COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT SOCIOECONOMIC ASSESSMENT

A Report for DEW

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Prepared by

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ASGC	Australian Standard Geographical Classification
BCR	Benefit Cost Ratio
CBA	Cost-Benefit Analysis
CI	Confidence Interval
CLLMM	Coorong, Lower Lakes & Murray Mouth
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSL	Coorong South Lagoon
DEH	Department for Environment and Heritage
DEW	Department for Environment and Water
DEWNR	Department for Environment, Water and Natural Resources
DIRD	Department of Infrastructure, Transport, Regional Development and Communications
DPMC	Department of the Prime Minister and Cabinet
GRP	Gross Regional Product
GSP	Gross State Product
GVP	Gross Value Product
mAHD	metres with respect to the Australian Height Datum
MCA	Multi-Criteria Analysis
MDBA	Murray-Darling Basin Authority
NPV	Net Present Value
OBPR	Office of Best Practice Regulation
PIRSA	Department of Primary Industries and Regions South Australia
RIAS	Regional Impact Assessment Statement
SARDI	South Australian Research and Development Institute
SO	Southern Ocean
WTA	Willingness-To-Accept
WTP	Willingness-To-Pay

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EXECUTIVE SUMMARY

The Coorong Infrastructure Investigations project, part of the broader Heathy Coorong Heathy Basin Project, is investigating the feasibility of multiple long-term operational infrastructure options to improve the ecological health of the Coorong.

This report provides a preliminary indication of the potential socio-economic implications of infrastructure options under investigation to improve the ecological health of the Coorong South Lagoon.

Potential socioeconomic implications of the options were identified through a review of published peer-reviewed literature and in consultation with the project delivery team at DEW and KBR. This report will be included as a chapter in a Feasibility Assessment Report.

The following conclusions were drawn from the preliminary assessment:

1. Potential impacts on the regional economy, in particular Gross Regional Product, is proportional to the magnitude of capital expenditure.
2. Whilst dregdate disposal during construction may have negative local impacts (e.g. fish productivity, commercial fisheries production and tourism opportunities) improvement in the ecological health of the Coorong would yield widespread productivity benefits in the long run.
3. Access restrictions will likely arise for all of the proposed infrastructure options at the construction phase. However, alternate access requirements may be established to reduce long term access restrictions.
4. Land acquisition is most relevant to the Lake Albert and Coorong connector and not relevant for the rest of the options located within the Coorong National Park.

In addition, this report outlines the following next steps, based on best practice guidelines and a gap analysis, for further investigations that may be required (i.e. a more detailed socio-economic assessment, Regional Impact Assessment Statement (RIAS) and a cost benefit analysis (CBA)) for infrastructure options deemed feasible for improving the ecological health of the Coorong:

1. Carry out an assessment of environmental and equity implications of the preferred option to adequately meet RIAS requirements according to the reviewed Commonwealth and state government best practice guidelines and requirements.
2. Collect additional data to monetise a broad set of positive and negative short- and long-term economic, social, and environmental impacts for input into a CBA.
3. Qualitatively assess impacts that cannot be monetised due to data availability.

1. INTRODUCTION

The objective of this report is to present potential socioeconomic implications of the infrastructure options undergoing feasibility investigations to improve the ecological health of the Coorong. Potential socioeconomic implications of the options were identified through a review of published peer-reviewed literature and in consultation with the project delivery team at Department for Environment & Water (DEW) and Kellogg Brown & Root Pty Ltd (KBR).

Table 1-1 provides an outline and descriptions of the 13 infrastructure options that are being considered through the multi-criteria analysis (MCA) process:

Table 1-1 Infrastructure options under investigation options to improve the ecological health of the Coorong

MCA Option #	Concept Design Option #	Description
1	1A	**Passive open channel connection between Lake Albert and Coorong North Lagoon:** • 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via an open channel with regulator structure and fishway.
2	1B	**Passive piped connection between Lake Albert and Coorong North Lagoon:** • 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via seven closed conduits (pipes) with regulator structure.
3	1A + 2	**Passive open channel connection between Lake Albert and Coorong North Lagoon + Dredge Parnka Point:** 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via an open channel with regulator structure and fishway. • Dredging 17.5 km long to a target depth of between -1.2 mAHD and -1.4 mAHD centred around Parnka Point to varying width.
4	1B + 2	**Passive piped connection between Lake Albert and Coorong North Lagoon + Dredge Parnka Point:** 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via seven closed conduits (pipes) with regulator structure. • Dredging 17.5 km long to a target depth of between -1.2 mAHD to -1.4 mAHD centred around Parnka Point to varying width.
5	3A	**Intermittent pumped connection out of Coorong South Lagoon – near shore discharge structure:** • 1,000 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a near shore discharge structure (within Southern Ocean).
6	3B	**Intermittent pumped connection out of Coorong South Lagoon – low visual impact discharge structure:** • 1,000 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a beach discharge structure (within tidal zone).
7	3C + 2	**Pumped connection out of Coorong South Lagoon – near shore discharge structure + Dredge Parnka Point:** • 250 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a near shore discharge structure (within Southern Ocean). • Dredging 17.5 km long to a target depth of between -1.2 mAHD to -1.4 mAHD centred around Parnka Point to varying width.
8	3D + 2	**Pumped connection out of Coorong South Lagoon – low visual impact discharge structure + Dredge Parnka Point:** 250 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a beach discharge structure (within tidal zone).

MCA Option #	Concept Design Option #	Description
		• Dredging 17.5 km long to a target depth of between -1.2 mAHD to -1.4 mAHD centred around Parnka Point to varying width.
9	4A	**Bi-directional pumped Southern Ocean connection – one location, separate pumping stations, pump in location with caisson structure:** • 350 ML/d bi-directional pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure in Coorong South Lagoon. Pumping can only occur in one direction at any one time.
10	4B	**Bi-directional pumped Southern Ocean connection – one location, one common pumping station, near shore discharge / intake protected by breakwater:** • 350 ML/d bi-directional pumped connection into and out of Coorong South Lagoon via a common dry well pumping station positioned within Younghusband Peninsula with reversible flow pipes and a single set of pumps. Pumping can only occur in one direction at any one time. Near shore protected discharge/intake provided.
11	5A + southern dredge alignment (SDA)	**Simultaneous pumped Southern Ocean connection – two locations, separate pumping stations, pump in location with caisson structure and pump out location with a near shore discharge structure (Option 3A) with southern dredge alignment:** • 350 ML/d simultaneous pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure near Parnka Point with infrastructure positioned at two separate locations allowing circulation of flows within Coorong South Lagoon (i.e. pumping out at Parnka Point and pumping in at Woods Well). Pumping can occur concurrently through each pumping station. • Dredging 9.25 km long to a target depth of between -1.2 mAHD to -1.4 mAHD south from Parnka Point pump out location to varying width.
12	5B + southern dredge alignment (SDA)	**Simultaneous pumped Southern Ocean connection – two locations, separate pumping stations, pump in location with caisson structure and pump out location with a low visual impact discharge structure (Option 3B) with southern dredge alignment:** • 350 ML/d simultaneous pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure near Parnka Point with infrastructure positioned at two separate locations allowing circulation of flows within Coorong South Lagoon (i.e. pumping out at Parnka Point and pumping in at Woods Well). Pumping can occur concurrently through each pumping station. • Dredging 9.25 km long to a target depth of between -1.2 mAHD to -1.4 mAHD south from Parnka Point pump out location to varying width.
13	6	**Bi-directional piped connection into and out of Coorong South Lagoon, near shore discharge / intake protected by breakwater:** • Bi-directional passive piped connection with flow driven by differing water levels (varying flow rates) between Coorong South Lagoon and Southern Ocean to a near shore ocean location. Near shore protected discharge/intake provided.

Source: KBR.

This report will facilitate deliberative evaluation of the performance of the infrastructure options against five socioeconomic criteria as part of the broader multi-criteria analysis (MCA):

- Opportunity for economic growth and financial benefits within the region (e.g. increased employment opportunities, increased economic activity during construction, improved tourism and education opportunities, etc.).

- Risk that the infrastructure options under investigation negatively impacts commercial enterprises currently operating in the region mainly Coorong, Lower Lakes and Southern Ocean fisheries.
- Risk that the community does not accept the change in visual amenity associated with the infrastructure options under investigation.
- Risk that the community does not accept the impact to adjacent landholders associated with the infrastructure options under investigation (e.g. land acquisition, access restrictions, etc.).
- Risk that the community does not accept the impact on current recreational activities associated with the infrastructure options under investigation, including recreational fishing, boating, birdwatching, bushwalking and camping.

The report primarily considers impacts (positive and negative) to commercial operations (i.e. fishing or construction) and recreation (including tourism). It is anticipated that the extensive knowledge of the landscape held by the Coorong Partnership will supplement this report in informing the MCA, providing insight into considerations and experiences of the community. Considerations may include impacts to visual amenity by local landholders, for example.

2. SOCIOECONOMIC IMPLICATIONS OF THE INFRASTRUCTURE OPTIONS UNDER INVESTIGATION

A preliminary assessment of potential socioeconomic implications of each infrastructure option under investigation against each socioeconomic criterion is provided in the following sections based on reviewed published peer-reviewed literature.

Table 2-1 provides a summary of potential socioeconomic implications of each infrastructure option against the five socioeconomic MCA criteria indicating where the potential socioeconomic implication is expected to be minor or large.

For purposes of this socioeconomic assessment report, the 13 infrastructure options are presented in three broad groups:

1. Lake Albert Coorong connector (Options 1A and 1B)
2. Coorong South Lagoon and Southern Ocean connector (Options 3A, 3B, 3C, 3D, 4A, 4B, 5A, 5B and 6)
3. Coorong Lagoon dredging (Options 1A + 2, 1B + 2, 3C + 2, 3D + 2, 5A and 5B)

Options that include a pumped connection may incur energy costs and additional costs of installing, operating and maintaining energy supply infrastructure (e.g. grid connection, solar farms or wind farms). Additionally, options that operate in combination with dredging Parnka Point may impact commercial fishing in the Southern Ocean where dredgate from Parnka Point may be disposed into the marine environment in addition to hyper saline water pumped from the Coorong South Lagoon (CSL) in the short term whhilst the dredging operation is underway.

The remainder of this section describes the potential impacts identified in Table 2-1 and provides detailed descriptions of the potential socioeconomic implications of the infrastructure options categorised into the three broad groups against the five socioeconomic criteria. A more detailed summary table with descriptions of potential socioeconomic implications of the options is provided in Appendix Table 1-1. The list of the reviewed literature supporting the socioeconomic assessment, including study description, approach and key findings, is provided in Appendix Table 2-1.

We note that the proposed construction and operation works considered in this report are underpinned by a feasibility investigation that identified infrastructure designs that would deliver on the objective of improving the health of the CSL. Therefore, in reading this report, where long -term impacts are discussed, it is assumed that the ecological health of the CSL and productivity of the CSL ecosystem would improve if the any of the listed options were implemented.

Table 2-1 A summary of expected socioeconomic implications of each infrastructure option

Options (broad groups)	Regional economy			Commercial enterprises	Visual amenity		Land acquisition and access restrictions		Recreational activities	
	GRP	Employment	Tourism[a]	Fishing	Short-term (construction)	Long-term (operation)	Land required?	Access restrictions[e]	Short-term (construction)	Long-term (operation)
1. Lake Albert Coorong Connector (MCA Options 1,2,3, and 4)	√/+	√/+		√/?	√ /-		√ /-	√ /-	√ minor/-	√ minor/-
2. CSL and Southern Ocean Connector (MCA Options 5, 6, 7, 8, 9, 10, 11, 12 and 13)	√/+	√/+	√/+	√ /?	√ /-	√ /-		√ /-	√ /-	√ /-
3. Coorong Lagoon Dredging (MCA Options 3, 4, 7, 8, 11 and 12)	√ large/+	√ large/+	√	√ /?	√ /-	√ minor/-		√ /-	√ /-	√ /-

Source: KBR and BDO EconSearch.

2.1. Lake Albert Coorong Connector (MCA Options 1,2,3, and 4)

This option involves setting up a connecting passive pipe or passive open channel between Lake Albert and the Coorong to improve water delivery to the Coorong. It is intended that a connection between Lake Albert and the Coorong could improve water delivery and therefore derive ecological benefits to the Coorong South lagoon through provision of a more direct flow path compared with tidal or barrage flows.

In the following sections, we provide a preliminary socioeconomic assessment of the Lake Albert to Coorong connector against each of the five socioeconomic criteria and with reference to findings from reviewed studies.

2.1.1. Regional economy and tourism

During the construction period, moderate capital establishment costs associated with constructing a connector channel or pipe between Lake Albert and the Coorong could have positive direct and indirect (flow-on, or multiplier) impacts on the regional economy, including Gross Regional Product (GRP) and employment. Relatively minor ongoing operations and maintenance expenditures may be incurred with this option. Estimates of the expected impacts of Lake Albert Coorong connector infrastructure options on regional and state economies are summarised in Table 2-2.

The economic impact of each option was estimated using input-output (I-O) models, which are widely used to assess the economic contribution of existing or changing levels of economic activity. Regional Industry Structure and Employment (RISE) models for The Coorong Local Government Area (LGA) and South Australia were used to assess the economic activity associated with each option. The key economic activity indicators considered in the analysis are gross regional product (GRP) and employment. When looking at impacts at the state level for South Australia, GRP is replaced with gross state product (GSP).

GRP is a measure of the contribution of an activity to the economy, and is calculated as value of gross output (business revenue) less the cost of goods and services (including imports) used in producing the output. Employment numbers are reported as full time equivalent (fte) units. An fte of 1.0 means that the person is equivalent to a full-time worker, while an fte of 0.5 signals that the worker is only half-time. In our analysis, 1 fte is equivalent to 37.5 hour weeks.

The total economic impact reported in Table 2-2 and Table 2-3 includes both direct and total contribution. The direct contribution includes construction and downstream activities (such as manufacturing and transport). The flow-on contribution includes the economic effects in other sectors of the economy (such as trade and professional services) generated by the construction industry activities, that is, the multiplier effects.

Table 2-2 Regional and state economic impacts of Lake Albert Coorong connector infrastructure options

Option	Construction			Operation		
	Employment (fte)	Gross Regional Product ($m)	Time period	Employment (fte)	Gross Regional Product ($m)	Time period
Coorong LGA						
1A	36	$13.4m	Total over 9 month construction period	0.0	$0.00m	Average annual impact from year 2
1B	208	$34.4m	Total over 1 year construction period	0.1	$0.01m	Average annual impact from year 2
1A + 2	41	$29.3m	Total over 2 year construction period	0.0	$0.00m	Average annual impact from year 3
1B + 2	213	$50.2m	Total over 2 year construction period	0.1	$0.01m	Average annual impact from year 3
South Australia						
1A	288	$41.9m	Total over 9 month construction period	0.2	$0.03m	Average annual impact from year 2
1B	1,180	$140.6m	Total over 1 year construction period	3.3	$0.41m	Average annual impact from year 2
1A + 2	583	$92.7m	Total over 2 year construction period	0.3	$0.04m	Average annual impact from year 3
1B + 2	1,474	$191.3m	Total over 2 year construction period	3.4	$0.42m	Average annual impact from year 3

Source: KBR and BDO EconSearch

The location for this option is distant from recreational sites in the Coorong National Park thus it is not expected to impact Coorong National Park users. In addition, no direct short-term impacts on tourism are expected from this option because it has low potential to attract engineering tourists.

Should productivity improvements from infrastructure options under investigation be realised, the additional positive economic benefits from recreational tourism particularly angling and birdwatching in the mid- and southern Coorong can be large in the long term (Brookes et al. 2015).

In addition, an increase in the frequency of tourist visits in response to improvements in the ecological health of the mid- and southern Coorong could have a positive and large impact on the regional economy in the long run (Rolfe and Dyack, 2011).

2.1.2. Commercial enterprises

Channel excavation and dredging at either end of the channel, required to enhance hydraulic connectivity, may generate large volumes of dredgate and spoil during construction that could have a negative short term impact depending on where the dredgate is disposed. Concurrently occurring engineering investigations are considering feasibility of dredgate disposal, with ocean disposal the proposed option.

Further, turbidity and nitrification impacts of dredging either end of the connector channel plus transfer of nutrients between Lake Albert and the CNL via the channel/pipe could cause gill clogging in commercial fish and negatively impact production of commercial fish species and profitability of commercial fisheries operating both in Lake Albert and the CNL (DEH, 2010; SARDI, 2020). These potential negative impacts may be short-term and localised during construction

Maintenance dredging operations at Lake Albert during low water levels when the likelihood of acid sulphate soils forming is high in Lake Albert could result in generation of toxic dredgate spoil material (CSIRO, 2012; DEWNR, 2014b). Consideration may have to be given to reduce this risk during construction. Disposal of dredgate spoil into Southern Ocean beaches and near shores could negatively impact economic benefits from commercial fisheries, in particular pipis, if it led to food safety implications or impacted breeding or lifecycle processes in the short run.

In the absence of a concrete alignment, channel bank erosion could occur due to bank instability from loose sandy soils that characterise the proposed location of the channel (CSIRO, 2010; Bark et al. 2016). This could lead to disposal of large volumes of sediments in the CNL which may impact commercial fish production negatively during construction.

In the long run, improved health of the system could support productivity gains and therefore profitability of existing commercial fishing enterprises operating in the mid- and southern Coorong fishing grounds, through increased catch-rates particularly for key species caught in the Lakes and Coorong Fishery (SARDI, 2020; EconSearch, 2021). The magnitude of this positive benefit is considered minor due to the relatively low levels of commercial fishing activity currently taking place in the mid- and southern Coorong.

2.1.3. Visual amenity

It is unlikely that there will be large short or long term impacts on campground users because the proposed location of the pipes and excavated channels is distant from recreational sites with the Long Point campground, the nearest recreational site, located approximately 8.2 km away from the construction site.

2.1.4. Land acquisition and access restrictions

Land Acquisition

The Lake Albert Connector is the only infrastructure option that sits outside the Coorong National Park, according land-acquisition may be considered.

Access Restrictions

Exclusion zones may be required involving fencing around the water infrastructure and regulators. In addition, permission may be required from adjacent landholders and recreational user-communities to access land for supporting infrastructure, including roads, laydown yards, construction offices and stockpiles. Access across the alignment of the open channel may be negatively impacted in the short run, however, with access restricted only to Narrung Road, bridging structures could be included in the design to mitigate this risk.

2.1.5. Recreational activities

Access restrictions in exclusion zones at either end of the pipe or channel and any fencing around the pipes or channel may have a long term negative impact on canoeists and other recreational users.

2.2. Coorong South Lagoon and Southern Ocean Connector (MCA Options 5, 6, 7, 8, 9, 10, 11, 12 and 13)

This option involves providing one or more conduits that permit exchange of water between the CSL and the Southern Ocean. The water may be pumped or exchanged passively. This option would provide a connection between the CSL and the Southern Ocean exchanging water either into and/or out of the South Lagoon to improve the ecological health of the CSL.

A preliminary assessment of potential socioeconomic implications of this option is provided in the following sections against each socioeconomic criterion with reference to reviewed studies.

2.2.1. Regional economy and tourism

Large capital and maintenance expenditures associated with this option could have a large positive direct and indirect (flow-on, or multiplier) positive impact on the regional economy, including Gross Regional Product (GRP) and employment over the construction period.

Large ongoing operations and maintenance expenditures may be incurred under this option particularly for options that include additional pumping stations, and other supporting infrastructure, including caisson, jetty, and breakwater structures. This could positively contribute to the regional economy by generating additional direct and flow-on expenditure, leading to employment in the long run.

Estimates of the expected impacts of CSL to Southern Ocean connector infrastructure options on regional and state economies are summarised in Table 2-3.

Table 2-3 Regional and state economic impacts of CSL to Southern Ocean connector options

Option	Construction			Operation		
	Employment (fte)	Gross Regional Product ($m)	Time period	Employment (fte)	Gross Regional Product ($m)	Time period
Coorong LGA						
3A	34	$27.3m	Total over 2 year construction period	0.1	$0.01m	Average annual impact from year 3
3B	29	$23.7m	Total over 1.5 year construction period	0.1	$0.01m	Average annual impact from year 3
3C + 2	34	$42.5m	Total over 2 year construction period	0.1	$0.01m	Average annual impact from year 3
3D + 2	25	$38.4m	Total over 2 year construction period	0.0	$0.01m	Average annual impact from year 3
4A	71	$35.2m	Total over 2 year construction period	0.1	$0.01m	Average annual impact from year 3
4B	66	$36.3m	Total over 2 year construction period	0.5	$0.06m	Average annual impact from year 3
5A + SDA	107	$76.8m	Total over 3 year construction period	0.2	$0.02m	Average annual impact from year 4
5B + SDA	103	$76.0m	Total over 3 year construction period	0.2	$0.02m	Average annual impact from year 4
6	172	$96.9m	Total over 4 year construction period	0.1	$0.01m	Average annual impact from year 5
South Australia						
3A	575	$84.3m	Total over 2 year construction period	13.6	$3.55m	Average annual impact from year 3
3B	451	$67.2m	Total over 1.5 year construction period	6.3	$1.52m	Average annual impact from year 3
3C + 2	771	$123.9m	Total over 2 year construction period	7.0	$1.66m	Average annual impact from year 3
3D + 2	662	$108.5m	Total over 2 year construction period	5.6	$1.39m	Average annual impact from year 3
4A	931	$128.7m	Total over 2 year construction period	13.7	$3.24m	Average annual impact from year 3
4B	1,606	$218.9m	Total over 2 year construction period	7.5	$1.23m	Average annual impact from year 3
5A + SDA	1,461	$222.4m	Total over 3 year construction period	20.5	$4.81m	Average annual impact from year 4
5B + SDA	1,383	$212.7m	Total over 3 year construction period	16.2	$3.64m	Average annual impact from year 4
6	1,773	$276.1m	Total over 4 year construction period	4.1	$0.51m	Average annual impact from year 5

Source: KBR and BDO EconSearch

Infrastructure options for improving the connectivity between the CSL and the Southern Ocean that involve a pumping component may also incur additional costs of installing, operating and maintaining energy supply infrastructure. This could also positively contribute to the regional economy by generating additional direct and flow-on expenditure, leading to employment in the long run.

In addition, this option has potential to attract engineering tourism thereby generating positive economic benefits for the tourism sector in the region in the short and long run.

Should productivity improvements from infrastructure options under investigation be realised, this may have a positive impact on recreational tourism activities in the CSL, including birdwatching, bushwalking, boating and camping in the long run (CSIRO, 2015).

An increase in the frequency of tourist visits in response to improvements in the ecological health of the CSL may have a positive impact on the regional economy in the long run.

2.2.2. Commercial enterprises

Options that involve disposal of hypersaline water and/or dredgate spoil at the Southern Ocean could impact productivity of commercial fish species as this may reduce availability of marine algae, an important food source for marine fish (Brookes et al. 2015).

In the short run, disposal of hypersaline water into the Southern Ocean could have a negative impact on fish productivity in the Southern Ocean thereby potentially affecting the operations and profitability commercial fisheries.

In the long run, improvements in the health of the CSL ecosystem could support productivity gains and therefore profitability of existing commercial fishing enterprises operating in the CSL fishing grounds. However the magnitude of this positive benefit is considered minor due to the relatively low levels of commercial fishing activity currently taking place in the CSL.

2.2.3. Visual amenity

Installation of pipes, pumps, sheds, access tracks, breakwaters, jetties, pontoon structures and energy supply infrastructure may have long-term negative visual impacts on the landscape. These installations may potentially occur in one of two locations, one North of Parnka Point (Options 5A and 5B) and one opposite the Jack's Point lookout and Fat Cattle Point, adjacent Woods Well (Options 3A, 3B, 3C, 3D, 4A, 4B, 5A, 5B and 6).

Building a connection through the Younghusband Peninsula dune system could require vegetation and habitat clearance, thereby having a short-term negative visual amenity impact, the extent of which may depend on the expected quantity of required earthworks and timeframe for any revegetating measures to regrow to a suitable height.

The location of the proposed Coorong South Lagoon and Southern Ocean Connector North of Parnka Point is unlikely to have a large impact on visual amenity for users of the picnic lookout because, although the opposite shore is only approximately 200m from the lookout, it will not be located within line of sight, instead being located around a bend in the shoreline. Visual amenity for boaters who launch from the Parnka Point boat ramp, may be negatively impacted slightly in the long run, as the channels in this area narrow to less than 200m, which may bring them close to the Coorong South Lagoon and Southern Ocean Connector.

The location of the proposed Coorong South Lagoon and Southern Ocean Connector opposite Jack's Point Lookout is also unlikely to negatively impact visual amenity for users of the facility because of the distance from the lookout (approximately 4.37km) and considering that infrastructure is situated within a natural bay.

2.2.4. Land acquisition and access restrictions

Land acquisition

No land acquisition is foreseen, noting that the proposed alignments are within the Coorong National Park.

Access restrictions

Exclusion zones may be required involving fencing around water infrastructure and discharge structures. However, this impact may be mitigated by choosing locations with relatively low human-activity intensity and providing alternative access routes.

2.2.5. Recreational activities

Establishment of water infrastructure and other supporting infrastructure, including jetties, pumping stations, energy supply infrastructure, and breakwaters could negatively impact Coorong National Park users, recreational fishers and canoeists in the CSL in the short and long run.

A Coorong South Lagoon and Southern Ocean Connector could limit accessibility of some recreational sites in the short run thereby negatively impacting existing recreational activities. For example, accessibility for boaters launching from the Parnka Point boat ramp may be impacted during construction as the channels are quite narrow in this area.

Further, access may be restricted to recreational users to enable utilisation of construction support infrastructure, including roads, laydown yards, construction offices and stockpiles. Consideration may be given to undertake construction during off-peak tourism seasons

Options that involve disposal of hypersaline water near the shore or the beach at the Southern Ocean could limit access of recreational users and impact recreational uses if the disposal process led to beach erosion. This risk could be mitigated by including measures to provide alternative access routes and minimise beach erosion.

However, in the long run, expected improvements in the health of the ecosystem as a result of the infrastructure options under investigation may increase the level of recreational activities in the CSL and generate economic benefits.

2.3. Coorong Lagoon Dredging (MCA Options 3, 4, 7, 8, 11 and 12)

This option involves dredging a 17.5 km stretch through Parnka Point to increase hydraulic connectivity between the North and South Lagoons of the Coorong. This infrastructure option may contribute to improvements in the ecological health of the CSL. However, ecological investigations to date indicate that it may realise higher benefits when implemented in combination with other infrastructure options.

A preliminary assessment of dredging Parnka Point against each socioeconomic criterion with reference to reviewed studies is provided in the following sections.

2.3.1. Regional economy and tourism

Capital and operations expenditures may be incurred to dredge Parnka Point. Repeat dredging, or maintenance dredging is expected to be infrequent and at very small scales of operation. Ongoing maintenance expenditure is thus expected to be minor for this option. Options that include dredging Parnka Point may generate additional benefits to the regional economy, including employment and GRP.

Additional salinity improvements in the CSL from incorporating dredging to other options may contribute to additional improvements in environmental conditions in CSL ecological systems particularly for ecosystems that are in close proximity to Parnka Point. This may contribute to improvements in the abundance of native fish and birds and in the frequency of tourist visits in the CSL thereby generating additional economic benefits for the tourism sector.

However, establishment of dredging infrastructure may have a negative impact on recreational tourism activities in neighbouring recreational tourism sites, including the Avocet campground and the Pelican Point campground during the construction phase.

2.3.2. Commercial enterprises

In the short run, high levels of turbidity created by dredging activities could cause gill clogging in commercial fish and negatively impact productivity and profitability in commercial fishing enterprises operating in close proximity to Parnka Point (DEH, 2010; SARDI, 2020).

Further, high turbidity levels from disposal of dredgate material could reduce availability of marine algae, an important food source for marine fish, if the Southern Ocean was used for dredgate disposal during construction (Brookes et al. 2015). Reductions in the production of marine algae could negatively impact fish productivity thereby negatively impacting commercial fisheries in the Southern Ocean. However, these impacts may be short-term and localised during construction.

Options that involve disposal of dredgate spoil near the shore or the beach at the Southern Ocean may impact productivity of commercial fish species negatively during construction particularly pipis if it led to food safety implications or impacted breeding or lifecycle processes. This impact may be exacerbated if the disposal process led to access restrictions and beach erosion.

Long-term improvements in salinity in the CSL from dredging operations may lead to increases in availability of phytoplankton, an important food source for fish, thus positively impacting productivity in commercial fish.

2.3.3. Visual amenity

Recreational users of the Parnka Point picnic lookout, campground and other facilities may be impacted by this option during construction and operation (DEWNR, 2014a). The location of campground facilities is in close proximity to the proposed site of the dredging thus picnickers, campers, boaters and birdwatchers may be negatively impacted during construction. However, this impact is short term and can be minimised by avoiding construction and dredging activities during these peak visitor times.

2.3.4. Land acquisition and access restrictions

Land acquisition

No land acquisition may be required if the Southern Ocean was used for dredgate disposal.

Access restrictions

Short term access restrictions may be required during the dredging operation to enable transportation of dredgate across Younghusband peninsula.

2.3.5. Recreational activities

Dredging Parnka Point may likely impact various recreational user-groups at nearby recreational sites, including Parnka Point picnic lookout, Avocet campground and the Pelican campground near the proposed disposal sites.

High levels of turbidity and nitrification potentially created by dredging activities could have a negative impact on the environmental condition of ecosystems in close proximity to Parnka Point particularly during the construction phase.

Long-term improvements from dredging operations at Parnka Point may contribute to improvements in water quality thereby having positive impacts on the overall ecological health of the CSL ecosystems and recreational sites in close proximity to Parnka Point. For example, improvements in the abundance of native fish and birds may contribute to an increase in visitors at the Avocet and Pelican campgrounds thereby generating economic benefits.

3. EVALUATION OF INFRASTRUCTURE OPTIONS

The assessment of potential socioeconomic implications of the infrastructure options under investigation options provided in this report will inform a process of deliberative multi-criteria evaluation of the expected performance of the options against the identified socioeconomic MCA criteria. The multi-criteria evaluation will be conducted by the Coorong Partnership via an individual online questionnaire completed by each Partnership member. The results of which will be presented and discussed at a stakeholder-community consultation workshop with the Partnership.

Specifically, the Coorong Partnership will:

1. review the identified socioeconomic implications under each criterion and note any omissions, and
2. score the options by each criterion based on their understanding of the expected likelihood of occurring and significance of the identified socioeconomic implications.

A score between zero and six will be assigned to each option against each criterion with zero being unlikely to occur and unlikely to be large and six being highly likely to occur and large (Table 3-1). Consideration of the likelihood and significance of potential impacts in assessment of options is consistent with Regional Impact Assessment Statement (RIAS) guidelines (PIRSA, 2018). The results of this process will be detailed in KBR's Multi-Criteria Analysis Outcomes Report.

Table 3-1 Assigning scores between zero and six based on the likelihood of occurring and the expected significance of the criterion

		Likelihood			
		Unlikely	Low	Medium	High
Significance	Unlikely	0	1	2	3
	Low	1	2	3	4
	Medium	2	3	4	5
	High	3	4	5	6

Source: BDO EconSearch analysis

Table 3-2 provides a table that will be used to assign scores to the infrastructure options against the socioeconomic MCA criteria to be completed at a deliberative MCA workshop.

Table 3-2 A framework that will be used to assign scores to the infrastructure options against the socioeconomic MCA criteria

Ref #	Option #	Description	Regional economy	Commercial enterprises	Visual amenity	Land acquisition and access restrictions	Recreational activities
1	1A	**Passive Lake Albert channel connector**					
2	1B	**Passive Lake Albert piped connector**					
3	1A + 2	**Passive Lake Albert channel connection + dredge**					
4	1B + 2	**Passive Lake Albert piped connector + dredge**					
5	3A	**Intermittent pumped connection out of CSL with near shore**					
6	3B	**Intermittent pumped connection out of CSL with low visual impact beach discharge**					
7	3C + 2	**Constant pumped connection out of CSL with near shore discharge (jetty) + dredge**					
8	3D + 2	**Constant pumped connection out of CSL with low visual impact beach discharge + dredge**					
9	4A	**Bi-directional pumped SO connection – 1 location, 2 pumping stations**					
10	4B	**Bi-directional pumped SO connection – 1 location, 1 pumping station, near shore discharge / inlet protected by breakwater**					
11	5A + SDA	**Simultaneous pumped SO connection – 2 locations, 2 pumping stations, caisson structure & jetty for pump in and near shore**					
12	5B + SDA	**Simultaneous pumped SO connection – 2 locations, 2 pumping stations, caisson structure & jetty for pump in and low visual**					
13	6	**Bi-directional passive pipe into and out of CSL, ocean pipework protected by breakwater**					

Source: BDO EconSearch.

4. GAP ANALYSIS

The State Government of South Australia Regional Impact Assessment Statement Policy requires that a Regional Impact Assessment Statement (RIAS) must be undertaken before implementing new programs, projects or initiatives that are expected to have a large impact on regional communities (hereafter, *interventions*) (PIRSA, 2018). The principal objective of a RIAS is to ensure effective consultation and communication with regional South Australian communities prior to implementing decisions which impact regional communities.

Further, the Australian Government recommends use of cost-benefit analysis (CBA) as a method of evaluating interventions to ensure efficient and effective use of public financial resources in order to encourage optimal decision making (OBPR, 2020).

The main objective of this section is to outline the next steps required to conduct a more detailed socio-economic assessment, RIAS and a CBA of the chosen infrastructure option for improving the ecological health of the Coorong South Lagoon based on best practice guidelines and a gap analysis. A gap analysis takes stock of the current state of knowledge, identifies outstanding knowledge gaps and lists the required set of actions for addressing the identified knowledge gaps.

4.1. Regional impact assessment statement

A RIAS provides a description of potential short and long-term regional social, economic, environmental and equity implications of implementing an intervention (PIRSA, 2018). The preliminary assessment carried out to date describes implications of the infrastructure options on economic and social and community factors.

To develop a detailed socioeconomic assessment and a RIAS, an assessment of potential environmental and equity implications of the infrastructure options may be required to augment the preliminary socioeconomic assessment consistent with the following nine steps[1]:

1. Enumerating potential social, economic and environmental implications of any proposed intervention and specifying all impacted regions defined using Planning SA administrative boundaries
2. Assessing the expected significance of the identified potential implications
3. Identifying potential negative impacts of the intervention and impacted stakeholders
4. Identifying and consulting with stakeholders that may be affected by the intervention directly and indirectly
5. Outlining the process undertaken to consult stakeholders, including the forum used (e.g. public meeting, mail-out), time, place and list of attendees
6. Providing a summary statement of potential direct and flow-on economic, social, environmental and equity impacts in the short, medium and long term
7. Providing measures for mitigating identified negative impacts of the intervention
8. Detailing any inter-agency coordination or cooperation with other government, including local and state government, and non-government organisations

1 PIRSA Regional Impact Assessment Statement template

9. Outlining the list of options that were considered, defining the preferred option and describing how the consultation process affected the selection of the preferred option

In addition, a description of various impacted community user-groups and regions is required in a RIAS submission, including specifications of affected locations described using maps of PlanSA's administrative boundaries for the identified regional social, economic, environmental and equity implications[2].

Table 4-1 provides a detailed description of RIAS best-practice guidelines and requirements outlined by the Commonwealth government's Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) and SA government's Department of Primary Industries and Regions (PIRSA).

Table 4-1 Commonwealth and State government regional impact assessment statement (RIAS) guidelines and requirements

Source	Key requirements
Guidelines for analysing regional Australia impacts and developing a Regional Australia Impact Statement (DITRDC, 2017).	A RIAS should consider economic, social and environmental positive and negative impacts on local regional communities as well as surrounding regional communities. Mitigation strategies for addressing negative impacts should be provided. The following checklist must be used when submitting a RIAS: 1. Contact the Department of Infrastructure and Regional Development (required for approval in case that project is considered to have regional implications) 2. Define "regional" (individual or company needs to determine extent to which policy will impact on communities and the scope in which these impacts are experienced geographically) 3. Assess the implications of your policy (compile extensive lists of possible positive and negative externalities associated with the project in question and whether these effects will occur at a metropolitan or regional level) 4. Identify and assess the positive and negative equity implications 5. Consult all potentially affected communities and communicate mitigation strategies for expected negative economic, social and environmental impacts to regional communities for example local businesses 6. Demonstrate how the option selected represents the option with equal distribution of benefits and minimal negative impacts 7. Identify unresolved implications or negative impact that will not be mitigated, or which must be lived with, and describe financial compensation arrangements for affected communities where applicable 8. Document all consultation processes with all levels of government and the stakeholder community

[2] Based on Australian Standard Geographical Classification (ASGC), or ABS' SA3 and SA4 boundaries

Source	Key requirements
Regional Impact Assessment Statement Policy and Guidelines (PIRSA, 2018).	A RIAS must be prepared when proposed interventions are expected to have a positive or negative impact on regional communities – either positively or negatively – and if it is determined that one is required, must be made publicly available The RIAS requirement may be waived under exceptional circumstances (state budget preparation, impact assessed development, or with approval from the Minister for Primary Industries and Regional Development) A RIAS is required if it is expected that there will be a change in regional aesthetic, a disruption to community cohesion, potential conflict with community planning, or alteration to regional infrastructure A RIAS is should: 1) consider impact on number of regions, 2) assess the extent of expected regional impacts 3) include strategies for mitigating negative impacts, and 4) consider future implications, including regional growth, export opportunities and opportunity costs RIAS should assess key implications for the regional community, including expected impacts on existing businesses, employment, business/capital investment, average income per capita, financial pressure on other bodies, economic factor flow-on effects, population and demographics, prospective business and capital attraction to the region, medium/long-term effects, effects from inaction The following social implications should be considered: services (e.g. access to education, health), social groups (equity and demographic requirement differences), lifestyle (quality i.e. improvement or reduction), recreation/leisure, status quo (does project have greater impact than leaving to natural flow), flow-on effect (future consideration for regional communities from implementation of project) Environmental implications should be assessed including impacts on recreation, leisure, tourism, aesthetic and flow-on effects from expected changes in water supply and quality, and soil or vegetation Assessment of equity implications should be included and mitigation strategies for ensuring equitable distribution of negative and positive impacts across various community groups in a region based on the following considerations: 1. Avoid – alter project so impact does not occur 2. Minimise – modify to reduce severity of impact 3. Mitigate – offset negative impact with introduction of appropriate resources 4. Enhance – add additional positive impacts to project to overcome negative externality

Source: See Source column

The socioeconomic assessment presented in this report presents economic and social implications of the options. Environmental and equity implications were not assessed. Additional work should be carried out to assess environmental and equity implications of the preferred option to adequately meet RIAS requirements according to the reviewed Commonwealth and State government best practice guidelines and requirements.

Environmental impacts are defined as any impacts of an intervention on the natural surroundings, ecosystems, heritage value, and social, economic and cultural aspects of a specific natural, environmental or cultural asset. Examples include national parks, wildlife habitats, sites of Aboriginal and post-settlement heritage significance and popular tourist attractions and other iconic assets of local environmental significance. Assessments underpinning a RIAS must include positive and negative impacts on key environmental indicators, including water supply and quality and impacts on soil and vegetation.

In a regional context, equity refers to ensuring that there are adequate arrangements for mitigating inadvertent inequitable distribution of positive and negative impacts across all communities in the region, including:

1. Identifying the beneficiary/impactor groups relevant to the outcomes of the intervention
2. Quantifying the identified positive and negative impacts for each group including, the broader community, commercial fishing and tourism industries, various recreational user-groups and the environment
3. Identifying appropriate cost recovery principles to guide arrangements for mitigating inequity in the distribution of positive and negative impacts. This may include consideration of beneficiary vs impactor pays, economic efficiency and equity

4.2. Cost-benefit analysis

A social CBA is typically utilised to justify implementation of an intervention by comparing costs and benefits with and without the intervention. Two main evaluation criteria are used in a CBA: 1) the Net Present Value (NPV), or the net social benefit of an intervention, and 2) the benefit-cost ratio (BCR), or the amount of dollars generated for every dollar invested.

The following nine CBA steps are outlined in the Commonwealth Government CBA Guidelines[3]:

1. Describe the 'base case' scenario and an alternative, or counterfactual, "with intervention" scenario for which costs and benefits will be estimated
2. Establish the overall time frame of analysis and the expected timelines over which each of the expected potential economic costs and benefits will be incurred or realised
3. Identify the full suite of potential costs and benefits of switching from the base case scenario to the counterfactual scenario
4. Identify the costs and benefits that will be quantified and describe how they will be quantified and any potential uncertainties
5. Monetise, or quantify the costs and benefit
6. Calculate the NPV and BCR for the counterfactual scenario
7. Conduct sensitivity analysis to address identified uncertainties
8. Detail any other factors for consideration in using and interpreting net benefit value estimates
9. Discuss the robustness of CBA outcomes to omission of unquantified cots and benefits

The Office of Best Practice Regulation (OBPR), a division of the Department of the Prime Minister and Cabinet (DPMC), has outlined CBA guidelines and requirements (DPMC, 2020). Table 4-2 provides a summary of the guidelines and requirements.

[3] Department of Finance and Administration 2006, *Handbook of Cost-Benefit Analysis*, Financial Management Reference Material No. 6, Commonwealth of Australia, Canberra.

Table 4-2 Description of CBA requirements based on commonwealth government guidelines

Step	Requirements
1. Specify the set of options under consideration	A description of the base case, or 'do nothing' option must be provided. Costs and benefits of the intervention should be described in reference to costs and benefits under the base case option.
2. List who will incur costs and who will benefit	Explicitly list who will be impacted positively or negatively from the proposed intervention. Under federal law, this includes all people and businesses residing in Australia.
3. Identify expected impacts and measurement indicators	Describe expected positive and negative impacts and provide numerical values for relevant measurement indicators (e.g. water supply and water quality, carbon emission and ecological indicators). Outline major uncertainties (e.g. gaps in knowledge or data) and how they will be addressed.
4. Assess potential future impacts over the life of the proposed intervention	Whilst the recommended timeline for CBA is 20 years, it is a requirement to outline potential long-term implications particularly if expected to be large. The CBA timeline can be extended beyond the recommended 20-year timeline to include large long-term impacts.
5. Monetise impacts	Assign dollar values to positive and negative impacts, including opportunity costs and willingness of future generations to pay for long-term impacts specifying who will incur costs and who will benefit. Provide justification if dollar values cannot be estimated.
6. Discount future costs and benefits	Future costs and benefits must be discounted using annual real discount rate values of 3%, 7%, and 10%. Inflationary and capital depreciation effects must be taken into account.
7. Compute net present values (NPV) and benefit-cost ratios (BCR)	Net present values should be calculated and presented for the intervention and for the base case scenario based on annual streams of costs and benefits under the two options. The timeline of all expected costs and benefits should be provided. Calculate and resent BCRs under each option.
8. Perform sensitivity analysis	A sensitivity analysis must be conducted to test the robustness of net present values to discount rate assumptions and other variable assumptions expected to be large enough to affect key CBA conclusions.
9. Reach a conclusion	Identify the preferred option with the highest NPV and BCR and test the robustness of relative NPVs and BCRs to variable CBA assumptions and assess the sensitivity of key CBA conclusions to key assumptions.

Source: DPMC, 2020

We note that whilst the Commonwealth government provides CBA guidelines and requirements state governments adapt application of the guidelines to tailor CBAs to contextual differences across states. For example, a review study of application of CBA Commonwealth guidelines and requirements found that discount rate values used in CBA vary across states (Argyrous, 2013).

Table 4-3 provides a summary of potential economic, social and environmental costs and benefits of the infrastructure options under investigation options and economic valuation techniques that can be utilised to monetise the costs and benefits for input into a CBA.

Table 4-3 Economic, social and environmental cost and benefit values for input into a CBA of infrastructure options for improving the ecological health of the Coorong South Lagoon

Impact	Indicators	Economic valuation method and data required
Financial costs	Capital and establishment or construction costs, operations and maintenance costs	Market price techniques based on expenditure data
Carbon footprint	Whole life embodied carbon in building material and energy use in construction and operation and maintenance	Market price techniques based on carbon prices
Water quality regulation	Deterioration or mitigation in salinity, turbidity, exposure of acid sulphate soils, sediments and nutrients, cyanobacterial bloom risk	Avoided cost of treatment based on data on data on treatment and mitigation activities and costs
Fish production	Change in annual catch and average catch per unit effort	Market price techniques based on change in net revenues from commercial fishing using data on fish production, production costs and fish prices
Aesthetic appreciation	Visual amenity or disamenity for recreational users. Total number of recreational sites within 1.5 km of an environmental asset or man-made landscapes	Hedonic pricing to estimate or isolate the value of visual characteristics or attributes from estimates of the overall recreational value of environmental assets. Property price data is typically used
Recreation and tourism	Increased number of days with adequate water quality levels suitable to support recreational activities. Improved conditions for recreational fishing and increased frequency of tourist visits	Travel costs based on tourists' travel expenditure data, including dollars spent per visitor per day and dollars spent per trip
Cultural and habitat values	Changes in native fish and bird habitats and populations that support multiple cultural activities	Stated preference valuation using survey data on the value placed on an environmental asset by users and non-users

Source: Based on a review of literature from various sources provided in Appendix Table 2-1

Benefits transfer techniques can be employed to estimate economic values for impacts by transferring available values from valuation studies in similar case study contexts. Adjustments must be made for differences in locational characteristics. Benefits transfer is typically preferred if the cost of primary data collection to support valuation using the traditional valuation techniques outlined in Table 4-3 is prohibitive.

Examples of economic valuation and estimates of monetary values for various economic, social and environmental costs and benefits that can be used to estimate values using benefits transfer techniques are provided in Appendix Table 2-1 based on our review of 18 peer-reviewed case studies in the CLLMM and the Murray-Darling Basin.

Additional work may be required to collect additional data to estimate most of the impacts presented in Table 4-3 where possible. Not all the impacts have to be quantified under the best practice guidelines. However, a justification may have to be provided for the impact that cannot be quantified.

Further, impacts that cannot be monetised may have to be assessed qualitatively. Further consultation with the potentially affected communities may also be recommended to assist in establishing qualitative or quantitative data that can be used in the necessary valuation processes.

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APPENDIX 1 A summary of potential socioeconomic implications of the infrastructure options

Appendix Table 1-1 Potential direct socioeconomic implications of infrastructure options under investigation options to improve the Coorong

Ref #	Option #	Description	Regional economy			Commercial enterprises	Visual amenity		Land acquisition and access restrictions		Recreational activities	
			GRP	Employment	Tourism	Fishing	Short-term (construction)	Long-term (operation)	Is land acquisition required?	Are access restrictions required?	Short-term (construction)	Long-term (operation)
1	1A	**Passive Lake Albert channel connector**	√	√ (minor)	Low potential for engineering tourism	√ (Coorong species)	√ (water infrastructure)	√	√	√ (exclusion zone around regulator and fenced easement)	√ (minor)	√ (minor)
2	1B	**Passive Lake Albert piped connector**	√	√ (minor)	Not within National Park & outside regular tourist loop from Goolwa	√ (Coorong)	√ (water infrastructure)	√ (minor)	√ (possible)	√ (exclusion zone around regulator)	√ (minor)	√ (minor)
3	1A + 2	**Passive Lake Albert channel connection + dredge**	√	√ (minor)	Low potential for engineering tourism	√ (Coorong and Southern Ocean)	√ (dredging plus water infrastructure)	√	√	√(exclusion zone around regulator and fenced easement)	√ (dredging)	√ (minor)
4	1B + 2	**Passive Lake Albert piped connector + dredge**	√	√ (minor)	√ (minor)	√ (Coorong and Southern Ocean)	√ (dredging plus water infrastructure)	√ (minor)	√ (possible)	√ (exclusion zone around regulator)	√ (dredging)	√ (minor)
5	3A	**Intermittent pumped connection out of CSL with near shore discharge (jetty)**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean beach, including, but not limited to pipis)	√ (water infrastructure and power supply)	√ (pontoons in Coorong, near shore structure - jetty)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (jetty, pipeline construction in Peninsula and pumping station)	√ (recreational fishing & canoeing, possible jetty access & beach access)
6	3B	**Intermittent pumped connection out of CSL with low visual impact beach discharge**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean, including, but not limited to pipis))	√ (water infrastructure and power supply)	√ (pontoons in Coorong, beach structure)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (pipeline construction in Peninsula and pumping station)	√ (recreational fishing & canoeing & beach access)
7	3C + 2	**Constant pumped connection out of CSL with near shore discharge (jetty) + dredge**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean beach, including, but not limited to pipis)	√ (dredging plus water infrastructure and power supply)	√ (pontoons in Coorong, near shore structure - jetty)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (jetty, pipeline construction in Peninsula, pumping station and dredging)	√ (recreational fishing & canoeing, possible jetty access & beach access)
8	3D + 2	**Constant pumped connection out of CSL with low visual impact beach discharge + dredge**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean, including, but not limited to pipis))	√ (dredging plus water infrastructure and power supply)	√ (pontoons in Coorong, beach structure)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (pipeline construction in Peninsula, pumping station and dredging)	√ (recreational fishing & canoeing & beach access)

Ref #	Option #	Description	Regional economy			Commercial enterprises	Visual amenity		Land acquisition and access restrictions		Recreational activities	
			GRP	Employment	Tourism	Fishing	Short-term (construction)	Long-term (operation)	Is land acquisition required?	Are access restrictions required?	Short-term (construction)	Long-term (operation)
9	4A	**Bi-directional pumped SO connection – 1 location, 2 pumping stations**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean beach, including, but not limited to pipis)	√ (water infrastructure & power supply)	√ (pontoons in Coorong, near shore structure – 300 m long jetty)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (pipeline construction in Peninsula and pumping stations in Coorong & Southern Ocean & jetty construction)	√ (recreational fishing & canoeing, possible jetty access & beach access)
10	4B	**Bi-directional pumped SO connection – 1 location, 1 pumping station, near shore discharge / inlet protected by breakwater**	√	√	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean, including, but not limited to pipis))	√ (water infrastructure & power supply)	√ (Dry well pumping station in Younghusband Peninsula, breakwater in Southern Ocean)	(in National Park)	√ (exclusion zone around water infrastructure and breakwater)	√ (pipeline construction in Peninsula and pumping station in Younghusband Peninsula & breakwater construction)	√ (recreational fishing & canoeing, possible breakwater access & beach access)
11	5A + southern dredge alignment	**Simultaneous pumped SO connection – 2 locations, 2 pumping stations, caisson structure & jetty for pump in and near shore discharge (jetty) for pump out**	√ (large)	√ (large)	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean beach, including, but not limited to pipis)	√ (water infrastructure – two locations & power supply)	√ (pontoons in Coorong at one location, near shore structure – 300 m long jetty at another location)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (pipeline construction in Peninsula and pumping stations in Coorong & Southern Ocean – two locations & jetty construction)	√ (recreational fishing & canoeing, possible jetty access & beach access)
12	5B + southern dredge alignment	**Simultaneous pumped SO connection – 2 locations, 2 pumping stations, caisson structure & jetty for pump in and low visual impact beach discharge for pump out**	√ (large)	√ (large)	√ Potential for engineering tourism, impact to National Park users	√ (Southern Ocean beach, including, but not limited to pipis)	√ (water infrastructure – two locations & power supply)	√ (pontoons in Coorong at one location, near shore structure – 300 m long jetty at another location)	(in National Park)	√ (exclusion zone around water infrastructure and discharge structure)	√ (pipeline construction in Peninsula and pumping stations in Coorong & Southern Ocean – two locations & jetty construction)	√ (recreational fishing & canoeing, possible jetty access & beach access)
13	6	**Bi-directional passive pipe into and out of CSL, ocean pipework protected by breakwater**	√ (large)	√ (minor)	√ Low potential for engineering tourism – buried infrastructure, impact to National Park users	√ (Southern Ocean, including, but not limited to pipis))	√ (water infrastructure)	√ (Breakwater in Southern Ocean)	(in National Park)	√ (exclusion zone around water infrastructure and breakwater)	√ (pipeline construction in Peninsula – ten pipelines & breakwater construction)	√ (recreational fishing & canoeing, possible breakwater access & beach access)

Source: KBR and BDO EconSearch analysis

APPENDIX 2 Detailed literature review summary

Appendix Table 2-1 Summary of key studies reviewed to understand potential socioeconomic implications of infrastructure options to improve the Coorong

Study Title	Description	Approach	Key findings
1. Fish productivity in the lower lakes and Coorong, Australia, during severe drought (Brookes et al. 2015).	This study reviewed data from multiple sources to investigate the extent to which salinity is a key determinant of the abundance of fish in the Coorong and Lower Lakes. Fishery production and value time-series data between 1985 and 2010 for key commercial species were analysed.	A structured review was conducted to integrate data from a variety of studies from the Lower Lakes and Coorong estuary and use it to understand the relationship between flow and fish productivity. The data were sourced from the MDBA, primary salinity data collection and CPUE data from SARDI. Time series salinity data and fisheries production data were analysed to establish relationships between the two variables.	Large increases in salinity in the Coorong during the 2000-2010 drought led to a decline in the abundance of fish. However, this is not well reflected in fishery catch data because of the concentration of fishing in available habitat. During the millennium drought, there was a reallocation of fishing effort from finfish, which became less abundant, to pipis measured using CPUE. These are correlative relationships that suggest there are flow and resource alterations that impact fishery productivity although in the case of the Coorong patterns are complicated by salinity altering habitat availability. Connectivity of river to estuary and estuary to the sea is critical in the Coorong, not only for allowing fish movement but also for maintaining salinity at appropriate concentrations.
2. Integrated valuation of ecosystem services obtained from restoring water to the environment in a major regulated river basin (Bark et al. 2016).	This study estimated monetary ecosystem service values associated with improvements in the ecological condition of floodplains, rivers and wetlands in south-eastern Australia.	Monetary values of potential improvements in the stock and quality of ecosystem services under improved environmental flows were estimated through a review of economic valuation literature and utilisation of benefits transfer approaches.	Estimated the value of increase in catch per unit effort and proportion gross production value based on differences in mean annual catch in low and medium-high barrage flow as $1.5-2.6M.
3. Economic and Social Indicators for the South Australian Lakes and Coorong Fishery 2019/20 (BDO EconSearch, 2021).	This report presented a time series of values for a set of various economic performance indicators for the Lakes and Coorong Fishery for 2000/1-2019/20. The economic indicators presented, include catch, gross value product and wholesale price by species.	The economic indicators for the Lakes and Coorong Fishery were derived using a range of primary and secondary data and survey-based indicators. SARDI Aquatic Sciences data were used to reflect changes in catch. Flow-on effects were estimated using input-output analysis.	The annual catch for black bream in the Lakes and Coorong ranged between 1-12 tonnes per year. The average annual wholesale price ranged between $8.25 and $15.00 per kg. The annual catch for greenback flounder ranged between 1-26 tonnes per year. The average annual wholesale price ranged between $5.95 and $16.00 per kg.
4. Coorong fish condition monitoring 2008-19 black bream, greenback flounder and smallmouth hardyhead populations (SARDI, 2020).	This report presents the findings of 11 years of a monitoring program (2008/9-2018/19) for black bream, greenback flounder and smallmouth hardyhead in the Murray Estuary, North Lagoon and South Lagoon of the Coorong.	Time series data were collected for fish recruitment and abundance under different freshwater flow and salinity regimes. The monitoring focused on black bream, being a key species of ecological and economic importance in the Coorong. Greenback flounder is also monitored because it supports commercial and recreational fisheries and have a high salinity tolerance.	The annual catch of black bream from the Coorong between 2014/14 and 2019/20 was 0.7-2.4 tonnes per year. The annual catch of greenback flounder from the Coorong between 2015/16 and 2018/19 was 0.3-4.5 tonnes per year.

Study Title	Description	Approach	Key findings
5. Ecosystem services from the Coorong, Lakes Alexandrina and Albert Ramsar site (CSIRO, 2015).	This study assessed the critical ecosystem services provided by the Coorong and Lakes Ramsar site.	This study is a review of published peer-reviewed scientific literature was carried out to identify the main ecosystem services provided by the Coorong and Lower Lakes. In addition, the most important ecosystem services were selected with reference to findings from the reviewed literature. 26 ecosystem services were identified. Of these, the most important for human well-being based on income generation were identified based on the reviewed studies as commercial and recreational fisheries, flow connectivity and water quality, habitat and resource provision for biodiversity, tourism and recreation.	For black bream, the tonnage of the recreational catch is more than half that of the commercial catch. Availability of water for boating is a very important ecosystem service, with an estimated 6,800 watercraft in regular use on the lakes and Coorong in 2001 (120,000 user days per year. Recreational boating was estimated to have a gross economic value of about $14M per year and employ approximately 140 people. Four wheel driving is popular on the ocean beach along Younghusband Peninsula. Duck hunting in wetlands in the South Coorong Region, Fairview Conservation Park and Messent Conservation Park, was worth $42-$62 per hunter per shoot, or $1M per year for 500-1500 hunters. There are historical heritage routes along the Coorong to the south-east and Victoria of important Spiritual, heritage and cultural values. Eco-tourism activities including bushwalking and visits to national parks were reasons for visiting given by 10% of visitors to the CLLMM region. GVP of commercial fish was estimated as $4.3M per year. Flow connectivity and water quality were valued at $3.6M based on avoided costs of dredging the Murray Mouth. Tourism and recreation benefits were estimated at $30.5M. Recreational fishing benefits were valued as $2.9M based on average expenditure of $114 per SA fisher per trip.
6. Ecosystem services from the Coorong, Lakes Alexandrina and Albert Ramsar site (CSIRO, 2004).	This report provides a review of the water balance, hydrodynamics and biogeochemistry of the CLLMM region and outlines knowledge gaps in the region.	A review of major research activities in the CLLMM region was conducted to synthesise key findings and identify knowledge gaps.	Sufficient connectivity ensures that there is exchange (mixing) of water along the lagoons and between the lagoons and that fish passage is not hindered and could encourage fish movement between the North and South Lagoon. Salinities within the Southern Lagoon may be mediated by having a two-way exchange past Parnka Point.
7. Valuing Recreation in the Coorong, Australia, with Travel Cost and Contingent Behaviour Models (Rolfe and Dyack, 2011)	This research estimated the recreational values associated with the Coorong.	Travel Cost and Contingent Behaviour Models were employed.	Recreational value of the Coorong was estimated as $111 per adult visitor per day, or $242 per trip, based on 120,000 visitors per year; a consumer surplus of $30.5M per year. Place attachment was extraordinarily high, with almost 40% of respondents having visited 18 times or more. A marginal value of at least $17.20 per person per trip is attached to each 1 per cent change in access.
8. Economic Valuation of Environmental Benefits in the Murray-Darling Basin (Morrison and Hatton MacDonald, 2010).	This report provides environmental and social values for key environmental assets in the Murray-Darling Basin.	Non-use environmental values were summarised based on a review of studies that provided estimates of the value that the community has for improving the quality of natural resources in the Basin apart from values derived from actual use.	The aggregate value of improving the Coorong from poor to good quality was estimated as $4.3 billion. At an estimate of 112,500 visitors per year to the Coorong, total recreation value is about $30.4 million per year. Recreational use values in the Murray-Darling Basin are $30-70 per visitor on average. Travel cost studies have found that the value of a recreational trip to the Coorong is $270 per trip. The willingness to pay value of an additional 1000 hectares of healthy native vegetation is $1-5 per household on average.

Study Title	Description	Approach	Key findings
			The willingness to pay value for a 1% increase in fish populations across the Murray River was estimated as $15.4 per household. Communities' willingness to pay to increase the frequency of colonial waterbird breeding in the Murray was valued at $65 per year. The willingness to pay to increase the number of waterbirds ranged from $4.3-7.4 per household. The willingness to pay to improve the health of the Coorong from poor to good quality was values at $57-173 per household per year.
9. Assessment of the ecological and economic benefits of environmental water in the Murray-Darling Basin (CSIRO, 2012).	This study identified and quantified the ecological and ecosystem services benefits that are likely to arise from recovering water for the environment in the Murray-Darling Basin. Estimates of monetary values of potential benefits were provided for input into a cost-benefit analysis of the proposal to buy environmental water.	Benefits transfer techniques were employed based on a review of findings from economic valuation studies in the Murray-Darling basin.	Evidence suggests that commercial fishery-related impacts from improvements in flows might be small due to adaptive management by fishery licensees. Under the 2800 scenario, and increase in catch of 77 tonnes per year was estimated giving an estimate of incremental revenue of AU$0.20 million annually. 12 trips per year at AU$114 expenditure per recreational fishing trip in SA. The number of fisher days in the Murray, Lakes and Coorong declined between 2000-01 and 2007-08, from 250,000-110,000 days, or AU$7.76M decline in recreational fishing benefits. At 2800GL environmental flows: - Cyanobacterial blooms at $5.29M-10.04M per year in avoided recreational benefit loss – lost recreational days (Morrison and Hatton MacDonald 2010). - the number of potential visitor nights that might be lost during a bloom is around 119,000 to 239,000 overnight visitors. - The New South Wales Office of Water estimated the annual costs of monitoring, managing and investigating cyanobacterial blooms in New South Wales to be AU$1 million in the 2008-09 and 2009-10 seasons. - the annual benefit of reduced risk of cyanobacterial blooms under the 2800 scenario in New South Wales is around AU$0.11 million. Aesthetic benefits: a 1m change in the lake level of Lake Alexandrina increases sales price by AU$58,000.
10. The Coorong, Lower Lakes and Murray Mouth Socio-Economic Report and Scenario Planning For CLLMM Project (DEH, 2009b).	This report documents expected socio-economic impacts of a proposed management actions of the long-term plan for the Coorong and Lower Lakes.	This report presents a mixture of quantitative and qualitative information from a wide range of sources.	Boat sale, boat maintenance and related tourism is worth $100 million to the Goolwa and Lower Lakes economy. A 50% decrease in commercial houseboat and charter bookings may have a negative economic impact of $15M per year. A 50% decrease in private houseboat and cruising fleet may have a negative economic impact of $15M per year. The economic loss from declining water levels in the Lakes and Coorong is estimated at $5M per year. Annual loss of revenues on moorings is estimated at $2M.
11. An ecosystem services approach to estimating	This study estimated the economic values associated with hydrological ecosystem	Estimates were underpinned by data on avoided costs and replacement costs	To mitigate the creation of acid sulphate soils, the South Australian government funded revegetation works around the Lower Lakes with aerial seeding of 4500 ha

Study Title	Description	Approach	Key findings
economic losses associated with drought (Banerjee et al. 2013)	service losses during the Millennium Drought in the South Australian portion of the Murray–Darling Basin.	incurred by the Commonwealth and State governments during the drought to mitigate loss of valuable ecosystem services.	of exposed lakebeds, the barrage islands and other exposed areas around the Goolwa Channel. Revegetation works were estimated to cost $10M (DEH, 2010).
12. Management Plan for the South Australian Commercial Lakes and Coorong Fishery (PIRSA, 2015).	This report presents the management Plan for the South Australian Commercial Lakes and Coorong Fishery.	This report presents quantitative and qualitative information from a wide range of sources used to develop the management plan for the Commercial Lakes and Coorong Fishery.	The Lakes and Coorong Fishery contribute: 1) a total of 150-200 jobs (FTE); 2) $5M-$10M in household income; $25M-$40M in value of output and $12M-$22M in GSP to the SA economy. In addition to revegetation works, the South Australian Government spent $10 million liming exposed lakebeds. Reductions in cultural amenity services due to low flows. Campsites were closed for remediation, while some mooring sites were rendered inaccessible. At one marina, 60 of its 64 boats were forced to relocate. Marinas also reportedly lost the opportunity to service around 1,000 boats at a fee of $5,500 per boat per year.
13. Engineering a Crisis in a Ramsar Wetland: the Coorong, Lower Lakes and Murray Mouth, Australia (Kingsford et al. 2009).	This study reviews a number of proposed engineering solutions in the Coorong, including a plan to pump hypersaline water from the Coorong to the ocean, to offset increasing hypersalinity in the South Lagoon caused by a lack of freshwater inflows.	A review of various sources was conducted to provide socioeconomic and ecological implications of various engineering options for addressing water quality and flow challenges in the CLLMM region.	The fishery in the Lower Lakes and the Coorong involves 37 fishers and produces at least $5.5 million per annum. The recreational boating industry in 2003 had an estimated value of $14.2 million, employing 140 people.
14. A combined site proximity and recreation index approach to value natural amenities: An example from a natural resource management region of Murray-Darling Basin (Tapsuwan, Hatton MacDonald, King and Poudyal, 2011)	This report analyses multiple studies of the hedonic price model and offers the inclusion of “recreational attractiveness” of environmental assets, rather than using standard ‘distance to’ or ‘size of’ measurements, to provide a richer scope of statistic s using a region of the Murray-Darling Basin as a case study.	This report presents hedonic property pricing models that are corrected for spatial dependency with the inclusion of recreational quality indices.	For communities near rivers with recreational attractiveness, moving from 1km to 0.5km within river distance increases property value by $245,000. Where the attractiveness is high, prices go up by $27,000. Where the attractiveness is low, prices fall by $14,000. Recreation attractiveness is based upon accessibility for activities including (in descending order of importance) canoeing/kayaking, water skiing, fishing, other water sports, and river cruising.
15. The impact of water quality and water level on the recreation values of Lake Hume (Crase and Gillespie, 2008)	This study explores how the recreational values of Lake Hume vary with differing water quality and water level scenarios; including activities undertaken on and near the lake, the report correlates the relationship between water quality and recreation.	The contingent travel cost method was employed to estimate relevant recreational values alongside extensive qualitative analysis.	Collection of large body of immobile water leads to higher instance of blue-green algal blooms and degradation in water quality (and increases cost of producing potable water). Total recreational benefits when the lake is near capacity and water quality is good is a little more than $3M. An algal bloom decreases this value by $1M (or almost one third). This implies algae prevents certain activities from occurring or allowing others to continue but at decreased benefit. About two thirds of recreational value is retained at poor water quality. It is put forth that this is because activities, such as boating and fishing, are uninterrupted from scenarios like algal blooms.

Study Title	Description	Approach	Key findings
			Recreational use benefits increase by $1.3M per annum when lake storage is lifted from 50% to near capacity. Recreational benefits are doubled when lake storage is lifted from 10% to near capacity.
16. The value of coastal lagoons: Case study of recreation at the Ria de Aveiro, Portugal in comparison to the Coorong, Australia (Clara, Dyack, Rolfe, Newton, Borg, Povilanskas and Brito, 2017)	This project was part of an international and interdisciplinary study to estimate the non-market value of recreation at endangered coastal lagoons. The study was conducted with the intention of filling in information gaps to help private businesses and differing levels of government evaluate alternative management options (of the lagoons) using cost-benefit analysis. The use of two different geographic locations allowed for testing of convergent validity.	Harnessed two econometric models – revealed and stated preference – for quantitative and qualitative analysis. Questionnaires employed valuation techniques from the travel cost method and contingent valuation method.	Travel cost method (Coorong): Consumer surplus per group per visit = $1,227. Consumer surplus per adult per visit = $455. Consumer surplus per adult per day = $206 (CI of 95% between $156 and $292). Total annual consumer surplus = $57.1M. Contingent valuation method (Coorong): Consumer surplus per adult per visit = $354. Consumer surplus per adult per day = $161 (CI of 95% between $137 and $196). Total annual consumer surplus = $44.6M. There was considerable overlap between values on the Ria de Aveiro and the Coorong. This implies effects and recreational values for coastal lagoons are not limited to geography or specific use - or composition of visitors (15% of survey correspondents in Portugal were tourists as opposed to 2% in Australia).
17. Valuing the visual impact of wind farms: A calculus method for synthesizing choice experiments studies (Wen, Dallimer, Carver and Ziv, 2018)	This paper seeks to introduce a new meta-analysis method as an alternative to the mainstream multivariate meta-regression analysis for synthesizing choice experiment studies and the general integral functions of WTP or WTA. The intention is to provide a model which can assist future spatial modelling and benefit transfer studies.	Used studies (which applied nonmarket valuation methods such as choice experiments to determine willingness-to-pay and willingness-to-accept values) to propose new meta-analysis method to establish general functions for relationships between WTP and WTA.	WTP to push wind farm away was $5.3 per household per year per km (in range of 0.4km-29km). Separate study found WTP of $55 per household per year per km (in range of 0.3km-2.5km). WTA of local windfarm was $19 per household per year per turbine, $18 per household per year per turbine, and $52 per household per year per turbine (three separate studies). WTA (as financial compensation) for increasing turbine height of $13 per household per year per metre (between 75m and 135m). Supported by another study with a WTP to decrease turbine height of $0.7 per household per year per metre (between 50m and 200m). WTP levels significantly differed from WTA levels – highest payment was $223 per household per year while highest acceptance payout was $888 per household per year. WTA additional turbines was found to be $37 per household per year per turbine. Another study found WTP to reduce number of turbines was $2.2 per household per year per turbine.
18. Visual Disamenity in the Queensland Wet Tropics: Estimating the Economic Impacts of Overhead	This paper examines potential procedures which may be applied to visual disamenity costs associated with the installation of high-voltage power cables in the wet tropics	Estimated specific figures through the employment of the travel cost method, WTA calculations (or compensation	WTP for abatement of aesthetic environmental damage from air pollution, strip mining and transmission lines was between $400-$700 per household per year.

Study Title	Description	Approach	Key findings
Transmission Lines (Harrison, 2002)	of QLD. These costs were explored through local ecotourism operations, agriculturalists, and house owners.	payments), and the hedonic price approach.	WTP for removal of a local power plant (with two 230m tall smoke stacks) was valued between $13-$20 per household per year with greater estimates for recreationalists than residents. WTP to avoid visual impacts of drilling, pipelines, transmission lines and electricity generation facilities (in installation of a new geothermal plant) was approximately $20 per person per visit. Assuming a decline in the visitation rate of 10%, expected loss for a local ecotourism business (over 20 years) was $2.7M. House prices were about $15,000 lower for houses located along transmission lines, and $12,600 lower for houses within visual distance of transmission lines, than unaffected houses.

Source: See ‘Study Title’ column of table

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