State of the Southern Coorong – Discussion paper

Building a shared understanding of current scientific knowledge | June 2021

Australian Government

SOUTH AUSTRALIA

Government of South Australia

Department for Environment and Water

What is the desired state of the Southern Coorong?

The Coorong is a wetland of local, national and international importance and one of the most significant waterbird habitats in the Murray-Darling system. The condition and value of the Coorong has suffered long-term decline and was further substantially damaged by the Millennium Drought.

The long-term accumulation of salt and nutrients in association with low water levels over late spring and summer have prohibited the recovery of the system to a recognisable healthy state. To restore the Southern Coorong to a state that meets the aspirations of the community, current scientific knowledge needs to be summarised in ways that can guide management actions to achieve it.

Purpose of this document

This discussion paper seeks to build a shared understanding of the existing and emerging scientific knowledge of the Southern Coorong (south lagoon and the central Coorong from the Needles southward). However, this is not intended as definitive. It incorporates community and stakeholder aspirations and is intended to facilitate discussion and scientific inquiry and to subsequently evolve.

The paper provides a high-level summary of current scientific knowledge in the Coorong. It draws on the results of detailed investigations on the Coorong, including hydrodynamics, water quality, aquatic plants, invertebrates, fish, and waterbirds. These are currently being delivered under Project Coorong and updates provided as technical reports.

To move forward, a shared understanding is needed of:

- the current state of the Southern Coorong
- the consequences of not acting to restore it
- the state it should be in
- how to achieve this.

This document has been reviewed via targeted stakeholder consultation to ensure that it aligns with broad community values. It will be updated in 2022 to incorporate the outcomes of First Nations engagement and final research outcomes from Healthy Coorong Healthy Basin details investigations.

Key points on our current scientific knowledge and understanding

1. *The Southern Coorong is a unique and complex ecological system that is in a degraded state, and requires complex management solutions to reform the system.*
2. *Waterbirds, fish, plants and invertebrates of the Southern Coorong have been affected by prolonged hyper-saline and hyper-eutrophic conditions.*
3. *The desired state for the Southern Coorong is a resilient and naturally variable system with only short periods of restricted connectivity and hyper-salinity.*
4. *The desired state is characterised by moderate levels of nutrients in persistent aquatic plants with diverse invertebrates that promote healthy nutrient cycling, and therefore the Southern Coorong can provide habitat for waterbirds and fish.*
5. *To reach the desired state, net export of salt and nutrients is needed by increasing inflows, water levels and system-wide connectivity.*

Desired state of the Southern Coorong - discussion paper
June 2021

	Current state	'Do-nothing' state	Proposed desired state	Ideas for getting there
Environmental value	**Degraded state** • at risk of no longer supporting some of the elements that make it a wetland of local, national, and international importance • low but variable volume and quality of water entering the Southern Coorong caused by flow regulation, land-use change and climate variability.	**Further degraded state** • increased risk of no longer supporting elements that make it a wetland of local, national and international importance • lacks resilience to environmental extremes • future ability to recover from current state lost.	**Resilient and naturally variable** • supports the environmental values that make it a wetland of local, national and international importance • able to withstand climate variability.	**Assess the risks and benefits of a range of management actions to** • improve salinity range, nutrient cycling, physical habitat and flow regime • evaluate the combined influence of potential management actions • implement feasible management options.
Connectivity and flow	**Connectivity and inflow variable but low** • insufficient inflow/flushing to dilute and export salt and nutrients • limited transport and exchange of microscopic animals (zooplankton) and fish that are important for foodwebs • restricted by the narrow channel at Parnka Point and nearby, openness of the river mouth and inflows from the River Murray and south-east flows.	**Persistently low connectivity and flow** • low rainfall and flows into the Coorong worsen due to climate change • water level remains persistently low • fish and microscopic animals have restricted movement.	**Connectivity and inflow variable but adequate** • water levels and inflow maintain flushing and connectivity most of the time • there are only short periods of restricted connectivity • microscopic animals are transported via inflows to support food webs • fish move freely between lagoons.	**Connectivity needs to be strengthened** • Maintain adequate system flushing (to export salt and nutrients) • maintain suitable water levels • adaptive management to maintain open flow conditions and reduce sedimentation under a changing climate.
Salinity	**Persistently hyper-saline (>60 g/L)** • water does not flush out because of low inflows and poor connectivity • evapo-concentration of salt is enhanced by the long residence time of water.	**Persistently extremely hyper-saline** • limited change associated with the timing and volume of inflows • evapo-concentration of salt enhanced by longer water residence time.	**Variable salinity** • long-term export of salt occurs • variable salinity including some periods of hyper-salinity (>60 g/L) and a range of lower maximum salinities between years • evapo-concentration is balanced with export through flushing.	**Ongoing export of salt is needed** • manage salinity to allow seasonal variation within and between years; minimise the duration and frequency of peak salinity events • assess options to improve long-term export of salt through inflow of low salinity water, flushing, and reducing salt load in flow sources.

Desired state of the Southern Coorong discussion paper

June 2021

	Current state	'Do-nothing' state	Proposed desired state	Ideas for getting there
Eutrophication (high-nutrient state)	**Predominantly hyper-eutrophic** • high levels of plankton (chlorophyll-*a*), nitrogen, phosphorus and filamentous algae in the water and depositing into sediments • hyper-salinity reinforces eutrophication by impacting plants and macroinvertebrates that cycle nutrients • the sediment is degraded with high nutrient levels, algal mats making them anoxic, and sulfidic black oozes.	**Persistently hyper-eutrophic** • nutrients have accumulated and continue to do so • filamentous, planktonic and benthic micro algal blooms are common • reduced capacity for aquatic plants and invertebrate populations to store nutrients and promote nutrient cycling • sulfidic black oozes are common.	**Mesotrophic** • moderate nutrient loads in the Coorong • sufficient inflows to carrying microscopic animals and productive pelagic (in-water) plankton • nutrients incorporated into persistent aquatic plants and macro-invertebrates • sediments re-worked and oxygenated by aquatic plants and invertebrates • nutrients flux out of sediments • near-absent sulfidic black oozes.	**Ongoing export of nutrients is needed** • reduce water residence time and increasing connectivity and flushing • facilitate aquatic plant community and invertebrate restoration to remove nutrients from water and sediment, and to re-work and oxygenate sediment to promote sediment-water nutrient fluxes • investigate immediate solutions including short-term, large-scale reductions in nutrient pools.
Food webs (plants, invertebrates, fish and waterbirds)	**Food web has low complexity** • algal blooms reduce growth and reproductive success of aquatic plants by inhibiting light availability, and seed set • algal blooms don't provide quality alternative food or habitat for fish and macro-invertebrates • salinity is too high to support a diverse macroinvertebrate community, which is dominated by chironomid (midge) larvae • salinity is too high for many fish species; hypersaline-tolerant smallmouth hardyhead are dominant in the Southern Coorong • more than half of routinely monitored waterbird species are reduced in abundance and distribution.	**Food web has collapsed** • nuisance species such as filamentous algae and phytoplankton dominate • aquatic plants are near-absent as food and habitat • macroinvertebrates are low in diversity and abundance, reducing food for fish and waterbirds • smallmouth hardyhead is the only fish species, are low in numbers, and are absent in areas with very high salinity • waterbird diversity is low, and species that rely on local habitat to complete key stages of their life-cycle (i.e. migratory shorebirds and colonial nesting species) are particularly low in number.	**Food web is diverse and resilient** • aquatic plants are extensive and produce large quantities of seed and turions that enable recovery over seasonal cycles and provide food for macroinvertebrates, fish and birds • diverse and abundant invertebrates vary along salinity gradients, and provide food for fish and waterbirds, oxygenate sediments and filter water • fish communities are moderately diverse, including yelloweye, mullet, congolli and greenback flounder that support a seasonal fishery • diverse and abundant waterbird populations are supported throughout life stages (including migration and breeding).	**Address each key component of the food web** • address hyper-salinity and hyper-eutrophication • improve water clarity and reduce filamentous algal blooms to increase the habitable quality for aquatic plants • improve connectivity to allow recolonization of macroinvertebrates and fish during seasonal and inter-annual salinity changes • increase frequency and volume of inflow to transport zooplankton and productive pelagic plankton • provide diverse habitats and food for waterbirds including invertebrates in shallow areas, prey fish in clear water, aquatic plants and water levels that co-ordinate with life cycles.

Glossary of terms

Anoxic — Lacking oxygen.

Aquatic plants — The truncated phrase used to describe the mixed submerged aquatic plant community that includes *Ruppia tuberosa* and *Althenia cylindrocarpa* known from the Coorong.

Benthic — Of, or associated with, the sediment at the bottom of an estuarine or marine system.

Chironomid larvae — The juvenile (larvae) form of non-biting midge that live in aquatic habitats.

Chlorophyll-*a* — One of the photosynthetic pigments of plants that is used as an indicator of the eutrophic state of water bodies. One of the symptoms of degraded water quality condition is the increase of algae biomass as measured by the concentration of chlorophyll-*a*. Waters with high levels of nutrients may have high concentrations of chlorophyll-*a* and excess amounts of algae.

Connectivity — A mechanism that allows for the movement of water, materials and animals between areas, including between the north and south lagoons of the Coorong, between the sea and the Coorong through the Murray mouth, and from the River Murray or south-east flows to the Coorong (but not typically vice versa). It is an important element of hydrodynamics, has a strong influence on water quality (through exchange of salt and nutrients) and is essential for some ecological processes, such as migration of fish at different times of year, and for the transport of zooplankton from freshwater inflows to support food webs of the Coorong.

Current state — The current state of the Southern Coorong.

Desired state — An aspirational goal for overall ecological health based on how the Southern Coorong should *function*

Do-nothing state — Deteriorated ecological health of the Southern Coorong if no action is taken to restore its functional processes. This will occur because climate change will intensify climate variability and extreme conditions that affect connectivity and flushing, and lead to salt and nutrient accumulation.

Ecosystem services — Ecosystem services are the benefits provided to humans through the transformations of resources into a flow of essential goods and services e.g. clean air, water, and food.

Eutrophication — The process of nutrient enrichment and the increase in the supply of organic matter to an ecosystem. Eutrophic systems are typically characterised by excessive plant and algal growth due to the increased availability of one or more limiting plant growth factors needed for photosynthesis including nutrients. It has cascading effects on ecosystem structure and function.

Evapo-concentration — The concentration of solutes, such as salt and contaminants, as water evaporates. The volume of water lost to evaporation increases with water residence time and at higher temperature in summer.

Filamentous algae — The green filamentous algal community which occurs in the Coorong, consisting of *Ulva paradoxa*, *Rhizoclonium sp*. and *Cladophora sp*. defined in Collier et al. 2017.

Food web — A natural interconnection of food chains showing what eats what.

Habitat — The natural home or environment of a plant, animal or other organism.

Hyper-eutrophic — An extreme state of eutrophication, or a very high nutrient state.

Hyper-salinity — High in salt concentration, i.e. salinity >60 g/L.

Invertebrates — Animals without a backbone. Benthic invertebrates live on or in the sediment, while pelagic invertebrates (e.g. zooplankton) live in the water.

Macroinvertebrate — Invertebrate fauna that are greater than 0.5 mm.

Mesotrophic — Intermediate levels of nutrients in an aquatic system, so that it is fairly productive (with plant and animal life), but could be at risk of having water quality problems.

Microalgae — unicellular photosynthetic algae that are invisible to the naked eye. They form an important base to aquatic foodwebs, cycle nutrients, and take up carbon dioxide and release oxygen.

Microscopic animals — Animals that either move by water currents or are weak swimmers in the water column and can spend partial or complete lives in the plankton, also referred to as zooplankton.

Millennium drought — The drought that affected southern Australia (e.g. Murray-Darling Basin) from 2001 to 2010.

Nitrogen — A nutrient that is essential to plants and animals and forms compounds such as amino acids and proteins. Nitrogen can be found in aquatic environments in dissolved, particulate, inorganic, organic and gaseous forms. Too much nitrogen can be associated with eutrophication.

Nutrient cycling — The movement or exchange of nutrients, such as nitrogen, from inorganic and organic forms into organic matter, including plants and animals, and back again.

Pelagic — Associated with the water column.

Plankton (planktonic) — Organisms that drift with the water as they are weak swimmers, which can be phytoplankton (plants) or zooplankton (animals).

Reef habitat — Tube-building bristle worms develop dense aggregations of intertwined tubes that form biogenic reef structures. They provide substrate for settlement of some organisms, and refuge or food source for others. As such, reef habitats are biodiversity hotspots compared to surrounding sediments.

Residence time (water) — The time taken by a parcel of water (and the materials carried by it) to leave a defined region of interest, namely the Southern Coorong.

Resilient/resilience — The ability of ecosystems to resist permanent structural change without fundamentally switching to an alternative state and maintain ecosystem functions by resisting damage and recovering quickly.

Ruppia — A genus of aquatic plant, referring to the species *Ruppia tuberosa* in the Southern Coorong.

Salinity — absolute salinity is the mass fraction of salts in seawater. It is also measured as electrical conductivity (EC), which is the presence of charged ionic species in solution that enables water conduct and electrical current. Salts increase the ability of a solution to conduct an electrical current, so a high EC value indicates a high salinity level and is commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS. 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25°C. Commonly reported at ppt (parts per thousand) equivalent to g/kg or g/L.

Sediment — The inorganic particles of mud, sand or other sizes, plus the organic matter and other nutrients that are deposited at the bottom of aquatic systems.

Southern Coorong — The part of the Coorong south of Hack Point, sometimes including the central region.

Sulfidic black oozes — Organic-rich and anoxic sediment that inhibit nutrient cycling and have a strong sulfurous smell.

Turion — Reproductive structure that *Ruppia tuberosa* and *R. polycarpa* (Type I) and *R. tuberosa* (Type I and Type II) produce at the base of shoots, usually found underground, that is capable of forming into a new plants after a period of dormancy.

Water quality — The condition of water or some water-related resource as measured by surveys, habitat-quality assessments, chemical-specific analyses of pollutants in water bodies, and toxicity tests.

Water delivery regime — The timing and volume of water delivered to the Coorong.

More information

To receive Healthy Coorong, Healthy Basin updates and opportunities, including citizen science activities and community consultations, please email project.coorong@sa.gov.au.

If you have any questions or comments at this time please let us know at projectcoorong@sa.gov.au

Visit the Project Coorong website.