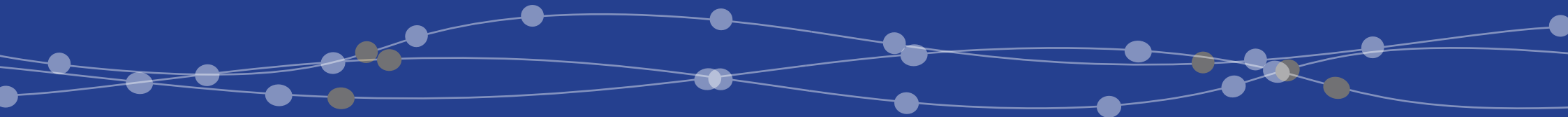




# COCKBURN SOUND REPORT CARD

2014  
- 2015



# Cockburn Sound Management Council Membership as at 30 June 2015

Chair: Emeritus Professor Kateryna Longley	
State Government	
Kelly Faulkner	Department of Environment Regulation
Stefan de Haan	Department of Parks and Wildlife
Rae Burrows	Department of Fisheries
Leon Brouwer	Department of Water
Ian Briggs	Department of Mines and Petroleum
Vivienne Panizza	Department of Planning
Jim Dodds	Department of Health
Gordon Groth	Water Corporation
Gino Valenti	Fremantle Ports
Local Government	
Deputy-Mayor Carol Reeve-Fowkes	City of Cockburn
Cr Ruth Alexander	City of Kwinana
Cr Ron Pease	City of Rockingham

Federal Government	
Jarrad Scott	Department of Defence
CSIRO	
Dr John Keesing	
Industry	
Chris Oughton	Kwinana Industries Council
Glenn Dibbin	WA Fishing Industry Council
Recreational Users	
Craig Bibra	Recfishwest
John Smedley	Cockburn Power Boats Association
Conservation	
Prof. David Harries	Conservation Council of WA
Community Members	
Bart Houwen	
John Polglaze	

Cockburn Sound is the most intensively used marine embayment in Western Australia. It is unique in Western Australia, as it has a State Environmental Policy to provide the framework for its environmental management. This Report Card provides a summary of the Cockburn Sound Management Council’s assessment of the extent to which the environmental quality objectives for Cockburn Sound were met in 2014–2015. This is based on the results of monitoring programs carried out during the 2014–2015 reporting period.

## Introduction

Cockburn Sound is the most intensively used marine embayment in Western Australia. It is used extensively for industry and shipping, and is important for activities such as fishing, aquaculture, tourism and recreation. Cockburn Sound has had a history of significant nutrient pollution, which resulted in the loss of more than three quarters of the seagrass meadows. Since then, in response to actions by industry, government and the community, water quality in Cockburn Sound has improved. Nevertheless, Cockburn Sound is under ongoing environmental pressure from increasing industrial, urban and recreational use.

## The State Environmental Policy for Cockburn Sound

The State Environmental Policy provides the framework for Cockburn Sound’s environmental management. The State Environmental Policy was updated in 2015. The overall objective of the State Environmental Policy is to ensure that water quality is maintained and, where possible improved, so that there is no further net loss and preferably a net gain in seagrass areas, and that other values and uses are maintained.

The State Environmental Policy identifies the environmental values for the Cockburn Sound marine area, and the environmental quality objectives that are required to be met to ensure the protection and maintenance of these values. The environmental quality objectives guide decision-making and provide the common goals for management.

The State Environmental Policy describes three levels of ecological protection (high, moderate and low) and where they apply in the Cockburn Sound marine area so that overall ecological integrity can be maintained. Most of Cockburn Sound is assigned a high level of ecological protection (HPA-N and HPA-S). Careening Bay on Garden Island (MPA-CB) and the eastern margin of Cockburn Sound adjacent to the industrial area (MPA-ES), where societal uses preclude a high level of ecological protection, are assigned a moderate level of protection. MPA-ES includes the Jervoise Bay Northern Harbour which is assessed separately (Moderate Protection Area Northern Harbour [MPA-NH]). A few small areas around outfalls are assigned a low level of ecological protection.

## The Environmental Quality Management Framework

The Environmental Protection Authority has established an environmental quality management framework for Cockburn Sound. Implementation of the environmental quality management framework requires a cooperative approach that involves all stakeholders.

Environmental quality criteria play an important role in the environmental quality management framework, providing the quantitative benchmarks for measuring success in achieving the environmental quality objectives. The goal of environmental management is to ensure that direct and indirect sources of contaminants are managed such that the environmental quality criteria are met and the environmental quality objectives are achieved.




There are two types of environmental quality criteria:

- Environmental Quality Guidelines (guidelines)—which, if met, indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. An exceedance of a guideline signals the need for more intensive investigation against an environmental quality standard.
- Environmental Quality Standards (standards)—which indicate a level beyond which there is a significant risk that the associated environmental quality objective has not been achieved and triggers a management response.

The environmental quality management framework implements monitoring strategies to provide data for measuring environmental performance against the environmental quality criteria. Responsibility for monitoring is shared across a number of public authorities. The Cockburn Sound Management Council (CSMC) coordinates environmental monitoring and reports annually to the Minister for Environment.

This Cockburn Sound Report Card summarises the assessment of the extent to which the 2014–2015 monitoring results met the environmental quality criteria and environmental quality objectives for Cockburn Sound. For more detailed information refer to the *Cockburn Sound Annual Environmental Monitoring Report 2014–2015* which is available at [www.der.wa.gov.au/about-us/cockburn-sound-management-council](http://www.der.wa.gov.au/about-us/cockburn-sound-management-council).

**Table 1: Key to interpreting the Report Cards**

Result	Assessment and Action
	Environmental Quality Guidelines met—continue monitoring
	Environmental Quality Guidelines not met—investigate against the Environmental Quality Standard
	Environmental Quality Standard not met—management response triggered

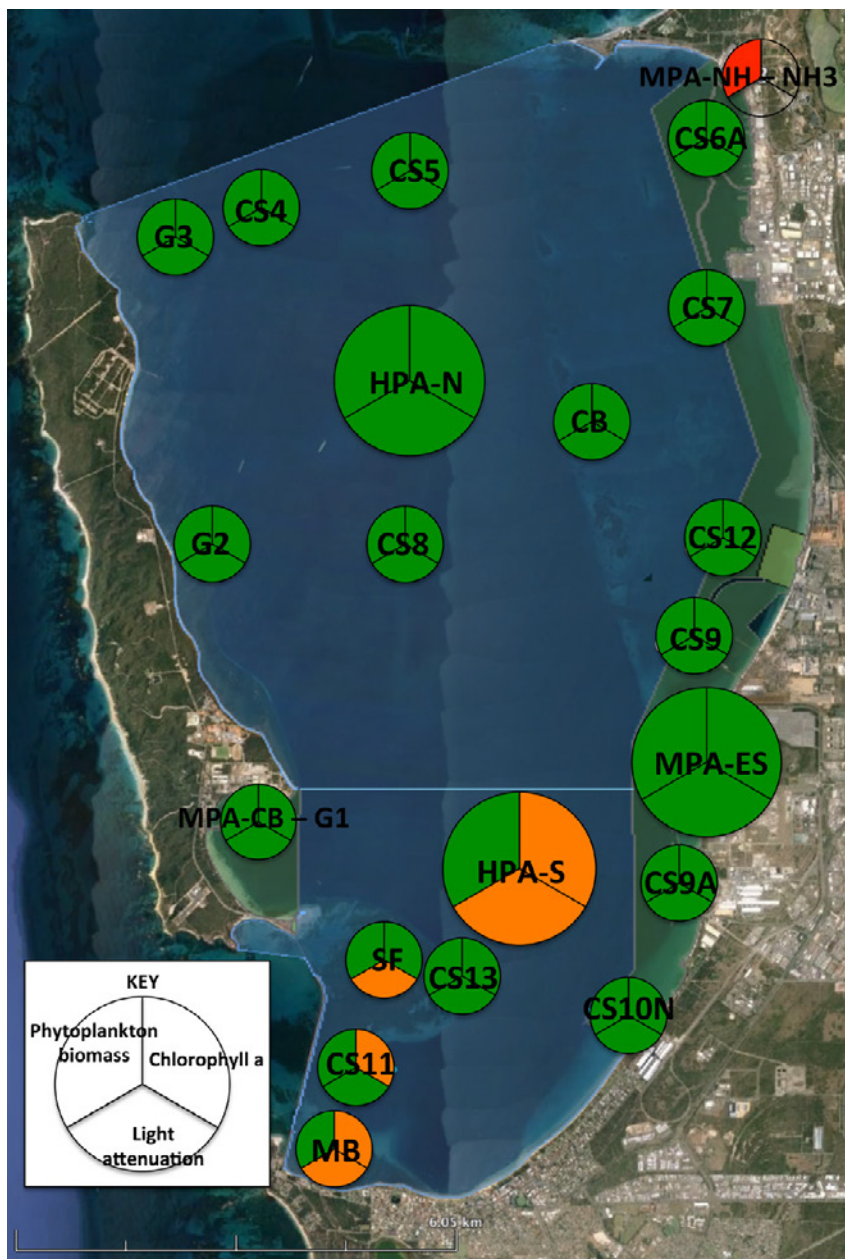


Figure 1: Assessment against the Nutrient Enrichment environmental quality criteria

## Maintenance of Ecosystem Integrity: Nutrient Enrichment

### Key Messages

- Water quality in Cockburn Sound has improved markedly over the past 30 years. Significant downward trends in the concentrations of nutrients are attributable to a reduction in nutrient inputs from external sources (for example, diversion of industrial wastewater, improvements in groundwater, interception of stormwater). While there has been a corresponding significant decrease in chlorophyll a concentrations over the same period, there have been significant increases in chlorophyll a concentrations at some sites in Cockburn Sound and Warnbro Sound over the past 10 years.
- Nutrient enrichment is not an issue in most of Cockburn Sound. The chlorophyll a and light attenuation guidelines were met in the northern high ecological protection area (HPA-N), as well as in the Careening Bay (MPA-CB) and the eastern Cockburn Sound (MPA-ES) moderate ecological protection areas, over the 2014–2015 non river-flow period (December to March).
- The southern part of Cockburn Sound continues to show signs of nutrient enrichment. The chlorophyll a and light attenuation guidelines were exceeded in the southern high ecological protection area (HPA-S) over the 2014–2015 non river-flow period. Exceedance of the nutrient enrichment guidelines in HPA-S triggered investigation against the nutrient enrichment standard. This required an assessment of seagrass shoot densities at the two seagrass health monitoring sites in HPA-S against shoot densities recorded at the Warnbro Sound reference sites. The standard was met, indicating that nutrient enrichment-related reduction in light availability at the seabed is unlikely to be driving declines in seagrass shoot density at these sites.
- With the exception of Jervoise Bay Northern Harbour, the phytoplankton biomass guidelines were met at all sites and in all ecological protection areas over the 2014–2015 non river-flow period. The phytoplankton biomass standard was also exceeded in Jervoise Bay Northern Harbour.

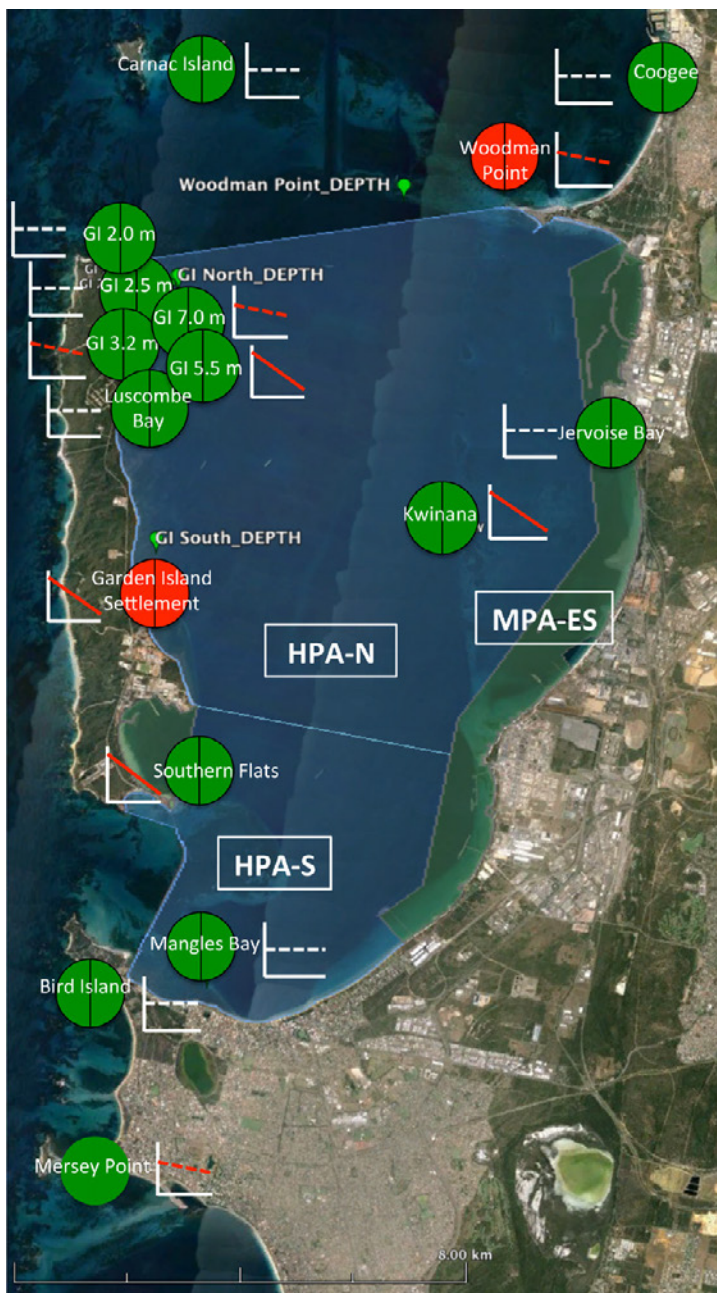


Figure 2: Summary of the 2015 seagrass health monitoring results

## Monitoring of Seagrass Health

- In 2015, median seagrass shoot densities at all the sites in Cockburn Sound, with the exception of the Garden Island Settlement site, were higher than the 'absolute minimum' and the rolling four-year percentiles of shoot densities at the Warnbro Sound reference sites.
- Analysis of mean seagrass shoot densities recorded at monitoring sites over the past 11-13 years indicates shoot densities have declined at six of the 11 sites in Cockburn Sound. At four of these six sites (Garden Island 5.5 m, Garden Island Settlement, Southern Flats and Kwinana), the decrease was statistically significant. With water quality meeting the nutrient enrichment criteria in HPA-N and MPA-ES, the reported declines in shoot densities do not appear to be linked to a nutrient enrichment-related decline in available light at the seabed. While there have been improvements in water quality in Cockburn Sound, these results suggest other environmental factors are likely to play an important role in seagrass decline or lack of recovery.
- Mean seagrass shoot densities also declined at two sites outside of Cockburn Sound (Woodman Point and Mersey Point) and there have been significant declines in shoot densities at four of the Warnbro Sound reference sites. The declines in shoot densities at the reference sites are thought to be the result of erosion and the development of 'blow outs'.
- In 2015, there was a significant increase in the maximum depth of seagrass distribution at the seagrass 'depth limit' sites GI South\_Depth and Woodman Point\_Depth. This indicates that the seagrass at these sites is extending into deeper waters, which is consistent with an increase in light penetration associated with an improvement in water quality. The maximum depth of seagrass distribution has remained stable since monitoring began in 2000 at the GI North\_Depth site and the Warnbro Sound\_Depth site.

Table 2: Key to interpreting the results for seagrass health

Result	Assessment
	Median seagrass shoot densities are higher than the: <ul style="list-style-type: none"> <li>• 'absolute minimum' criteria which represent historical baseline shoot densities recorded at the Warnbro Sound reference sites during the first four years of monitoring prior to 2005</li> <li>• annually updated rolling four-year percentiles of shoot densities recorded at the reference sites.</li> </ul>
	Median seagrass shoot densities are lower than the: <ul style="list-style-type: none"> <li>• 'absolute minimum' criteria which represent historical baseline shoot densities recorded at the Warnbro Sound reference sites during the first four years of monitoring prior to 2005</li> <li>• annually updated rolling four-year percentiles of shoot densities recorded at the reference sites.</li> </ul>
Trends in mean shoot density	
	No significant change in mean shoot density
	Trend analysis indicates a decrease in mean shoot density ( $p \leq 0.2$ )
	Statistically significant decrease in mean shoot density ( $p = 0.05$ )

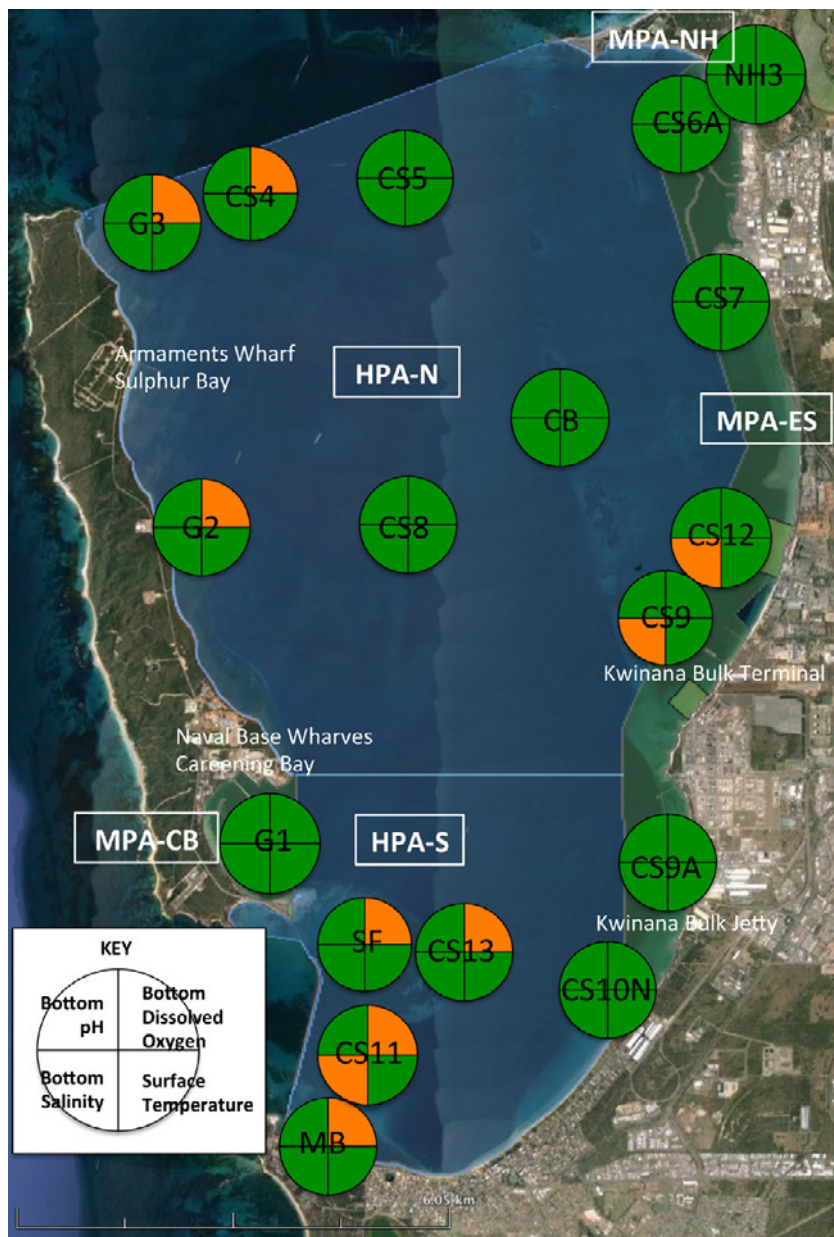


Figure 3: Assessment against the Other Physical and Chemical Stressors environmental quality criteria

## Maintenance of Ecosystem Integrity: Other Physical and Chemical Stressors

### Key Messages

#### Dissolved Oxygen

- Dissolved oxygen concentrations in bottom waters at sites in the moderate protection areas met the moderate protection guideline (> 80% saturation) on all 16 sampling occasions over the 2014–2015 non river-flow period (December to March).
- At sites within HPA-N, dissolved oxygen concentrations in bottom waters were generally higher than the high protection guideline (> 90% saturation) over the 2014–2015 non river-flow period. However, on single occasions during the non river-flow period, dissolved oxygen concentrations in bottom waters at CS4, G2 and G3 did not meet the guideline.

- Dissolved oxygen concentrations in bottom waters at SF, CS13, CS11 and MB in HPA-S did not meet the high protection guideline on between two and 10 of the 16 sampling occasions over the non river-flow period. The lowest dissolved oxygen concentration was recorded at MB (81%) on 2 February 2015 during a period of six weeks when dissolved oxygen concentrations were below 90%.

Exceedance of the guideline triggered investigation against the dissolved oxygen standard. Dissolved oxygen concentrations were greater than 60% saturation at all the sites over the 2014–2015 non river-flow period. There were no known reports of deaths of marine organisms over the 2014–2015 reporting period that may have been attributable to deoxygenation.

#### Water Temperature

- Surface water temperature met the guideline at all the sites over the 2014–2015 non river-flow period.

#### Salinity

- The salinity of bottom waters at most sites met the guideline over the 2014–2015 non river-flow period.
- The salinity of bottom waters did not meet the guidelines at CS9, CS11 and CS12. Median bottom water salinities at these sites exceeded the guideline by less than one practical salinity unit (psu). The higher salinities recorded at CS9 and CS12 in MPA-ES are possibly associated with the discharge from the Perth Seawater Desalination Plant.

#### pH

- Bottom water pH met the guideline at all the sites over the 2014–2015 non river-flow period.

## Toxicants in Marine Waters and Sediments

- Concentrations of contaminants (ammonia, copper and benzene-toluene-ethylbenzene-xylene [BTEX]) in water samples collected around the Kwinana Bulk Terminal and the Kwinana Bulk Jetty were below their respective guidelines.
- Concentrations of contaminants (metals [such as copper, lead, zinc], tributyltin [TBT] and Polycyclic Aromatic Hydrocarbons [PAHs]) in sediments around the Kwinana Bulk Terminal and the Kwinana Bulk Jetty were below their respective guidelines.
- Concentrations of contaminants (metals [such as cadmium, copper, nickel], TBT and PAHs) in sediments around the Armaments Wharf in Sulphur Bay were below their respective guidelines.
- Concentrations of contaminants (metals and PAHs) in the sediments around the wharves in Careening Bay were below their respective guidelines. However, elevated concentrations of TBT were recorded. Elutriate testing was undertaken to investigate the bioavailability and potential impact of release of dissolved TBT on water quality if the sediments were mobilised, for example during dredging. The concentrations of TBT from elutriate testing were below the moderate protection guideline value for TBT in marine waters.

## Has the Environmental Quality Objective 'Maintenance of Ecosystem Integrity' been achieved?

Based on the results from the 2014–2015 monitoring programs, it can be concluded that there is a low risk that the environmental quality objective is not being achieved in most of Cockburn Sound. Routine monitoring should be continued.

TBT concentrations in the sediment in some areas in Careening Bay adjacent to the naval base wharves exceeded the toxicity guidelines. This indicated that there is uncertainty as to whether the environmental quality objective has been achieved and a more detailed assessment was triggered. Elutriate testing was undertaken and the concentrations of TBT were below the relevant guidelines.

The 'Nutrient enrichment' and the 'Dissolved oxygen' guidelines were not met in HPA-S, indicating there is uncertainty as to whether the environmental quality objective has been achieved. This triggered a more detailed assessment against the standards. The respective standards were met, indicating there is a low risk that the environmental quality objective has not been achieved. A management response is therefore not considered to be required and routine monitoring should be continued.

Similar to previous reporting periods (such as *The State of Cockburn Sound Report 2014*), the 'Phytoplankton biomass' standard was not met in MPA-NH. This indicates that there is a significant risk that the environmental quality objective has not been achieved. Exceedance of the phytoplankton biomass standard in Jervoise Bay Northern Harbour triggered the requirement to identify the cause (or source) of the exceedance and initiate a management response to reduce nutrient loads.

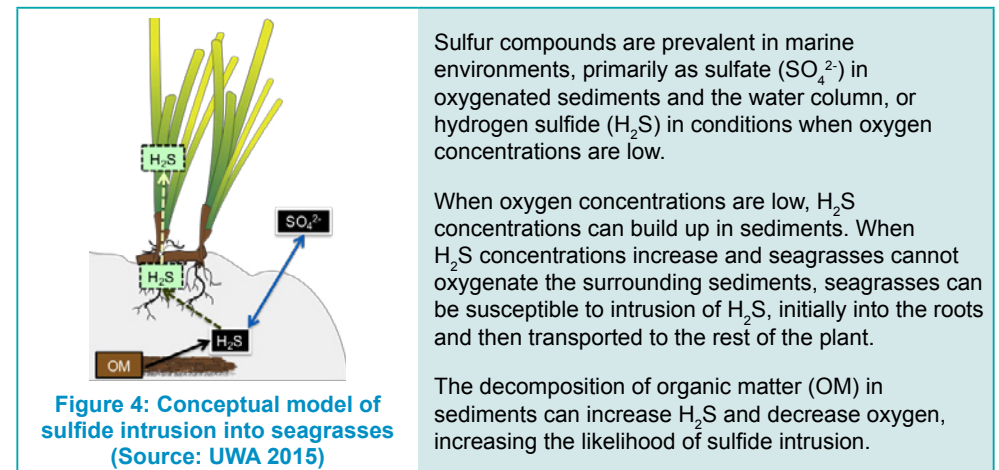
## Investigative Study: Environmental Drivers of Seagrass Decline in Cockburn and Warnbro Sound (University of Western Australia 2015)

This study investigated the potential role of sediment stressors in contributing to the continued decline of *Posidonia sinuosa* meadows in Cockburn and Warnbro Sounds in spite of improvements in water quality.

Sites with high rates of seagrass decline (particularly Garden Island and Warnbro Sound) were found to have the highest rates of sulfide intrusion from sediments into seagrass tissues. While seagrasses can tolerate intrusion of sulfides from sediments when they can transport oxygen from tissues, detoxifying the sulfide into less harmful substances, the intrusion of sulfides is potentially toxic to seagrasses. Sulfide intrusion into seagrass tissues is generally more prevalent when seagrasses are already exposed to other stressors (such as low oxygen, high temperatures or nutrient loading), as oxygen transport is already limited within the plants.

Seagrass rhizome cadmium concentrations were also found to be negatively correlated with seagrass biomass and shoot density, suggesting a potential role in seagrass decline. Uptake of cadmium can interfere with sulfur metabolism in plants and elevated cadmium concentrations may indicate plants that are particularly susceptible to sulfide intrusion. There has, however, been very little research on the impacts of cadmium in seagrasses.

The University of Western Australia (UWA) study recommended that further work is required to determine the drivers of sulfide intrusion in *Posidonia sinuosa* in Cockburn and Warnbro Sounds. This would help identify the areas and times that seagrasses are particularly at risk, thereby improving the management of further declines. The study also noted that it is unlikely that one stressor alone is responsible for seagrass decline and that it is important to examine multiple stressors simultaneously to determine whether the additive or synergistic effects of these stressors contribute to seagrass decline.



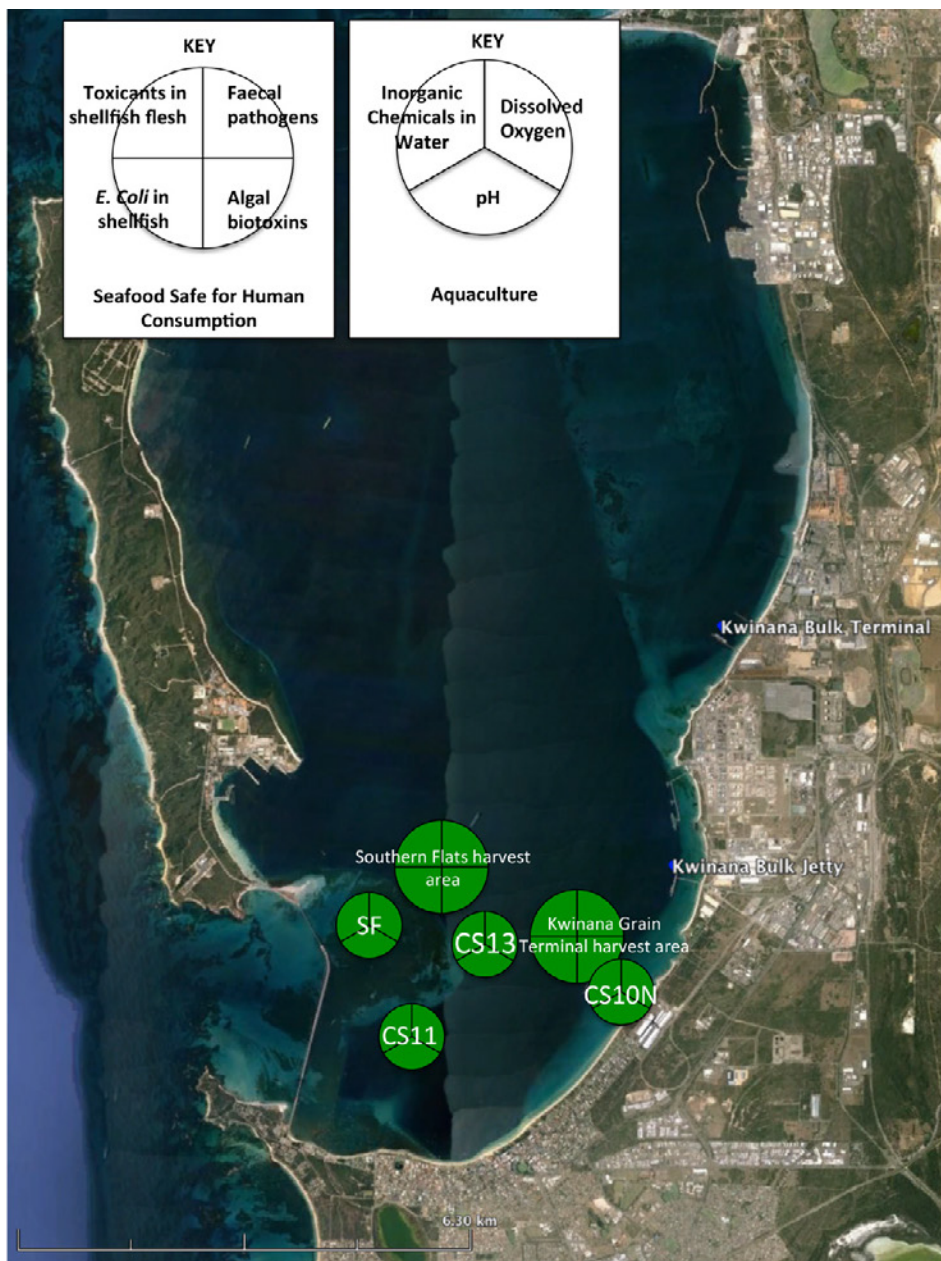


Figure 5: Assessment against the environmental quality criteria for the 'Maintenance of Seafood Safe for Human Consumption' and the 'Maintenance of Aquaculture'

## Maintenance of Seafood Safe for Human Consumption

### Key Messages

The guidelines for biological (faecal pathogens in water, *Escherichia coli* (*E. coli*) in shellfish flesh and algal biotoxins) and chemical (metals, organochlorine and organophosphate pesticides and Polychlorinated Biphenyls [PCBs] in shellfish flesh) contaminants were met in the Kwinana Grain Terminal and Southern Flats commercial shellfish growing areas in Cockburn Sound.

The concentrations of chemical contaminants (metals, TBT and PAH) in sentinel mussels deployed at the Kwinana Bulk Terminal and the Kwinana Bulk Jetty were below the relevant guidelines.

## Maintenance of Aquaculture

### Key Messages

The guidelines for physical-chemical stressors (dissolved oxygen concentration in bottom waters and surface waters pH) were met at water quality monitoring sites (SF, CS10N, CS11, CS13) adjacent to the aquaculture leases in Cockburn Sound on all sampling occasions over the 2014–2015 non river-flow period (December to March). The concentrations of selected inorganic chemicals (ammonia, nitrate + nitrite) were also below the relevant guidelines over the same period.

The concentrations of selected contaminants (copper, ammonia and nitrate + nitrite) in water samples collected in February 2015 around the Kwinana Bulk Terminal and the Kwinana Bulk Jetty were below the relevant guidelines.

### Have the Environmental Quality Objectives 'Maintenance of Seafood Safe for Human Consumption' and 'Maintenance of Aquaculture' been achieved?

Based on the results of the 2014–2015 monitoring programs, there is a high degree of certainty that the environmental quality objectives have been achieved in the approved shellfish harvesting areas in southern Cockburn Sound.

Accredited quality assurance monitoring programs, based on the requirements of the Western Australian Shellfish Quality Assurance Program, are currently only conducted for approved shellfish harvesting areas in southern Cockburn Sound where shellfish are grown commercially for the food market. There is no information available from other areas in Cockburn Sound or for wild shellfish or fish. The Department of Health advises that people who collect and eat wild shellfish may be putting their health at risk and recommends only eating shellfish harvested commercially under strict quality assurance monitoring programs.<sup>1</sup>

1 Department of Health (2010). *Wild shellfish collection*.



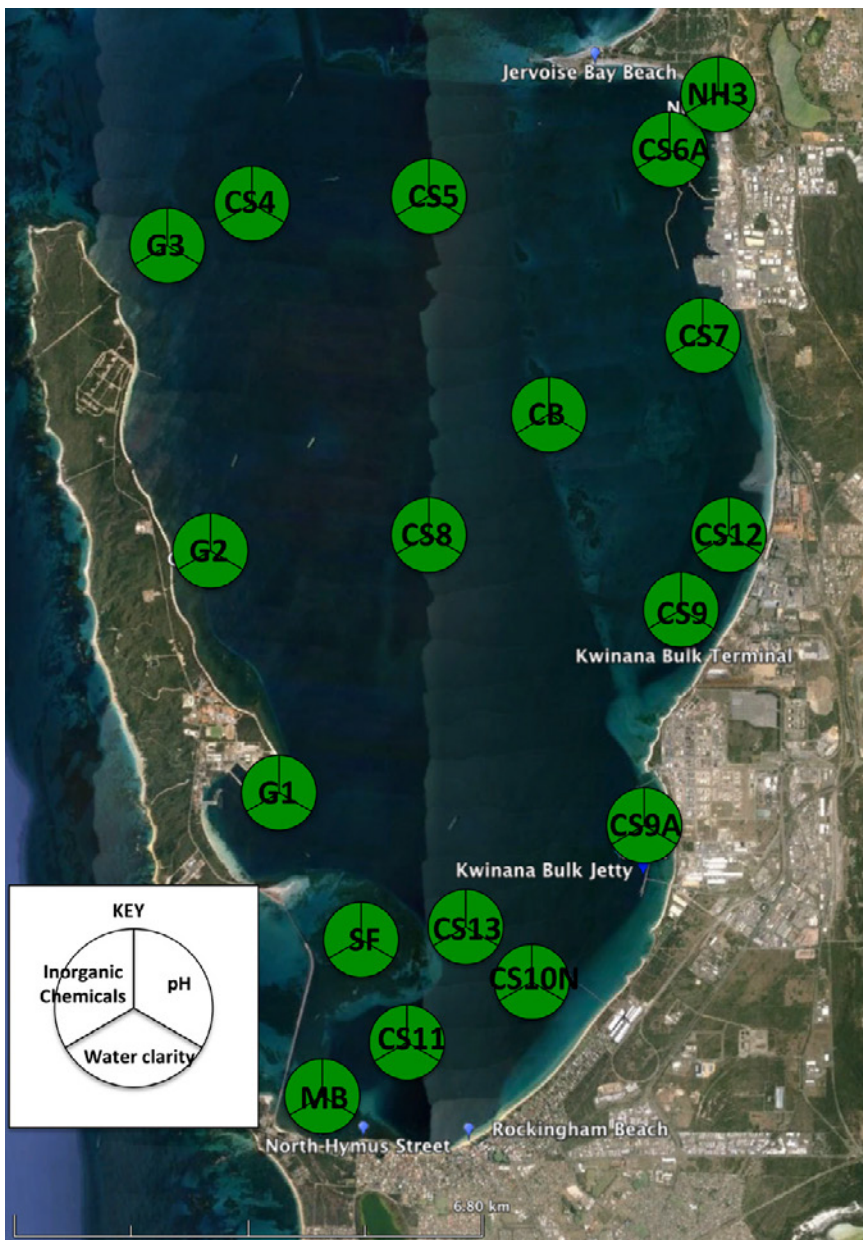


Figure 6: Assessment against the environmental quality criteria for the ‘Maintenance of Primary and Secondary Contact Recreation Values’

## Maintenance of Primary and Secondary Contact Recreation Values

### Key Messages

The guidelines for faecal pathogens for primary (such as swimming, water-skiing and diving) and secondary (such as boating, canoeing and fishing) contact recreation were met at Jervoise Bay Beach, Rockingham Beach/Jetty and North Hymus Beach over the 2014–2015 monitoring period.

Water clarity and pH met their respective guidelines or standards for primary and secondary contact recreation at the 18 water quality monitoring sites in Cockburn Sound over the 2014–2015 non river-flow period (December to March). Concentrations of nitrate + nitrite at these sites over the same period met the guidelines for primary contact recreation.

Concentrations of contaminants (nitrate + nitrite, copper and BTEX) in water samples collected around the Kwinana Bulk Terminal and the Kwinana Bulk Jetty were below the relevant guidelines for primary contact recreation.

### Have the Environmental Quality Objectives ‘Maintenance of Primary Contact Recreation Values’ and ‘Maintenance of Secondary Contact Recreation Values’ been achieved?

Based on the results of the 2014–2015 monitoring programs, there is a high degree of certainty that the environmental quality objectives have been achieved.

## Maintenance of Water Quality For Industrial Use

### Key Messages

The results from the 2014–2015 monitoring of the intake seawater from Cockburn Sound into the Perth Seawater Desalination Plant indicate there were minor, short-lived exceedances in two parameters (total suspended solids and boron concentrations). There were no exceedances in the other parameters monitored by the Water Corporation.

### Has the Environmental Quality Objective ‘Maintenance of water quality for industrial use’ been achieved?

The Water Corporation advised that it did not report a significant reduction in efficiency of the desalination process or a significant increase in the maintenance requirements caused by the variance in intake seawater quality reported. There is therefore a high degree of certainty that the environmental quality objective has been achieved.

## What Have We Done in Response

### Investigation into Possible Environmental Drivers of Seagrass Decline in Cockburn and Warnbro Sounds

The CSMC provided a research grant to the UWA to investigate possible environmental drivers of seagrass decline in Cockburn and Warnbro Sounds. A summary of the findings from this study is included on page 7 and the full report is available at [www.der.wa.gov.au/about-us/cockburn-sound-management-council](http://www.der.wa.gov.au/about-us/cockburn-sound-management-council).

### Assessment of Water Column Nitrogen Trends in Cockburn Sound Relative to Existing Loads, Concentrations and Fluxes

The CSMC is supporting a project being undertaken by CSIRO to develop a nitrogen budget for Cockburn Sound to determine the relative importance of inputs of nitrogen into Cockburn Sound. A report on the spatial and temporal analysis of water quality monitoring data is available at [www.der.wa.gov.au/about-us/cockburn-sound-management-council](http://www.der.wa.gov.au/about-us/cockburn-sound-management-council). This work is still in progress and further reports will be available at [www.der.wa.gov.au/about-us/cockburn-sound-management-council](http://www.der.wa.gov.au/about-us/cockburn-sound-management-council) when they become available.

### The Jervoise Bay Northern Harbour Management Action Plan

In response to concerns about the state of water and sediment quality and the environmental conditions in Jervoise Bay Northern Harbour, and following extensive consultation with stakeholders, the CSMC has previously developed the *Jervoise Bay Northern Harbour Management Action Plan* (2012).

Previous mitigation strategies have included the removal of nitrogen point sources in the early 2000s and the implementation of a groundwater recovery scheme. Water quality monitoring and modelling to predict the likely future concentrations of nutrients concluded that:

- the median total nitrogen levels and associated chlorophyll *a* concentrations in the Northern Harbour had decreased by 58% over the previous 13 years;
- the 90<sup>th</sup> percentile chlorophyll *a* concentration had decreased by 73% and major algal blooms with chlorophyll *a* concentrations in the range 20 to 40 micrograms per litre ( $\mu\text{g/L}$ ) no longer occurred; and
- without a significant reduction in the diffuse background nitrogen, median chlorophyll *a* concentrations will likely remain within the range 2.2 to 2.9  $\mu\text{g/L}$  and chlorophyll *a* concentration in the Northern Harbour is unlikely to ever consistently meet the existing guidelines or standard for phytoplankton biomass.<sup>2</sup>

<sup>2</sup> Source: Parsons Brinckerhoff (2011) *Risk-based assessment of Groundwater Contamination Discharging into Northern Harbour – Version 2*. Unpublished report prepared for the Department of Commerce.

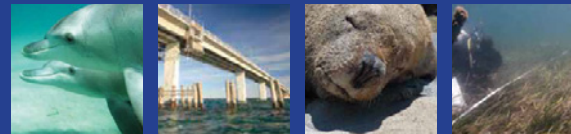
The Management Action Plan provides a roadmap to address the environmental problems and includes recommendations on future management actions to improve water and sediment quality within Northern Harbour. The CSMC has recently reviewed the Management Action Plan and determined that no further consideration of the recommendations in the Management Action Plan is necessary at this stage. The CSMC will continue to monitor and report on water quality in Northern Harbour and to provide advice to the Minister for Environment on appropriate management responses. The CSMC does not believe it appropriate to seek to modify the environmental quality criteria for Jervoise Bay Northern Harbour to avoid triggering further consideration of appropriate management actions in the future.

## About the Cockburn Sound Management Council

Since the 1970s, the Western Australian State Government, in partnership with industry, local government and the community, has worked to improve the environmental health of Cockburn Sound. The partnerships formed over a number of years, and strong community support and concern for the state of the marine environment resulted in the formation of the CSMC. The CSMC was formed in 2000 for the purpose of maintaining the value of Cockburn Sound as a multiple-use marine area.

The CSMC was originally established as a Committee of the Board of the Water and Rivers Commission under the *Water and Rivers Commission Act 1995*. Since 2007, the CSMC has been an advisory council to the Minister for Environment established under the *Environmental Protection Act 1986*. The CSMC is composed of an independent Chair, and representatives from State, Local and Federal Government, industry, as well as recreational user groups, conservation interests and the community.

Between July 2014 and June 2015, the full Council met four times and the Executive met once.



For more information please contact the Cockburn Sound Management Council:

Phone: 6467 5000

Email: [CSMC@DER.wa.gov.au](mailto:CSMC@DER.wa.gov.au)

Or visit the Cockburn Sound Management Council's website

[www.der.wa.gov.au/about-us/cockburn-sound-management-council](http://www.der.wa.gov.au/about-us/cockburn-sound-management-council)