 10th Meeting of the Conference of Contracting Parties. In 2012, a subsequent update was provided at the 11th Meeting of the Conference of the Contracting Parties noting that the condition of the site had stabilised due to activities undertaken by the Australian and South Australian governments, and due to improved inflows to the site in the second half of 2010. Under the CLLMM Recovery Project, the ECD and Ramsar Information Sheet for the site are being updated.

The Ramsar site is a complex ecosystem that encompasses riverine, lentic, wetland, terrestrial, littoral, estuarine, marine, and hypersaline habitats that support nationally and internationally significant species listed under the EPBC Act and international agreements (Figure 18). The Coorong and Lower Lakes are located in the south-western edge of the Murray Geological Basin (Haese *et al*. 2009) which contains significant aquifers that are in good hydraulic connection (Barnett 1994).

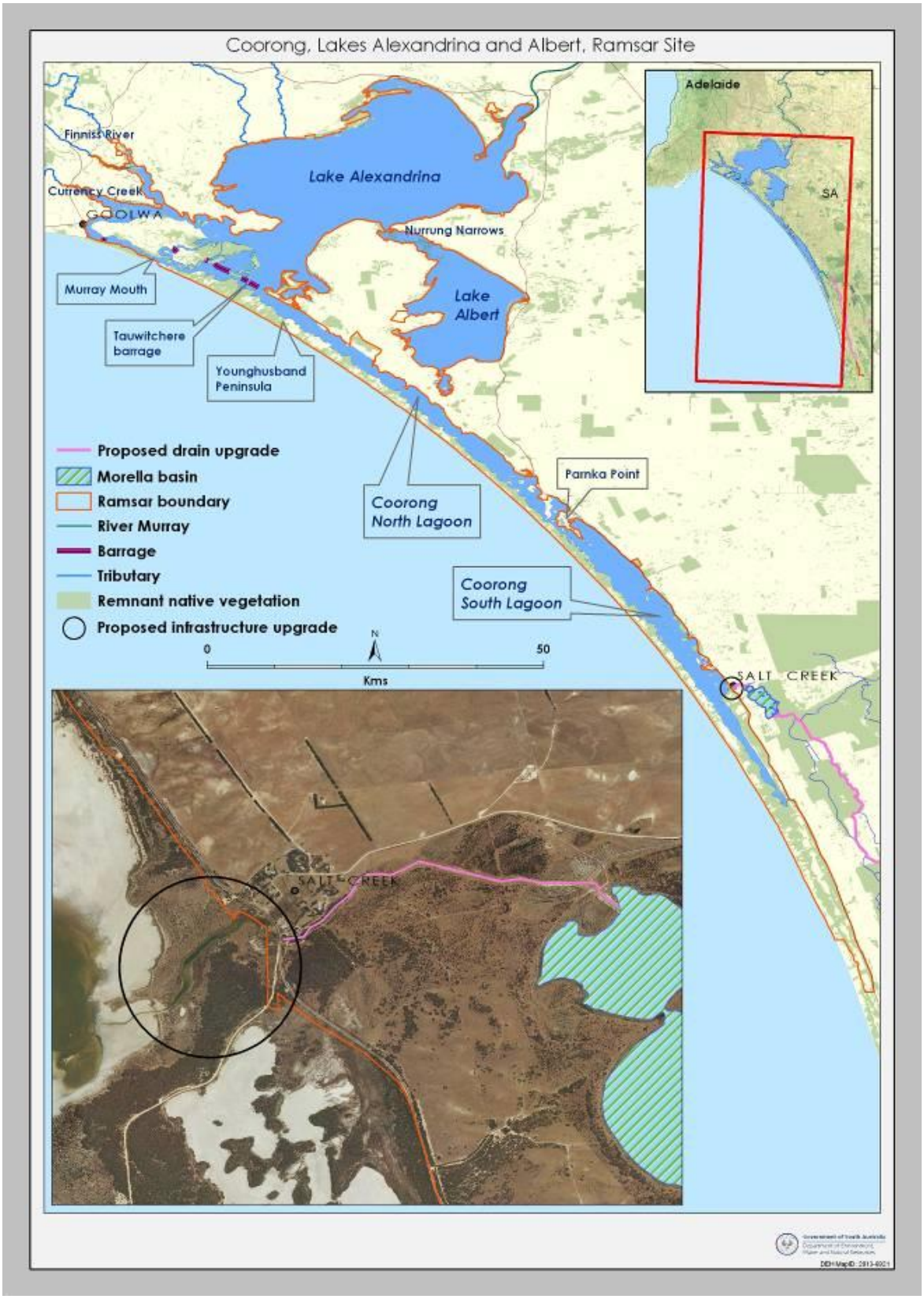

Figure 18: Coorong, Lakes Alexandrina and Albert Ramsar Site, highlighting Salt Creek and the Salt Creek outfall

The Lower Lakes

The Lower Lakes are large freshwater lakes covering approximately 650 km^2. They receive freshwater inflows principally from the River Murray, but also the Eastern Mount Lofty Ranges tributaries (Finniss River and Currency Creek), groundwater discharge, local run-off, and rainfall on the lakes surface. Lakes Alexandrina and Albert are connected by the Narrung Narrows, which represents the predominant source of flows into and out of Lake Albert. Lake Alexandrina is separated from the Murray Mouth estuary and the Coorong by five barrages with 593 independently operated gates that release flow into the estuary. The five barrages are used to manage water levels, water quality and to provide passage for fish.

The Coorong

As noted in Section 2.1.1, the Coorong is a large coastal lagoon complex situated at the mouth of the River Murray. It stretches for 140 km in a south-easterly direction. The Younghusband Peninsula, a Holocene barrier dune, separates the Coorong from the Southern Ocean. However, Carbonate deposits in the form of cylindrical tubes are found to be pervasive along the eastern shore of the Coorong South Lagoon, indicative of groundwater discharge from the Coorong to the Southern Ocean (Haese *et al*. 2009).

The Coorong can be separated into three main sections; the Murray Mouth and estuary, the Coorong North Lagoon, and the Coorong South Lagoon (Geddes and Hall 1990). The Coorong South Lagoon is the larger of the two with a surface area of approximately 110 km^2 when full, compared to 85 km^2 for the North Lagoon. The South Lagoon is a predominantly hypersaline water body and is connected to the North Lagoon by a narrow channel at the northern end (Parnka Point). The Coorong North Lagoon is a saline water body and is connected to the ocean via the Murray Mouth estuary. According to Phillips and Muller (2006) there are ten different wetland types present in the South Lagoon, ranging from rocky marine shores to shrub-dominated wetlands, which support various aspects of the sites' ecological character.

Primary determinants of ecological character

The ECD for the Ramsar site (Phillips and Muller, 2006) outlines six primary determinants for the maintenance of ecological character for each ecological component within the site, these are:

1. Salinity
2. Turbidity and sedimentation
3. Keystone aquatic plant species and assemblages
4. Water levels
5. Habitat availability

6. Water regime

If these primary determinants are maintained within limits relevant to the key ecosystem requirements then the expectation, based on scientific and local knowledge, is that the system as a whole, and its individual components and processes, will also operate or function as expected (Phillips and Muller, 2006).

The following description of the characteristics for each primary determinant focuses on the Coorong and Murray Mouth, as these are the most relevant to the following assessment of impacts upon matters of NES in relation to the SEFRP.

Salinity

Phillips and Muller (2006) note that in the 300 years prior to European settlement the Coorong South Lagoon occasionally experienced hypersaline conditions. However, the rest of the Coorong typically experienced salinities at or below 35 ppt, with evidence that the southern end of the Coorong South Lagoon regularly received freshwater inputs. Phillips and Muller (2006) note that following European settlement, the reduction in flows from groundwater and the South East has led to increased salinities in the Coorong South Lagoon.

Based on the condition of the Coorong South Lagoon in 2006 Phillips and Muller (2006) note that the Coorong South Lagoon is classified as saline to hypersaline. The Coorong South Lagoon has a salinity gradient consistent with that of the Coorong North Lagoon, with lower salinities recorded in the north west, and higher salinities towards the south-eastern end.

Coorong South Lagoon salinities are influenced by the water exchange with the Coorong North Lagoon, openness of the Murray Mouth, rainfall, evaporation, groundwater inputs and inflows from the South East of South Australia. Salinities increase when the Murray Mouth is restricted or closed through evaporation from an essentially closed and already saline system (Phillips and Muller, 2006).

An ecologically healthy Coorong South Lagoon requires the ongoing maintenance of both salinity and water level within their management target ranges (section 2.1.2.1). Studies to date (Lester *et al.* 2011; Lester *et al.* 2012) indicate that the delivery of flows from the South East have a greater impact on salinity than water levels; water levels remain largely constant regardless of the (relatively small) volume from the South East (Lester *et al.* 2012).

The target management ranges for salinity to support a healthy ecosystem in the Coorong South Lagoon is between 60 g/L to 100 g/L (MDBA, 2014a; Phillips and Muller, 2006). Maintaining salinities below a maximum supports an ecosystem optimal for key flora and fauna species. A target minimum salinity level of ~60 g/L has been determined on the basis that salinities should not favour the undesirable competitor species; *Ulva* sp. (CLLAMMecology Research Cluster 2008).

Importantly, the determination of lethal and preferred maximum salinity targets for key indicator species (refer to Table 4) enables consideration of sub-lethal salinity thresholds. The preferred maximum salinities for *Ruppia tuberosa*, Small-mouthed hardyhead and chironomids are 110 g/L, 94 g/L and 90 g/L respectively. In addition, Paton and Bailey (2010) note that the growth, flowering, seed set and turion growth in *Ruppia tuberosa* is severely curtailed at salinities above 120 g/L, at which point the mobile species would have been excluded from the relevant habitat.

Salinity

- ***Salinity of 60 g/L – 100 g/L represents the desirable management target range for South Lagoon salinities to be maintained in all years to support the ecology of the Coorong.***
- ***120 g/L represents a maximum salinity that should not be exceeded to avoid harm to the ecology of the Coorong South Lagoon.***

Turbidity and sedimentation

Phillips and Muller (2006) define turbidity in relation to sedimentation and suspended solids, and do not include discussion of algal biomass. Turbidity and sedimentation are related, in that suspended sediment contributes to water column turbidity and then may drop out of the water column or be resuspended back into the water column depending on physical drivers such as wind speed and direction, wave action, or flow rates (Phillips and Muller 2006).

Lake Alexandrina and Lake Albert both act as sinks for sediment brought in by the River Murray, with erosion of Lake Albert also a likely source of sediment. Lake Alexandrina also acts as a sediment source for the Murray Mouth, Coorong, and Southern Ocean.

Phillips and Muller (2006) discuss the increase in turbidity since European settlement, as indicated by shifts in diatom species assemblages over time. These diatoms show that possibly very early in European settlement, but definitely by the 1940s when barrages were constructed, the Coorong lagoons became more turbid. Gell and Haynes (2005) report that the sedimentation rates for the past 20 years in some parts of the Coorong has been greater than 15mm/year.

Turbidity and sedimentation rates can influence such factors as light penetration to aquatic plants, lakeshore bathymetry and thus water levels at a habitat scale, promotion of algal growth, the success of sight-feeding birds and fish, smothering of benthic macroinvertebrates, and pollution accumulation. Turbidity and sedimentation rates can also affect the respiratory and feeding structures of fish (Phillips and Muller 2006; Lester *et al.* 2011). Aquatic vegetation can assist in controlling turbidity and sedimentation by slowing water movement and thus

increasing the rate of sediment settlement and preventing re-suspension of fine particles (Phillips and Muller 2006).

Ruppia tuberosa is an annual that grows at depths of 0.3 to 0.9 m. Although salinity and water levels are the primary drivers for this species, turbidity can also influence its growth.

The Ecological Character Description (Phillips and Muller 2006) indicates knowledge gaps regarding turbidity. However, it does provide a guide for turbidity management for the Coorong South Lagoon namely, turbidity of no more than 90 cm using a Secchi disc is desirable as this represents the light range required for the support of aquatic flora in the Coorong South Lagoon.

Turbidity and Sedimentation

- ***The Coorong is historically very turbid.***
- ***Turbidity of no more than 90 cm using a Secchi disc is desirable.***
- ***This represents the light range required for the support of South Lagoon aquatic flora.***

Keystone aquatic plant species

Keystone aquatic plant species are defined as those whose loss from an ecosystem would have a negative impact on many others because of their direct or indirect dependence on them (Phillips and Muller 2006). The loss of keystone aquatic plant species is indicative of a shift in ecological state because of the resultant alterations to ecosystem components and processes.

A key species for the estuarine-saline areas of the Ramsar site is the salt tolerant *Ruppia tuberosa*, which historically dominated the Coorong South Lagoon but shifted into patches within the Coorong North Lagoon during the recent drought. *Ruppia* provides a food resource for water fowl, shelter for macroinvertebrates and fish, and provides detritus to fuel decomposition, and thus nutrient cycling and carbon cycling (Phillips and Muller 2006). The submerged *Ruppia megacarpa* species was once dominant in the Coorong North Lagoon, however has not been recorded in the Coorong since the 1980s.

Ecosystem components and processes in the Coorong have been adversely affected by the loss of *Ruppia tuberosa* from the South Lagoon during the drought; and its limited recovery without any surrogate species having replaced its function in the ecosystem. Loss of structured submergent vegetation that utilises and reduces the bioavailable nutrient load in the waterbody will likely result in the dominance of mobile and fast-growing primary producers such as algae (Phillips and Muller 2006). Such a change is expected to impact food sources for higher trophic

levels, either directly through lack of seeds and turions for herbivorous birds, or indirectly through the subsequent loss of Small-mouthed hardyhead fish that piscivorous birds feed on (Higham, 2012) in favour of brine shrimp.

A combination of monitoring data and results from research trials (including *in situ* and *ex situ* experiments) has informed the following understanding of the conditions required for *Ruppia tuberosa* to flourish in the Coorong:

- Successful growth occurs in water depths between 0.3-1.0 m. Below 0.3 m *Ruppia tuberosa* performs poorly due to wind and tide changes, however 0.3 m appears to be a suitable lateral seiching buffer. The maximum depth is linked to turbidity and minimum light requirements.
- Target salinity for the Coorong South Lagoon is 60-100 g/L. The plant can survive in lower salinities, however it may be out-competed by other plants, particularly filamentous green algae. Higher salinities have adverse impacts on overall biomass and reproductive ability.
- The duration of the 'normal annual life-cycle' for *Ruppia tuberosa* exploiting the ephemeral mudflats of the Coorong is for the seeds and turions to germinate and sprout when water returns to the exposed mudflats during late autumn and winter. The plants then grow over winter and spring, flower during spring and continue to grow and produce turions post-flowering until water levels retreat (Paton *et al*. 2011).

Keystone Aquatic Plant Species

- ***Ruppia tuberosa is a keystone aquatic plant species for the Coorong South Lagoon.***
- ***Water levels to promote growth should be between 0.3 – 1.0 m.***
- ***Salinity levels to promote growth should be between 60-100 g/L.***

Water levels

Seasonal water level variation in the Murray Mouth estuary and Coorong is driven by a combination of sea level outside the Murray Mouth and discharge through the barrages (Phillips and Muller 2006). Water levels naturally vary with tides, winds, and Barrage outflows (Phillips and Muller 2006). Water levels are typically higher in winter than summer, driven predominantly by seasonally higher barrage outflows. Seasonal water levels in the Southern Ocean appear to have the most significant effect on the seasonal lows, due to the relatively modest barrage outflows common during summer, as a result of delivery constraints and availability of environmental water (Webster 2007).

The seasonal variation of water levels totals approximately 0.9 m in the Coorong South Lagoon, which is particularly important in the seasonal exposure of mudflat habitat. Shorter

term water level variations of ~0.05 m typically are due to the 'tilting' of the waters' surface by the wind. Figure 19 illustrates seasonal water level and salinity cycling in the Coorong South Lagoon.

Water levels, and importantly, natural water level cycling, plays a critical role in all ecosystem components and processes in the Ramsar site. Water levels influence salinity through the dilution and concentration of salt loads, and the amount of salt exchange between the South and North Lagoon and ultimately through the Murray Mouth. Seasonal variability of water levels provides cues for fish spawning and recruitment (Lester *et al*. 2011; Phillips and Muller 2006). Water levels inundate or expose mudflats, and alter access to feeding habitats and food availability for migratory wading birds, according to timing (Rogers and Paton 2009).

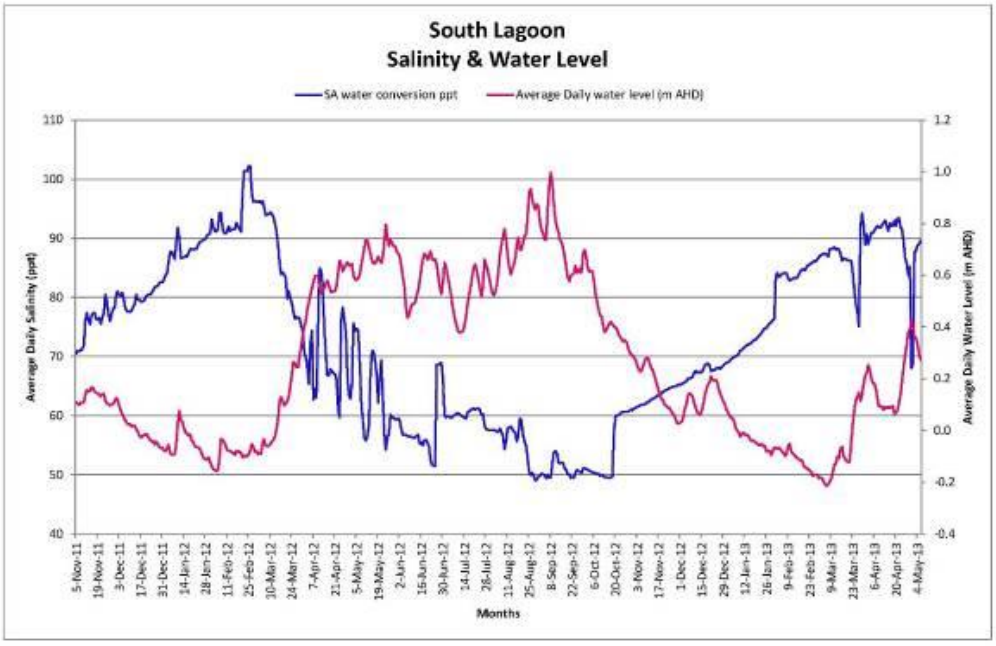

Figure 19: Water level and Salinity cycling in the Coorong South Lagoon.

Below a water level of 0.0 m AHD, the channel connecting the two Coorong lagoons becomes too shallow to support sufficient flows to replenish evaporative losses from the Coorong South Lagoon (Webster 2010). Consequently, the water level in the Coorong South Lagoon continues to drop below the level in the Coorong North Lagoon. The water volume of the Coorong South Lagoon in summer is only about two thirds of the winter volume because of a seasonal drop in the oceanic water level, poor hydrologic connectivity between the North and South Lagoon, no significant freshwater inflow, and high evaporation during summer.

When the Murray Mouth is fully open, the volumes of sea water entering and exiting the estuary on any given tide cycle is equal. However, if the Murray Mouth is restricted the volume of water entering the Coorong exceeds that which leaves on any given tidal cycle. Thus, water levels in the lagoons increase on each cycle, and will be lowered again by evaporation (Phillips and Muller 2006).

Higham (2012) draws on work completed by Overton *et al*. (2009), Rogers and Paton (2009) and Lester *et al*. (2009) which support a target water level in the South Lagoon to support *Ruppia tuberosa* populations of greater than 0.27m AHD.

Water Levels

- ***Water levels in the Coorong undergo a seasonal cycle, higher levels tending to occur in late winter to early spring and lower in late summer-early autumn.***
- ***Seasonal variation of water levels (of approximately 0.9 m) in the Coorong South Lagoon is particularly important; resulting in the seasonal exposure of mudflats.***
- ***The Coorong South Lagoon should have an average water level equal or less than 0.423m AHD.***

Habitat availability and connectivity

Habitat availability, referring to all aspects of habitat use and requirements, varies naturally over space and time, driven by geomorphology, climate, and hydrology. Habitat connectivity can affect population demographics, including genetic composition and community structure (Lester *et al*. 2011). In order for biota to survive, the right habitat type/s need to be available and connected in the right condition at the right time/s to support populations, for example by use of a fishway (Phillips and Muller 2006; Lester *et al*. 2011). Barriers to connectivity may be physical (e.g. disconnection of water) or can include chemical barriers such as pollutants and an unfavourable salinity gradient (Lester *et al*. 2011). In the Coorong, Lakes Alexandrina and Albert Ramsar site, a variable water level is one way to maximise aquatic-terrestrial connectivity.

At low water levels, habitat connectivity within the Coorong South Lagoon can be lost between the Coorong Lagoons and to aquatic vegetation such as Ruppia. However, the seasonal exposure of some aquatic habitat is considered an important component of the system's healthy function by exposing food-rich mudflat habitat for birds and instigating nutrient cycling processes.

It is important for the successful recolonisation of a stable *Ruppia tuberosa* population that seasonal water level changes are timed to allow the plant to complete its lifecycle, thus replenishing the seedbank that was lost during the drought (Frahn *et al* 2012). A healthy Ruppia population will allow the availability of seasonal mudflat habitat without the loss of all vegetated aquatic habitat.

Habitat availability and connectivity

- ***Improved connection between the Coorong North Lagoon and Coorong South Lagoon increases habitat connectivity.***
- ***This connection enables water, nutrients and species to move which promotes healthy estuarine processes to occur.***

Water regime

Water regime refers to the timing, extent, duration, and frequency of inundation, which is primarily determined by rates of flow into, out of, and through the system (Phillips and Muller 2006).

The key drivers for water regime in the Coorong South Lagoon are River Murray flows, barrage operations and their interaction with Murray Mouth opening, and local meteorology (Phillips and Muller 2006, Webster 2007, 2010).

As outlined in Phillips and Muller (2006) water regime, and particularly the water level regime, can influence the persistence of aquatic vegetation, in turn influencing habitat availability and connectivity. An appropriate water level regime in the Coorong has the potential to not only maintain sufficient inundation of *Ruppia tuberosa* but also to mitigate high salinities in the Coorong South Lagoon, thereby enhancing *Ruppia tuberosa* growth and maintaining invertebrate populations.

The effects of flow from the South East on the hydrodynamics and ecological condition of the Coorong were modelled by Lester *et al*. (2009). The findings of that study indicate that while significant benefit to Coorong salinity can result from additional volumes from the South East, the seasonal cycle of water levels in both lagoons is not substantially affected by increased discharge from Salt Creek (for the volumes investigated). This is believed to be because in most years, flows from the South East terminate in early summer before the channel between the two lagoons effectively closes due to seasonal changes in sea level. Thus, inflow to the South Lagoon from the South East can be balanced by outflow through the channel and water levels are largely unaffected.

Water Regime

- ***The key drivers for water level regime in the Coorong South Lagoon are River Murray flows, barrage operations, and their interaction with Murray Mouth opening and local meteorology.***
- ***The water level regime is principally affected by flows from the Murray-Darling Basin with flows from the Upper South East having little to no impact on water level regime.***
- ***Flows from the Upper South East in combination with flows from the Murray-Darling Basin has the potential to mitigate high salinities in the South Lagoon, thereby enhancing Ruppia tuberosa growth, maintaining invertebrate populations and proving habitat for migratory waders and other waterbirds.***
- ***River inflows and barrage operations are the overarching management tool for controlling aspects of water regime in the Coorong.***

3.1.3.2 Nature and extent of likely impact upon the Ramsar wetland

Impact Assessment Rationale and Assumptions

The components of the proposed action being assessed in this section focused primarily on the delivery of additional flows (diverted from the Blackford drain) to the Coorong via a modified Salt Creek outfall. Construction impacts are also considered, including minor disturbance as a result of the potential installation of a fishway close to the Salt Creek outlet is also considered.

This assessment focuses on the Coorong as a whole, although it is noted that potential impacts will be more significant in the South Lagoon than in the North Lagoon. The Lower Lakes are not included in this assessment due to the presence of barrages preventing additional water entering the lakes, and the absence of construction works in that area.

The significant impact criteria for the Ramsar site outlined in *Matters of National Environmental Significance - Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (2013) have been used to guide this assessment. It is noted that these criteria encompass the primary determinants of ecological character for the Ramsar site and species that contribute to the ecological character of the Ramsar site.

Summary of likely impact

The assessment of potential impacts to the Coorong has identified that no significant adverse impacts to the ecological character of the site are likely as a result of the SEFRP. By helping to maintain a healthy salinity gradient, the SEFRP is expected to benefit:

- Areas of the wetland being destroyed or substantially modified (primary determinant of ecological character – habitat connectivity)
- Habitat or lifecycle of native species (primary determinants of ecological character – key aquatic plant species and habitat connectivity)
- water quality (Salinity) (primary determinant of ecological character – salinity)

The SEFRP is not expected to result in the introduction of any invasive or harmful species to the Coorong South Lagoon.

A significant impact to the water quality parameters of turbidity and nutrients is not expected as a result of construction (see Table 9). However, as a precaution, water quality will be monitored pre-construction, during and post construction to ensure that water quality is managed. Water quality monitoring is discussed in more detail in Section 4.

The Management Principles that govern the delivery of water to the Coorong will ensure that potential risks regarding water quality of the Coorong are considered in determining the flow volumes and timing to be delivered along the SEFRP channel, including how flow is delivered through *en route* wetlands. The approach will aim to maximise benefits and minimise risks to the Coorong. Given this approach to management, the project it is not considered likely to result in a significant adverse impact to the Coorong.

The nature and extent of likely impacts upon the Coorong is described in Table 9.

Table 9: Nature and extent of likely impact of the proposed action on the Coorong.

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
(1) Areas of the wetlands being destroyed or substantially modified	Habitat connectivity	**No significant impact**	The Salt Creek outfall is located within the Ramsar site and contains three wetland types: G- intertidal mudflat; M - permanent rivers/ streams/ creeks; and Ss – Seasonal / intermittent / brackish / alkaline marshes / pools. Access for the construction / installation of a potential fishway at Salt Creek site will be via an existing track and all works at the site will involve minimal vegetation disturbance.	Disturbance to native vegetation, flora and fauna in the Ramsar site, in particular the Coorong South Lagoon, will be managed through an Environmental Management Plan, discussed in more detail in Section 4.
(2) A substantial and measurable change in the hydrological regime of the wetland (for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland)	Water levels, Water regime, particularly flow patterns	**No significant impact**	As described in Section 3.1.3 the Coorong receives water from multiple sources, the most significant being from the River Murray via the barrages. Currently, in a median year the Coorong receives 29.7 GL from the South East drainage system. Under the proposed action the Coorong will receive up to an additional 26.5 GL in a median flow year in the South East Drainage System catchment (50 percent of the time under historic climatic conditions). This would represent a total of up to 56.2 GL of annual flows to Salt Creek in a median year. CSIROs Coorong Hydrodynamic Model shows this volume is insufficient to significantly impact upon the water level regime of the Coorong (Lester *et al.* 2012). Seasonal water level changes in the southern Coorong are influenced primarily by seasonal sea level changes and barrage flows (Webster	No significant impact anticipated which would require mitigating/ management actions.

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			2007), with short-term water level fluctuations driven by weather conditions, particularly wind speed and direction. Under the approved Murray-Darling Basin Plan the South Australian government is assuming minimum barrage outflow of 2,000 GL per year. The timing of flows from the South East drainage system into the Coorong at Salt Creek is not anticipated to change under the proposed action. Currently these flows occur from mid-winter to early summer, with peak flows typically occurring in late winter/early spring (Government of South Australia 2016). Timing of flows in the Blackford Drain are very similar to current Salt Creek flows. The travel time of water from the Blackford Drain to Salt Creek under the proposed action is anticipated to be approximately 8 days (KBR 2015), which is not anticipated to alter the timing of Salt Creek flows significantly. The projected change to the volume of flows from the South East drainage system considered insufficient to affect the openness of the Murray Mouth. The additional flows into the Coorong under the proposed action are not anticipated to have any affect upon groundwater levels in the vicinity of the Coorong or lead to any change to groundwater-surface water interactions in the Coorong.	
(3) The habitat or lifecycle of native	Key aquatic plant species	**No significant impact**		No significant adverse impact anticipated which would

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	Habitat connectivity	**No significant impact**	The construction footprint of the proposed action within the Coorong Ramsar site is not anticipated to have a significant impact upon wetland dependent fauna (see (1) above). Coorong mudflats are typically seasonally inundated, with maximum inundation (peak water level) occurring in winter/early spring and maximum exposure (low water level) occurring in late summer/early autumn. The seasonal pattern of inundation and exposure is ecologically important. Winter/spring mudflat inundation stimulates the growth and reproduction of the annual aquatic plant *Ruppia tuberosa* and the establishment of the aquatic benthic invertebrate community. Both are key food resources for waterbirds and fish. As water levels over the mudflats drop in late spring/summer these resources become more accessible to waterbirds, particularly waders, whose foraging success is strongly influenced by water depth (Paton 2010). As discussed above (2), the proposed action is not predicted to cause any significant change to the water level regime in the Coorong. The timing, duration, frequency and depth of inundation of mudflats will continue as if the proposed action had not been undertaken. Aside from the construction footprint, the potential impacts of the proposed action to wetland dependent fauna relate to potential changes to water quality. These are discussed in (4) below.	require mitigating/management actions.
(4) A substantial and measurable change in	Salinity	**No significant impact**	The Coorong South Lagoon provides important feeding habitat for a waterbird community that is internationally recognised under the Ramsar	Water quality in the Ramsar site, in particular the Coorong

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health			Convention. The waterbird community is supported by a food web, which is in turn dependent upon an appropriate water level regime and water quality. As discussed above (2), the proposed action is not anticipated to have any affect upon the water level regime of the Coorong. Implications of the proposed action for water quality in the Coorong South Lagoon, and consequent implications for ecological integrity, have been examined in detail by a water quality risk assessment (WQRA) (Wilson *et al.*2016). The WQRA was undertaken to: • identify potential water quality risks to the Coorong caused by the proposed action; • determine the level and tolerability of these risks; and • identify and evaluate the effectiveness of any treatment (management) options to reduce risks to tolerable levels. This WQRA used DEWNR's risk management framework for water planning and management, which is based on the AS/NZS ISO 31000:2009 risk management standard for water planning and management activities in Australia and New Zealand. According to the standard, the risk management process comprises three key steps: 1. Establishing the context, 2. Assessing the risks, including: a. Risk identification,	South Lagoon, will be monitored and managed through a Site Operations Manual being developed through the CLLMM Recovery Project. This will be cross-referenced with management of the SEFRP channel under the USE Drainage Network Management Strategy. These are discussed in more detail in Section 4.
	Turbidity	**No significant impact**		
	Nutrients	**No significant impact**		

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			b. Risk analysis, c. Risk evaluation, and 3. Identifying risk treatments. Experts in water quality, Coorong ecology and risk assessment, both internal and external to DEWNR, were invited to participate in the risk assessment. The external organisations involved were: • University of Adelaide • Environmental Protection Authority • Flinders University • CSIRO • SARDI Aquatic Sciences The WQRA considered the first 10 years of SEFRP operation. The assessment focused on the southernmost 56 linear km of the Coorong, covering the entire South Lagoon and approximately 5 km of the southernmost North Lagoon. 'End points' are the features or values that a risk assessment seeks to protect. In the Coorong South Lagoon these are: • Tuberous sea-tassel *Ruppia tuberosa* – the only aquatic plant species present;	

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			• Small-mouthed hardyhead *Atherinosoma microstoma* – one of the more abundant fish species; and • Aquatic larvae of the insect *Tanytarsus barbitarsis*, a chironomid or midge which occurs on seasonally and permanently inundated mudflats and is an important link in the food web. Use of these three end points is consistent with contemporary scientific understanding and management of the Coorong. The species are key components of the food web that supports the internationally recognized waterbird community of the Coorong South Lagoon. Seven categories of water quality risk were identified: 1. Risks related to over freshening, 2. Risks related to increased turbidity, 3. Risks related to increased loading of total nutrients (nitrogen and/or phosphorus), 4. Risks related to increased loading of bioavailable nutrients (nitrogen and/or phosphorus), 5. Risks related to increased loading of total organic carbon (TOC) (comprising dissolved organic carbon (DOC) and particulate organic carbon (POC)), 6. Risks related to changed water temperature, and	

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			7. Risks during construction. The risk analysis enabled these risk categories to be examined in combination (cumulative risk) and separately. A modelling approach to the risk analysis was adopted, using a Bayesian Belief Network (BBN) as the modelling platform. Raw outputs of the BBN were evaluated using a first pass (low resolution) approach and second pass (high resolution) approach. The conclusions of the WQRA are: • Taken cumulatively, given both the first (low resolution) and second pass (high resolution) evaluations, there is a low risk that the SEFRP will lead to significant adverse impacts to the ecological character of the Coorong due to water quality changes. • When considered individually, given the first pass (low resolution) evaluation, no risk category appears likely to cause a significant adverse impact to the ecological character of the Coorong due to water quality changes. • The second pass (high resolution) evaluation indicated a moderate risk to the vigour of *Ruppia* stands due to increased loading of bioavailable nutrients under the SEFRP, but this risk would readily be avoided by routine adherence to the existing salinity target minima for the CSL.	

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			The conclusions of the risk assessment are valid provided that the following design, operational and monitoring features are incorporated into the SEFRP, as is proposed: • The ability to divert Blackford Drain water to sea to avoid over freshening of the CSL. • The ability to slow or stop Salt Creek inflows to the Coorong by closing Morella Basin outlet regulator and storing water for later release or complete draw down (via evaporation and seepage) to create storage for the following winter. The purpose is to avoid risks related to over freshening and bioavailable nutrients. • To incorporate operational flexibility into the design such that flows through the Tilley Swamp Watercourse can either be held and allowed to draw down completely or allowed to pass through to Morella Basin the and Coorong. The purpose is to avoid risks related to over freshening, bioavailable nutrients and total organic carbon. • Existing real-time salinity monitoring in the CSL be should be maintained as it is necessary to avoid over freshening of the CSL. • Real time water level gauges (i.e. storage volume) in Morella Basin and Tilley Swamp Watercourse should be maintained and installed respectively. The purpose is to enable real time decision	

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			making regarding the diversion of Blackford Drain flows, which is necessary to avoid over freshening of the CSL. • CSL salinity forecasting based on barrage flows forecasting should be incorporated into SEFRP operations. The purpose is to avoid over freshening of the CSL.	
(5) An invasive species that is harmful to the ecological character pre the wetland being established (or an existing invasive species being spread) in the wetland		**No significant impact**	The SEFRP is not likely to result in the introduction of any invasive or harmful species to the Coorong South Lagoon, both during construction and post-implementation. There are no known aquatic pest species present in the South East drainage system that do not already have a potential invasion pathway, via hydraulic connection, to the Coorong. A hydraulic connection between the Coorong and parts of the South East drainage system where the pest fish species Eastern Gambusia (*Gambusia holbrooki*) occurs already exists. Gambusia are also present in the River Murray. Thus the proposed action does not establish an invasion pathway for this species into the Coorong – that pathway already exists. Moreover, despite the existing hydraulic connection, Gambusia have not been recorded in the Coorong because, as a freshwater species, the high salinity precludes them. In the Coorong South Lagoon the minimum target salinity of 60 g/L has been set to maintain unfavourable conditions for filamentous green algae	The possibility of invasive or harmful species being introduced into the Ramsar site, in particular the Coorong South Lagoon, is extremely low will be managed through an Environmental Management Plan which will guide construction. Mitigation/management actions as discussed in more detail in Section 4.

Significant Impact Criteria	Primary Determinants of Ecological Character	Impact Status	Rationale	Related Management and Mitigation Actions
			(*Ulva sp.*), which is considered a competitor capable of reducing the cover, distribution and seedbank of *Ruppia tuberosa* (Paton *et al.* 2015). Filamentous green algae is currently relatively abundant in the Coorong South Lagoon. Adherence to the target salinity range is anticipated to prevent filamentous green algae from further proliferating. This issue was considered by the water quality risk assessment (see (4) above). The pest plant Spiny Rush (*Juncus acutus*) occurs along the margins of wetlands and watercourses, particularly in saline areas. The species is known to disperse via seeds carried by water. Infestations of the species on the margins of the Coorong are rare but three recent (post 2000) records are documented in the BDBSA. The species also occurs in the lower River Murray and very sparsely (two locations in the BDBSA) within the existing Salt Creek catchment. Thus there are existing hydraulic connections providing potential invasion pathways between known *J. acutus* populations and the Coorong. Given the current distribution of the species, the SEFRP will not establish an invasion pathway for the species into the Coorong – that pathway already exists and the species is already established (in low abundance) in the Coorong. The management of pest flora is an objective of the Coorong National Park Management Plan (NPWS 1990).	

3.1.4 Listed Threatened Ecological Communities

3.1.4.1 Description of listed threatened ecological communities

Three threatened ecological communities were listed in the Protected Matters Report:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions;
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains; and
- Subtropical and Temperate Coastal Saltmarsh

Table 10 describes the characteristics, distribution and potential occurrence within the SEFRP of these threatened ecological communities.

Table 10: Threatened ecological communities identified in EPBC protected matters report.

Ecological community	Status	Type of Presence (from the Protected Matters Report)	Regional distribution	Occurrence / likelihood of impact
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	E	Community may occur within area	Near Bordertown in South Australia through to the north west of Victoria and south west of New South Wales.	Does not occur within the project area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	CE	Community likely to occur within area	Lowland plains of Victoria, south-eastern South Australia (SA), and southern New South Wales (NSW).	Does not occur in project area.
Subtropical and Temperate Coastal Saltmarsh	V	Community likely to occur within area	Occurs within a relatively narrow margin of the Australian coastline, south of the central Mackay coast on the east coast of Queensland, southerly around Australia to the west coast of Western Australia.	Occurs close to project area near Salt Creek, however easily avoided and not likely to be impacted by the project

3.1.4.2 Nature and extent of likely impact on threatened ecological communities

Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions

Description

The 'Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions' ecological community (Buloke Woodlands) encompasses a number of closely-related woodland communities in which Buloke (*Allocasuarina luehmannii*) is usually the dominant or co-dominant tree. This community in the Riverina and Murray-Darling Depression Bioregions occurs from south-eastern South Australia through north-western and northern central Victoria into south central New South Wales. In South Australia, Buloke Woodlands occur near Bordertown, in the far south-east of the Murray-Darling Depression Bioregion (Cheal, D. *et al.* 2011).

The Buloke Woodlands community has suffered a considerable reduction in distribution since European settlement, largely due to extensive clearing for agriculture and grazing by domestic stock, native and feral herbivores. Buloke Woodlands now exist as a patchy, highly fragmented, mostly highly degraded community across much of its former range. Remnants persist on roadsides, private land and some public land including several parks and reserves.

The Buloke Woodlands have been extensively cleared in the past, and the remnants that survive face ongoing major threats from incremental clearance, grazing by rabbits and stock, invasion by exotic plants, weedicide application and fertiliser drift. The community is poorly represented in conservation reserves throughout its range.

Occurrence and likely impact in project area

The Buloke Woodlands of the Riverina and Murray-Darling Depression do not occur within the SEFRP area, with known communities occurring near Bordertown.

Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Description

The Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains ecological community (Seasonal Herbaceous Wetlands) are temporary freshwater wetlands that are inundated on a seasonal basis, typically filling after winter-spring rains, and then drying out. The vegetation is generally treeless and dominated by an herbaceous ground layer, often with a considerable graminoid component and with forbs present. The herbaceous species present are characteristic of wetter locations and are typically absent or uncommon in any adjoining dryland grasslands and woodlands. The dominant plants present are subject to seasonal and

site conditions, and the diversity of the flora may range from relatively species-poor to species-rich composition.

The Seasonal Herbaceous Wetlands occur on the lowland plains of Victoria, south-eastern South Australia (SA), and southern New South Wales (NSW). In some places the plains may be broken by local areas of higher relief (e.g. stony rises on the Victorian Volcanic Plain), or grade into hills (e.g. where plains grade into the Victorian Midlands bioregion). In some cases, the terrain is characterised by gilgais[1] with wetlands forming in the gilgai depressions. The ecological community is limited to plains and lower slopes or stony rises at elevations below 500 m above sea level (asl).

The soils on which the Seasonal Herbaceous Wetlands occur are generally fertile but poorly draining clays of various geologies. In the Victorian Volcanic Plain clays are derived from basalt whereas in the Riverina they are alluvial deposits associated with grey or mixed soil types. Many examples of the ecological community have heavy soils formed locally by the long-term presence of the wetlands. In some areas, particularly on the Victorian Volcanic Plain, larger stones and rocks may be present in the soils within or around the wetland.

Occurrence

Table 11: Likely distribution of the wetland ecological community by IBRA bioregions and subregions.

IBRA Bioregion	IBRA Subregion (SA)
Victorian Volcanic Plain	Mt Gambier
Naracoorte Coastal Plain	Glenelg Plain
	Lucindale
	Tintara
Murray Darling Depression	Wimmera
	Lowan Mallee (southern extension)

Note that the ecological community may not extend across an entire bioregion or subregion but is limited by the presence of landscape characteristics, as noted in the description and key diagnostic characteristics outlined above.

[1] **Gilgai** refers to surface micro-relief formed by the shrinking and swelling of clays during alternate drying and wetting cycles. The surface eventually becomes covered by a pattern of small mounds and depressions that give the soil surface a 'pock-marked' appearance. Gilgai depressions are sometimes also called crabholes or melonholes.

The extent of the ecological community in SA effectively represents an extension of wetlands from the plains of western Victoria into south-eastern SA. A preliminary analysis of South Australian vegetation datasets, including the South Australian Wetland Inventory Database (SAWID), indicates that much of the ecological community occurs east of Millicent to the Victorian border. Scattered occurrences also occur further west or north, to the districts around Padthaway and Mt Scott. About 86 wetland sites across south-eastern SA were identified as consistent with the description for the national ecological community, of which 29 were rated as having high to very high ecological significance.

The Seasonal Herbaceous Wetlands ecological community is likely to occur in the following Catchment Management Authorities (CMAs) / Natural Resource Management (NRM) Regions, as structured in August 2011.

- Victoria: West Gippsland, Port Phillip and Westernport, Corangamite, Glenelg-Hopkins, Wimmera, North Central, Goulburn-Broken, and North East.
- NSW: Murray, and Murrumbidgee.
- SA: South East.

Biological surveys and the biodiversity plan for the south-eastern region of South Australia (Croft *et al*., 1999; Foulkes and Heard, 2003) identify remnant vegetation communities in this region, including some wetland communities. However, many of the wet grassland and sedgeland communities identified do not correspond with the national ecological community, as they are dominated by atypical genera [e.g. *Gahnia* (sawsedges), *Typha* (cumbungi), *Leptocarpus*)]. A generic 'Cyperaceae spp, Gramineae spp. Sedgeland' may partly relate to the national ecological community. However, this is a broad unit, requiring further investigation, as it groups several different elements (Foulkes and Heard, 2003).

Occurrence and likely impact in project area

No examples of seasonal herbaceous wetlands were recorded in the field survey of the study area. Current data and our recent field observations suggest that no important populations exist in the study area, and therefore it will not be affected by the SEFRP.

Subtropical and Temperate Coastal Saltmarsh

The Subtropical and Temperate Coastal Saltmarsh (hereafter Coastal Saltmarsh) ecological community occurs within a relatively narrow margin of the Australian coastline, within the subtropical and temperate climatic zones south of the South-east Queensland IBRA bioregion boundary at 23° 37' latitude along the east coast and south of (and including) Shark Bay at 26° on the west coast.

The physical environment for the ecological community is coastal areas under regular or intermittent tidal influence. In southern latitudes saltmarsh is often the main vegetation-type in the intertidal zone and commonly occurs in association with estuaries (TSSC, 2013). It is typically restricted to the upper intertidal environment, occurring in areas within the astronomical tidal limit, often between the elevation of the mean high tide and the mean spring tide (TSSC, 2013).

The *Coastal Saltmarsh* ecological community may also include areas that have groundwater connectivity to tidal water bodies. For example, groundwater hydrology may play a role in the occurrence of species such as the nationally vulnerable *Tecticornia flabelliformis* (bead samphire) which has a preference for water logging (TSSC, 2013).

Key diagnostic characteristics

The ecological community is the assemblage of organisms including and associated with coastal subtropical and temperate saltmarsh. Key diagnostic characteristics for describing the Coastal Saltmarsh ecological community include:

- occurs south of 23° 37' S latitude - from the central Mackay coast on the east coast of Australia, southerly around to Shark Bay on the west coast of Australia (26° latitude), and including the Tasmanian coast and islands within the above range
- occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coasts
- occurs on places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences, but not areas receiving only aerosol spray
- occurs on sandy or muddy substrate and may include coastal clay pans (and the like)
- consists of dense to patchy areas of characteristic coastal saltmarsh plant species (i.e. salt- tolerant herbs, succulent shrubs or grasses, that may also include bare sediment as part of the mosaic) and
- proportional cover by tree canopy such as mangroves, Melaleucas or Casuarinas is not greater than 50%, nor is proportional ground cover by seagrass greater than 50%.

Occurrence in the SEFRP Project Footprint

The flora and fauna field survey undertaken in 2015 recorded an area of the Subtropical and Temperate Coastal Saltmarsh ecological community 40m from the salt creek outlet structure, adjacent to the Coorong. Given the distance to the structure, and appropriate contractor avoidance measures which will be implemented through the EMP, it is not expected that the community will be impacted by the project. In addition, given the low risk to Coorong water quality the community is not expected to be impacted by any water quality risk. However, the community will potentially benefit from the management of salinity in the Coorong South Lagoon.

3.1.5 Listed threatened and migratory species

3.1.5.1 EPBC Act listed species assessment methodology

The Protected Matters Report generated on 10 November 2014 identified 54 Threatened and 57 Migratory species that have the potential to be present within the project footprint. Since that time, two species listed as migratory, the Curlew Sandpiper and Eastern Curlew, have had their status revised to Critically Endangered. Subsequently these species have been included in the threatened species assessment.

A four step methodology was applied to assess the potential of the SEFRP to result in significant adverse impacts on EPBC listed species (Figure 20):

1. Separate and define project sub-areas based on the different activities and resultant impacts which will occur as part of SEFRP;
2. Describe the impacts that are likely to occur within each sub-area;
3. Determine the likelihood of EPBC Act listed threatened and migratory species and/or species habitat occurring within each sub-area, including a detailed field survey;
4. Applying the EPBC Significant Impact Guidelines, determine the potential of the SEFRP to significantly impact EPBC listed species by assessing the impact within each sub-area and likely occurrence of the species and/or its habitat.

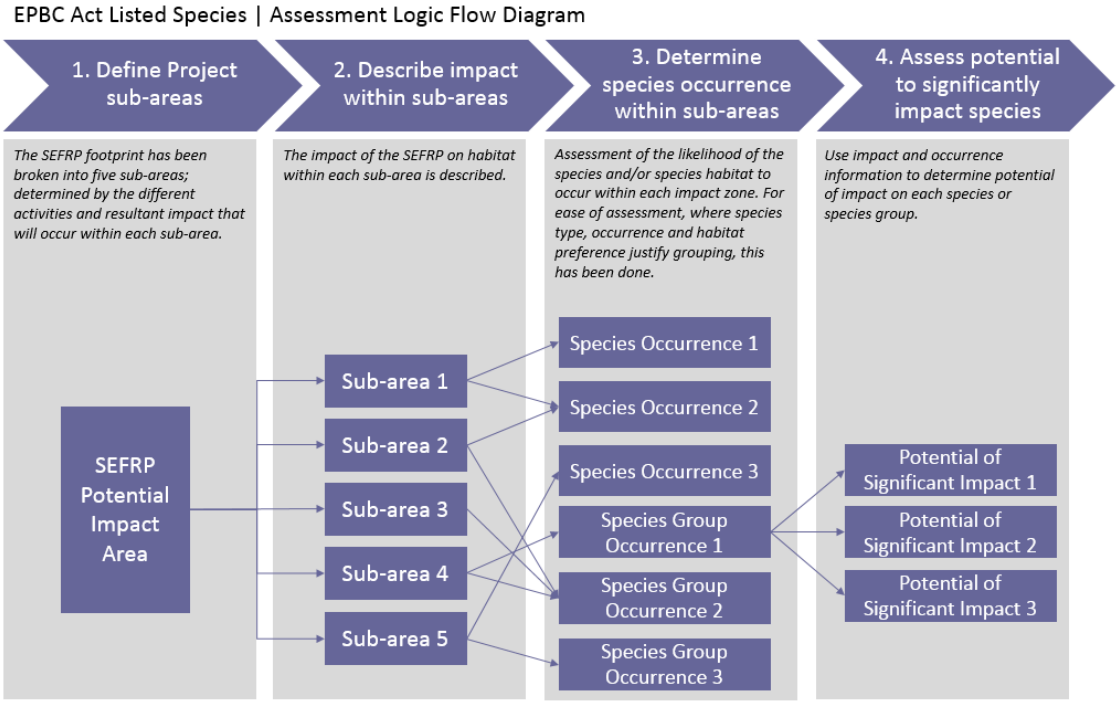

Figure 20: EPBC threatened and migratory species assessment simple logic diagram. *Example only*.

3.1.5.2 Project sub-area descriptions and impacts

Because the SEFRP results impacts different In order to assess the potential impacts to listed threatened and migratory species, this referral has divided the SEFRP area into the following project sub-areas.

- **Sub-area 1: the Coorong** - includes both the Coorong South Lagoon and North Lagoon (Figure 21), noting that the project will primarily influence the South Lagoon.
- **Sub-area 2: Salt Creek to Blackford Construction Corridor** - includes the existing Tilley Swamp and Taratap drains with an expanded width (including channel, spoil bank and access tracks) of between 80 and 100 metres (Figure 22), and approximately 12 km of new channel connecting the Taratap Drain to the Blackford Drain.
- **Sub-area 3: Salt Creek to Blackford Watercourse (*en route* wetlands)** - comprises approximately 11,290 hectares of wetland habitat (Figure 23). This wetland habitat includes 9,440 ha managed for conservation:

- Martin Washpool Conservation Park, 2,851 hectares
- Tilley Swamp Conservation Park, 1,515 hectares
- Seven Heritage Agreement areas (privately managed) totalling 4,037 hectares
- Four Management Agreement areas (privately managed) totalling 1,037 hectares

- **Sub-area 4: Marine** - (Figure 24) is defined as the marine area located at the Blackford Drain outlet near Kingston.
- **Sub-area 5: Blackford Drain downstream of the diversion weir** (Figure 25) - comprises the section of the Blackford Drain downstream of the diversion weir (major regulator) proposed as part of the SEFRP to divert Blackford water northwards towards the Coorong.

Figure 21: Coorong Sub-area.

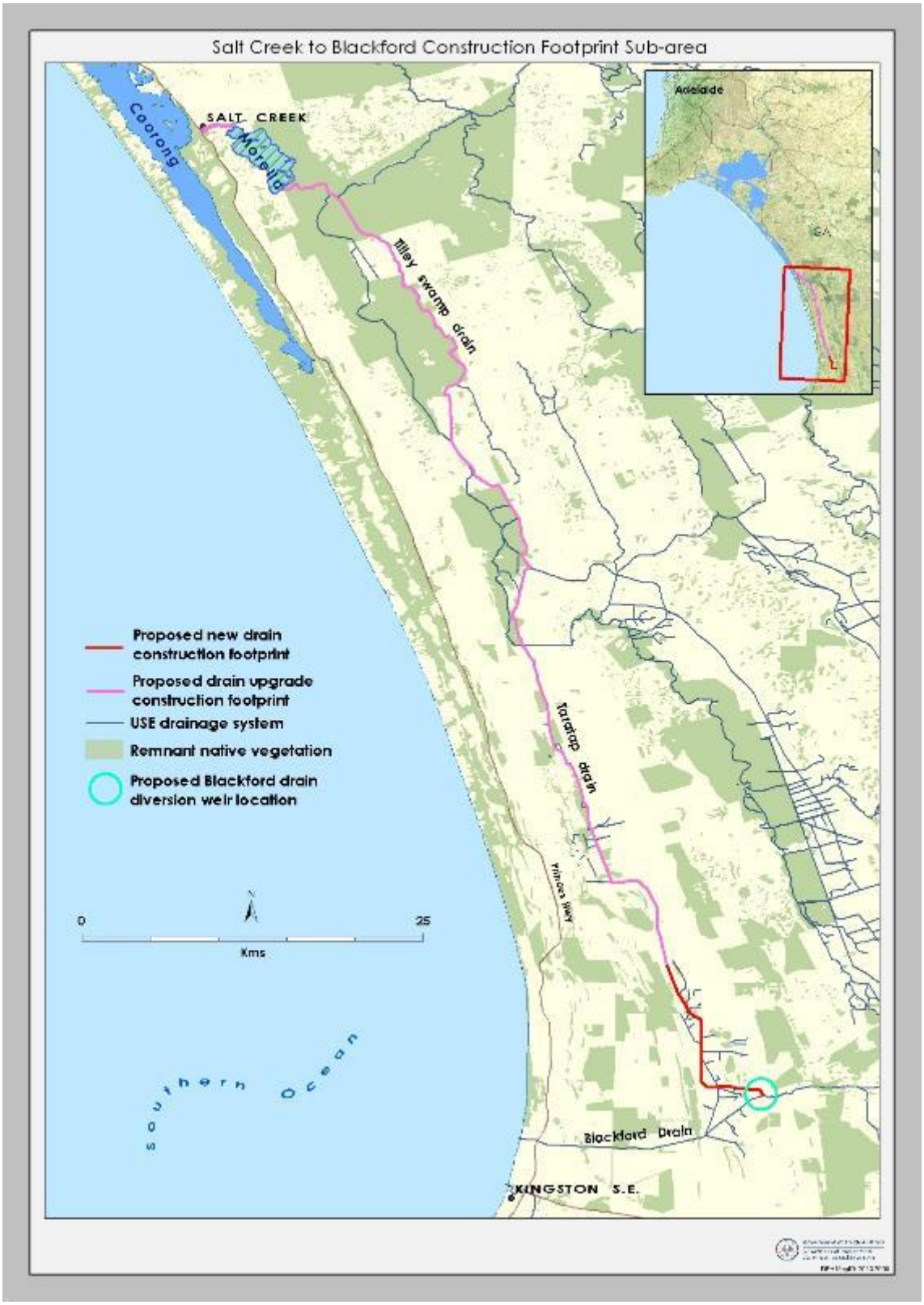

Figure 22: Salt Creek to Blackford Construction Footprint Sub-area

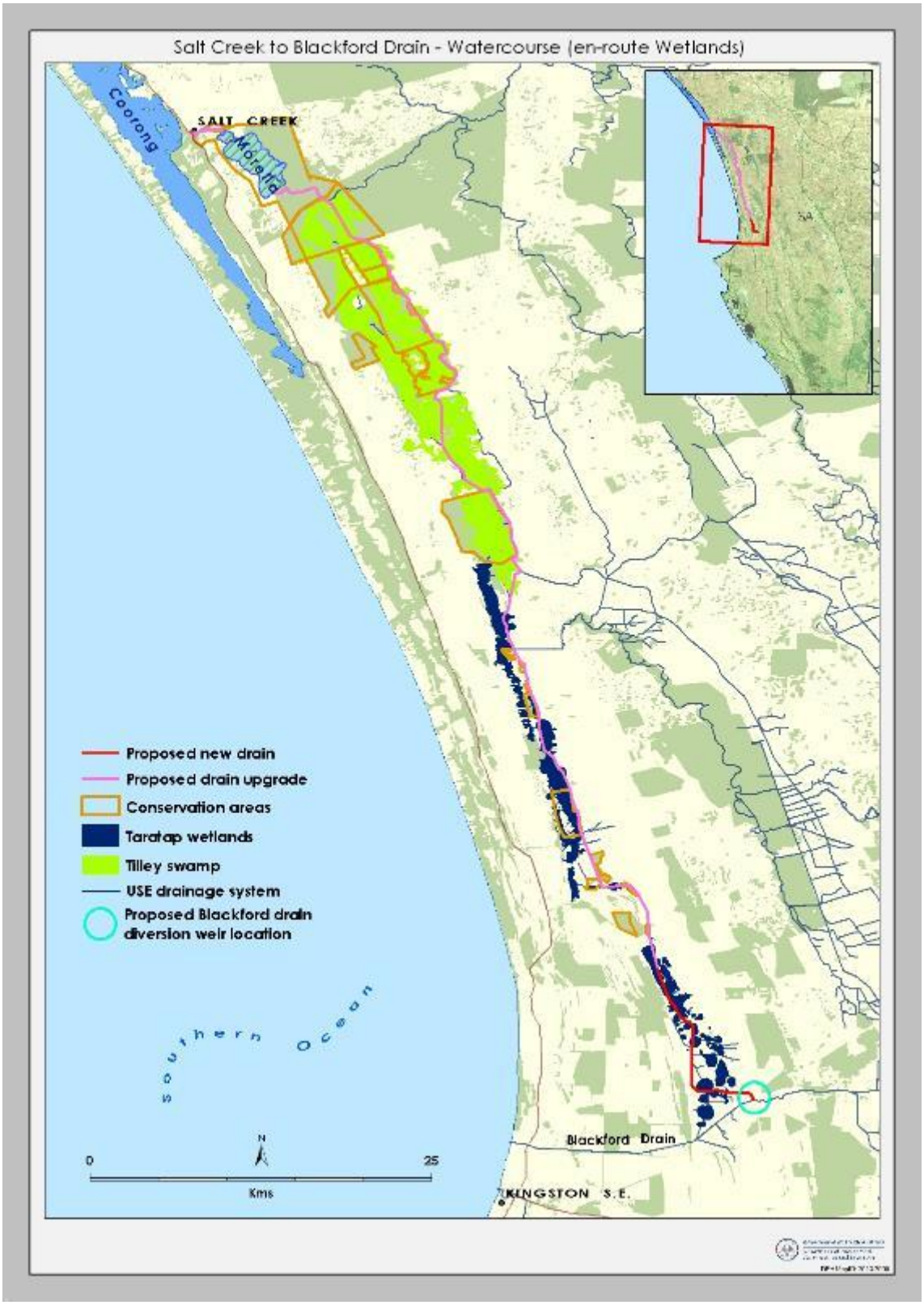

Figure 23: Salt Creek to Blackford Drain Watercourse (en-route wetlands) Sub-area.

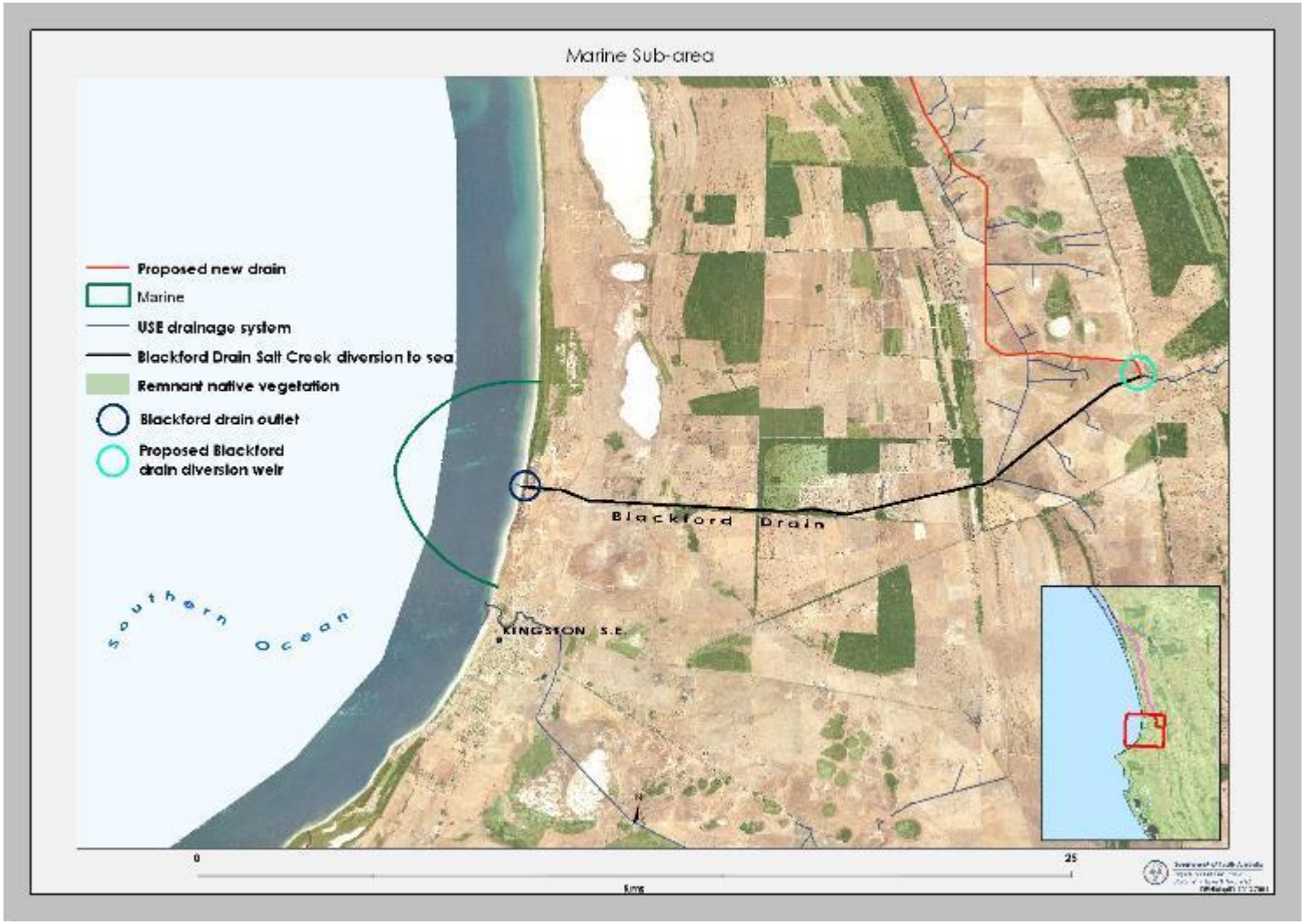

Figure 24: Marine Sub-area

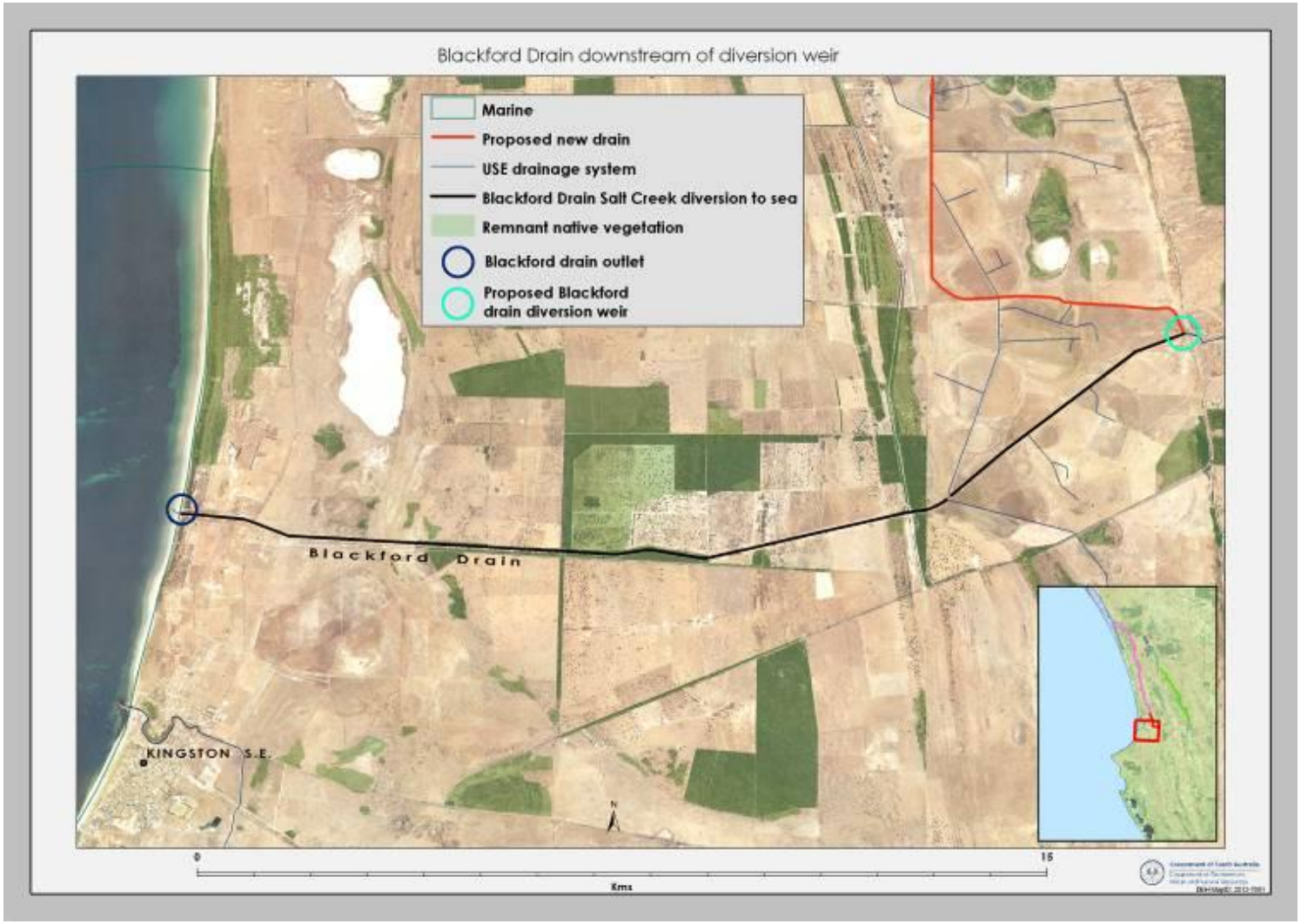

Figure 25: Blackford Drain downstream of diversion weir Sub-area

Sub-area 1: the Coorong

Figure 26: Salt Creek outfall into the Coorong South Lagoon (M de Jong).

Figure 27: Salt Creek outfall into the Coorong South Lagoon (M de Jong).

The impact of the SEFRP on the Coorong is described as part of the assessment against Wetlands of International Importance (Section 3.1.3). This assessment determined that the Coorong is not likely to be significantly impacted by the SEFRP. The purpose of the SEFRP is to assist in managing salinity in the Coorong South Lagoon in order to maintain a healthy ecosystem. Thus the SEFRP provides long term ecological benefits and greater resilience to the Coorong South Lagoon and is expected to have beneficial outcomes for species utilising the Coorong.

Sub-area 2: Salt Creek to Blackford (SEFRP Channel) Construction Corridor

Figure 28: Existing Taratap Drain looking North (M de Jong)

Figure 29: Existing Taratap Drain looking South (M de Jong)

The potential impact assessment for EPBC Act listed species within the Salt Creek to Blackford Construction Footprint (described in Section 2.1.4) will focus on key activities such as vegetation clearance, excavation and spoil placement. It will also considers shorter-term disturbances during construction such as noise and vibration.

Most of the construction corridor is on cleared agricultural land. However, the widening of existing drains in the Taratap and Tilley Swamp areas will involve some unavoidable clearance of native vegetation habitat. A worst-case estimate suggests a maximum clearance of 287 hectares of native vegetation.

The likelihood of EPBC Act listed fauna and flora occurring within the corridor, and the potential for significant impacts, is discussed in Section 3.1.5.4. Targeted surveys for these species and their habitats within the construction corridor have been undertaken (Jacobs 2015) and inform this assessment, as well as impact avoidance, minimisation and mitigation measures.

Sub-area 3: Salt Creek to Blackford Watercourse (*en route* wetlands)

Figure 30: Taratap Wetlands Looking North (M de Jong).

Figure 31: Taratap Wetlands Looking South (M de Jong).

Figure 32: Tilley Swamp Watercourse (M de Jong).

Figure 33: Morella Basin (M de Jong).

Shifts in the vegetation composition of wetlands along the Salt Creek to Blackford watercourse during the last decade, particularly the northern end of the watercourse (north of Petherick Road but south of Morella Basin) indicate a drying trend (Dickson *et al.* 2013). The SEFRP provides the opportunity increase flows to this watercourse. In time, increased flows to the watercourse are anticipated to led to increased aquatic vegetation and improved habitat for wetland dependent species, including waterbirds.

As discussed previously, the extent to which the Tilley Swamp watercourse can be inundated is the subject of ongoing consultation with relevant private landowners. The assessment below assumes the maximum change from existing environmental state (a 'worst-case' scenario - although this change is considered ecologically beneficial). The assessment assumes a change from the current water regime where inundation of the Tilley Swamp watercourse is infrequent, shallow and of limited duration, to a future regime where inundation would occur in most years to a maximum standing water level of 5.4 m AHD. Under this scenario, approximately 4,000 ha more of the watercourse would be inundated compared to the current arrangement.

Operational decision-making regarding the diversion of flow into the watercourse will be guided by Management Principles consistent with and complimentary to the existing Decision Support System by which the South East drainage system is operated.

Sub-area 4: Marine environment

Figure 34: Blackford drain outfall looking East (M de Jong)

Figure 35: Blackford drain outfall looking South (M de Jong)

Prior to the construction of the South East Drainage System, there were very few locations along the South East coast where freshwater discharged directly into the sea (SEDB 1980, Turner and Carter 1989). Today there are more than 20 constructed channels that, at times, discharge considerable quantities of fresh water into the marine environment. This includes the Blackford Drain outlet.

Discharge of fresh water to the marine environment via artificial drains is known to contribute to environmental degradation in the South East. Wear *et al*. (2006) measured a range of parameters indicative of seagrass health and of water quality at the Blackford Drain outlet, and at a control site more than 3km away. The same comparisons were made for three other drain outlets in the region. Results showed that seagrass health was poorer in proximity to drain outlets including the Blackford Drain. It was also shown that the inshore edge of seagrass beds at the Blackford Drain outlet had receded 84 m in the preceding 20 years. Further south, at the Drain M outlet, another study showed that the extent of seagrass beds had declined by 80 percent since the 1950s (Seddon *et al*., 2003). These investigations indicate that drain discharge to the marine environment is having a negative impact upon the marine environment. The greatest impacts are observed at the outlets of drains with the greatest average discharge volumes (Wear *et al*., 2006).

None of the listed migratory or threatened species which have been identified as likely to occur in the Marine sub-area (see Table 13 and Table 14) are dependent on freshwater

outputs from the Blackford Drain outlet. As such, these species are not expected to be significantly impacted by the SEFRP. On the contrary, species occurring in the Marine project sub-area (i.e. in the vicinity of the Blackford Drain outlet) are anticipated to benefit from the SEFRP due to improved seagrass health.

Sub-area 5: Blackford Drain downstream of the diversion weir

Figure 36: Blackford drain downstream of the diversion weir (R. Seaman)

This 15.6 km section of drain is a constructed channel with a base width of 25 m. A small proportion, approximately 8 percent, of the catchment area of the Blackford Drain lies downstream of the proposed SEFRP diversion weir. The drain does not supply water to any wetlands *en route* to the sea.

Winter/spring flows in the lower Blackford Drain typically peak at 200 ML/day, although flows of up 1,200 ML/day have been recorded. Autumn flows typically fall to less than 10 ML/day, often ceasing completely. When inundated, the drain bed is known to support submerged and emergent aquatic vegetation and salt marsh (Ehmke *et al*. 2009). A preliminary assessment of aerial imagery indicates that the bed of the Blackford Drain (when dry) is largely unvegetated, with perennial vegetation, most likely *Tecticornia* sp. (mixed) shrubland or similar, occupying at most 20% of the total surface area of the channel. This amounts to a total area of *Tecticornia* sp. (mixed) shrubland of 10 hectares. The Blackford Drain is not considered important habitat for native fish (Hammer 2002) and was not identified as a drain habitat of high ecological value in a regional assessment (Slater and Farrington 2010).

Despite this, nationally threatened species, in particular Orange-bellied Parrots (Ehmke *et al*. 2009), have been recorded in the area.

Operation of the SEFRP channel will result in the diversion of flows northwards from the Blackford drain along the channel pathway towards the Coorong. The volume of water that will be diverted, and the resultant reduction in flow volumes in the Blackford Drain downstream of the diversion point, will be dependent on the water requirements of the Coorong and *en route* wetlands, but is anticipated to be a high proportion of Balckford Drain flows.

Thus the SEFRP is likely to result in a decrease in the depth and duration of inundation and elimination of high velocity flows. The drain bed is likely to "terrestrialise" i.e. plant species tolerant of deep inundation may be displaced by species that typically occur at higher elevations. The likely result is an increase in saltmarsh vegetation. The reduced frequency of high velocity flows, that can scour the drain bed and remove vegetation, may mean that such vegetation will be more likely to persist. The drain is likely to remain dominated by aquatic flora due to the likely persistence of flows, albeit at reduced flow rates.

3.1.5.3 Likelihood of occurrence of EPBC-listed threatened and migratory species

From the Protected Matters Report, tables have been developed to show the likelihood of occurrence of EPBC listed threatened and migratory species. The distribution and habitat of each species has been summarised from the Department of the Environment's Species Profile and Threats (SPRAT) database. The likelihood of occurrence was then determined based on known references, including the Biological Database of South Australia (BDBSA).

Table 14 and Table 15 provide a summary of threatened species and migratory species respectively that are likely to occur within each of the project sub-areas. Species highlighted in yellow are unlikely to occur within any of the project sub-areas and therefore have not be subject to further impact assessment in this referral. This list was provided as a reference for the targeted field survey of the project area, which in turn informed the further assessment of each species.

The full likelihood of occurrence table for EPBC listed threatened species is at Appendix 2 and EPBC listed migratory species at Appendix 3.

Table 12: Summary of threatened species likely to occur within the project area.

Species	Common Name	EPBC Listing	Likelihood of Occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Birds							
Botaurus poiciloptilus	Australasian Bittern	E	n	y	y	n	n
Calidris ferruginea	Curlew Sandpiper	CE	y	y	y	y	y
Calyptorhynchus banksii graptogyne	Red-tailed Black-Cockatoo (south-eastern)	E	n	y	n	n	n
Diomedea epomophora	Southern Royal Albatross	V	n	n	n	n	y
Diomedea epomophora sanfordi	Northern Royal Albatross	E	n	n	n	n	y
Diomedea exulans antipodensis	Antipodean Albatross	V	n	n	n	n	y
Diomedea exulans	Tristan Albatross	E	n	n	n	n	y
Diomedea exulans (sensu lato)	Wandering Albatross	V	y	n	n	n	y
Halobaena caerulea	Blue Petrel	V	y	n	n	n	y
Lathamus discolor	Swift Parrot	E	n	n	n	n	n
Leipoa ocellata	Malleefowl	V	y	y	y	y	n
Macronectes giganteus	Southern Giant-Petrel	E	n	n	n	n	y
Macronectes halli	Northern Giant-Petrel	V	n	n	n	n	y
Neophema chrysogaster	Orange-bellied Parrot	CE	y	y	y	y	n
Numenius madagascariensis	Eastern Curlew	CE	y	y	y	y	y
Psophodes nigrogularis leucogaster	Western Whipbird (eastern)	V	n	n	n	n	n
Pterodroma mollis	Soft-plumaged Petrel	V	y	n	n	n	y
Rostratula australis	Australian Painted Snipe	V	y	y	y	n	n
Sternula nereis nereis	Fairy Tern (Australian)	V	y	y	y	y	y

Species	Common Name	EPBC Listing	Likelihood of Occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Thalassarche cauta	Shy Albatross, Tasmanian Shy Albatross	V	y	n	n	n	y
Thalassarche cauta salvini	Salvin's Albatross	V	y	n	n	n	y
Thalassarche cauta steadi	White-capped Albatross	V	n	n	n	n	y
Thalassarche melanophris	Black-browed Albatross	V	y	n	n	n	y
Thalassarche melanophris impavida	Campbell Albatross	V	y	n	n	n	y
Fish							
Galaxiella pusilla	Eastern Dwarf Galaxias, Dwarf Galaxias	V	n	n	n	n	n
Maccullochella peeli	Murray Cod	V	n	n	n	n	n
Frogs							
Litoria raniformis	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	V	n	n	n	n	n
Mammals							
Balaenoptera musculus	Blue Whale	E	n	n	n	n	y
Eubalaena australis	Southern Right Whale	E	n	n	n	n	y
Isoodon obesulus	Southern Brown Bandicoot (Eastern)	E	n	n	n	n	n
Megaptera novaeangliae	Humpback Whale	V	n	n	n	n	y
Miniopterus schreibersii bassanii	Southern Bent-wing Bat	CE	n	y	y	n	n
Neophoca cinerea	Australian Sea-lion	V	y	n	n	n	y
Plants							
Caladenia colerata	Coloured Spider-orchid; Small Western Spider-	E	n	y	n	n	n

Species	Common Name	EPBC Listing	Likelihood of Occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
	orchid, Painted Spider-orchid						
Caladenia conferta	Coast Spider-orchid	E	n	y	y	n	n
Caladenia formosa	Elegant Spider-orchid, Blood-red Spider-orchid	V	n	y	n	n	n
Caladenia richardsiorum	Little Dip-Spider-orchid	E	n	y	n	n	n
Caladenia tensa	Greencomb Spider-orchid, Rigid Spider-orchid	E	n	y	n	n	n
Caladenia versicolor	Candy Spider-orchid	V	n	y	y	n	n
Cassinia tegulata	Avenue Cassinia	CE	n	y	y	n	n
Glycine latrobeana	Clover Glycene, Purple Clover	V	n	n	n	n	n
Olearia pannosa subsp. Pannosa	Silver Daisy-bush	V	n	y	y	n	n
Prasophyllum murfetii	Fleurieu Leek Orchid	CE	n	n	n	n	n
Prasophyllum pallidum	Pale Leek-orchid	V	n	n	n	n	n
Prasophyllum validum	Sturdy Leek-orchid	V	n	n	n	n	n
Pterostylis arenicola	Sandhill Greenhood Orchid	V	n	y	n	n	n
Pterostylis cucullata	Leafy Greenhood	V	n	n	n	n	n
Pterostylis sp. Hale	Hale Dwarf Greenhood	E	n	y	n	n	n
Senecio macrocarpus	Large-fruit Fireweed, Large-fruit Groundsel	V	n	y	y	n	n
Thelymitra epipactoides	Metallic Sun-orchid	E	n	y	y	n	n
Thelymitra matthewsii	Spiral Sun-orchid	V	n	y	y	n	n
Reptiles							
Caretta Caretta	Loggerhead Turtle	E	y	n	n	n	y

Species	Common Name	EPBC Listing	Likelihood of Occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Chelonia mydas	Green Turtle	V	n	n	n	n	y
Delma impar	Striped Legless Lizard	V	n	y	y	n	n
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E	y	n	n	n	y
Sharks							
Carcharodon carcharias	Great White Shark	V	y	n	n	n	y

Key

Likely to occur within project sub-area

Does not occur at all within project sub-area

Table 13: Summary of migratory species likely to occur within the project area.

Species	Common Name	EPBC Listing	Likelihood of occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Migratory Marine Birds							
Apus pacificus	Fork-tailed Swift		y	y	y	y	y
Diomedea exulans antipodensis	Antipodean Albatross	V	n	n	n	n	y
Diomedea dabbenena	Tristan Albatross	E	n	n	n	n	y
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	V	n	n	n	n	y
Diomedea exulans (sensu lato)	Wandering Albatross	V	y	n	n	n	y
Diomedea sanfordi	Northern Royal Albatross	E	n	n	n	n	y
Macronectes giganteus	Southern Giant-Petrel	E	n	n	n	n	y
Macronectes halli	Northern Giant-Petrel	V	n	n	n	n	y
Puffinus carneipes	Flesh-footed Shearwater, Fleshy-footed Shearwater		y	n	n	n	y
Sterna albifrons	Little Tern		y	n	n	y	y
Sterna caspia	Caspian Tern		y	y	y	y	y
Thalassarche cauta (sensu stricto)	Shy Albatross, Tasmanian Shy Albatross	V	y	n	n	n	y
Thalassarche impavida	Campbell Albatross	V	y	n	n	n	y
Thalassarche melanophris	Black-browed Albatross	V	y	n	n	n	y
Thalassarche salvini	Salvin's Albatross	V	y	n	n	n	y

Species	Common Name	EPBC Listing	Likelihood of occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Thalassarche steadi	White-capped Albatross	V	n	n	n	n	y
Migratory Marine Species							
Balaenoptera edeni	Bryde's Whale		n	n	n	n	y
Balaenoptera musculus	Blue Whale	E	n	n	n	n	y
Caperea magrinata	Pygmy Right Whale		n	n	n	n	y
Carcharodon carcharias	Great White Shark	V	y	n	n	n	y
Caretta caretta	Loggerhead Turtle	E	y	n	n	n	y
Chelonia mydas	Green Turtle	V	n	n	n	n	y
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E	y	n	n	n	y
Eubalaena australis	Southern Right Whale	E	n	n	n	n	y
Lagenorhynchus obscurus	Dusky Dolphin		n	n	n	n	y
Lamna nasus	Porbeagle, Mackerel Shark		n	n	n	n	y
Megaptera novaeangliae	Humpback Whale	V	n	n	n	n	y
Orcinus orca	Killer Whale, Orca		n	n	n	n	y
Migratory Terrestrial Species							
Haliaeetus leucogaster	White-bellied Sea-Eagle		y	y	y	y	y
Hirundapus caudacutus	White-throated Needletail		y	y	y	y	y
Merops ornatus	Rainbow Bee-eater		y	y	y	y	n

Species	Common Name	EPBC Listing	Likelihood of occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Myiagra cyanoleuca	Satin Flycatcher		n	y	y	y	n
Rhipidura rufifrons	Rufous Fantail		n	y	y	n	n
Migratory Wetland Species							
Actitis hypoleucos	Common Sandpiper		y	y	y	y	n
Ardea alba	Great Egret, White Egret		y	y	y	y	y
Ardea ibis	Cattle Egret		y	y	y	y	n
Arenaria interpres	Ruddy Turnstone		y	n	n	n	y
Calidris acuminate	Sharp-tailed Sandpiper		y	y	y	y	y
Calidris alba	Sanderling		y	y	y	y	y
Calidris canutus	Red Knot, Knot		y	y	y	y	y
Calidris ferruginea	Curlew Sandpiper	CE	y	y	y	y	y
Calidris ruficollis	Red-necked Stint		y	y	y	y	y
Calidris tenuirostris	Great Knot		y	y	y	y	y
Charadrius bicinctus	Double-banded Plover		y	y	y	y	y
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover		y	y	y	y	y
Charadrius veredus	Oriental Plover, Oriental Dotterel		y	y	y	y	y
Gallinago hardwickii	Latham's Snipe, Japanese Snipe		y	y	y	y	n
Limosa lapponica	Bar-tailed Godwit		y	y	y	y	y

Species	Common Name	EPBC Listing	Likelihood of occurrence within the Project Sub-Area				
			Coorong	Salt Creek to Blackford construction footprint	Salt Creek to Blackford Watercourse (*en route* wetlands)	Blackford Drain downstream of diversion weir	Marine
Limosa limosa	Black-tailed Godwit		y	y	y	y	y
Numenius madagascariensis	Eastern Curlew	CE	y	y	y	y	y
Numenius minutus	Little Curlew, Little Whimbrel		y	y	y	y	n
Pluvialis fulva	Pacific Golden Plover		y	y	y	y	y
Pluvialis squatarola	Grey Plover		y	y	y	y	y
Rostratula benghalensis (sensu lato)	Painted Snipe	V	y	y	y	y	n
Tringa glareola	Wood Sandpiper		y	y	y	y	n
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank		y	y	y	y	y
Xenus cinereus	Terek Sandpiper		y	y	y	y	y

Key

Likely to occur within project sub-area

Does not occur at all within project sub-area

Field Survey

A detailed field survey for flora and fauna was undertaken on behalf of DEWNR in 2015 to better determine the likely presence of species and species habitat within the project area, with an emphasis on the construction footprint (Jacobs 2015). The survey report is provided to the Australian Government as supplementary information to the referral. Table 12 and Table 13 were provided as a reference to the field surveyors so that key species could be targeted during the survey.

The findings of the field survey have informed the assessment of the likelihood and extent of expected impacts on threatened and migratory species.

3.1.5.4 Nature and extent of likely impact on threatened and migratory species

Method of assessment

The significant impact assessments of the threatened and migratory species likely to occur within the project area have been based on – *Matters of National Environmental Significance - Significant Impact Guidelines 1.1* (DoE, 2013a).

Where species have similar habitat requirements, the same threatened rating or are expected to be affected by the SEFRP in similar ways, the species have been grouped for the purpose of assessment. Explanations of the groups are provided.

Assessment of impact significance to matters of NES (threatened and migratory species)

Detailed discussion regarding rationale in determining whether there is likely to be a significant adverse impact on each listed species is located through pages 112 to 145 and summarised in Table 14.

Table 14: Summary of impact significance assessment on threatened and Migratory Species.

Species	Common Name	EPBC Status*	Sub area Occurrence**	Likely Significant Impact (Yes/No)
BIRDS				
Botaurus poiciloptilus	Australasian Bittern	E	2, 3	No

Species	Common Name	EPBC Status*	Sub area Occurrence**	Likely Significant Impact (Yes/No)
Calidris ferruginea	Curlew Sandpiper	CE, M	1, 2, 3, 4, 5	No
Calyptorhynchus banksii graptogyne	South-eastern Red-tailed Black Cockatoo	E	2	No
Leipoa ocellata	Malleefowl	V	1, 2, 3, 5	No
Neophema chrysogaster	Orange-bellied Parrot	CE	1, 2, 3, 5	No
Numenius madagascariensis	Eastern Curlew	CE, M	1, 2, 3, 4, 5	No
Rostratula australis	Australian Painted Snipe	V, M	1, 2, 3	No
Sternula nereis nereis	Fairy Tern	V	1, 2, 3, 4	No
Sterna albifrons	Little Tern	M	1, 4, 5	No
Sterna caspia	Caspian Tern	M	1, 2, 3, 4, 5	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	1, 2, 3, 4, 5	No
Threatened and/or migratory pelagic seabirds		E/V, M	1, 4	No
Diomedea epomophora epomophora	Southern Royal Albatross	V, M		
Macronectes halli	Northern Giant-Petrel	V, M		
Diomedea epomophora sanfordi	Northern Royal Albatross	E, M		
Diomedea dabbenena	Tristan Albatross	E, M		
Macronectes giganteus	Southern Giant-Petrel	E, M		
Diomedea exulans (sensu lato)	Wandering Albatross	V, M		
Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	V, M		
Thalassarche salvini	Salvin's Albatross	V, M		
Thalassarche melanophris	Black-browed Albatross	V, M		
Thalassarche melanophris impavida	Campbell Albatross	V, M		
Halobaena caerulea	Blue Petrel	V		
Pterodroma mollis	Soft-plumaged Petrel	V		
Diomedea antipodensis	Antipodean Albatross	V, M		
Thalassarche steadi	White-capped Albatross	V, M		
Puffinus carneipes	Flesh-footed Shearwater, Fleshy-footed Shearwater	M		

Species	Common Name	EPBC Status*	Sub area Occurrence**	Likely Significant Impact (Yes/No)
Migratory Exclusively Aerial Birds		M	1, 2, 3, 4, 5	No
Apus pacificus)	Fork-tailed Swift	M		
Hirundapus caudacutus	White-throated Needletail	M		
Migratory Waterbirds		M	1, 2, 3, 4, 5	No
Ardea alba	Great Egret, White Egret	M		
Ardea ibis	Cattle Egret	M		
Migratory Bush Birds		M	1, 2, 3, 5	No
Merops ornatus	Rainbow Bee-eater	M		
Myiagra cyanoleuca	Satin Flycatcher	M		
Rhipidura rufifrons	Rufous Fantail	M		
Migratory Shorebirds		M	1, 2, 3, 4, 5	No
Actitis hypoleucos	Common Sandpiper	M		
Arenaria interpres	Ruddy Turnstone	M		
Calidris acuminate	Sharp-tailed Sandpiper	M		
Calidris alba	Sanderling	M		
Calidris canutus	Red Knot, Knot	M		
Calidris ferruginea	Curlew Sandpiper	CE, M		
Calidris ruficollis	Red-necked Stint	M		
Calidris tenuirostris	Great Knot	M		
Charadrius bicinctus	Double-banded Plover	M		
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover	M		
Charadrius veredus	Oriental Plover, Oriental Dotterel	M		
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	M		
Limosa lapponica	Bar-tailed Godwit	M		
Limosa limosa	Black-tailed Godwit	M		
Numenius madagascariensis	Eastern Curlew	CE, M		
Numenius minutus	Little Curlew, Little Whimbrel	M		
Pluvialis fulva	Pacific Golden Plover	M		
Pluvialis squatarola	Grey Plover	M		
Tringa nebularia	Common Greenshank	M		
Tringa glareola	Wood Sandpiper	M		
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	M		
Xenus cinereus	Terek Sandpiper	M		
MAMMALS				
Miniopterus schreibersii bassanii	Southern Bent-wing Bat	CE	2, 3	No

Species	Common Name	EPBC Status*	Sub area Occurrence**	Likely Significant Impact (Yes/No)
Neophoca cinerea	Australian Sea Lion	V	1, 4	No
Threatened and/or migratory marine species/ mammals/ sharks		V/E, M	1, 4	No
Balaenoptera musculus	Blue Whale	E, M		
Eubalaena australis	Southern Right Whale	E, M		
Megaptera novaeangliae	Humpback Whale	V, M		
Carcharodon carcharias	Great White Shark	V, M		
Balaenoptera edeni	Bryde's Whale	M		
Caperea magrinata	Pygmy Right Whale	M		
Lagenorhynchus obscurus	Dusky Dolphin	M		
Lamna nasus	Porbeagle, Mackerel Shark	M		
Orcinus orca	Killer Whale, Orca	M		
REPTILES				
Delma impar	Striped Legless Lizard	V	2, 3	No
Threatened and/or Migratory Marine Turtles		V	1, 4	No
Caretta caretta	Loggerhead Turtle	V		
Chelonia mydas	Green Turtle	V		
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	V		
PLANTS				
Cassinia tegulata	Avenue Cassinia	CE	2, 3	No
Olearia pannosa subsp. Pannosa	Silver Daisy-bush	V	2, 3	No
Senecio macrocarpus	Large-fruit Fireweed, Large-fruit Groundsel	V	2, 3	No
Endangered Orchids		E	2, 3	No
Caladenia colerata	Coloured Spider-orchid; Small Western Spider-orchid, Painted Spider-orchid	E		
Caladenia conferta	Coast Spider-orchid	E		
Caladenia richardsiorum	Little Dip-Spider-orchid	E		
Caladenia tensa	Greencomb Spider-orchid, Rigid Spider-orchid	E		
Pterostylis sp. Hale	Hale Dwarf Greenhood	E		

Species	Common Name	EPBC Status*	Sub area Occurrence**	Likely Significant Impact (Yes/No)
Thelymitra epipactoides	Metallic Sun-orchid	E		
Vulnerable Orchids		V	2, 3	No
Caladenia formosa	Elegant Spider-orchid, Blood-red Spider-orchid	V		
Caladenia versicolor	Candy Spider-orchid	V		
Pterostylis arenicola	Sandhill Greenhood Orchid	V		
Thelymitra matthewsii	Spiral Sun-orchid	V		

*Note: *CE – Critically Endangered; E – Endangered; V – Vulnerable; M – Migratory*

***1 – Coorong; 2 – Salt Creek to Blackford construction footprint; 3 – Salt Creek to Blackford watercourse (en route) wetlands; 4 – Marine; 5 – Blackford drain downstream of the diversion weir*

Threatened and Migratory Bird Assessment

Australasian Bittern (*Botaurus poiciloptilus*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Endangered
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for the Australian Bittern focuses on potential impacts in the Salt Creek to Blackford Construction Footprint sub-area. The species may occur in the Salt Creek to Blackford Watercourse (en route wetlands) sub-area, however increased inflows to these wetlands would be beneficial for the species.

The Australasian Bittern favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over muddy or peaty substrate (Marchant and Higgins 1990). The Salt Creek to Blackford Construction Footprint sub-area requires (as a worst case) the clearance of approximately 54 ha of *Gahnia filum* sedgeland and 16 ha of *Gahnia trifida* sedgeland. Other vegetation types in the construction footprint requiring clearance are non-preferred and not likely to provide feeding or breeding habitat for the species. Clearance of 70 ha represents a very small proportion of the 8,484 ha total remnancy of *Gahnia filum* within the South East NRM Region.

It represents an even smaller proportion of the 15,648 ha area of favourable habitat for the Australasian Bittern in the South East NRM Region, which, in addition to *Gahnia filum* sedgeland, also includes:

- *Apodasmia brownii* (mixed) sedgeland (1,301 ha)
- *Baumea juncea* (mixed) sedgeland (1,274 ha)
- *Baumea juncea, Apodasmia brownii* sedgeland (190 ha)
- Cyperaceae sp., Gramineae sp. Sedgeland (3,594 ha)
- *Juncus* sp. (mixed) sedgeland (572 ha)
- *Phragmites australis, Typha domingensis* grassland (7 ha)

- *Typha domingensis* sedgeland (226 ha).

The Australasian Bittern has not been recorded in the Salt Creek to Blackford Construction Footprint sub-area despite recent waterbird surveys (Dickson *et al*. 2013) and targeted fauna assessment for the SEFRP (Jacobs 2015). Thus there is a very low probability that the species will be present within the small area of suitable habitat to be cleared as part of construction.

Patches of favourable habitat for the species in the Salt Creek to Blackford Construction Footprint sub-area are already separated by the existing drain. The SEFRP will simply widen the gap between patches of favourable habitat by up to approximately 40 m. Even if a population exists in the Salt Creek to Blackford Construction Footprint sub-area, the ability to fly between patches of favourable habitat on either side of the drain will ensure such fragmentation does not occur.

The key invasive species that pose a threat to the Australasian Bittern are foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) (TSSC, 2011). Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. No new pathways for invasion will be created by the project. The SEFRP is not anticipated to have any impact upon the fox or feral cat populations of the project area.

While the field survey did not record the presence of the species, the report notes that there is potential for the species to occur. However, given mobile nature and sub-optimal habitat found within the study area (i.e. patchy occurrences of reeds as opposed to reed beds), the species has a low likelihood of occurrence and therefore no significant impact is expected.

Curlew Sandpiper (*Calidris ferruginea*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain downstream of diversion weir Marine
Threatened Status	Critically Endangered
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessment for the Curlew Sandpiper focuses on all five sub-areas of the overall project area. The Curlew Sandpiper is regularly recorded in the Coorong, although its abundance has declined markedly in recent years (Paton 2010). The BDBSA holds records of the Curlew Sandpiper from the northern end of Tilley Swamp Conservation Park (5 individuals) in 1996. There are also records of the species from 2001 in the Morella Basin, from 2002 in Tilley Swamp and (Claire Harding, DEWNR, pers. comm. Feb. 2016). All non-Coorong locations are within the Salt Creek to Blackford watercourse (*en route* wetlands) sub-area.

The potential impacts of the SEFRP in the Coorong relate to water quality changes and the implications for the ecosystem. The Water Quality Risk Assessment undertaken for the project (Wilson *et al*. 2016) has concluded the SEFRP presents a low risk to the Coorong ecosystem (see Table 9, Section 3.1.3.2). Impact to the Curlew Sandpiper in the Coorong sub-region is therefore not anticipated.

The Salt Creek to Blackford construction footprint supports habitat of very marginal value to Curlew Sandpiper. The shrubland, woodland and agricultural (pasture) vegetation of the construction footprint is not favoured by this waterbird that breeds in the Arctic and migrates annually to Australia to feed in shallowly inundated mudflats. There are no records of the species within the construction footprint and the species was not detected there during the 2015 field assessment (Jacobs 2015), noting that the timing of this assessment was not optimal for detection. Vegetation clearance within the construction footprint is not anticipated to significantly impact the species.

Recent records of Curlew Sandpiper in the Salt Creek to Blackford watercourse (*en route* wetlands) sub-area exist (see above), however these wetlands are not recognised as important shorebird habitat. They are most well vegetated and lacking in the open, shallowly inundated mudflat habitat favoured Curlew Sandpiper and other shorebirds. The SEFRP is likely to increase the frequency of inundation of these *en route* wetlands, many of which, particularly those in the northern Tilley Swamp area, are 'terrestrialising' due to decreased inundation since 2000, when the existing Tilley Swamp drain was constructed. The project is therefore anticipated to improve the habitat value of these *en route* wetlands for Curlew Sandpiper and other waterbirds.

There are no known records of Curlew Sandpiper in the Blackford Drain downstream of the proposed SEFRP diversion weir in the BDBSA or any other source. The bed of the drain represents a tiny proportion of available habitat within the region. It would only be suitable for Curlew Sandpiper foraging when shallowly inundated under very low flows. High flows or no flows (dry) would render the drain bed unsuitable for the species. The reduction in flows caused by the SEFRP will reduce the frequency of high flows and extend the duration

of no flows. Low flows will the drain receives flows from a catchment downstream of the proposed SEFRP diversion weir. A gradual shift in vegetation from aquatic species to less inundation tolerant saltmarsh species is anticipated. Given the small amount of suitable habitat (approx. 40 ha) and the likely absence of the species, impacts to Curlew Sandpiper due to habitat changes in the lower Blackford Drain are not anticipated.

As a shorebird species, Curlew Sandpiper may forage on the beach in the vicinity of the Blackford Drain outlet, however there are no known records from the area. The marine ecosystem in the vicinity of the Blackford Drain is anticipated to improve as a consequence of the SEFRP, therefore impacts to Curlew Sandpiper are not anticipated in this sub-area.

In summary, there are no sub-areas of the SEFRP project area where impacts to Curlew Sandpiper are anticipated to be significant. The species is anticipated to benefit from improved conditions in the Coorong and increased inundation of *en route* wetlands.

South-eastern Red-tailed Black Cockatoo (*Calyptorhynchus banksii graptogyne*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint
Threatened Status	Endangered
Migratory Species	No
Impact Status	No Significant Impact

The SEFRP project area is outside the “current normal range” for the species as described in the Recovery Plan (DEWR 2007). However, the BDBSA contains recent records of the species outside the current normal range as close as 7.5 km from the project area. The four records closest to the project area are:

- 15 individuals observed in April 2009 in Coastal Mallee (*Eucalyptus diversifolia*) near Smith Swamp, 7.5 km from the SEFRP construction corridor;
- 8 individuals observed in June 2009 in stringybark vegetation near Water Valley Road, 14.7 km from the SEFRP construction corridor;
- 26 individuals observed in January 2009 in Manna Gum near Water Valley Road, 18 km from the SEFRP construction corridor; and
- 11 individuals observed in September 2009 in Hill Gums (*Eucalyptus fasciculosa*) near Water Valley Road, 21.1 km from the SEFRP construction corridor.

The cockatoo has highly specialised feeding habits, feeding primarily on the seeds of Desert and Brown Stringybark (*Eucalyptus baxteri and E. arenacea*), and seasonally on the seeds of Buloke (*Allocasuarina leuhmannii*) (DEWR 2007).

The cockatoo requires very old, large, hollow eucalypts for nesting. Over 95% of known nest sites are within 2 km, and all within 5 km, of >5 ha blocks of stringybark (Hill and Burnard 2001). Nests have been recorded in *Eucalyptus camaldulensis*, *E. baxteri*, *E. arenacea*, *E. viminalis*, *E. leucoxylon* and *E. fasciculosa* (DEWR 2007).

Vegetation clearance within the SEFRP construction footprint includes clearance of the following (as a worst case):

- *Eucalyptus diversifolia* mallee forest: 16.40 ha
- *Eucalyptus fasciculosa/Eucalyptus leucoxylon* open woodland: 2.60 ha

Both vegetation types, if located within the "current normal range" for the species, would comprise potential nesting habitat, provided other criteria were met (presence of hollows, hollows located within 5 km of >5 ha patch of Desert or Brown Stringybark woodland). However, vegetation affected by the project is located 38.5 km away from the closest known record (BDBSA) of South-eastern Red-tailed Black Cockatoo (near Smith Swamp) and approximately 56 km from the area defined as the "current normal range" for the species. It is therefore highly unlikely that the species utilises the patch. For this reason the SEFRP is not likely to:

- lead to a long-term decrease in the size of the population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or,
- interfere with the recovery of the species.

The field fauna and flora survey (Jacobs 2015) recorded limited habitat to support this species along the proposed alignment (open shrubland, no open forest). Given the species is highly mobile, the project as unlikely to have a significant impact on the species.

Malleefowl (*Leipoa ocellata*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain downstream of diversion weir
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

Summary

The impact assessment for this species focuses on the Salt Creek to Blackford construction footprint and Salt Creek to Blackford watercourse (*en route* wetlands) subareas.

The targeted survey for Malleefowl (Jacobs 2015) focussed on the construction corridor and also assessed ares of the watercourse in Tilley Swamp. While suitable habitat exists no nesting mounds or other evidence of occurrence was observed in the construction corridor. However, a single Malleefowl individual was observed in the immediate vicinity of the construction corridor. The clearance of Malleefowl habitat is considered minor and not likely to significantly impact the local population.

Increased inundation of the northern end of the Salt Creek to Blackford watercourse sub area, as a consequence of the project, will render this marginal Malleefowl habitat seasonally unavailable for the species in some years. However, when dry the watercourse habitat will remain available to Malleefowl. This impacts is not considered to be significant for the local population.

Disturbance to individuals during construction (noise, vibration, increased traffic) will be minor,short term and readily avoided by this mobile species. A Contractor Environmental Management Plan (CEMP) will be developed in collaboration with Mallefowl experts and stakeholders to guide construction contractors such that impacts during construction are minimised.

Assessment of Malleefowl is discussed in greater detail below.

Populations

The population, or populations, of Malleefowl in the South East of South Australia are likely to be “important” because they are populations that are near the limit of the species range (DEWHA 2009). The South East region populations lie at the southern edge of the species extent of occurrence (Benshemesh 2007).

Definitions of population and geographic boundaries to delineate distinct populations have not been articulated for Malleefowl in the South East. However, a single population, or metapopulation, may occupy several remnants, dispersing regularly and freely between them. Due to the absence of information in this respect, a conservative approach has been used in this assessment that adopts the edges of distinct, geographically isolated patches of remnant vegetation known to support the species as the geographic boundaries of individual populations.

Based on the above definition, there are approximately 15 distinct populations of Malleefowl within the South East (Le Duff and Harley 2009). The SEFRP involves potential impacts to one such population - the Northern Tilley Swamp remnant population. Impacts to a second potential population - the Tilley Swamp Conservation Park remnant population, have also been examined.

Clearance of potential breeding habitat

The favoured breeding habitat of Malleefowl is mallee vegetation and, in southern South Australia, stringybark (*Eucalyptus baxteri*, *E. arenacea*) woodland on light, sandy soils (Benshemesh 2007). Lighter soils are favoured for the construction of nest mounds. Within the SEFRP area, the native vegetation types that most closely align with the preferred, potential breeding habitat for Malleefowl are *Eucalyptus arenacea* woodland, *Eucalyptus diversifolia* mallee forest and *Eucalyptus fasciculosa/Eucalyptus leucoxylon* woodland. These vegetation types occur only in the Salt Creek to Blackford Construction Footprint sub-area. There are areas of these vegetation types within the greater Salt Creek to Blackford watercourse (*en route* wetlands) sub-area, however they occupy elevated locations and would not be inundated (i.e. impacted) as a consequence of increased diversions into *en route* wetlands.

Northern Tilley Swamp remnant population

The only part of the SEFRP area where potential Malleefowl breeding habitat requires clearance is within a single large remnant of 16,100 ha that includes Martin Washpool Conservation Park (incorporating Morella Basin) and several heritage agreements i.e. the Northern Tilley Swamp remnant. It is assumed to define the geographic boundary of a

distinct Malleefowl population. This remnant is also the only area of native vegetation containing records of Malleefowl that will be affected by vegetation clearance for the SEFRP. The Northern Tilley Swamp remnant contains 6,587 ha of potential Malleefowl breeding habitat including *Eucalyptus arenacea* woodland (84 ha), *Eucalyptus diversifolia* mallee forest (5,598 ha), *Eucalyptus fasciculosa* woodland (820 ha) and *Eucalyptus leucoxylon* woodland (85 ha). Total clearance for the SEFRP of these vegetation types combined is 18.9 ha (worst case) within the construction corridor. The total clearance required represents 0.31 of the potential breeding habitat within the Northern Tilley Swamp remnant. Such a proportionally small area of clearance is not likely to adversely affect the Malleefowl population of this remnant. The targeted Malleefowl survey (Jacobs 2015) did not detect any Malleefowl nesting mounds within the construction footprint, however one individual bird was observed within *Eucalyptus diversifolia* mallee approximately 50 m from the construction footprint.

The Northern Tilley Swamp remnant may be of relatively low importance for Malleefowl breeding than nearby remnant vegetation in the Coorong National Park and elsewhere in the South East region. The BDBSA contains only eight Malleefowl records in the Northern Tilley Swamp remnant, mostly from the period 1996 to 2005. This is a much lower density of records in both space and time than the Coorong National Park, which includes 47 Malleefowl records in the vicinity of Salt Creek (in habitat outside of the proposed construction footprint). None of the Northern Tilley Swamp records indicate the presence of nesting mounds. DEWNR (and precursor departments) has not established monitoring grids for Malleefowl nests in Martin Washpool Conservation Park (within the Northern Tilley Swamp remnant) yet such grids have been established in nearby Coorong National Park, Mount Scott Conservation Park, Gum Lagoon Conservation Park and Mount Boothby Conservation Park. Grids were established in known nesting habitat to monitor Malleefowl breeding (Le Duff and Harley 2009).

Clearance of feeding habitat

Salt Creek to Blackford construction footprint sub-area

The preferred habitat for Malleefowl is mallee and *Eucalyptus* woodlands on light sandy soils, favoured due to its suitability for both breeding and the provision of food resources. However, for feeding, the species is likely to range into a more diverse suite of habitats that may include areas with heavier soils that are less suitable for mound building. Such habitat may include the other (non-preferred) vegetation types within the Salt Creek to Blackford construction footprint sub-area. Within the Northern Tilley Swamp remnant, in addition to the 18.9 ha of potential breeding habitat, clearance of non-preferred, potential feeding habitat amounts to 124.84 ha and includes (as a worst case):

- Regrowth *Melaleuca halmaturorum* shrubland on existing spoil mounds (16.58 ha to be cleared),
- *Allocasuarina verticillata* ± *Melaleuca lanceolata* open woodland (0.43 ha to be cleared),
- *Gahnia filum* sedgeland ± *Melaleuca halmaturorum* (1.16 ha to be cleared),
- *Gahnia trifida* sedgeland ± *Melaleuca brevifolia* (0.57 ha to be cleared),
- *Melaleuca brevifolia* closed shrubland (14.92 ha to be cleared),
- *Melaleuca halmaturorum* shrubland to tall shrubland (83.11 ha to be cleared),
- *Samolus repens/Wilsonia backhousei* herbland ± *Melaleuca halmaturorum* (8.07 ha to be cleared)

The importance of these vegetation types as feeding habitat is likely to vary. The density of Malleefowl in an area of habitat tends to be positively correlated with the diversity of shrubs (Benshemesh 2007). Shrub diversity in the Tilley Swamp area ranges from relatively high within *Melaleuca brevifolia* shrubland to low within *Melaleuca halmaturorum* shrubland (Telfer *et al*. 2000). *Gahnia filum* (mixed) sedgeland in the South East region typically supports a low diversity and abundance of shrubs (e.g. Stewart *et al*. 2001), while *Samolus repens/Wilsonia backhousei* herbland is a brackish to saline wetland vegetation type unlikely to be utilised by Malleefowl. The majority of vegetation clearance is of low shrub diversity, which is therefore likely to support a low density of Malleefowl. The clearance of 124.84 ha represents 1.3 percent of the 9,513 ha of non-preferred, potential feeding habitat for the species within the Northern Tilley Swamp remnant. Such a proportionally small area of clearance of predominantly marginal, non-breeding habitat is not likely to significantly reduce the Malleefowl population.

There are no BDBSA records of the species in the Tilley Swamp Conservation Park remnant (2,465 ha, includes both the Conservation Park and adjacent areas) further south. The species may not occur there due to the isolation of the remnant and the relatively small amount of potential breeding habitat (208 ha). Additionally, approximately 1,600 ha of this remnant, including the whole of the Tilley Swamp Conservation Park and almost all of the potential Malleefowl breeding habitat, was burned by wildfire in February 2013. Given that Malleefowl prefer long-unburned vegetation (Benshemesh 2007), the likelihood that this remnant supports a population of Malleefowl is very low. However, the potential occurrence of the species cannot be ruled out completely. Vegetation clearance required for the SEFRP within this remnant is 18.42 ha of non-preferred, potential feeding habitat (1.15 ha of *Gahnia filum* sedgeland ± *Melaleuca halmaturorum* and 17.27 ha of *Melaleuca halmaturorum* shrubland to tall shrubland). This clearance represents 0.8 percent of the 2,257 ha of non-preferred, potential feeding habitat for the species within the Tilley Swamp Conservation

Park remnant. Such a proportionally small area of clearance of likely marginal, non-breeding habitat is not likely to adversely affect any Malleefowl population within this remnant.

Blackford Drain downstream of diversion weir sub-area

BDBSA records of Malleefowl located within the Blackford Drain downstream of diversion weir sub-area (1 record from 1999) indicate the potential presence of a population. This record was almost certainly made within terrestrial (non-wetland) vegetation adjacent to the drain, probably *Banksia ornata* mixed shrubland. This vegetation will not be affected by the project. The drain itself supports aquatic vegetation when flowing, and possibly sedgeland or samphire vegetation when flows reduce or cease. Neither habitat type is likely to be utilised by Malleefowl for either breeding or feeding. Significant impacts to Malleefowl within this sub-area of the project can therefore be ruled out.

In summary, vegetation clearance for the SEFRP (worst case estimate) amounts to 0.3 percent of the preferred breeding and feeding habitat in one remnant known to support the species, 1.3 percent of the non-preferred potential feeding habitat within the same remnant, and 0.8 percent of the non-preferred potential feeding habitat within another remnant unlikely to support the species.

Increased inundation of feeding habitat

Salt Creek to Blackford Watercourse (en route wetlands)

The Taratap wetlands are not known to support a Malleefowl population. These wetlands are inundated in most years under current management. An increase to the frequency of inundation of the Taratap wetlands under the SEFRP is not anticipated to have any implications for Malleefowl.

Tilley Swamp Conservation Park, as discussed above, is unlikely to support Malleefowl. Inundation of the wetlands within the Park currently occurs in most years. Seasonally inundated wetlands provide, at best, very marginal feeding habitat for Malleefowl. The frequency of inundation of wetlands in the Park may increase under the SEFRP, however a significant impact to the local Malleefowl population, in the unlikely event that one persists, is not considered likely as a consequence.

The northern Tilley Swamp watercourse currently supports extensive areas of *Melaleuca halmaturorum* shrubland and smaller (shrinking) areas of open herbland, both providing very marginal feeding habitat for Malleefowl. Historic aerial photographs show that in the 1990s this area was largely devoid of shrubs, consisting primarily of open herbland and bare pipeclay basins that were seasonally inundated. The evidence is supported by anecdotal reports from landholders. This wetlands habitat would have provided very marginal feeding

habitat for Malleefowl when dry, and been unavailable to Malleefowl when inundated. Construction of the Tilley Swamp Drain in 2000 altered the hydrology of this wetland system, greatly reducing the frequency, depth and duration of inundation. As a consequence, the vegetation of the northern Tilley Swamp watercourse has 'terrestrialised', i.e. plant species tolerant of frequent, extended inundation have been replaced by species less tolerant of inundation that were previously confined to shallow wetland margins. The most obvious and extensive change has been the invasion of *Melaleuca halmaturorum* shrubs onto formerly open wetland basins. As discussed above, *Melaleuca halmaturorum* shrubland provides very marginal feeding habitat for Malleefowl. It has low shrub diversity, which is an indicator of its low value for Malleefowl (Benshemesh 2007). However, given its proximity to high value feeding and breeding habitat for Malleefowl, and its large size (approx. 3,000 ha), this terrestrialised wetland habitat may provide marginal feeding habitat for Malleefowl.

Under the SEFRP the frequency, depth and duration of inundation of the northern Tilley Swamp may (subject to landholder agreement) increase. Inundation renders this habitat unavailable to Malleefowl, which are not known to forage in surface water. Thus, marginal feeding habitat for Malleefowl (*M. halmaturorum* shrubland and open herbland) would become unavailable more frequently due to more frequent inundation. Seasonal drying of these wetlands would still occur, and drying may extend for several years under conditions where all SEFRP water is required for diversion into the Coorong, rather than *en route* wetlands. Thus, this habitat would remain available for Malleefowl, however it would be more frequently inaccessible due to inundation. There would also be likely changes to the vegetation, with plants less tolerant of inundation gradually displacing less tolerant species. However, such changes are unlikely to change the favour of this habitat for Malleefowl given it is of low value in its current state.

In summary, increased inundation of the northern Tilley Swamp watercourse is not anticipated to cause a significant impact to the local Malleefowl population because it affects only habitat of very marginal value to Malleefowl, and that habitat will remain available to Malleefowl when the watercourse is dry, as is anticipated to occur at least annually on a seasonal basis. Additionally, increased inundation of northern Tilley Swamp will partially restore a hydrological regime that the local Malleefowl population co-existed with prior to 2000, at which time the total size of the Northern Tilley Swamp remnant (all vegetation types) was the same as it is currently.

Breeding cycle and fragmentation

Malleefowl nesting mounds have not been observed within the Salt Creek to Blackford construction footprint despite a targeted survey (Jacobs 2015) and regular visitation of the

area by South Eastern Water Conservation and Drainage Board staff for management purposes. The seasonal breeding window for Malleefowl, from early egg-laying to late hatching, extends from September until March. The risk of noise impacting the populations breeding cycle is considered low, and any impact of noise on breeding activity is not considered likely to result in significant impact. However the CEMP will be developed and implemented to ensure such impacts are minimised.

The SEFRP will not fragment an existing population of Malleefowl because a cleared channel already exists through the Northern Tilley Swamp remnant and the Tilley Swamp Conservation Park remnant. The SEFRP will merely widen the cleared gap between vegetation on either side of the existing drain by up to approximately 40 m. Note that four fauna crossings (vegetated bridges) over the existing Tilley Swamp drain are currently in place within the Northern Tilley Swamp remnant. These crossings will be maintained and upgraded to accommodate the wider channel. It is likely that the ability of the species to fly between patches of favourable habitat on either side of the drain has, and will continue to, ensure such fragmentation does not occur.

Habitat critical to the survival of the species, invasive species and introduction of disease

Habitat critical to the survival of the species has not been identified or mapped in detail (Benshemesh 2007). However, potential breeding habitat is important. Due to the very large extent of occurrence (900,000 km2) and area of occupancy (40,000 km2), the clearance of potential breeding habitat required for the SEFRP (18.9 ha) is not anticipated to adversely affect habitat critical to the survival of the species.

The key invasive species that pose a threat to the Malleefowl are foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) (Benshemesh 2007). Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. Any invasive flora species that could impact upon habitat quality have had similar previous opportunities for invasion. No new pathways for invasion of these species will be created by the project.

There is no information on disease in wild Malleefowl populations (Benshemesh 2007) and no reason to anticipate that the SEFRP will introduce disease that may cause the species to decline.

Overall the SEFRP is not anticipated to result in a significant impact on Malleefowl when assessed against the significant impact criteria.

Orange-bellied Parrot (*Neophema chrysogaster*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain downstream of diversion weir
Threatened Status	Critically Endangered
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessment for the Orange-Bellied Parrot (OBP) focuses on the Salt Creek to Blackford Construction Footprint, the Salt Creek to Blackford Watercourse (*en route* wetlands) and Blackford Drain Downstream of Diversion Weir sub-areas.

Salt Creek to Blackford construction footprint

The Salt Creek to Blackford construction footprint incorporates part of the mainland over-wintering habitat of the OBP. The construction footprint includes saltmarshes, pastures and shrublands within 10 km of the coast, which are habitats known to be used by OBPs (Orange-Bellied Parrot Recovery Team 2006). However, during winter, on mainland Australia the species is found mostly within 3 km of the coast (Starks *et al*. 1992). The BDBSA records of the species within the project area support this, with nearly all located in the Coorong area. Only one record is located in the Salt Creek to Blackford area, within the watercourse sub-area, 7.5 km from the coast. It is probable that, on their winter migration through the region, OBPs stay mainly on the Coorong side of the low range that runs parallel to the coast inland of the Coorong, venturing only occasionally east of that range into the Taratap Flat/Tilley Swamp (i.e. Salt Creek to Blackford sub-areas). However, occasional utilisation of the Salt Creek to Blackford construction footprint cannot be ruled out.

The OBP forms a single but widely distributed population within the wintering range (Orange-Bellied Parrot Recovery Team 2006). Thus the geographic extent of the wintering population includes all suitable feeding and roosting habitat from approximately the River Murray Mouth to Jack Smith Lake in south Gippsland, up to approximately 10 km inland from the coast (Orange-Bellied Parrot Recovery Team 2006). From an impact assessment perspective it is more useful, and more conservative, to consider the habitat available at a smaller spatial scale. The Salt Creek to Blackford Construction Footprint sub-area occupies approximately 72 linear kilometres from south to north. The local range of OBP can be described as the

area bound by the 72 linear kilometres of coastline parallel with the construction footprint, extending inland for 10 km.

Within this area, preferred OBP feeding habitat is samphire shrubland, best defined by DEWNR mapping as *Sarcocornia sp.* (mixed) shrubland, occupies 2,262 hectares. The field survey undertaken by Jacobs (2015) identified the samphire community within the alignment as *Tecticornia sp.* - low open shrubland, with worst case clearance requirements of 31.55 ha, or 1.4 percent of the DEWNR mapped locally available samphire feeding habitat. This clearance is not considered likely to have any adverse impact upon the species. The OBP Recovery Plan indicates that agricultural land (e.g. crops and pastures) may be utilised for feeding. Such areas are extensive within the same local range and the construction footprint occupies an insignificant proportion of such potential feeding habitat.

Roosting habitat for OBPs in their over-wintering range consists of wooded areas including shrublands, mallee and woodlands. Within the local range defined above, the total area of potential roosting habitat is 28,183 hectares. The worst case area of potential roosting habitat to be cleared within the Salt Creek to Blackford Construction Footprint sub-area is 259 hectares, or 1 percent of the locally available roosting habitat. The roosting habitat to be cleared is located in an area with few OBP records (BDBSA contains only one record, from 1992, within the Salt Creek to Blackford watercourse), suggesting it may be rarely utilised by the species.

Given the species was not observed during the field survey, and that it will likely be absent from the area through spring/summer (offshore breeding) (Jacobs, 2015), when most of the construction activity will occur, clearance in the channel corridor is not likely to have any adverse impact upon the species.

Salt Creek to Blackford Watercourse (en route wetlands)

The Salt Creek to Blackford Watercourse can be dividied into two parts, the Taratap Watercourse and the Tilley Swamp Watercourse. Inundation of the Taratap Watercourse currently occurs in most years. The Taratap Watercourse does not support the saltmarsh vegetation favoured by orange-bellied parrots. Increased inundation as a consequence of the SEFRP is not anticipated to cause saltmarsh vegetation to become established. The SEFRP is not anticipated to have any impact upon the species in the Taratap Watercourse.

The Tilley Swamp Watercourse supports approximately 130 ha of *Tecticornia* low open shrubland on land that has been previously cleared and is currently grazed. The remainder of the Tilley Swamp Watercourse is not known to support this plant association, and given the dominant vegetation is *Melaleuca halmaturorum* shrubland, the watercourse is not likely to provide suitable habitat for orange-bellied parrots. Increased inundation of the Tilley Swamp Watercourse is likely to provide a water regime more favourable for saltmarsh

vegetation, which may therefore increase in extent. Inundation of the Tilley Swamp Watercourse is therefore not anticipated to cause significant impact to orange-bellied parrots.

Blackford Drain Downstream of the Diversion Weir sub-area

The BDBSA contains seven records of the OBP in the Blackford Drain Downstream of the Diversion Weir sub-area. The dates of these records are from 1981 to 1993. The number of individual birds observed for each record ranges from 1 to 6. Most of these records were made by local field naturalists. The birds were typically observed foraging amongst samphire vegetation on "islands" within the drain channel and along the edges of the channel, and also roosting in adjacent terrestrial vegetation (Vicki Natt, pers. com., 30/4/2013). Increased winter flows have occurred in the Blackford Drain since 1998, when the upstream catchment was enlarged via construction of the Fairview Drain. These higher flows, the timing of which typically corresponds with the timing of OBP presence in the area, may have rendered the samphire islands in the Blackford Drain less accessible due to higher winter water levels. This may partly explain the absence of recent OBP records in this location. The absence of recent records may also be explained by reduced survey effort, although the location is still surveyed occasionally (Vicki Natt, pers. com., 30/4/2013), and also the reduced abundance of OBPs generally. Only one individual was recorded in South Australia in winter 2012 despite a survey effort equivalent to previous years (Bob Green, SA OBP Regional Coordinator, pers. com., 30/4/2013). It is difficult to confidently predict the likely changes the SEFRP may induce to the quality of the OBP habitat in the Blackford Drain. It is highly unlikely that the project will have a significant negative impact on the species due to impacts downstream of the Blackford Drain. The project may, however, improve conditions for OBPs in this location by promoting the expansion of samphire vegetation within the drain bed (see Section "Summary of Impacts to Project Sub-Areas").

Population, breeding cycles and habitat

Only a small proportion of locally available OBP feeding habitat is proposed to be cleared or degraded, and only a very small proportion of which is rarely utilised roosting habitat.

The SEFRP will not fragment an existing population of the OBP because a cleared channel already exists through the native vegetation along the Salt Creek to Blackford alignment. The SEFRP will merely widen the cleared gap between vegetation on either side of the existing drain by up to 40 m approximately. The ability of the species to fly between patches of favourable habitat on either side of the drain has, and will continue to, ensure such fragmentation does not occur.

The OBP breeds in Tasmania in summer and migrates to mainland Australia during the winter. The SEFRP will not disrupt the breeding cycle of a population.

Habitat critical to the survival of the species, invasive species and introduction of disease

The key invasive fauna that pose a threat to the OBP are foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) through predation and European Rabbit (*Oryctolagus cuniculus*) through habitat degradation (Orange-Bellied Parrot Recovery Team 2006). Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. Invasive flora species that could impact upon habitat quality have had similar previous opportunities for invasion. No new pathways for invasion of these species will be created by the project. The SEFRP is not anticipated to have any impact upon populations of invasive species within OBP habitat. The SEFRP is not anticipated to result in invasive species harmful to the species becoming established in the species habitat.

Psittacine Circoviral Disease (PCD) has caused death of captive OBPs and was detected in wild birds in 1993 (Orange-Bellied Parrot Recovery Team, 2006). However, while a significant number of individuals are antibody positive to PCD, there has not been any detected outbreak of the disease in the wild population. The illegal import of exotic psittacine birds presents a risk of introducing and establishing new virulent diseases to Australian wild and captive populations (Orange-Bellied Parrot Recovery Team, 2006). The SEFRP does not involve actions likely to increase the risk of PCD, or any other disease, to wild or captive populations of the OBP.

Overall, the project is not anticipated to result in a significant impact on the OBP.

Eastern Curlew (*Numenius madagascariensis*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain downstream of diversion weir Marine
Threatened Status	Critically Endangered
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessment for the Eastern Curlew focuses on all five sub-areas of the overall project area. The Eastern Curlew is regularly recorded in the Coorong, predominantly in the Murray Estuary area where it forages on intertidal mudflats (Paton 2010, supported by BDBSA data). Prey items include large invertebrates such as crabs, shrimps and large molluscs (Geering *et al*. 2007, Birdlife Australia 2016). The daily tidal influence within the Murray Estuary, and the prevalence of large invertebrates, is in stark contrast to conditions in the South Lagoon, where water level fluctuations are predominantly seasonal and the higher salinities are above the tolerance of the larger invertebrates, such as crabs, shrimps and large molluscs (Paton 2010). There are only two BDBSA records of the Eastern Curlew in the South Lagoon (from 2000 and 2001).

The potential impacts of the SEFRP in the Coorong relate to water quality changes and the implications for the ecosystem. The Water Quality Risk Assessment undertaken for the project (Wilson *et al*. 2016) has concluded the SEFRP presents a low risk to the Coorong ecosystem (see Table 9, Section 3.1.3.2). Impact to the Eastern Curlew in the Coorong sub-region is therefore not anticipated.

The Salt Creek to Blackford construction footprint supports habitat of very marginal value to Easter Curlew. The shrubland, woodland and agricultural (pasture) vegetation of the construction footprint is not favoured by this waterbird that breeds in the Arctic and migrates annually to Australia to feed in intertidal mudflats. There are no BDBSA records of the species within the construction footprint and the species was not detected there during the 2015 field assessment (Jacobs 2015), noting that the timing of this assessment was not optimal for detection. Vegetation clearance within the construction footprint is not anticipated to significantly impact the species.

The BDBSA contains no records of the Eastern Curlew in the Salt Creek to Blackford watercourse (*en route* wetlands) sub-area. These wetlands provide very marginal feeding habitat at best. They are mostly well vegetated and lacking in the open, shallowly inundated mudflat habitat favoured by Eastern Curlew and other shorebirds. The water regime of the *en route* wetlands is seasonal, yet Eastern Curlew prefer habitats with a daily tidal water regime. The SEFRP is likely to increase the frequency of inundation of these *en route* wetlands, many of which, particularly those in the northern Tilley Swamp area, are 'terrestrialising' due to decreased inundation since 2000, when the existing Tilley Swamp drain was constructed. The project is therefore anticipated to improve the habitat value of these *en route* wetlands for Eastern Curlew and other waterbirds.

There are no known records in the BDBSA or any other source of Eastern Curlew in the Blackford Drain downstream of the proposed SEFRP diversion weir. The bed of the drain represents a tiny proportion of available habitat within the region. Given its seasonal water

regime, it provides very marginal feeding habitat for Eastern Curlew at best. Given the small amount of potential, marginal habitat (approx. 40 ha) and the likely absence of the species, impacts to Eastern Curlew due to habitat changes in the lower Blackford Drain are not anticipated.

As a shorebird species, Eastern Curlew may forage on the beach in the vicinity of the Blackford Drain outlet, however there are no known records from the area. The marine ecosystem in the vicinity of the Blackford Drain is anticipated to improve as a consequence of the SEFRP, therefore impacts to Eastern Curlew are not anticipated in this sub-area.

In summary, there are no sub-areas of the SEFRP project area where impacts to Eastern Curlew are anticipated to be significant. The species may benefit from improved conditions in the Coorong and increased inundation of *en route* wetlands.

Australian Painted Snipe (*Rostratula australis*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Vulnerable
Migratory Species	Yes
Impact Status	No Significant Impact

Summary

The impact assessment for the Australian Painted Snipe focuses on impacts in the Salt Creek to Blackford Construction Footprint sub-area. Given the SEFRP is not anticipated to cause a significant impact to the Ecological Character of the Coorong, impacts to Australian Painted Snipe in that sub-area are not anticipated. The SEFRP may increase inundation of the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area, which would enhance the habitat suitability of this sub-area for Australian Painted Snipe.

The Australian Painted Snipe is a highly mobile, infrequent visitor to the region (Jacobs, 2015). The BDBSA contains no records of the species in the project area. The species was not observed during the 2015 flora and fauna survey of the SEFRP project area. Given the species mobility, and its likely absence from the project area, the SEFRP is not anticipated to result in a significant impact on the species.

The species assessment is discussed in greater detail below.

Population, breeding cycles and habitat

The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett and Crowley 2000). For purposes of this assessment, impacts have been assessed at the scale of the South East NRM region, which is a conservative approach given the population is far more wide ranging.

The preferred habitat of the Australian Painted Snipe is described as “shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled” (DEH 2003).

Within the South East NRM region, the habitat types that best correspond with this description have a combined area of 462,330 hectares and include:

- *Apodasmia brownii* (mixed) sedgeland
- *Baumea juncea* (mixed) sedgeland
- *Baumea juncea*, *Apodasmia brownii* sedgeland
- Cyperaceae sp., Gramineae sp. sedgeland
- *Gahnia filum* (mixed) sedgeland
- *Juncus* sp. (mixed) sedgeland
- *Phragmites australis*, *Typha domingensis* grassland
- *Sarcocornia* sp. (mixed) shrubland
- *Selliera radicans* forbland
- *Typha domingensis* sedgeland; and
- *Wilsonia rotundifolia* forbland.

Of these habitat types, two lie within the Salt Creek to Blackford Construction Footprint sub-area. Worst case clearance of 54 ha of *Gahnia filum* shrubland may be required, which comprises 1 percent of the regional total (8,484 ha). Worst case clearance of 31.55 ha of *Tecticornia sp.* low open shrubland (samphire) is also required, comprising less than 1 percent when compared to the DEWNR mapped regional total (4,080 ha) of preferred samphire habitat - *Sarcocornia sp.* (mixed) shrubland. Total clearance of preferred habitat is less than one percent of the regional total.

The species may also forage in inundated pasture (DSEWPAC 2013), which can be described as marginal habitat for the species. Areas of pasture prone to seasonal inundation lie within the SEFRP construction footprints. However, vast areas of this habitat type occur

within the South East region and in this context the proportion affected by the project is not considered to be a significant impact.

A very small proportions (at the regional scale) of preferred and marginal habitat for the Australian Painted Snipe requires clearance for the SEFRP. The SEFRP will not fragment an existing population of the Australian Painted Snipe because a cleared channel already exists through the native vegetation along the Salt Creek to Blackford alignment. The SEFRP will involve widening the cleared gap between vegetation on either side of the existing drains by up to 40 m approximately. However, the ability of the species to fly between patches of favourable habitat on either side of the drain has, and will continue to, ensure such fragmentation does not occur. The SEFRP is not anticipated to fragment an existing important population into two or more populations.

Habitat critical to the survival of the species, invasive species and introduction of disease

Invasive fauna that may pose a threat to the Australian Painted Snipe are foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) through predation (DSEWPAC 2013a). Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. Invasive flora species that could impact upon habitat quality have had similar previous opportunities for invasion. No new pathways for invasion of these species will be created by the project.

Terrestrialisation may impact upon the quality of habitat for the Australian Painted Snipe due to its preference for unwooded, open sedgeland, mudflat and grassland habitats. Terrestrialisation is occurring in some wetlands in the South East region, including those within the project area (see Dickson *et al*. 2013). Vegetation clearance within the construction footprint sub-area is not anticipated to exacerbate this problem. On the contrary, by increasing freshwater flows to *en route* wetlands, the SEFRP is more likely to slow, halt or reverse the process of terrestrialisation in these areas. The SEFRP is therefore not anticipated to have any impact upon populations of invasive species within the habitat of the Australian Painted Snipe. The SEFRP is not anticipated to result in invasive species harmful to the species becoming established in the species habitat.

There are no known diseases contributing to the decline of the Australian Painted Snipe (DSEWPAC 2013a) and the SEFRP is not anticipated to introduce disease that may cause the species to decline.

Fairy Tern (*Sternula nereis nereis*)

Area of Occurrence	Coorong

	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Marine
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for the Fairy Tern focuses on the Salt Creek to Blackford construction Footprint sub-area. The SEFRP is anticipated to have a positive effect upon the suitability of the remaining three project sub-areas for Fairy Tern.

There is insufficient information to define distinct populations of the Fairy Tern within South Australia with a high degree of confidence (DENR 2012). However, a "Coorong population" has been referred to in several studies (Paton 2010, DENR 2012). The SEFRP area, particularly the Salt Creek to Blackford Construction Footprint sub-area, is much closer to the Coorong than to the next closest Fairy Tern population, the Lower South East population, which occupies the coastal and near-coastal area from approximately Robe to the Victorian border. Therefore, for the purposes of this assessment, the Fairy Tern population assessed is the Coorong population. This population can be defined as an important population under the EPBC Act criteria for vulnerable species (DEWHA 2009) because it is likely to be a key source population for breeding. Four nesting colonies of the species were recorded in the Coorong sub-area in the summer of 2011/12 (DENR 2012). The size of the Coorong population has been recently estimated at 322 individuals (DENR 2013).

Population, breeding cycles and habitat

Breeding habitat for the Fairy Tern consists of sheltered sandy beaches, spits and banks above the high tide line and below vegetation (DSEWPAC 2013). The native vegetation and areas of improved pasture to be cleared within the Salt Creek to Blackford Construction Footprint sub-area do not comprise breeding habitat for the species. Thus the project is not anticipated to lead to the loss of actual or potential breeding habitat. The species is not known to breed in the near vicinity of the construction footprint, nor was it observed during the field survey (Jacobs 2015).

The nearest known breeding locations are within the Coorong National Park, which is several kilometres from the Salt Creek to Blackford Construction Footprint sub-area. Known breeding locations will therefore not be affected by noise and activity associated with

construction. The SEFRP is not likely to disrupt the breeding cycle of an important population of the species.

Habitat critical to the survival of the species, invasive species and introduction of disease

Foraging habitat for the species comprises open water supporting small-bodied fish populations in wetlands, estuaries and sheltered embayments. The Salt Creek to Blackford construction footprint does not include this habitat type. Areas of open water occur mainly on the deeper, western side of the Salt Creek to Blackford watercourse. The SEFRP is not anticipated to result in the loss of foraging habitat for Fairy Terns.

Invasive species that pose a key threat to Fairy Terns are introduced mammals such as the European Fox (*Vulpes vulpes*), dogs (*Canis familiaris*), cats (*Felis catus*) and Black Rats (*Rattus rattus*). These species prey upon adult birds, chicks and eggs. Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. No new pathways for invasion of these species will be created by the project. The SEFRP is therefore not anticipated to have any impact upon populations of invasive species within the habitat of the Fairy Tern. The SEFRP is not anticipated to result in invasive species harmful to the species becoming established in the species habitat.

The SEFRP will not fragment an existing population of the Fairy Tern because a cleared channel already exists through the native vegetation along the Salt Creek to Blackford construction footprint sub-area. The SEFRP will involve widening the cleared gap between vegetation on either side of the existing drains by up to 40 m approximately. However, the ability of the species to fly between areas of favourable habitat on either side of the drain has, and will continue to, ensure such fragmentation does not occur.

There are no known diseases contributing to the decline of the Fairy Tern (DSEWPAC 2011) and the SEFRP is not anticipated to introduce disease that may cause the species to decline.

Overall the SEFRP is not anticipated to result in a significant impact on the Fairy Tern when assessed against the significant impact criteria.

Little Tern (*Sterna albifrons*)

Area of Occurrence	Coorong Blackford Drain Downstream of Diversion Weir Marine
Threatened Status	Nil
Migratory Species	Yes

Impact Status	No Significant Impact

The impact assessment for the Little Tern focuses on the Blackford Drain Downstream of Diversion Weir sub-area. The SEFRP is anticipated to have a positive effect upon the suitablility of the remaining three project sub-areas for Little Tern.

Population, breeding cycles and habitat

The Little Tern has a cosmopolitan distribution, occurring through much of Europe, scattering along the coast and inland in parts of Africa, in much of western, central and the extreme east and south of Asia, and in northern parts of Australasia (BirdLife International 2013).

The Little Tern population that occurs in the project area is the eastern subpopulation that breeds on the eastern and south-eastern coast of mainland Australia and northern and eastern Tasmania, occasionally extending as far west as western Victoria and south-eastern South Australia. The species is very occasionally recorded as far west as the Coorong (Paton 2010).

Little Terns forage in shallow waters of estuaries, coastal lagoons and lakes, frequently over channels next to spits and banks or entrances, and often close to breeding colonies. They also forage along open coasts, especially around bars off the entrances to rivers and lagoons, less often at sea, and usually within 50 m of shore. The Blackford Drain Downstream of Diversion Weir sub-area may provide seasonal foraging habitat for the species, particularly during periods of low flow in early winter and late spring/summer. During high flows, typically mid-winter to early spring, the depth and velocity of the water in the drain may render it unsuitable for Little Tern foraging. Periods of no flow render the drain channel dry along most of its length and thus unsuitable for Little Tern foraging. The Blackford Drain downstream of the diversion weir provides up to 47 hectares of habitat for the species that may be accessible for approximately half of a typical year. Under a worst-case scenario, the project, by reducing flows in the Blackford Drain downstream of the diversion weir, may render this 47 hectares of habitat permanently unsuitable for Little Tern foraging.

Habitat critical to the survival of the species, invasive species and introduction of disease

Suitable foraging habitat within the South East NRM region includes a number of coastal lakes and lagoons including the Coorong, Southern Ephemeral Lakes, Lake Robe, Lake Eliza, Lake St Claire, Lake George and Lake Bonney. These areas alone have a combined area of 70,585 hectares. Forty seven hectares represents 0.07 percent of the lacustrine-like habitat available for Little Terns in the region. Additionally, an extensive area of suitable foraging habitat is likely to exist along the coast.

Very low numbers of Little Terns breed in the South East region and the species often nests in association with Fairy Tern colonies (Maureen Christie, pers. com., 10/5/2013). There are no known breeding sites for Little Tern within the vicinity of the Blackford Drain (Maureen Christie, pers. com., 10/5/2013). The nearest breeding sites are located in the Coorong and near Part MacDonnell. Birds breeding at these sites would not forage in the Blackford Drain while protecting eggs or chicks because the distances are too great. The species was not observed during the field survey (Jacobs 2015). The SEFRP is not likely to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Overall the SEFRP is not anticipated to result in a significant impact on the Little Tern when assessed against the significant impact criteria.

Caspian Tern (*Sterna caspia*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (en route wetlands) Marine Blackford Drain Downstream of Diversion Weir
Threatened Status	Migratory
Migratory Species	No
Impact Status	No Significant Impact

The BDBSA contains records of the Caspian Tern from the Coorong and Salt Creek to Blackford Watercourse (*en route* wetlands) sub-areas (specifically Morella Basin). However, the habitat requirements and broad geographic range of the species make it highly likely that Caspian Terns utilise habitat within all five project sub-areas.

The Caspian Tern has a sub-cosmopolitan distribution occurring in North America, Europe, Africa, Asia, Australia and New Zealand (DOE 2013b). Within Australia the species is predominantly coastal but also occurs throughout inland eastern Australia (Morcombe 2003). The total global population has been estimated at 240,000 to 420,000 individuals (DOE 2013b). Caspian Terns are not known to occur in large numbers within the project area, with most records in the BDBSA referring to individual birds or small groups. The species was not observed during the field survey. Given the diverse populations and limited

numbers within the project area, the population that occasionally observed within the project area is not considered a significant population for the species.

Favoured habitats include sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas), particularly those with sandy or muddy margins. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks (DOE 2013).

The ecological benefits the SEFRP is anticipated to provide for the Coorong, Salt Creek to Blackford Watercourse (en route wetlands) and Marine project sub-areas are likely to benefit the Caspian Tern. Impacts associated with vegetation clearance and drain widening within the Salt Creek to Blackford Construction Footprint are more likely to favour the Caspian Tern than disadvantage it. The area of favoured aquatic (channel) habitat will increase but the corresponding loss of terrestrial and riparian vegetation will not disadvantage the species because this habitat is not preferred. Therefore only the Blackford Drain Downstream of Diversion Weir sub-area will become less suitable for Caspian Terns. This 39 ha area represents a tiny proportion of the available, habitat within the vicinity of the project area, which includes the nearby coastline, Coorong lagoons and large inland wetlands. The Blackford Drain currently, given its linear morphology, is likely to provide sub-optimal habitat for the species, which favours more open and expansive waterbodies for foraging. The BDBSA contains no records of the species within this 39 ha area.

The SEFRP is not likely to:

- substantially modify, destroy or isolate an area of important habitat for the Caspian Tern;
- result in an invasive species that is harmful to the Caspian Tern becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the Caspian Tern.

White-bellied Sea-Eagle (*Haliaeetus leucogaster*)

Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain Downstream of Diversion Weir Marine

Threatened Status	Nil
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessment for the White-bellied Sea-Eagle focuses on the Salt Creek to Blackford construction footprint sub-area, and the Blackford Drain Downstream of Diversion Weir sub-area. The SEFRP is anticipated to have a positive effect upon the habitat extent and/or quality of the remaining three project sub-areas for White-bellied Sea-Eagle.

The White-bellied Sea-Eagle occurs from India through south east Asia to Papua New Guinea, the Solomon Islands and Australia (Pizzey and Knight 2003). Within Australia the species occurs in coastal areas throughout the continent and Tasmania and inland along major river systems in south eastern, eastern and northern Australia. The species is likely to occur at a very low density throughout the project area.

Typical foraging habitat for the species is large expanses of open water such as coastal waters, inlets, estuaries, large rivers, lakes and wetlands. However, the White-bellied Sea-eagle will also forage over open terrestrial habitats such as grasslands. None of the project sub-areas of concern contain typical foraging habitat. The Salt Creek to Blackford construction footprint sub-area does contain open terrestrial habitat in the form of improved pasture, however the region contains vast areas of this habitat type.

White-bellied Sea-Eagles nest on remote coastal cliffs, on the ground on islands and in tall living trees near open waterbodies. Suitable nesting sites may be present in Red Gum (*Eucalytpus camaldulensis*) woodland around the margins of Morella Basin. It is possible that areas of *Eucalyptus spp.* woodland within the Salt Creek to Blackford Construction Footprint sub-area (20.41 hectares in total) may contain nesting trees, however this is unlikely given these areas are not adjacent to open waterbodies. No individuals or nests of the species were observed during the field survey (Jacobs 2015).

The SEFRP is not anticipated to impact foraging habitat for the White-bellied Sea-Eagle. Populations of invasive species that pose a threat to the White-bellied Sea-eagle (introduced predatory mammals, introduced fish) will not be affected positively or negatively by the project.

Overall the SEFRP is not anticipated to result in a significant impact on the White-bellied Sea-Eagle when assessed against the significant impact criteria.

Threatened and/or migratory pelagic seabirds

Species	Southern Royal Albatross *(Diomedea epomophora epomophora)* Northern Giant-Petrel *(Macronectes halli)* Northern Royal Albatross *(Diomedea epomophora sanfordi)* Tristan Albatross *(Diomedea exulans*) Southern Giant-Petrel *(Macronectes giganteus)* Wandering Albatross *(Diomedea exulans (sensu lato))* Shy Albatross, Tasmanian Shy Albatross *(Thalassarche cauta cauta*) Salvin's Albatross *(Thalassarche cauta salvini)* Black-browed Albatross *(Thalassarche melanophris)* Campbell Albatross *(Thalassarche melanophris impavida)* Blue Petrel *(Halobaena caerulea)* Soft-plumaged Petrel *(Pterodroma mollis)* Antipodean Albatross (*Diomedea antipodensis*) White-capped Albatross (*Thalassarche cauta cauta*) Flesh-footed Shearwater, Fleshy-footed Shearwater *(Puffinus carneipes)*
Area of Occurrence	Coorong Marine
Threatened Status	Vulnerable/Endangered
Migratory Species	Yes/No
Impact Status	No Significant Impact

The species in this group have vast extents of occurrence over, predominantly, open ocean. The Coorong and Marine project sub-areas represent a small portion of the extents of occurrence of these species and none are regularly recorded in either area. Therefore the SEFRP is not anticipated to result in a significant impact.

Migratory Exclusively Aerial Birds

Species	Fork-tailed Swift *(Apus pacificus)* White-throated Needletail *(Hirundapus caudacutus)*
Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Marine Blackford Drain Downstream of Diversion Weir

Threatened Status	Nil
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessments for the Migratory Exclusively Aerial Birds focuses on the Salt Creek to Blackford construction footprint sub-area, and the Blackford drain downstream of diversion weir sub-area.

These species are almost exclusively aerial, foraging over a wide variety of habitats. Both species occur outside Australia, with distributions extending throughout eastern to central Asia. The White-throated Needletail has an estimated global extent of occurrence of between 1,000,000 and 10,000,000 km². For the Fork-tailed Swift the figure is likely to be similarly large. The 300 ha of native vegetation clearance within the construction footprints, and the 47 ha of potential vegetation change within the Blackford Drain Downstream of Diversion Weir sub-area, represent a tiny proportion of the potential foraging habitat available to these species. The SEFRP is not anticipated to substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for the migratory species.

There are no invasive species known to pose a threat to these migratory, exclusively aerial birds that will be affected in any way by the SEFRP. The SEFRP is not anticipated to result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

Neither the Fork-tailed Swift nor the White-throated Needletail breeds in Australia. Given the almost exclusively aerial behaviour of these species, the SEFRP is not anticipated to create any new barriers to migration. The project area does not contain any known sites utilised by these species for resting during migration. The SEFRP is not anticipated to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of these species. The species were not observed through the field survey.

Migratory Waterbirds

Species	Great Egret, White Egret *(Ardea alba)* Cattle Egret *(Ardea ibis)*
Area of Occurrence	Coorong

	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Marine Blackford Drain Downstream of diversion weir
Threatened Status	Nil
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessment for the Migratory Waterbirds focuses on the Salt Creek to Blackford construction footprint sub-area, and the Blackford Drain Downstream of Diversion Weir sub-area. The SEFRP is anticipated to have a positive effect upon the habitat extent and/or quality of the remaining three project sub-areas for Migratory Waterbirds.

Both species of Migratory Waterbirds are cosmopolitan, occurring throughout Australia (except desert regions), but also in Africa, the Americas, Europe, India, South-East Asia and Papua New Guinea. Thus both have a vast extent of occurrence.

Feeding habitat for these species includes wetland margins and inundated pastures (McKilligan 2005), both of which occur within the two construction footprint sub-areas. When flows are low, the Blackford Drain Downstream of Diversion Weir sub-area is also likely to provide feeding habitat. The vegetation and general habitat types that provide potential feeding habitat for Migratory Waterbirds within these project sub-areas include:

- *Gahnia filum* (mixed) sedgeland
- *Melaleuca brevifolia* shrubland
- *Melaleuca halmaturorum* shrubland
- *Sarcocornia sp*. (mixed) shrubland
- Existing drain channels
- Improved pasture subject to inundation.

The total combined area of these habitat types within the three affected project sub-areas is approximately 1,000 hectares. However, not all of this potential feeding habitat will be “lost” as a consequence of the project. The Blackford Drain Downstream of Diversion Weir sub-area (47 hectares of drain channel and *Sarcocornia sp.* (mixed) shrubland) will remain potential feeding habitat for Migratory Waterbirds because it will remain as wetland habitat. Channel habitat within the Salt Creek to Blackford Construction Footprint sub-area will occupy approximately 239 hectares. Thus, of the approximately 1,000 hectares of existing

feeding habitat for Migratory Waterbirds within the three affected sub-areas, 286 hectares will remain as feeding habitat in the form of drain channel.

Given the extensive global extents of occurrence of Migratory Waterbirds, an examination of habitat loss in the context of the South East NRM region is conservative (more likely to provide an over-estimate than an under-estimate of impact).Mapped wetlands within the region have a total extent of 240,650 hectares. Thus the project will reduce the extent of potential feeding habitat for Migratory Waterbirds by 0.3 percent.

Migratory Waterbirds nest colonially, often with other species such as ibis, spoonbills and cormorants, in reedbeds, shrubs or trees close wetlands (McKilligan 2005). There are no known nesting colonies in the Salt Creek to Blackford construction footprint sub-area, or the Blackford Drain Downstream of Diversion Weir sub-area (Mark de Jong, South Eastern Water Conservation and Drainage Board, pers. comm., 7/5/2013). These areas are regularly visited and observed by aerial survey by staff of the South Eastern Water Conservation and Drainage Board. Waterbird colonies are highly visible and likely to be observed if present. The species were not observed during the field survey (Jacobs 2015). Therefore the absence of such colonies from the three sub-areas in question is known with a high degree of confidence.

There is a very small proportion of regionally available feeding habitat to be removed within the SEFRP, and no breeding colonies within the impacted sub-areas.

Invasive species that may pose a key threat to Migratory Waterbirds are introduced mammalian predators, specifically the European fox (*Vulpes vulpes*) and feral cat (*Felis catus*), and introduced plants that can reduce habitat quality. Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. No new pathways for invasion of these species will be created by the project. The SEFRP is not anticipated to have any impact upon populations of invasive species within Migratory Waterbird habitat. The SEFRP is not anticipated to result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

Overall the SEFRP is not anticipated to result in a significant impact on the Migratory Waterbirds when assessed against the significant impact criteria.

Migratory Bush Birds

Species	Rainbow Bee-eater *(Merops ornatus)* Satin Flycatcher *(Myiagra cyanoleuca)*

	Rufous Fantail *(Rhipidura rufifrons)*
Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Blackford Drain Downstream of Diversion Weir
Threatened Status	Nil
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessments for Migratory Bush Birds focuses on the Salt Creek to Blackford construction footprint sub-area and the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area. The SEFRP is anticipated to have no effect upon the habitat extent and/or quality of the remaining two project sub-areas for Migratory Bush Birds as the habitat, both pre- and post project implementation, does not support these species.

These species all occur seasonally or as residents in Indonesia (except Satin Flycatcher) and Papua New Guinea as well as Australia. The project area is at the south western extreme of the range for Satin Flycatcher and Rufous Fantail, while the Rainbow Bee-eater's range covers most of the continent. All three species favour a broad range of terrestrial habitats including rainforests, wet Eucalyptus forests, closed to open woodlands, coastal scrub, mangroves, watercourses, parks and gardens (Pizzey and Knight 2003). The Satin Flycatcher and Rufous Fantail both build nests in shrubs or trees while the Rainbow Bee-eater nests in a burrow in sandy ground or embankment, often in a loose colony (Pizzey and Knight 2003).

The BDBSA contains one record of Rainbow Bee-eater, three records of Satin Flycatcher and no records of Rufous Fantail in the general vicinity of the project area, none of which are within the construction corridor or *en route* wetlands sub-areas. None of these species were detected during the targeted survey of the project area (Jacobs 2015).

Salt Creek to Blackford construction footprint sub-area

Within the construction footprint sub-area the potential for impacts is associated with the loss of foraging and/or nesting habitat due to vegetation clearance. For the Rainbow Bee-eater there is also a possibility that excavation may disturb nests in the existing drain banks or spoil heaps. A conservative approach to impact assessment for these species is to consider the regional context. In relation to vegetation clearance, the loss of foraging and nesting habitat for the SEFRP is very small given that all three species are habitat generalists and able to utilise nearly all of the 462,330 hectares of remnant native vegetation

within the South East NRM region. The 287 hectares of worst-case clearance for the SEFRP represents a very small proportion of the regionally available foraging and breeding habitat for these species.

Salt Creek to Blackford Watercourse (en route wetlands) sub-area

The Taratap wetlands are not known to support populations of Migratory Bush Birds. These wetlands are inundated in most years under current management. An increase to the frequency of inundation of the Taratap wetlands under the SEFRP is not anticipated to have any implications for Migratory Bush Birds.

Tilley Swamp Conservation Park is not known to support populations of Migratory Bush Birds. Inundation of the wetlands within the Park currently occurs in most years. Seasonally inundated wetlands, and adjacent terrestrial vegetation, may provide habitat for Migratory Bush Birds. The frequency of inundation of wetlands in the Park may increase under the SEFRP, however a significant impact to Migratory Bush Birds, in the unlikely event populations exist, is not considered likely as a consequence.

The northern Tilley Swamp watercourse is not known to support populations of Migratory Bush Birds. The area currently supports extensive areas of *Melaleuca halmaturorum* shrubland and smaller (shrinking) areas of open herbland, both providing marginal habitat for Migratory Bush Birds. Under the SEFRP the frequency, depth and duration of inundation of the northern Tilley Swamp may (subject to landholder agreement) increase. In time, this is anticipated to change the vegetation of the area, with shrubland areas likely to decline in extent and open wetland habitat likely to increase. The implications of this habitat shift for Migratory Bush Birds are likely to be positive. Rainbow Bee-eaters often forage over water, a situation likely to occur more frequently under the project. The extent of shrubland, while it may reduce, will remain a dominant vegetation type in this sub-area of the project. Both Satin Flycatcher and Rufous Fantail are more likely to utilise woodland habitat within the project area. Woodland habitat will be unaffected by the project within the *en route* wetlands sub-area.

Populations of invasive species that pose a threat to Migratory Bush Birds (introduced predatory mammals, pest plants that may reduce habitat quality) will not be affected positively or negatively by the project. The SEFRP is not likely to result in an invasive species that is harmful to these migratory species becoming established in an area of important habitat for these migratory species.

In summary, the SEFRP is not anticipated to result in a significant impact on the Migratory Bush Birds when assessed against the significant impact criteria.

Migratory Shorebirds

Species	Common Sandpiper *(Actitis hypoleucos)* Ruddy Turnstone *(Arenaria interpres)* Sharp-tailed Sandpiper *(Calidris acuminate)* Sanderling *(Calidris alba)* Red Knot, Knot *(Calidris canutus)* Curlew Sandpiper *(Calidris ferruginea)* Red-necked Stint *(Calidris ruficollis)* Great Knot *(Calidris tenuirostris)* Double-banded Plover *(Charadrius bicinctus)* Lesser Sand Plover, Mongolian Plover *(Charadrius mongolus)* Oriental Plover, Oriental Dotterel *(Charadrius veredus)* Latham's Snipe, Japanese Snipe *(Gallinago hardwickii)* Bar-tailed Godwit *(Limosa lapponica)* Black-tailed Godwit *(Limosa limosa)* Eastern Curlew *(Numenius madagascariensis)* Little Curlew, Little Whimbrel *(Numenius minutus)* Pacific Golden Plover *(Pluvialis fulva)* Grey Plover *(Pluvialis squatarola)* Common Greenshank *(Tringa nebularia)* Wood Sandpiper *(Tringa glareola)* Marsh Sandpiper, Little Greenshank *(Tringa stagnatilis)* Terek Sandpiper *(Xenus cinereus)*
Area of Occurrence	Coorong Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands) Marine Blackford Drain Downstream of Diversion Weir
Threatened Status	Nil
Migratory Species	Yes
Impact Status	No Significant Impact

The impact assessments for Migratory Shorebirds focuses on the Salt Creek to Blackford construction footprint sub-area, and the Blackford Drain Downstream of Diversion Weir sub-area. The SEFRP is anticipated to have a positive effect upon the habitat extent and/or quality of the remaining three project sub-areas for Migratory Shorebirds.

All of these species are seasonal migrants to the project area from overseas, mostly the northern hemisphere. They utilise wetlands and ocean beaches within the project area as feeding habitat during the southern summer.

The Australasian Waders Study Group (AWSG) has been monitoring shorebird abundance throughout the South East region since 2002. Monitoring occurs at sites that regularly support shorebirds. The Salt Creek to Blackford construction footprint sub-area is not part of the area monitored nor does the BDBSA contain records of these species within the construction footprints. These project sub-areas do not feature the shallowly inundated mudflats that are preferred foraging habitat for Migratory Shorebirds. Although these species may occasionally fly over or alight upon the construction footprint sub-areas, abundances are highly unlikely to represent an ecologically significant proportion of a population of any of these species.

The Blackford Drain Downstream of Diversion Weir sub-area is a site regularly monitored by the AWSG. However, it is a very small site and generally only low numbers of Migratory Shorebirds are recorded there. The section monitored is the drain channel from the mouth to a bridge located 3.4 km upstream (i.e. an area of drain channel of 10.2 ha), although sometimes a smaller area is monitored (Maureen Christie, pers. com., 9/5/2013). Migratory shorebird counts at this site since monitoring commenced in 2004 are shown in Table 15.

Table 15: Abundance of Migratory Shorebirds in the Blackford Drain 2004 – 2010 (sources: Gosbell and Christie 2006, AWSG unpublished data, Maureen Christie, pers. com. 9/5/2013).

Species	Date							
	Feb 2004	Feb 2005	Feb 2006	27 Oct 2006	Feb 2007	Feb 2008	Mar 2009	Jan 2010
Wood Sandpiper	2							
Common Greenshank	1	7					2	
Latham's Snipe		1						
Marsh Sandpiper		4	1					
Sharp-tailed Sandpiper		16	18	80				6
TOTAL	**3**	**28**	**19**	**80**	**0**	**0**	**2**	**6**

Nationally important habitat for Migratory Shorebirds is defined by DEWHA (2009) as habitat that supports at least 0.1 percent of the flyway population of a single species (Table 16), 2000 migratory shorebirds or 15 shorebird species.

Table 16: 0.1% flyway abundance for the five species of Migratory Shorebird that have been recorded in the Blackford Drain (source: DEWHA 2009).

Species	0.1% Flyway Abundance
Wood Sandpiper	100 - 1000
Common Greenshank	60
Latham's Snipe	n/a (see below)
Marsh Sandpiper	100 - 1000
Sharp-tailed Sandpiper	160

As defined by DEWHA (2009), important habitat for Latham's snipe occurs at sites that are identified as internationally important for the species, or those sites that:

- support at least 18 individuals of the species; and
- have the following characteristics: a naturally occurring freshwater wetland with vegetation cover nearby (for example tussock grasslands, sedges, lignum and reeds).

The section of the Blackford Drain regularly surveyed by the AWSG does not meet the criteria of nationally important habitat for Migratory Shorebirds. However, this section of the drain represents only 22 percent of the total area of the Blackford Drain downstream of diversion weir. To translate these data so that they reflect the entire 15.6 km of the Blackford Drain downstream of diversion weir it is not legitimate to simply multiply each species count by 4.54 (i.e. 22% × 4.54 = 100%). This is because:

- the quality of Migratory Shorebird habitat within the Blackford Drain is unlikely to be consistent along its length;
- even if habitat quality was consistent throughout, at a given point in time the distribution of birds along the length of the drain is unlikely to be even.

Note that if the 4.54 multiplication was legitimate, individual counts for all species would still be below the 0.1 percent flyway abundance threshold, with the exception of one count for Sharp-tailed Sandpiper (27 October 2006, 80 birds). Thus the question of whether the Blackford Drain downstream of diversion weir is nationally important habitat for Migratory Shorebirds becomes a question of whether the October 2006 count of 80 Sharp-tailed Sandpiper indicates that the site as a whole supported ≥160 Sharp-tailed Sandpiper at that time. Given that the other eight surveys undertaken recorded much lower abundances of this species (0 – 18 birds), it seems reasonable to conclude that this is unlikely. The single

count of 80 birds appears to be unusually high and most likely reflects with an unusually high density of birds at the survey location, rather than an indication of the density of birds along the entire length of the site. It can be concluded that the Blackford Drain downstream of diversion weir is not a nationally significant site for Migratory Shorebirds.

Irrespective of the significance of the site, the SEFRP is unlikely to completely eliminate the habitat values of the Blackford Drain downstream of diversion weir for Migratory Shorebirds. Changes to the nature of the habitat in the lower Blackford Drain due to the SEFRP are difficult to predict. However it is likely that the drain will continue to support a wetland character due to the likely persistence of flows, albeit at greatly reduced flow rates.

It is also important to consider the regional context. There are large areas of suitable habitat, including recognised nationally and internationally significant sites for a number of Migratory Shorebird species, in the South East region (Gosbell and Christie 2006, Christie 2008, Paton 2010). These include the Coorong (22,500 ha), Morella Basin (858 ha), Paranki Lagoon (566 ha), Lake Fox and Pub Lake (approx. 10 ha), Lake Robe (366 ha), Lake Eliza (5,138 ha), Lake St Clair (2,829 ha), Lake George (6,391 ha), Lake Hawdon North (2,475 ha), Lake Hawdon South (3,298 ha), Legoes Swamp (343 ha), Mullins Swamp (277 ha), Lake Frome (894 ha) and Lake Bonney (8,348 ha). The Blackford Drain downstream of diversion weir, at 47 hectares, is a very small proportion of the regionally available habitat. It is also centrally located within the region and close to other sites, e.g. Paranki Lagoon, and unlikely to represent important “stepping stone” habitat within the regional landscape. Even in the unlikely event that it was rendered completely unsuitable for Migratory Shorebirds, the implications for the regional population of these species would likely be negligible.

None of these Migratory Shorebirds breed in Australia. All breed in the northern hemisphere except Double-banded Plover, which breeds in New Zealand.

Of all the species above, only the Common Greenshank was observed during the field fauna survey (Jacobs 2015). Although observed, given populations and habitat preferences, the project is not expected to significantly impact this species.

Populations of invasive species that may pose a threat to Migratory Shorebirds (introduced predatory mammals, pest plants that may reduce habitat quality) will not be affected positively or negatively by the project. The SEFRP is not likely to result in an invasive species that is harmful to these migratory species becoming established in an area of important habitat for these migratory species.

Overall the SEFRP is not anticipated to result in a significant impact on the Migratory Shorebirds when assessed against the significant impact criteria.

Threatened and Migratory Mammals Assessment

Southern Bent-wing Bat (*Miniopterus schreibersii bassanii*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Critically Endangered
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for the Southern Bent-wing Bat focuses on the Salt Creek to Blackford construction footprint sub-area only.

Population, breeding cycles and habitat

The population of the Southern Bent-wing Bat that may occur within the project area is the Naracoorte population, which utilises Bat Cave at Naracoorte as a maternity cave. This population is important because it is one of only two known populations of the sub-species, the other utilises Starlight Cave near Warrnambool as a maternity cave (DSEWPAC 2013b). The Naracoorte population is 3–4 times larger than the Warrnambool population.

Foraging habitat for the species includes a wide range of habitats such as forest, woodland, grassland, coastal scrub, along beaches and within urban areas (Kerr and Bonifacio 2009). Preferred foraging habitat is woodlands in the vicinity of large natural wetlands. It is likely that all of the vegetation types requiring clearance for the SEFRP represent potential foraging habitat for the species.

Outside of the breeding season, the Naracoorte population of the Southern Bent-wing Bat disperses to over-wintering roosts throughout the South East region, roughly south of an east-west line through Padthaway (Kerr and Bonifacio 2009). None of the known winter roosting sites are located within the SEFRP area. The total coverage of native vegetation (i.e. potential foraging habitat) within the South East region south of Padthaway is approximately 158,300 ha. The 287 ha of vegetation clearance required for the SEFRP represents 0.2 percent of the potential winter foraging habitat for the Naracoorte population.

The entire Naracoorte population migrates to Bat Cave within the World Heritage listed Naracoorte Caves National Park for breeding. The limited research that has been undertaken regarding foraging behaviour of bats when roosting in Bat Cave indicates that

individuals typically forage within 3 to 4 km of the colony, but have been recorded up to 22.5 km away (Kerr and Bonifacio 2009). The SEFRP area is located at least 60 km from Bat Cave. Therefore vegetation clearance for the SEFRP is not anticipated to impact upon the foraging success of bats roosting in Bat Cave. Similarly, construction activities (e.g. noise) are not anticipated to disturb breeding bats. The SEFRP is therefore not likely to disrupt the breeding cycle of a population.

Habitat critical to the survival of the species, invasive species and introduction of disease

Invasive species that pose a key threat to the Southern Bent-wing Bat are introduced mammalian predators, specifically the European fox (*Vulpes vulpes*) and feral cat (*Felis catus*) (Kerr and Bonifacio 2009). Opportunities and pathways for the invasion of these species into the project area have existed for many years and both are almost certainly well established in the area. No new pathways for invasion of these species will be created by the project. The SEFRP is not anticipated to have any impact upon populations of invasive species within Southern Bent-wing Bat habitat. The SEFRP is not anticipated to result in invasive species harmful to the species becoming established in the species habitat.

The SEFRP will not fragment an existing population of the Southern Bent-wing Bat because a cleared channel already exists through the native vegetation along the Salt Creek to Blackford alignment. The SEFRP will involve widening the cleared gap between vegetation on either side of the existing drains by up to 40 m approximately. However, the ability of the species to fly between areas of favourable habitat on either side of the drain has, and will continue to, ensure such fragmentation does not occur. The SEFRP is not anticipated to fragment an existing important population into two or more populations.

Disease has not been identified as a threat to the species and no known diseases are discussed in the Regional Action Plan (Kerr and Bonifacio 2009). Vegetation clearance and other activities associated with the SEFRP are not anticipated to have any impact upon disease within the Naracoorte population. The SEFRP is not likely to introduce disease that may cause the species to decline.

The field survey (using ANABAT) did not record the presence of the species within the project construction footprint, nor are there BDSBSA records within the broader study area. Overall, the SEFRP is not anticipated to result in a significant impact on the Southern Bent-wing Bat when assessed against the significant impact criteria.

Australian Sea Lion (*Neophoca cinerea*)

Area of Occurrence	Coorong Marine

Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

Both the Coorong and Marine sub-areas are anticipated to benefit ecologically from the project. Therefore the SEFRP is not anticipated to have any impact upon the Australian Sea Lion.

Threatened and/or migratory marine species/mammals and sharks

Species	Blue Whale *(Balaenoptera musculus)* Southern Right Whale *(Eubalaena australis)* Humpback Whale *(Megaptera novaeangliae)* Great White Shark *(Carcharodon carcharias)* Bryde's Whale *(Balaenoptera edeni)* Pygmy Right Whale *(Caperea magrinata)* Dusky Dolphin *(Lagenorhynchus obscurus)* Porbeagle, Mackerel Shark *(Lamna nasus)* Killer Whale, Orca *(Orcinus orca)*
Area of Occurrence	Coorong Marine
Threatened Status	Vulnerable/Endangered
Migratory Species	Yes
Impact Status	No Significant Impact

The species in this group have vast extents of occurrence over coastal and open ocean water. The Coorong and Marine project sub-areas combined represent a small portion of the extents of occurrence of these species and none are regularly recorded in either area, with the possible exception of the Southern Right Whale. Southern Right Whales migrates along the South East coastline to calving and nursery areas in Encounter Bay during winter. Therefore the SEFRP is not anticipated to result in a significant impact.

Threatened and Migratory Reptiles Assessment

Striped Legless Lizard (*Delma impar*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for the Striped Legless Lizard focuses on the Salt Creek to Blackford construction footprint sub-area.

The likelihood of occurrence of the Striped Legless Lizard in the Salt Creek to Blackford construction footprint sub-area is extremely low. In the early 1990s the species was presumed extinct in South Australia, until populations were discovered in the South East region at Lake Ormerod and Hacks Lagoon Conservation Park. The SEFRP construction footprint is located at least 45 km from the nearest known population at Lake Ormerod. The favoured habitat for the species, temperate lowland grasslands, does not occur within either construction footprint. However, the grassland sites of known populations can be relatively weedy (Smith and Robertson 1999) and therefore reasonably similar in floristic composition and structure to parts of the cleared areas within the construction footprint. Current data suggests that no important population of this species occurs within the project area, and it was not observed during the field survey (Jacobs 2015). Therefore the species is not anticipated to be affected, either positively or negatively, by the project.

Threatened and/or Migratory Marine Turtles

Species	Loggerhead Turtle *(Caretta caretta)* Green Turtle *(Chelonia mydas)* Leatherback Turtle, Leathery Turtle, Luth *(Dermochelys coriacea)*
Area of Occurrence	Coorong Marine
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

Both the Coorong and Marine sub-areas are anticipated to benefit ecologically from the project. Therefore impacts to Threatened and/or Migratory Marine Turtles are not likely.

Threatened Plant Assessment

Avenue Cassinia (*Cassinia tegulata*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Critically Endangered
Migratory Species	No
Impact Status	No Significant Impact

Cassinia tegulata occurs in seasonally inundated *Melaleuca brevifolia, Gahnia filum* shrublands (DoE 2016c). While similar vegetation types are known to occur in both the Salt Creek to Blackford Construction Footprint and the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-areas, the species itself has not been recorded in either sub-area. There are five known populations of the species recorded in the BDBSA, with the closest located on a roadside approximately 5.3 km south of the southern end of the project footprint.

Salt Creek to Blackford Watercourse (en route wetlands) sub-area

The Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area is not known to support *Cassinia tegulata*. The BDBSA contains no records of the species in this sub-area and it was not recorded during the targeted survey (Jacobs 2015), although the extensive size of the sub-area made it impossible to comprehensively survey. In the unlikely event that the species is present, the increased inundation that may occur as a consequence of the SEFRP is not anticipated to cause significant impact to the species. The generally seasonal water regime of the Taratap and Tiiley Swamp Conservation Park wetlands will remain, while the frequency of inundation of the northern Tilley Swamp Watercourse may increase from very occasional to a frequency more closely aligned with the water regime favoured by of *C. tegulata*. Thus, a greater proportion of the *en route* wetlands sub-area may have a water regime favourable for *C. tegulata* with the project in place than without it.

Salt Creek to Blackford Construction Footprint sub-area

The plant association that *Cassinia tegulata* is known to occur in, *Melaleuca brevifolia, Gahnia filum* shrubland, has not been recorded in the construction footprint despite detailed mapping (Jacobs 2015). *Melaleuca brevifolia, Gahnia filum* shrubland is an atypical plant community of the South East region. More typically, vegetation is dominated by eitheir *M. brevifolia* or *G. filum* as single dominant species. If any plant associations featuring *M. brevifolia* or *G. filum* as dominant or co-dominant species (but not together) are considered potential, sub-optimal habitat for the *C. tegulata*, then 86 ha of such habitat requires clearance within the construction footprint sub-area (worst case). However, *C. tegulata*, which is perennial shrub and thus readily detected, has not been recorded in the Salt Creek to Blackford Construction Footprint sub-area historically (BDBSA) or by the recent targeted flora survey undertaken for the SEFRP (Jacobs 2015), which focussed specifically on the construction footprint. Thus, there is a low likelihood the *C. tegulata* is present and therefore a low likelihood of any impact.

Silver Daisy-bush (*Olearia pannosa subsp. pannosa*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

Olearia pannosa subsp. pannosa occurs in woodland and mallee vegetation. The only sub-area where the project affects such vegetation is the Salt Creek to Blackford Construction Footprint sub-area. The vegetation within the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area is wetland vegetation that, although 'terrestrialising' due to reduced inundation, is highly unlikely to support the species.

Clearance of woodland and mallee vegetation types within the construction footprint sub-area, that have the potential to support *O. pannosa subsp. pannosa*, totals 19.3 ha (worst case). However *Olearia pannosa ssp. pannosa*, which is a perennial shrub and thus readily detected,has not been recorded in the Salt Creek to Blackford Construction Footprint sub-area historically (BDBSA) or during the recent targeted flora survey (Jacobs 2015), which focussed specifically on the construction footprint. Thus, there is a low likelihood the *O. pannosa subsp. pannosa* is present and therefore a low likelihood of any impact.

Large-fruit Fireweed, Large-fruit Groundsel (*Senecio macrocarpus*)

Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

Senecio macrocarpus occurs in a broad range of vegetation types including sedgelands, shrublands and woodlands (DoE, 2016b). A large populationn (c. 35,000 individuals) occurs in Messent Conservation Park (DoE, 2016b) approximately 7 km from the construction footprint. *Senecio macrocarpus,* which is a perennial shrub and thus readily detected, has not been recorded in the Salt Creek to Blackford Construction Footprint or Salt Creek to Blackford Watercourse (*en route* wetlands) sub-areas historically (BDBSA) or by the recent targeted flora suvey (Jacobs 2015), which focussed specifically on the construction footprint. Thus, while some vegetation types potentially favourable for the species require clearance within the construction footprint, the species appears to be absent from this sub-area, and significant impact is therefore not anticipated.

Within the *en route* wetlands sub-area vegetation clearance is not required, but more frequent inundation may occur. The SPRAT states that *S. macrocarpus* "occurs most commonly in depressions in low lying closed sedgeland", including in Messent Conservation Park nearby to the SEFRP project area (DoE, 2016b). Closed sedgeland has not been recorded in the *en route* wetlands sub-area despite mapping undertaken by Jacobs (2015). Closed sedgeland in low lying areas is likely to be subject to inundation at times, suggesting *S. macrocarpus* may be tolerant of inundation. Given the likely absence of the species, likely absence of favoured habitat, and likely benign nature of the potential changes arising form the project (increased inundation), significant impact to *S. macrocarpus* in the Salt Creek to Balckford Watercourse (*en route* wetlands) sub-area is not anticipated.

Endangered Orchids

Species	Coloured Spider-orchid; Small Western Spider-orchid, Painted Spider-orchid *(Caladenia colorata)*

	Coast Spider-orchid *(Caladenia conferta)* Little Dip-Spider-orchid *(Caladenia richardsiorum)* Greencomb Spider-orchid, Rigid Spider-orchid *(Caladenia tensa)* Hale Dwarf Greenhood *(Pterostylis sp. Hale)* Metallic Sun-orchid *(Thelymitra epipactoides)*
Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Endangered
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for these species focuses on the Salt Creek to Blackford construction footprint sub-area only. The wetland habitat of the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area is extremely unlikely to support these species given that all favour terrestrial scrub and/or woodland habitats (see relevant SPRATs).

None of these species have been recorded in the Salt Creek to Blackford construction footprint sub-area historically (BDBSA) or during the 2015 targeted flora survey (Jacobs, 2015) (noting that the timing of this survey (winter) was not ideal for detecting these species).

A biological survey of the Tilley Swamp in December 1996 (Stewart *et al*. 1998), which surveyed 16 sites throughout the Tilley Swamp area, did not record any of the endangered orchids listed. Stewart *et al*. (1998) noted a previous record of the Metallic Sun-orchid from Tilley Swamp Conservation Park in 1991 “on a ridge above the watercourse”. Metallic Sun-orchid (but no other endangered orchids) is listed in the Tilley Swamp Conservation Park Management Plan (DEHAA 1999). The EPBC species SPRAT notes observations in 2005, 2006, and 2007 (Dickson, 2008 pers comm. in DoE, 2016a), which suggests there is a viable population within the Tilley Swamp Conservation Park. The Martin Washpool Conservation Park Management Plan (NPWSA 2000) does not list Metallic Sun-orchid, or any other endangered orchid, as present within the reserve. The preferred habitat of Metallic Sun-orchid is coastal heathlands, grasslands and woodlands on sandy loams (Obst 2005 in DoE 2016a). In the worst case clearance footprint, there is minor clearance of *Eucalyptus fasciculosa/Eucalyptus leucoxylon* open woodland (1.96 ha); E*ucalyptus diversifolia* mallee (open understorey) (3.78 ha); and *Allocasuarina verticillata* ± *Melaleuca lanceolata* open woodland (0.43 ha) within the Salt Creek to Blackford construction footprint. Given this, and

that the soil characteristics of the drain corridor are predominantly clay-loam, it is unlikely that the species is present, or will be impacted significantly by the project.

The total clearance of potential (woodland and mallee) habitat for endangered orchids within the Salt Creek to Blackford contruction footprint (19.3 ha worst case) represents a very small proportion of the total potential habitat for these species in the local area (over 6,500 ha).

In summary, the project is not anticipated to significantly impact any of the endangered orchids because:

- there are no records of any of these species occuring within the construction footprint; and
- clearance of preferred habitat is exceedingly small, particularly relative to the local area.

Vulnerable Orchids

Species	Elegant Spider-orchid, Blood-red Spider-orchid (*Caladenia formosa*) Candy Spider-orchid *(Caladenia versicolor)* Sandhill Greenhood Orchid *(Pterostylis arenicola)* Spiral Sun-orchid *(Thelymitra matthewsii)*
Area of Occurrence	Salt Creek to Blackford Construction Footprint Salt Creek to Blackford Watercourse (*en route* wetlands)
Threatened Status	Vulnerable
Migratory Species	No
Impact Status	No Significant Impact

The impact assessment for these species focuses on the Salt Creek to Blackford construction footprint sub-area only. The wetland habitat of the Salt Creek to Blackford Watercourse (*en route* wetlands) sub-area is extremely unlikely to support these species given that all favour terrestrial woodland habitats (see relevant SPRATs).

None of these species have been recorded in the Salt Creek to Blackford construction footprint sub-area historically (BDBSA) and none are listed in the Tilley Swamp Conservation Park Management Plan (DEHAA 1999), Martin Washpool Conservation Park Management Plan (NPWSA 2000) or were recorded in the December 1996 biological survey of Tilley Swamp (Stewart *et al*. 1998). None were detected in the 2015 targeted flora survey of the

contruction foorptint (Jacobs 2015) (noting that the timing of this survey (winter) was not ideal for detecting these species). The likelihood that any of these species are present within the construction footprint is very low.

The total clearance of potential (woodland and mallee) habitat for vulnerable orchids within the Salt Creek to Blackford construction footprint (19.3 ha worst case) represents a very small proportion of the total potential habitat for these species in the local area (over 6,500 ha).

The project is not anticipated to significantly impact any of the endangered orchids because:

- no records of any of these species exist within the construction footprint; and,
- clearance of preferred habitat is exceedingly small, particularly relative to the local area

3.1.6 South-east Marine Region

The Protected Matters Search results identified the potential presence of the South east Marine Region in the footprint of the project. The South-east Marine Region is predonminantly offshore, and the minimal impact of potentially reduced outflow at Salt Creek outfall is not anticipated to have any impact on Commonwealth marine waters or the South-east Marine Region (Figure 37). In addition, the project will not impact any Commonwealth reserves in the South East Marine region (Figure 38). The closest Commonwealth reserve is the Murray Commonwealth Marine reserve, located at the Murray mouth. The project will not materialy impact outflows at the Murray mouth.

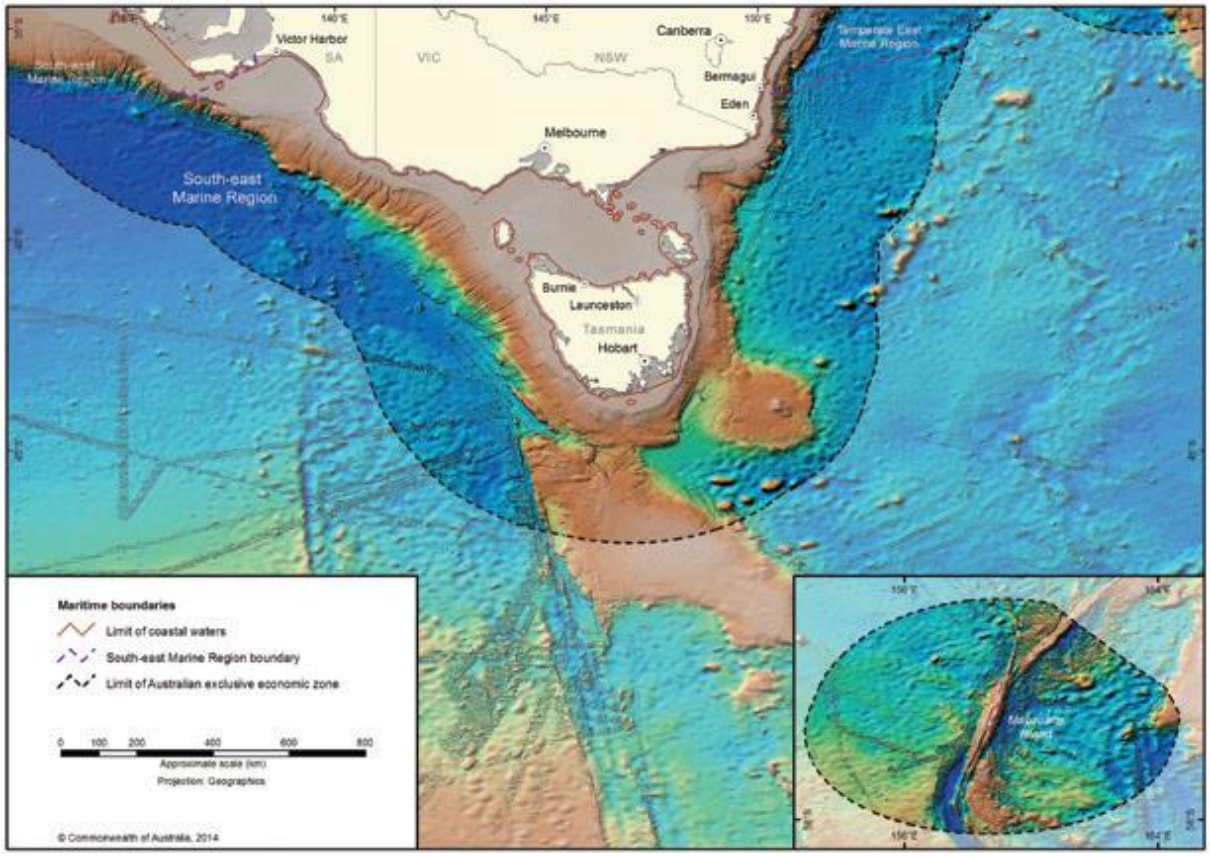

Figure 37: South East Marine Region [Source: DoE 2015]

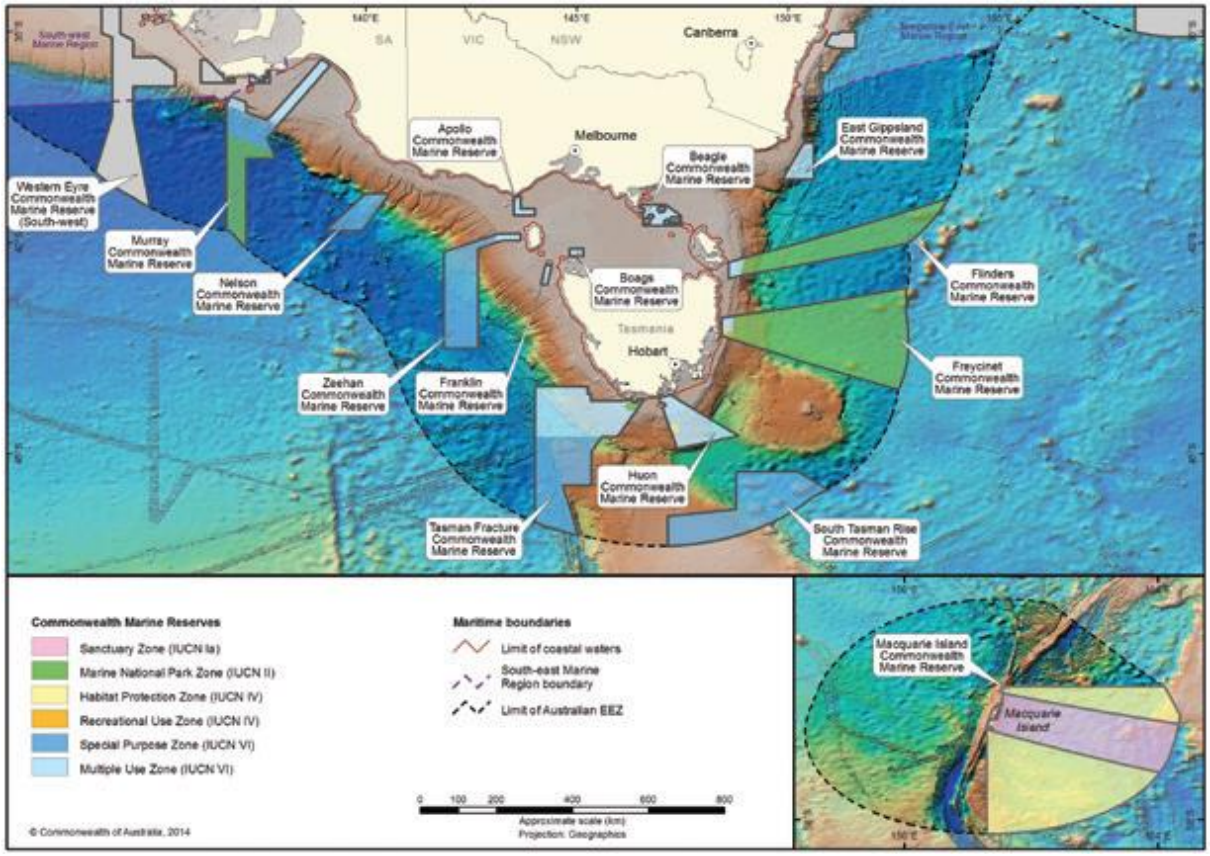

Figure 38: Commonwealth marine reserves in the South east Marine Region [Source: DoE 2015]

3.1.7 Commonwealth Marine Area

The the minimal impact of potentially reduced outflow at Salt Creek outfall is not anticipated to have any impact on marine waters. The PMR also identified a number of marine species.

EPBC listed Marine Species

Table 17 lists those species that could be present in this region adjacent to Commonwealth Marine Areas. Of these, the Australian white ibis (*Threskiornis moluccus*), Black-winged stilt (*Himantopus himantopus*), Silver gull (*Chroicocephalus novaehollandiae*) and Common greenshank (*Tringa nebularia*) were observed during the field fauna survey (Jacobs, 2015). Although observed, the project is not anticipated to have any impact of the project on any Commonwealth marine areas or any significant impact on these species.

Table 17: Marine species potentially present in region

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Birds			
Actitis hypoleucos	Common Sandpiper		Foraging, feeding or related behaviour known to occur within area
Apus pacificus	Fork-tailed Swift		Species or species habitat likely to occur within area
Ardea alba	Great Egret, White Egret		Species or species habitat known to occur within area
Ardea ibis	Cattle Egret		Species or species habitat likely to occur within area
Arenaria interpres	Ruddy Turnstone		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata	Sharp-tailed Sandpiper		Foraging, feeding or related behaviour known to occur within area
Calidris alba	Sanderling		Foraging, feeding or related behaviour known to occur within area
Calidris canutus	Red Knot, Knot		Foraging, feeding or related behaviour known to occur within area
Calidris ferruginea	Curlew Sandpiper		Foraging, feeding or related behaviour known to occur within area
Calidris melanotos	Pectoral Sandpipe		Foraging, feeding or related behaviour known to occur within area
Calidris ruficollis	Red-necked Stint		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris	Great Knot		Foraging, feeding or related behaviour known to occur within area
Catharacta skua	Great Skua		Species or species habitat may occur within area
Charadrius bicinctus	Double-banded Plover		Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover		Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus	Red-capped Plover		Foraging, feeding or related behaviour known to occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Charadrius veredus	Oriental Plover, Oriental Dotterel		Foraging, feeding or related behaviour known to occur within area
Diomedea antipodensis	Antipodean Albatross	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena	Tristan Albatross	Endangered	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Diomedea exulans (sensu lato)	Wandering Albatross	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi	Northern Royal Albatross	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii	Latham's Snipe, Japanese Snipe		Foraging, feeding or related behaviour known to occur within area
Gallinago megala	Swinhoe's Snipe		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura	Pin-tailed Snipe		Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster	White-bellied Sea-Eagle		Species or species habitat known to occur within area
Halobaena caerulea	Blue Petrel	Vulnerable	Species or species habitat may occur within area
Himantopus himantopus	Black-winged Stilt		Foraging, feeding or related behaviour known to occur within area
Hirundapus caudacutus	White-throated Needletail		Species or species habitat likely to occur within area
Larus novaehollandiae	Silver Gull		Breeding known to occur within area
Lathamus discolor	Swift Parrot	Endangered	Species or species habitat likely to occur within area
Limosa lapponica	Bar-tailed Godwit		Foraging, feeding or related behaviour known to occur within area
Limosa limosa	Black-tailed Godwit		Foraging, feeding or related behaviour known to occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Macronectes giganteus	Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
Macronectes halli	Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
Merops ornatus	Rainbow Bee-eater		Species or species habitat may occur within area
Myiagra cyanoleuca	Satin Flycatcher		Species or species habitat known to occur within area
Neophema chrysogaster	Orange-bellied Parrot	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis	Eastern Curlew		Foraging, feeding or related behaviour known to occur within area
Numenius minutus	Little Curlew, Little Whimbrel		Foraging, feeding or related behaviour likely to occur within area
Pandion haliaetus	Osprey		Species or species habitat likely to occur within area
Phalacrocorax fuscescens	Black-faced Comorant		Foraging, feeding or related behaviour likely to occur within area
Phalaropus lobatus	Red-necked Phalarope		Foraging, feeding or related behaviour known to occur within area
Philomachus pugnax	Ruff (Reeve)		Foraging, feeding or related behaviour known to occur within area
Pluvialis fulva	Pacific Golden Plover		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola	Grey Plover		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes	Flesh-footed Shearwater, Fleshy-footed Shearwater		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae	Red-necked Avocet		Foraging, feeding or related behaviour likely to occur within area
Rhipidura rufifrons	Rufous Fantail		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)	Painted Snipe	Endagered	Species or species habitat likely to occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Sterna albifrons	Little Tern		Species or species habitat may occur within area
Sterna bergii	Crested Tern		Breeding known to occur within area
Sterna Caspia	Caspian Tern		Foraging, feeding or related behaviour known to occur within area
Sterna fuscata	Sooty Tern		Breeding known to occur within area
Sterna nereis	Fairy Tern		Breeding known to occur within area
Thalassarche cauta (sensu stricto)	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida	Campbell Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini	Salvin's Albatross	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi	White-capped Albatross	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis rubricollis	Hooded Plover		Roosting known to occur within area
Thinornis rubricollis rubricollis	Hooded Plover (eastern)		Species or species habitat known to occur within area
Tringa glareola	Wood Sandpiper		Foraging, feeding or related behaviour known to occur within area
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank		Foraging, feeding or related behaviour known to occur within area
Xenus cinereus	Terek Sandpiper		Foraging, feeding or related behaviour known to occur within area
Fish			
Acentronura australe	Southern Pygmy Pipehorse		Species or species habitat may occur within area
Campichthys tryoni	Tryon's Pipefish		Species or species habitat may occur within area
Heraldia nocturna	Upside-down Pipefish, Eastern Upside-down		Species or species habitat may occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
	Pipefish, Eastern Upside-down Pipefish		
Hippocampus abdominalis	Bigbelly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse		Species or species habitat may occur within area
Hippocampus breviceps	Short-head Seahorse, Short-snouted Seahorse		Species or species habitat may occur within area
Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish, Ringback Pipefish		Species or species habitat may occur within area
Hypselognathus rostratus	Knifesnout Pipefish, Knife-snouted Pipefish		Species or species habitat may occur within area
Kaupus costatus	Deepbody Pipefish, Deep-bodied Pipefish		Species or species habitat may occur within area
Leptoichthys fistularius	Brushtail Pipefish		Species or species habitat may occur within area
Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish		Species or species habitat may occur within area
Lissocampus runa	Javelin Pipefish		Species or species habitat may occur within area
Maroubra perserrata	Sawtooth Pipefish		Species or species habitat may occur within area
Notiocampus ruber	Red Pipefish		Species or species habitat may occur within area
Phycodurus eques	Leafy Seadragon		Species or species habitat may occur within area
Phyllopteryx taeniolatus	Common Seadragon, Weedy Seadragon		Species or species habitat may occur within area
Pugnaso curtirostris	Pugnose Pipefish, Pug-nosed Pipefish		Species or species habitat may occur within area
Solegnathus robustus	Robust Pipehorse, Robust Spiny Pipehorse		Species or species habitat may occur within area
Solegnathus spinosissimus	Spiny Pipehorse, Australian Spiny Pipehorse		Species or species habitat may occur within area
Stigmatopora argus	Spotted Pipefish, Gulf Pipefish		Species or species habitat may occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Stigmatopora nigra	Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish		Species or species habitat may occur within area
Stipecampus cristatus	Ringback Pipefish, Ring-backed Pipefish		Species or species habitat may occur within area
Urocampus carinirostris	Hairy Pipefish		Species or species habitat may occur within area
Vanacampus margaritifer	Mother-of-pearl Pipefish		Species or species habitat may occur within area
Vanacampus phillipi	Port Phillip Pipefish		Species or species habitat may occur within area
Vanacampus poecilolaemus	Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish		Species or species habitat may occur within area
Vanacampus vercoi	Verco's Pipefish		Species or species habitat may occur within area
Mammals			
Arctocephalus forsteri	New Zealand Fur-seal		Species or species habitat may occur within area
Arctocephalus pusillus	Australian Fur-seal, Australo-African Fur-seal		Species or species habitat may occur within area
Neophoca cinerea	Australian Sea-lion	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles			
Caretta caretta	Loggerhead Turtle	Endangered	Breeding likely to occur within area
Chelonia mydas	Green Turtle	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	Endangered	Species or species habitat known to occur within area
Whales and other Cetaceans			
Balaenoptera acutorostrata	Minky Whale		Species or species habitat may occur within area
Balaenoptera edeni	Bryde's Whale		Species or species habitat may occur within area
Balaenoptera musculus	Blue Whale	Endangered	Species or species habitat may occur within area
Caperea marginate	Pygmy Right Whale		Species or species habitat may occur within area

Species	Common Name	EPBC Status	Type of Presence (from DoE PMR)
Delphinus delphis	Common Dolphin, Short-beaked Common Dolphin		Species or species habitat may occur within area
Eubalaena australis	Southern Right Whale	Endangered	Species or species habitat known to occur within area
Grampus griseus	Risso's Dolphin, Grampus		Species or species habitat may occur within area
Lagenorhynchus obscurus	Dusky Dolphin		Species or species habitat may occur within area
Megaptera novaeangliae	Humpback Whale	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca	Killer Whale, Orca		Species or species habitat may occur within area
Tursiops aduncus	Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin		Species or species habitat likely to occur within area
Tursiops truncates s. str.	Bottlenose Dolphin		Species or species habitat may occur within area

The SEFRP has the potential to improve marine habitat by reducing freshwater outfall through the Blackford Drain. There will be no impact to species adjacent to Commonwealth Marine Areas.

3.1.8 Commonwealth Land

The nearest Commonwealth Land is on the shores of Lake Albert. The proposed action will not take place in, nor will it impact upon, Commonwealth land.

3.1.9 The Great Barrier Reef Marine Park

The proposed action is not in the vicinity of the Great Barrier Reef Marine Park and as such there will be no impact upon this matter of NES.

3.1.10 A water resource, in relation to coal seam gas development and large coal mining development

The proposed action is not a coal seam gas development or large coal mining development that has, or is likely to have, a significant impact on water resources.

3.2 Nuclear actions, action taken by the Commonwealth, actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

The proposed action is not a nuclear action.

3.3 Other important features of the environment

3.3.1 Current state of the environment

Background to the South East Region of South Australia, including the current state of the environment, is located in Section 2.1.1.2.

3.3.2 Hydrology, including water flows

Background to the hydrology of the South East Region, including the South East Drainage Network, is located in Section 2.1.1.2.

3.3.3 Unique values of the environment

The Biodiversity Plan for the region (Croft *et al* 1999) identifies a large area within the proposed action as being of particular importance to the conservation of biodiversity in the South East (Figure 39):

- The North East District, encompassing Salt Creek, Martin Washpool Conservation Park and Tilley Swamp

This area is considered important as it has high habitat value, comprises blocks of remnant vegetation greater than 1000 ha, contains high numbers of species, good estimated population sizes and species of high conservation significance. The priority actions for this area are defined in the Biodiversity Plan for the South East of South Australia (Croft *et al* 1999) and aligns with planned management and restoration activities such as:

- Pest and weed control measures

- Maintenance of wildlife crossings across drainage structures
- Restoring linkages between remnant areas
- Restoring degraded vegetation
- Planting local native species that support vegetation communities of conservation significance.

Background to the Taratap and Tilley Swamp Wetlands and Morella Basin is provided in Section 2.1.1.2.

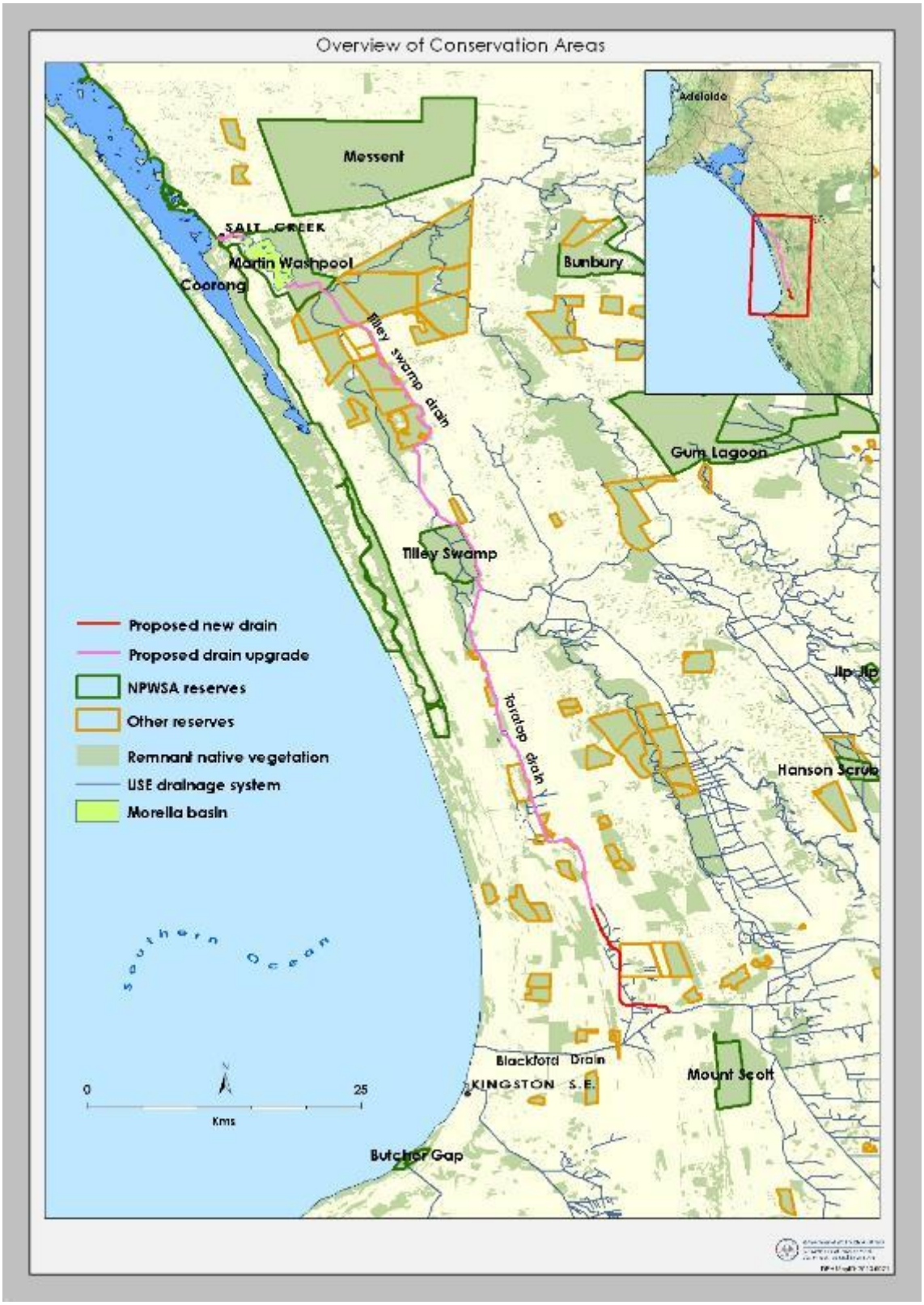

Figure 39: Upper South East Conservation Areas

3.3.4 Outstanding natural features

The South East region represents the western limit of wetter South East Australian habitat, and the southern limit of drier Mallee vegetation communities. Unique geomorphological attributes include limestone caves and sinkholes, granite outcrops, relic volcanic areas, and long parallel relic coastlines, which provide unique habitat types (Croft *et al*. 1999). Relic coastlines create a series of flats, valleys and ranges that contribute to the unique hydrology, and vegetation structure, of the region.

The coastline is largely undeveloped and has distinctive features which include coastal lakes and limestone cliffs. The marine environment is mostly high energy and is significant for its high biodiversity and high productivity.

3.3.5 Soil characteristics

The South East was formed under an oceanic environment creating inherently salty soils. The historical removal of native vegetation and planting of shallow-rooted species allowed for mobilisation of salts under wet conditions. After flooding, salts expressed in the root zone leached through the soil profile to water tables. Saline conditions are present in every sub-catchment in the USE. Salt can enter aquatic ecosystems in the USE catchment in several ways including to wetlands through the drainage system; leached from the soil profiles within a wetland; express at the surface via direct groundwater discharge; or through interflow (Everingham and Kawalec 2009).

3.3.6 Indigenous heritage values

The alignment of the proposed SEFRP is situated across the traditional lands and waters of the Ngarrindjeri and the Aboriginal decedents of the Tanganekald, Meintangk, Potaruwutji, and Buandik language groups.

Today, the Aboriginal people of the South East recognise their cultural heritage in the landscapes of the region in many ways. Places showing evidence of past Aboriginal occupation are particularly important to contemporary Aboriginal society and may exist anywhere within the region. However certain landforms are more likely to contain such evidence. These landforms include (SENRMB 2010):

- areas within 2 km of coasts and major waterways
- areas within 100 m of the banks of all other creeks, rivers, watercourses, lakes, waterholes, rock holes, wells and springs, especially in more arid areas
- rocky outcrops

- dunes, sand hills and sand deposits, especially in the vicinity of water sources, wells, springs, and waterholes
- craters and sinkholes
- unusual land features
- areas of bush, forested areas, natural vegetation
- intact ground surface such as parklands, reserves, open space and road verges.

The close association of the Ngarrindjeri people is expressed through Creation stories that reveal the significance of the relationship between the country and the people, both spiritually and practically:

'The land and waters is a living body. We the Ngarrindjeri people are a part of its existence. The land and waters must be healthy for the Ngarrindjeri people to be healthy.'

'The waters flowing down the Murray-Darling system bring life to the river, the lakes and the Coorong. The waters bring life to the Ngarrindjeri too. This is both a practical and a spiritual statement' (Ngarrindjeri Tendi, 2006).

Given the rich history and the strong and continuing connections the lands and waters of the region, the importance of close partnerships with Indigenous communities throughout implementation of the SEFRP to ensure that Indigenous knowledge and values are incorporated, and Native title and cultural heritage values are protected and respected, is well recognised.

Traditional Owner groups have been engaged in development of the proposed action since 2008. The Traditional Owner groups are supportive of the SEFRP as it will enhance their cultural values by increasing connectivity between South East wetlands and contributes to their economic well-being. Since the initiation of the planning, other Traditional Owner organisations have been established. DEWNR will notify these groups regarding the SEFRP prior to the construction phase and consult with them at the time DEWNR seeks authorisations under the *Aboriginal Heritage Act*.

The cultural values and aspirations of the Ngarrindjeri (represented by the Ngarrindjeri Regional Authority), and the South East Aboriginal people (represented by the South East Aboriginal Focus Group) are further explained in Appendices 4 and 5.

3.3.7 Commonwealth Heritage Places or other places recognised as having heritage values

There are no listed Commonwealth Heritage Places in the vicinity of the proposed action.

A number of places located in the vicinity of the proposed action have heritage value under the Register of the National Estate (the Register). The Register of the National Estate was closed in 1997 and references to the Register in the EPBC Act were removed in 2012. As such it is no longer a statutory list.

It is expected that there will be no significant impacts upon any places of heritage value found on the Register as they are not at the site of the proposed action. The only site that intercepts with the proposed action is the Coorong National Park. However, only minor works will be undertaken in the area and will be managed to minimise impacts.

Table 18: Heritage value sites found in the South East region.

South East Region Heritage Values	
• Bunbury Swamp and Bushland	• Jip Jip Conservation Park and Swamp
• Cantara Homestead	• Jaffray Complex
• Coorong Carbonate Lakes	• Bool Lagoon Wetland System
• Coorong National Park	• Hacks Lagoon Conservation Park (part of Bool and Hacks Lagoons Ramsar site)
• Mandina Marshes / Cortina Lakes / Mandina Lakes	• Big Heath Conservation Park
• Pretty Johnnys Swamp	• Bloomfield Swamp
• Dirty Joes Lake	• Fairview Conservation Park
• Messent Conservation Park	• Lochaber Swamp
• Mrs Whites Lagoon / Caora Complex	• Tresant Swamp

3.3.8 Any proposed land/marine uses of area

There are no proposed land or marine uses of the area that differ significantly from the current land and marine uses.

4. Measures to avoid or reduce impacts

Section 3 has determined that no significant adverse impacts to matters of national environmental significance are likely as a result of the SEFRP. Potential adverse impacts to water quality (not considered to be significant) in the Coorong, and Lakes Alexandrina and Albert Wetland of International Importance will be managed through Management Principles under the USE Drainage Network Management Strategy (DFW 2011), that will govern operations of the SEFRP channel. DEWNR will be developing a Site Operations Manual for the Coorong, Lower Lakes and Murray Mouth, containing a module on SEFRP Operations, which will be cross-referenced with the USE Management Principles to coordinate outcomes for the Coorong South Lagoon.

Assessments of likely adverse impacts to threatened and migratory species (Section 3.1.5) note that presence of listed species within the construction footprint has not been confirmed, and that the proposed clearance of potential habitat is insignificant given the extent of potential habitat within the general project area and South East region. Construction will be guided by a Construction Environmental Management Plan (CEMP), to minimise, where possible, disturbance to flora and fauna, or habitat used by flora or fauna. Design considerations, such as fauna crossings and fishways, have also been included to reduce long-term impacts of the project.

For the most part, the SEFRP proposes works to upgrade the existing drainage system in the Upper South East. A large proportion of the proposed construction footprint lies within existing cleared land (approximately 400 ha). A worst case estimate indicates a total clearance of 287 hectares of native vegetation

Threatened species

Listed Fauna Species

Although no records exist in the SEFRP construction footprint, including the 2015 field assessment undertaken for the SEFRP (Jacobs 2015), the footprint does contain suitable habitat to support populations of listed fauna, including:

1) Malleefowl (*Leipoa ocellata*)
2) Striped Legless Lizard (*Delma impar*)
3) White-bellied Sea Eagle (*Haliaeetus leucogaster*)
4) Migratory Bush Birds: Rainbow Bee-eater (*Merops ornatus*), Satin Flycatcher (*Myiagra cyanoleuca*), Rufous Fantail (*Rhipidura rufifrons*)

The CEMP being developed will outline measures to ensure the impact on any individuals, should they be present during construction, are avoided.

Malleefowl (*Leipoa ocellata*)

As discussed in Section 3.1.5.3, there are no confirmed records of Malleefowl (individuals, signs or nests) within the SEFRP construction footprint. However, two individuals were recorded in the general project area (but outside of the footprint) during the 2015 assessment (Jacobs 2015) and suitable habitat for the species occurs within the footprint.

The CEMP, that will be developed in consultation with local Malleefowl interest groups, will outline measures to ensure the impact on any individuals, should they be present during construction, are avoided. This will include a final walkover of vegetation to be cleared to identify any nests, and recommend appropriate management if present.

Further activities will be undertaken upon the completion of construction to improve habitat for Malleefowl. These may include:

- actively promoting the regeneration of native habitat
- carrying out weed control (particularly bridal creeper, coastal wattle, and sallow wattle).

Actions identified within the Regional Action Plan for the Malleefowl *Leipoa ocellata* in the South East of South Australia (Harley and Le Duff, 2009) and the National Recovery Plan for Malleefowl *Leipoa ocellata* (Benshemesh, 2007) will also be considered, particularly those currently being undertaken where further value can be added.

Listed Flora Species

As discussed previously in Section 3.1.5.3, there is the potential for suitable habitat to support populations of *Cassinia* and *Senecio*, although no records exist in the construction footprint.

While a flora survey has been undertaken along the construction footprint, the construction EMP will contain measures to identify and minimise impact should these species be present during construction.

Such actions will be undertaken in collaboration with regional and state threatened species officers to maximise conservation outcomes.

Endangered and Vulnerable Orchids

As discussed previously in Section 3.1.5.3, there is the potential for suitable habitat to support populations of orchids, although no records exist in the construction footprint.

The relevant orchids listed under the EPBC Act include:

- Coast Spider-orchid *(Caladenia conferta)*
- Elegant Spider-orchid, Blood-red Spider-orchid (*Caladenia formosa*)
- Little Dip-Spider-orchid (*Caladenia richardsiorum*)
- Greencomb Spider-orchid, Rigid Spider-orchid *(Caladenia tensa)*
- Metallic Sun-orchid *(Thelymitra epipactoides)*
- Candy Spider-orchid *(Caladenia versicolor)*
- Sandhill Greenhood Orchid *(Pterostylis arenicola)*
- Spiral Sun-orchid *(Thelymitra matthewsii)*

While a flora survey has been undertaken along the construction footprint, the construction EMP will contain measures to identify and minimise impact should these species be present during construction.

Such actions will be undertaken in collaboration with regional and state threatened species officers to maximise conservation outcomes.

4.1 Mitigation actions during and post-construction (water quality management)

Proposed mitigation actions for during and post-construction of the SEFRP relate to water quality management.

Operational Water Quality Management

An Environmental Management Plan will be developed to manage any water quality issues during construction. A water quality monitoring program, in consultation with the EPA and in line with the *Environment Protection (Water Quality) Policy 2015*, will be undertaken during construction. Water quality (various parameters) will be monitored immediately up- and downstream of the construction area regularly throughout the construction period.

Post-construction, the operation of the SEFRP infrastructure will be integrated with the South Eastern Water Conservation and Drainage Board's Upper South East (USE) Drainage Network Management Strategy and the supporting adaptive flows management systems.

Through the SEFRP, 'Management Principles' will be developed under the USE Drainage Network Management Strategy to govern operations of the SEFRP channel. The Management Principles will list the 'Critical Control Points' (points along the system where flow can be held, diverted or released) and 'Priorities' that guide operational decision making. These priorities will flow into a Decision Support System which supports real-time operations within the Network.

Separately, the CLLMM Recovery Project will be developing a Site Operations Manual for the Coorong, Lower Lakes and Murray Mouth. The Site Operations Manual requires a module on SEFRP Operations which will be developed as part of the SEFRP. This module will be cross-referenced with the USE Drainage Network Management Strategy Management Principles to coordinate outcomes for the Coorong South Lagoon.

Broadly, operational control points for the management of water along the SEFRP channel will allow for water to be:

- diverted along the SEFRP Channel towards the Coorong;
- allowed to flow to sea via the Blackford drain (as currently occurs);
- diverted from the SEFRP channel into *en route* wetlands;
- held in Morella Basin; and
- released from Morella Basin to the Coorong via Salt Creek.

The following principles will be considered in the development of the SEFRP channel Management Principles that guide operations:

- the capacity for the SEFRP channel to accept diversions from the Blackford Drain without overtopping and flooding agricultural land;
- the salinity level within the Coorong South Lagoon;
- predicted volume and timing of flows from the River Murray into the Coorong and resultant impact on South Lagoon salinity;
- the available volume and timing of flow in the Blackford Drain;
- the retention capacity of *en route* wetlands; and
- salinity in the SEFRP channel and (existing) salinity thresholds for *en route* wetlands.

Note that water quality parameters other than salinity have been considered by the water quality risk assessment undertaken for the project (Wilson *et al*. 2016) and have been determined to be low risk (see Section 3.1.3.2). Nonetheless, water quality monitoring in the Coorong and South East drainage system in the project area, which has been undertaken during the design phase of the project (and previously by various government agencies) will continue until the completion of the SEFRP. Water quality monitoring data will further refine knowledge of how water management within the drainage system influences water quality entering the Coorong, and how water quality entering the Coorong at Salt Creek influences water quality throughout the Coorong. Contemporary understanding of these issues has been articulated in the water quality risk assessment for the project (Wilson *et al*. 2016). An adaptive management approach will be taken in supporting SEFRP channel operational decision making and information synthesised from all environmental management activities will form the basis for concise operating rules for the SERFP.

Operation of Morella Basin

The South Australian government currently has management rights over Morella Basin, a large wetland at the terminus of the wetland and drainage system, immediately upstream of Salt Creek. This site is currently operated to achieve three objectives:

(1) maintain the site's intrinsic ecological values - particularly as feeding habitat for migratory shorebirds and as a source population for small-mouthed hardyhead and *Ruppia tuberosa* close to the Coorong South Lagoon,

(2) as a through-flow system for water flowing from the drainage system to the Coorong, with a likely role in improving water quality prior to release into the Coorong, and

(3) as a storage basin that provide some (limited) control over the rate and timing of flows from the drainage system into the Coorong, in particular the objective

to retain ‘tail’ water in late spring for release during summer months when this water may be of increased ecological value to the Coorong South Lagoon.

Wetlands are well known for their capacity to improve water quality. Under the SEFRP there is potential, dependent upon the final design, to increase the storage capacity of Morella Basin and adjacent wetlands by increasing the maximum permissible water level (currently limited due to backwater effects). This would enhance the ability to achieve the above three objectives. If the final SEFRP design does not permit an increase in storage capacity, the SEFRP is anticipated to have a neutral effect upon the above three objectives.

Water Quality Monitoring

Operational decision making along the SEFRP channel will be underpinned by data collected through water quality monitoring. The monitoring of flow rates, water levels and water quality (basic parameters: salinity, dissolved oxygen, pH) throughout the South East Drainage System is critical to the effective and efficient management of the system to achieve the objectives set out in the USE Drainage Network Management Strategy.

Hydrological monitoring stations provide this information. Much of the existing hydrological monitoring infrastructure is live with web-based data available for managers, enabling a rapid management response to issues and opportunities as they arise (see https://www.waterconnect.sa.gov.au/Systems/RTWD/Pages/Default.aspx). For example, a pulse of fresh water through a typically saline area provides an opportunity to divert into wetlands, requiring a rapid response. In addition to the basic water quality parameters, some monitoring stations feature composite samplers; devices that enable the collection of water samples at specified times and/or frequencies. These samples can then be manually collected, transported and laboratory analysed to measure a range of water quality parameters.

The SEFRP, by widening existing drains, will disturb four existing hydrological monitoring stations in the Salt Creek to Blackford area. The hydrological monitoring component of the project involves the reinstatement of these four stations to accommodate the new channel width. Additionally, four new hydrological monitoring stations are proposed between the Blackford Drain and Salt Creek to manage the expanded system . A composite sampler, allowing for future detailed water quality analysis, already exists at Salt Creek. Two additional composite samplers will be added. One will be located upstream of Morella, to better inform the role that Morella is playing in water quality improvement prior to release into the Coorong South Lagoon. A second will be located on the SEFRP channel immediately downstream of the Blackford Drain diversion location (Taratap Drain DS

Blackford diversion) to enable the assessment of water quality entering the new SEFRP channel at its upstream end. A rainfall gauge is proposed at Morella to better inform net evaporation from this waterbody. Note that hydrological monitoring infrastructure additional to that listed exists within the project area but will be unaffected by the project.

5. Conclusion on the likelihood of significant impacts

5.1 Do you THINK your proposed action is a controlled action?

DEWNR does not consider that the SEFRP is a controlled action.

5.2 Proposed action IS NOT a controlled action

The risk assessment and mitigation measures for potential impacts of the SEFRP demonstrate that it is unlikely that the project will have any significant adverse impacts upon matters of national environmental significance. Consequently, it is considered that the proposed action is **not a controlled action**.

Detailed assessments of potential impacts to identified matters of national environmental significance (including the Coorong, and Lakes Alexandrina and Albert Wetland of International Importance, and listed threatened and migratory species) have determined that:

- No significant adverse impact to the ecological character of the Ramsar site is expected as a result of the project;
- Threatened ecological communities identified in the Protected Matters Report are unlikely to occur in the project area or are unlikely to be influenced by the project;
- While the SEFRP footprint provides suitable habitat for some threatened and migratory species, through field flora and fauna surveys combined with detailed desktop analysis of recorded presence and habitat preferences, no significant impacts on any threatened or migratory species are considered likely as a result of the project.

Potential adverse impacts will be managed through mitigation measures, including:

- Implementing a construction Environmental Management Plan which includes water quality monitoring and processes for managing potential impacts to flora and fauna;
- Actively promoting the regeneration of vegetation cleared within the construction corridor.
- 'Management Principles' for operations under the South East Drainage Network Management Strategy that consider any risks to receiving environments and

mitigation strategies, which will be integrated with the development of the CLLMM Site Operations Manual and management objectives of the Coorong;

The proposed action is expected to benefit matters of national environmental significance. In particular, the SEFRP will assist in managing salinity in the Coorong South Lagoon, a key component of the Coorong, and Lake Alexandrina and Lake Albert Wetland of International Importance, by providing up to an estimated additional 26.5 GL of water per year. This action promotes suitable water quality for key species that use the area, including any threatened or migratory species which forage, feed and/or breed in the Coorong South Lagoon. This action also reduces the risk of salinity in the Coorong exceeding upper management limits (100 g/L) and causing widespread ecological degradation, as was seen during the recent drought of 2006 to 2010.

In addition, the SEFRP is expected to benefit the *en route* wetlands of the Salt Creek to Blackford channel, thereby indirectly benefiting any threatened or migratory species which may use these areas.

Without the proposed intervention, the ecological values of the Coorong South Lagoon would remain at risk of ecological decline due to the impact of increased salinity during periods of reduced River Murray flows, such as the recent drought of 2006 to 2010.

5.3 Proposed action IS a controlled action

None of the matters of NES identified in the table below are expected to be significantly adversely impacted by the SEFRP.

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

6. Environmental Record of the Responsible Party

6.1 Does the party taking the action have a satisfactory record or responsible environmental management?

The South Eastern Water Conservation and Drainage Board (SEWCD Board) deliver the conservation and management of water and the prevention of flooding of rural land in the South East of South Australia. The action is being delivered by South Australian Department for Environment, Water and Natural Resources (DEWNR) in agreement with the SEWCD Board, who will be the ultimate owner and operator of the SEFRP infrastructure.

DEWNR has a strong record of responsible environmental management. The Department is responsible for South Australia's water and natural resources management, nature and heritage conservation, and animal welfare. The Department manages the state's public land including national parks, marine parks, botanic gardens and the coastline.

DEWNR is responsible for coordinating the State's implementation of the Murray Darling Basin Plan, and signed the Inter-governmental Agreement on Implementing Water Reform in the MDB on 27 June 2013.

DEWNR is part of the Sustainability, Environment and Conservation portfolio and the Water and River Murray portfolio and reports to the South Australian Minister for Sustainability, Environment and Conservation and the Minister for Water and River Murray. The Department delivers the State government's environment and water policies directly and through partnerships with local and indigenous communities, industry bodies, non-government organisations, and with other government agencies such as the Environment Protection Authority, Primary Industries and Resources SA, and Zero Waste SA.

The work of DEWNR is determined by its obligation to achieve related targets in South Australia's Strategic Plan, to administer legislation dedicated to the Minister for Sustainability, Environment and Conservation and the Minister for Water and River Murray, and to respond to the needs of South Australians.

6.2 Has the party proposing to take the action ever been subject to any proceedings under a Commonwealth, State or Territory

law for the protection of the environment or the conservation and sustainable use of natural resources?

DEWNR, nor the SEWCD Board, has never been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

6.3 Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act

DEWNR has previously referred many actions requiring consideration under the EPBC Act, including those listed in Section 1.13. Actions undertaken in the Coorong, Lake Alexandrina and Lake Albert Wetland of International Importance and in regard to the Upper South East Drainage Network which have been referred include the below:

EPBC Reference No.	Title of Referral	Date Received
2010/5526	Department of Environment and Heritage (South Australia)/Natural resources management/Coorong National Park/SA/Coorong South Lagoon Salinity Reduction Strategy: Pumping Scheme	4/06/2010
2009/5227	South Australian Department for Environment and Heritage/Water management and use/Goolwa Channel/SA/Goolwa Channel Water Level Management Project	1/12/2009
2009/4833	SOUTH AUSTRALIAN DEPARTMENT FOR ENVIRONMENT AND HERITAGE/Water Management and Use/Goolwa Channel, Finniss River and Currency Creek/South Australia/Emergency Response for the Crisis Management of Acid Sulphate Soils	6/04/2009
2008/4618	South Australian Department for Environment and Heritage/Natural resources management/Lake Alexandrina	28/11/2008

	and the Coorong/SA/Opening the barrage network separating the lakes	
2007/3223	South Australian Department of Water, Land and Biodiversity Conservation / Water management and use / The Coorong / SA / Water capture to restore wetlands and restore environmental flows to the Upper South East of SA	4/01/2007

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7.2 Reliability and date of information

The information presenting in this referral has been obtained from a number of scientific and government sources, and is considered by DEWNR to be the most reliable currently available.

7.3 Attachments

Appendix 1 – EPBC Act Protected Matters Report dated 10 November 2014

Appendix 2 – Threatened Species: Likelihood of Occurrence

Appendix 3 – Migratory Species: Likelihood of Occurrence

Appendix 4 – Hemming, S. and Rigney D. (2008) *Coorong South Lagoon Flows Restoration Feasibility Investigations. Ngarrrindjeri Regional Authority Inc. and Murrapeena Heritage Committee Position Paper for the Coorong South Lagoon Flow Restoration Project Feasibility Investigations.* Report prepared for the Ngarrindjeri Regional Authority Inc., the Murrapeena Heritage Committee and the South Australian Murray-Darling Basin Natural Resource Management Board. Ngarrindjeri Regional Authority Inc. and Flinders University, Adelaide, South Australia.

Appendix 5 – Watson, I. (2012). *South East Aboriginal Focus Group Position Paper on the SE Flows Restoration Project Plan*

Appendix 6 – Coorong and Lakes Alexandrina and Albert Ramsar Information Sheet

8. Contacts, signatures and declarations

Project title: South East Flows Restoration Project

8.1 Person proposing to take action

Name	Mr Tim Bond
Title	Acting Regional Director, Natural Resources South East
Organisation	Department of Environment, Water and Natural Resources
ABN	36 702 093 234
Postal address	GPO Box 1047, Adelaide, SA, 5001
Telephone	(08) 8735 1352
Email	tim.bond@sa.gov.au
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence. I agree to be the proponent for this action. I acknowledge that I may be liable for fees related to my proposed action following the introduction of cost recovery under the EPBC Act.

Signature  Date 11 March 2016