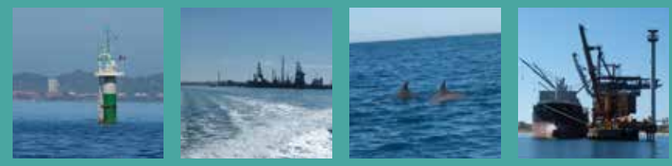


COCKBURN SOUND REPORT CARD 2016–2017

Cockburn Sound Management Council Membership as at 30 June 2017

Chair: Emeritus Professor Kateryna Longley

State Government	
Sarah McEvoy	Department of Environment Regulation
Vacant	Department of Fisheries
Leon Brouwer	Department of Water
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 Chris Elliott	City of Rockingham
Federal Government	
Mark Sweetman	Department of Defence

Industry	
Chris Oughton	Kwinana Industries Council
Glenn Dibbin	WA Fishing Industry Council
Recreational Users	
Craig Bibra	Recfishwest
Desmond Kelly	Cockburn Power Boats Association
Conservation	
Prof. David Harries	Conservation Council of WA
Community Members	
Peter Green	
James Mumme	
John Polglaze	

Members were appointed by the Minister for Environment for a period of three years from 1 January 2016.

The Department of Water and Environmental Regulation was established by the Government of Western Australia on 1 July 2017. It is a result of the amalgamation of the Department of Environment Regulation, Department of Water and the Office of the Environmental Protection Authority. This publication may contain references to previous government departments and programs. Please contact CSMC@dwer.wa.gov.au to clarify any specific information.

Cockburn Sound is one of the most intensively used marine embayments in Western Australia. Since the 1970s, government, industry and the community have worked in partnership to improve the environmental health of Cockburn Sound and to protect its intrinsic values. This Report Card provides a summary of the Cockburn Sound Management Council's assessment of the extent to which the environmental quality criteria and objectives for Cockburn Sound were met in 2016–17. This is based on the results of monitoring carried out during the 2016–17 reporting period.

Introduction

Cockburn Sound is a sheltered marine area located to the south-west of the Perth metropolitan region. The protection from the prevailing winds and seas provided by Garden Island and the Sound's relatively calm deep waters provide a safe anchorage and maritime facilities for industry and the Australian Defence Force. Cockburn Sound also supports recreational and commercial fisheries and aquaculture operations. It is highly valued by the community as an important ecological and recreational area.

Cockburn Sound has had a history of nutrient pollution that resulted in the loss of more than three-quarters of its seagrass meadows. In response to actions by industry, government and the community, water quality in the Sound has improved, but concerns remain about the decline and lack of recovery of seagrass beds. The diversity and sometimes competing nature of activities means that Cockburn Sound is under ongoing environmental pressure from increasing industrial, urban and recreational use.

The State Environmental Policy for Cockburn Sound

Cockburn Sound is unique in Western Australia as it has a State Environmental Policy. The Policy provides an important mechanism to ensure that the ecological, social, economic, scientific, educational, cultural, recreational and aesthetic values of the Sound are protected.

The State Environmental Policy has provided the framework for Cockburn Sound's environmental management since 2005. The Policy identifies the environmental values for the Cockburn Sound marine area, and the environmental quality objectives that are required to be met to protect and maintain 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 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 (High Protection Area North [HPA-N] and High Protection Area South [HPA-S]). Careening Bay on Garden Island (MPA-CB) and the eastern margin of Cockburn Sound adjacent to the industrial area (MPA-ES) are assigned a moderate level of protection. MPA-ES includes the Jervoise Bay Northern Harbour, which is assessed separately (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 (criteria) play an important role in the environmental quality management framework. The criteria represent 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 criteria are met and the environmental quality objectives are achieved.

There are two types of environmental quality criteria:

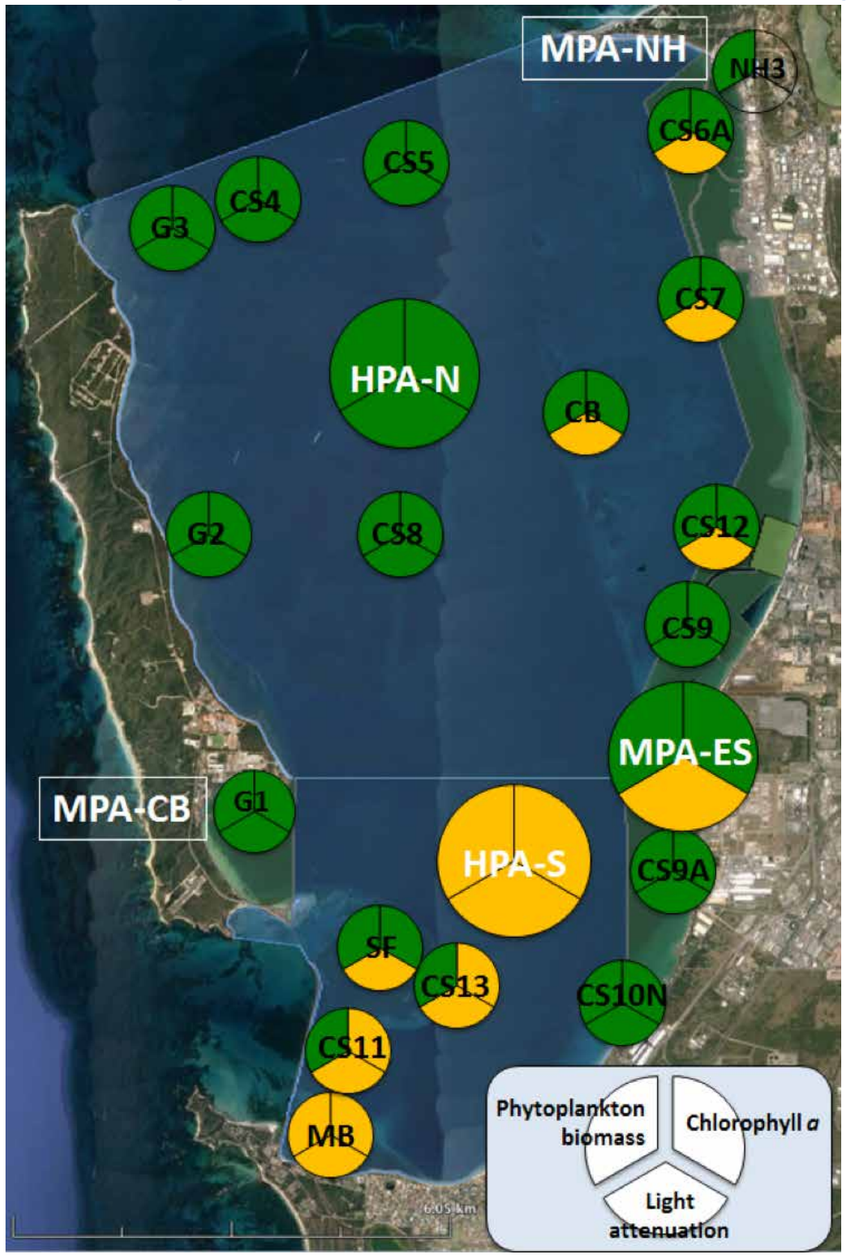
- **Environmental quality guidelines (guidelines)** – which, if met, indicate there is a high degree of certainty that the associated environmental quality objective has been achieved. If a guideline is not met, there is uncertainty whether the environmental quality objective has been achieved. This triggers a more detailed assessment 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. This triggers an adaptive management response. The response would normally focus on identifying the cause (or source) and reducing loads of the contaminant of concern.

The environmental quality management framework implements monitoring strategies to provide data for measuring environmental performance against the 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 and the community.

This Report Card summarises the assessment of the extent to which the results from the 2016–17 monitoring 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 2016–2017* which is available on the Cockburn Sound Management Council website.

Environmental Value: Ecosystem Health
Environmental Quality Objective: Maintenance of Ecosystem Integrity

Figure 1: Assessment against the nutrient enrichment-related environmental quality criteria



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

The achievement of this environmental objective is assessed, in accordance with the *Environmental Quality Criteria Reference Document for Cockburn Sound* (Environmental Protection Authority 2017), on the basis of results from monitoring of:

- the nutrient enrichment indicators chlorophyll *a*, light attenuation, seagrass shoot density and lower depth limit, and phytoplankton biomass;
- the physical-chemical stressors dissolved oxygen concentration, water temperature, salinity and pH;
- toxicants in marine waters; and
- toxicants in sediment.

The environmental quality criteria set a level of environmental quality so that the overall ecological integrity of Cockburn Sound can be maintained. The level of environmental quality considered acceptable varies according to the level of ecological protection assigned to the area.

Nutrient Enrichment (Figure 1)

Background

Cockburn Sound has had a history of nutrient inputs from industrial and wastewater discharge, groundwater discharge and surface run-off from urban and rural areas. Nutrient enrichment resulted in poor water quality and the loss of seagrass meadows in the Sound in the late 1960s and early, 1970s. The loss of seagrass was attributed to increased growth of phytoplankton and epiphytes[1] which reduced the availability of light reaching the seagrass.

Water quality monitoring in Cockburn Sound focuses on nutrient-related effects. Chlorophyll *a* concentration and water clarity (measured as light attenuation coefficient), which are affected by nutrient availability and water residence time, are used as indicators of nutrient enrichment. Chlorophyll *a* concentrations also provide a measure of phytoplankton biomass, which is an indicator of the occurrence of algal blooms in Cockburn Sound.

Measurements of chlorophyll *a* concentration and light attenuation were made at 18 sites in Cockburn Sound and two reference sites in Warnbro Sound on 16 occasions over the non river-flow period (December 2016–March 2017) (see Summer water quality sampling fact sheet). The results were assessed against the nutrient enrichment guidelines for Cockburn Sound. Measurements of phytoplankton biomass (as chlorophyll *a*) were assessed against the phytoplankton biomass criteria.[2]

1 Algae that grow on seagrass leaves.

2 Due to the absence of macro-benthic primary producers (for example seagrass) within Jervoise Bay Northern Harbour (MPA-NH) the results for NH-3 are only assessed and reported against the phytoplankton biomass criteria, not the nutrient enrichment guidelines for Cockburn Sound. These sectors of the pie-chart in Figure 1 are therefore transparent.

Seagrass shoot densities were measured at 11 sites in Cockburn Sound, five sites outside Cockburn Sound and five reference sites in Warnbro Sound (see Seagrass monitoring fact sheet). Shoot densities were assessed against the 'absolute minimum' shoot densities[3] and the rolling four-year percentiles of shoot densities[4] at the Warnbro Sound reference sites. The lower depth limit[5] of seagrass distribution was recorded at four sites in Cockburn Sound,[6] one site outside Cockburn Sound and one site in Warnbro Sound.

Key findings

Chlorophyll *a*

The chlorophyll *a* guidelines were met in the northern high ecological protection area (HPA-N) and the Careening Bay (MPA-CB) and the eastern Sound (MPA-ES) moderate ecological protection areas. The guideline was not met in the southern high ecological protection area (HPA-S), which is indicative of nutrient enrichment in the southern part of Cockburn Sound.

Light attenuation

The light attenuation guidelines were met in the northern high ecological protection area (HPA-N) and the Careening Bay (MPA-CB) moderate ecological protection area. The guidelines were not met in the southern high ecological protection area (HPA-S) and the eastern Sound moderate ecological protection area (MPA-ES). This is indicative of nutrient enrichment in parts of Cockburn Sound.

The nutrient enrichment guidelines were not met in HPA-S and MPA-ES which triggered assessment against the nutrient enrichment standards. The standards were developed to identify changes in seagrass health, specifically, seagrass shoot density and seagrass lower depth limit. The standards were met, indicating that the seagrass declines and lack of recovery in Cockburn Sound are possibly being driven by environmental factors other than water quality and light availability, such as sediment stressors, hydrodynamics or temperature changes.

Phytoplankton biomass

The phytoplankton biomass guidelines were met at all sites and in all ecological protection areas except in the southern high ecological protection area (HPA-S) and at Mangles Bay (MB) in HPA-S. This triggered assessment against the phytoplankton biomass standard. The standard was met.

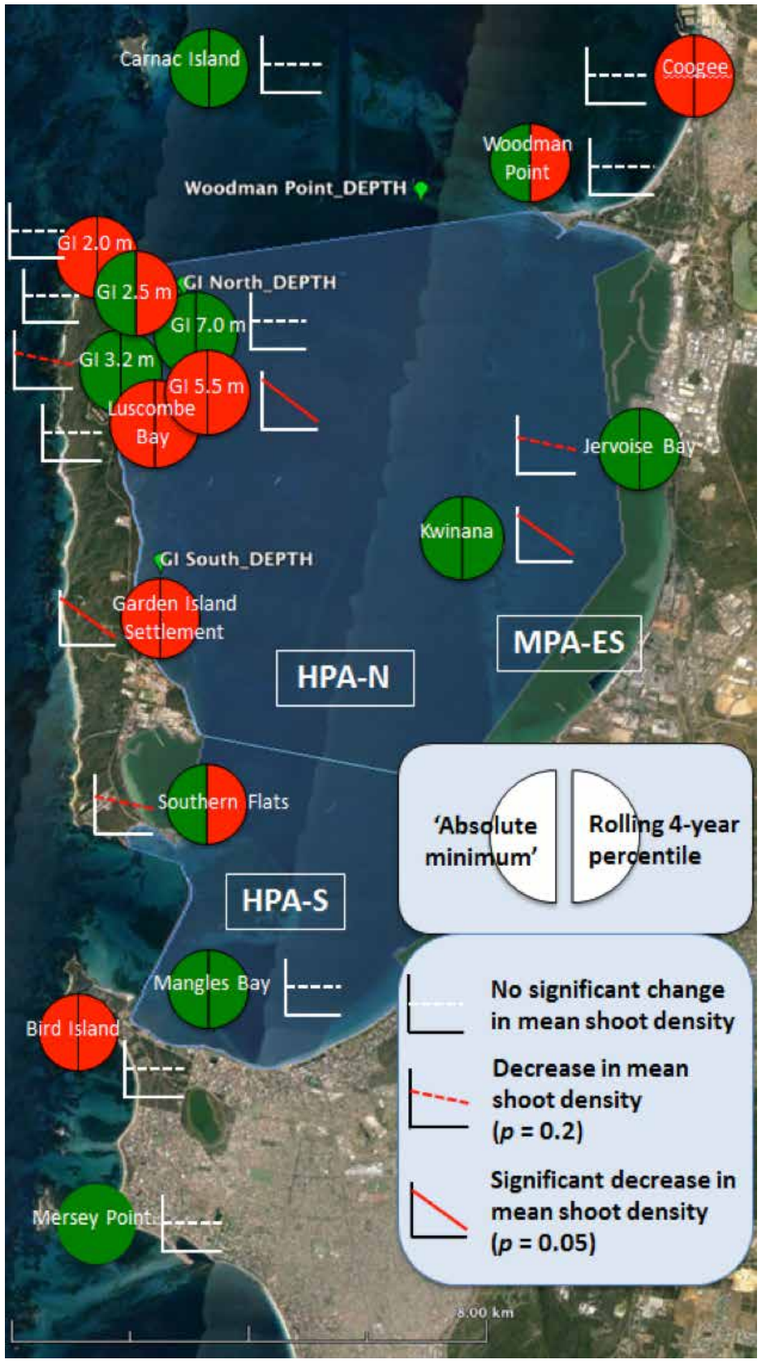
3 A baseline condition at the Warnbro Sound reference sites during the first four years of monitoring prior to 2005.

4 Shoot density at each Warnbro Sound reference site is measured each year and the data added to the historical reference data set. The percentiles are re-calculated from the last four years (approximately 100 data points) for each reference site.

5 The maximum depth at which seagrass shoots are observed.

6 Two new lower depth limit sites were established in 2017 in the southern high ecological protection area (HPA-S).

Figure 2: Summary of the 2017 seagrass health monitoring results



Result	Assessment	Result	Assessment
	Median seagrass shoot densities are higher than the: • 'absolute minimum' criteria • rolling four-year percentiles of shoot densities		Median seagrass shoot densities are lower than the: • 'absolute minimum' criteria • rolling four-year percentiles of shoot densities

Seagrass Health (Figure 2)

Key findings

Shoot density

Median[7] seagrass shoot densities at monitoring sites in Cockburn Sound were lower in 2017 than in 2016 at all the sites except Mangles Bay and Kwinana. In 2017 the median shoot densities at Garden Island Settlement, Garden Island 2.0 m and Garden Island 5.5 m were less than half the densities recorded in 2016. Median seagrass shoot densities were also lower in 2017 than in 2016 at four of the sites outside Cockburn Sound (Coogee, Bird Island, Mersey Point and Carnac Island).

In 2017, at monitoring sites inside Cockburn Sound:

- median seagrass shoot densities at Garden Island 3.2 m, Garden Island 7.0 m, Kwinana and Jervoise Bay were above both the 'absolute minimum' shoot density and the annually updated rolling four-year percentiles of shoot densities at the Warnbro Sound reference sites;
- median shoot densities at Mangles Bay were above the 'absolute minimum' shoot density and equalled the annually updated rolling four-year percentile;
- median shoot densities at the other sites were below the 'absolute minimum' shoot density and/or the annually updated rolling four-year percentiles of shoot densities at the Warnbro Sound reference sites;
- there were no significant trends in mean shoot densities at eight of the seagrass monitoring sites over the past 11–15 years; and
- there were significant negative trends in mean shoot density at Garden Island Settlement, Garden Island 5.5 m and Kwinana.

At monitoring sites outside Cockburn Sound:

- median seagrass shoot densities at Mersey Point and Carnac Island were above the 'absolute minimum' shoot density and the annually updated rolling four-year percentiles of shoot densities at the Warnbro Sound reference sites; and
- median shoot densities at the other sites were below the 'absolute minimum' shoot density and/or the annually updated rolling four-year percentiles of shoot densities at the Warnbro Sound reference sites.

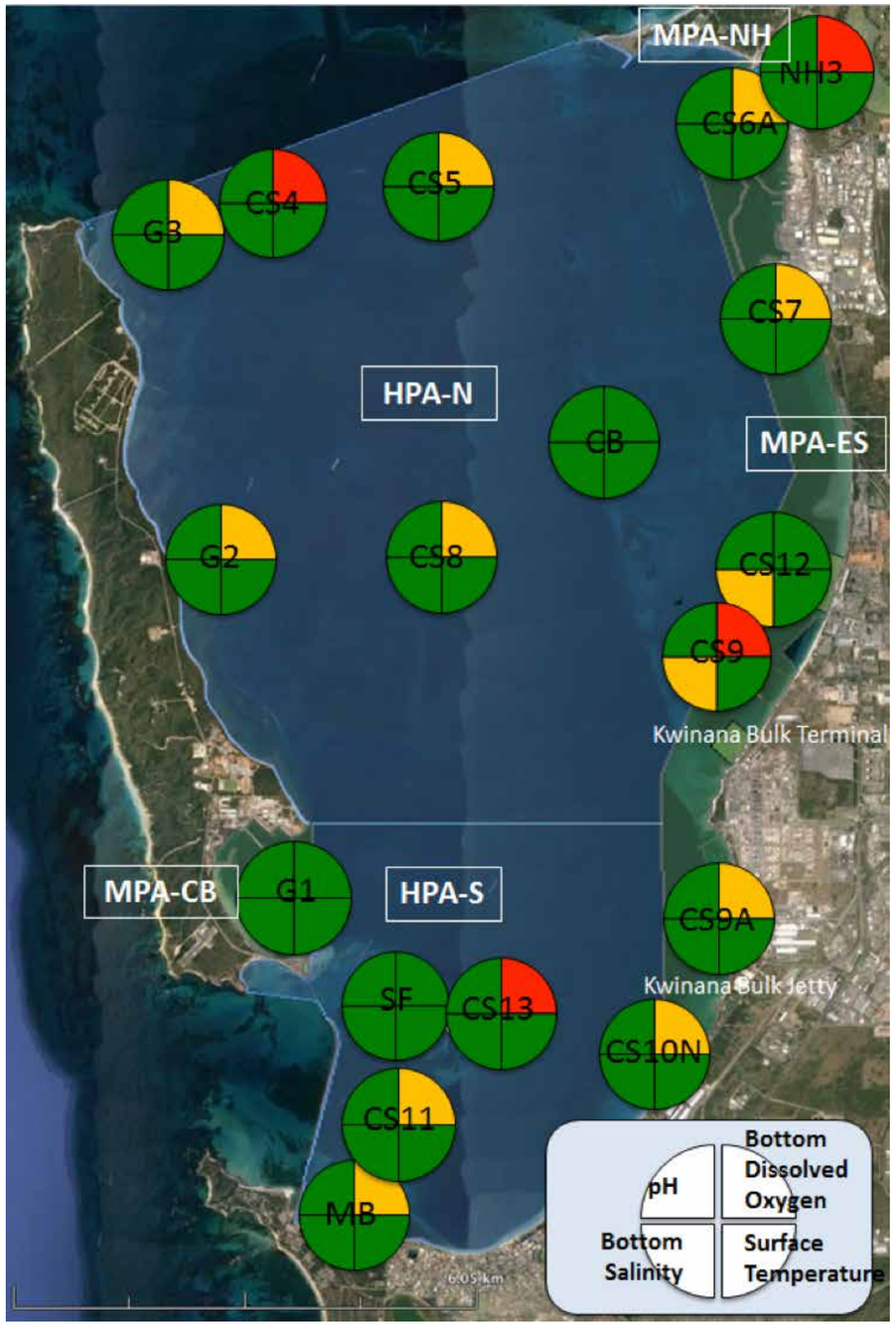
Lower depth limit of seagrass

The lower depth limit of seagrass distribution has decreased (in other words was shallower) at the Garden Island South_Depth, Woodman Point_Depth and Warnbro Sound_Depth sites in 2017 compared to recent years. This suggests that 'thinning' of the seagrass meadows is occurring at the depth extents at these sites. This is potentially a result of reduced light availability associated with increased turbidities observed at the sites during the 2017 monitoring program.

The lower depth limits have nevertheless increased significantly at Garden Island South_Depth and Woodman Point_Depth sites over the 17 years that the sites have been monitored. There were no significant trends in the lower depth limits at the Garden Island North_Depth or Warnbro Sound_Depth sites.

7 A measure used in statistics representing the 'middle' number in a sequence of numbers that has been arranged from the smallest value to the largest value.

Figure 3: Assessment against the physical and chemical stressors environmental quality criteria



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

Physical and Chemical Stressors (Figure 3)

Background

Changes in dissolved oxygen concentration, water temperature, salinity and pH can have a negative impact on marine organisms if the parameters extend beyond their normal range for Cockburn Sound.

Measurements of dissolved oxygen concentration, water temperature, salinity and pH were made at 18 sites in Cockburn Sound and two reference sites in Warnbro Sound on 16 occasions over the non river-flow period (December 2016–March 2017).

The results were assessed against the criteria for physical-chemical stressors for Cockburn Sound.

Key findings

Dissolved oxygen

Dissolved oxygen concentrations in bottom waters at eight of the 10 monitoring sites in the high ecological protection areas (HPA-N and HPA-S) did not meet the high protection guideline (90% saturation) on between two and 11 of the 16 sampling occasions. Dissolved oxygen concentrations in bottom waters at six of the eight monitoring sites in the moderate ecological protection areas (MPA-ES, MPA-CB and MPA-NH) did not meet the moderate protection guideline (80% saturation) on between one and four of the 16 sampling occasions.

This triggered assessment against the dissolved oxygen concentration standard. With four exceptions, dissolved oxygen concentrations in bottom waters met the standard (60% saturation) at all the sites. Dissolved oxygen concentrations below the standard were reported at Jervoise Bay Northern Harbour (NH3) on 27 February 2017 (55% saturation) and at NH3 (59% saturation), CS4 (54% saturation), CS13 (49% saturation) and CS9 (59% saturation) on 6 March 2017.

There were no known reports of deaths of marine organisms that may have been attributable to deoxygenation during the periods when low dissolved oxygen concentrations were recorded over the 2016–17 non river-flow period.

Dissolved oxygen concentrations below 90% saturation were recorded on six occasions at the deeper Warnbro Sound reference site and on two occasions at the shallower Warnbro Sound reference site.

Dissolved oxygen concentrations below the standard triggered the requirement to initiate a management response, which would normally focus on identifying the cause (or source) and implementing appropriate controls. Noting that low dissolved oxygen concentrations were reported at sites throughout Cockburn Sound as well as in Warnbro Sound over the 2016–17 non river-flow period, rather than in any one specific area of the Sound; the unusual weather events this summer (refer to the section *'A wet summer…'* on page 9 this report); and that the waters of Cockburn Sound are generally well mixed and well oxygenated, the CSMC does not consider that a management response is required at this time. The CSMC will continue to review dissolved oxygen concentrations from each monitoring period in the context of previous year's data to assess whether there is evidence of a downward trend in the oxygen status of Cockburn Sound.

Water temperature

At all the sites surface and bottom water temperatures met the guidelines.

Salinity

The salinity of bottom waters at most sites met the guidelines.

At two sites, CS9 and CS12 in the eastern Sound moderate ecological protection area (MPA-ES), the salinity of bottom waters was above the guideline. The higher salinities recorded at these sites are possibly associated with the saline water discharge from the Perth Seawater Desalination Plant.

The higher salinities reported at CS9 and CS12 triggered assessment against the salinity standard. The salinities recorded at these sites were higher than the guideline by less than one practical salinity unit and were below the default salinity trigger value for Cockburn Sound. The risk of a persistent and significant change beyond natural variation in ecological or biological indicators that are affected by changing salinity is considered to be low.

There were no known deaths of marine organisms over the 2016–17 non river-flow period that may have been attributable to anthropogenically-sourced salinity stress.

pH

At all the sites pH met the guidelines in surface and bottom waters.

Toxicants in Marine Waters and Sediments

Background

The concentrations of selected contaminants were measured in water and surface sediment samples collected at sites around the Kwinana Bulk Terminal and the Kwinana Bulk Jetty in the eastern Sound moderate ecological protection area (MPA-ES).

Sampling and analysis for dissolved metals was undertaken in October 2016 and January 2017 at six sites in Mangles Bay. This was part of an investigation into the slightly elevated concentrations of dissolved cadmium and zinc recorded in December 2015 in a single water sample collected in Mangles Bay in the southern high ecological protection area (HPA-S).

In response to reports of perfluoroalkyl and polyfluoroalkyl substances (commonly referred to as PFAS) in groundwater on Garden Island,[8] water samples were collected in January 2017 to measure the concentrations of PFAS in the marine waters of Cockburn Sound. Samples were collected at each of the 18 monitoring sites in Cockburn Sound and the two reference sites in Warnbro Sound (see PFAS water quality sampling fact sheet).

Contaminant concentrations were assessed against the criteria for toxicants in marine waters or sediments.

8 GHD (2016). *Defence per- and poly-fluoroalkyl substances (PFAS) Environmental Management Preliminary Sampling Program. HMAS Stirling (Garden Island).*

9 The lowest amount of a substance in a sample that can be determined with acceptable precision and accuracy under the stated analytical conditions.

10 Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (2017). *Assessment, Management and Remediation for PFOS and PFOA. Part 4: Application of HSLs and ESLs.* Technical Report No. 38.

Key findings

Marine waters

Kwinana Bulk Terminal and Kwinana Bulk Jetty:

- Dissolved metals: concentrations below the guidelines.
- Benzene-Toluene-Ethylbenzene-Xylene (BTEX): concentrations below the laboratory limits of reporting[9] and the guidelines.
- Naphthalene (a polycyclic aromatic hydrocarbon): concentrations below the limits of reporting and the guideline.
- Petroleum hydrocarbons: concentrations below the limits of reporting.

Mangles Bay:

- With one exception, concentrations of metals were below or equal to the limits of reporting or the guidelines on both sampling occasions.
- The concentration of dissolved copper in one sample collected from a shallow (2.5 metre depth) site in south-western Mangles Bay was slightly higher than the high protection guideline, but below the moderate protection guideline. The elevated copper concentration reported in this sample is possibly due to antifouling or corrosion inhibiting products on vessels anchored in proximity to the site.

PFAS in Cockburn Sound and Warnbro Sound

Concentrations of PFAS were equal to or below the limits of reporting at all the sites sampled in Cockburn Sound and Warnbro Sound. The limits of reporting are well below the draft and interim 99% species protection ecological screening levels (ESLs) for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) in marine waters.[10]

Sediments

Kwinana Bulk Terminal and Kwinana Bulk Jetty:

- Median concentrations of metals, tributyltin (TBT) and Polycyclic Aromatic Hydrocarbons (PAHs) were below the guidelines.
- There are no guidelines for petroleum hydrocarbons however the concentrations at in all the samples were below the laboratory limits of reporting.

Has the Environmental Quality Objective ‘Maintenance of Ecosystem Integrity’ been achieved?

Based on the results from the 2016–17 monitoring programs, it can be concluded that nutrient enrichment was not an issue in most of Cockburn Sound over the 2016–17 non river-flow period. There is a high degree of certainty that, with respect to nutrients, the environmental quality objective is being achieved in most of Cockburn Sound.

In the southern high ecological protection area (HPA-S), elevated chlorophyll *a* concentrations, higher light attenuation coefficients and increased phytoplankton biomass are indicative of elevated dissolved inorganic nutrient concentrations. Dissolved inorganic nutrient concentrations are still relatively high in the southern and the south-eastern areas of Cockburn Sound compared to northern Cockburn Sound and Warnbro Sound. Higher nutrient concentrations in the south-eastern area of Cockburn Sound are consistent with the predicted concentrations of submarine groundwater nutrient inputs south of James Point and may also be related to poor circulation compared to other parts of the Sound.[11]

While there have been improvements in water quality in Cockburn Sound over the past 30 years, analysis of trends in seagrass shoot densities indicates there have been declines over the past 11–15 years at some sites in Cockburn Sound. This suggests that environmental factors other than a nutrient enrichment-related reduction in light availability at the seafloor may also be playing an important role in seagrass decline or lack of recovery in Cockburn Sound.

The dissolved oxygen concentration guidelines were not met in the bottom waters at 14 of the 18 monitoring sites in Cockburn Sound on one or more occasions over the 2016–17 non river-flow period. The standard was not met on one occasion at three sites (CS4, CS13 and CS9) and on two occasions at one site (NH3 in Jervoise Bay Northern Harbour [MPA-NH]).

With the exception of localised elevated bottom water salinities at two sites (CS9 and CS12) in the eastern Sound moderate ecological protection area (MPA-ES), the criteria for protecting the marine ecosystem from the effects of the other physical and chemical stressors were met.

There were no known reports of deaths of marine organisms over the 2016–17 reporting period that may have been attributable to deoxygenation or anthropogenically-sourced stress. The results from the 2016–17 monitoring program in Cockburn Sound indicate that there is a low risk that the environmental quality objective is not being achieved in most of Cockburn Sound.

The results from investigations of toxicants in marine waters and sediments in areas of Cockburn Sound indicate that the guidelines for toxicants in sediments and marine waters were generally met. There is a high level of confidence that in these areas the environmental quality objective is being achieved.

11 Keesing, J., Greenwood, J., Donn, M. and McFarlane, D. (2016). *Spatial and temporal analysis of water quality monitoring data collected from Cockburn Sound and Warnbro Sound between 1982/83 and 2013/14.* Report to the Cockburn Sound Management Council and the Western Australian Department of Water, CSIRO Australia.

A wet summer…..

The 2016–17 summer, in particular February 2017, was one of the wettest summers on record in southwest Western Australia, including the Perth area.[12,13,] The combination of high rainfall in late January and early February resulted in flooding to large parts of southwest Western Australia, with flooding reported in the Avon catchment and downstream in the Swan. This resulted in a large plume of turbid fresh water from the Swan River estuary flowing into coastal waters and extending well into Cockburn Sound (Figure 4). This above average rainfall and the associated flooding would be expected to have an effect on Cockburn Sound water quality and needs to be taken into account when evaluating the water quality monitoring results.

The unusual rainfall and associated flooding in late January and early February may have contributed to the increased nutrient and chlorophyll *a* concentrations (Figure 5), increased light attenuation and declines in seagrass shoot density recorded in Cockburn Sound over the 2016–17 monitoring period. The decomposition of particulate organic matter from the catchment and increased algal productivity associated with elevated nutrient inputs may have contributed to the depleted oxygen concentrations recorded in bottom waters at sites across Cockburn Sound over the 2016–17 monitoring period.

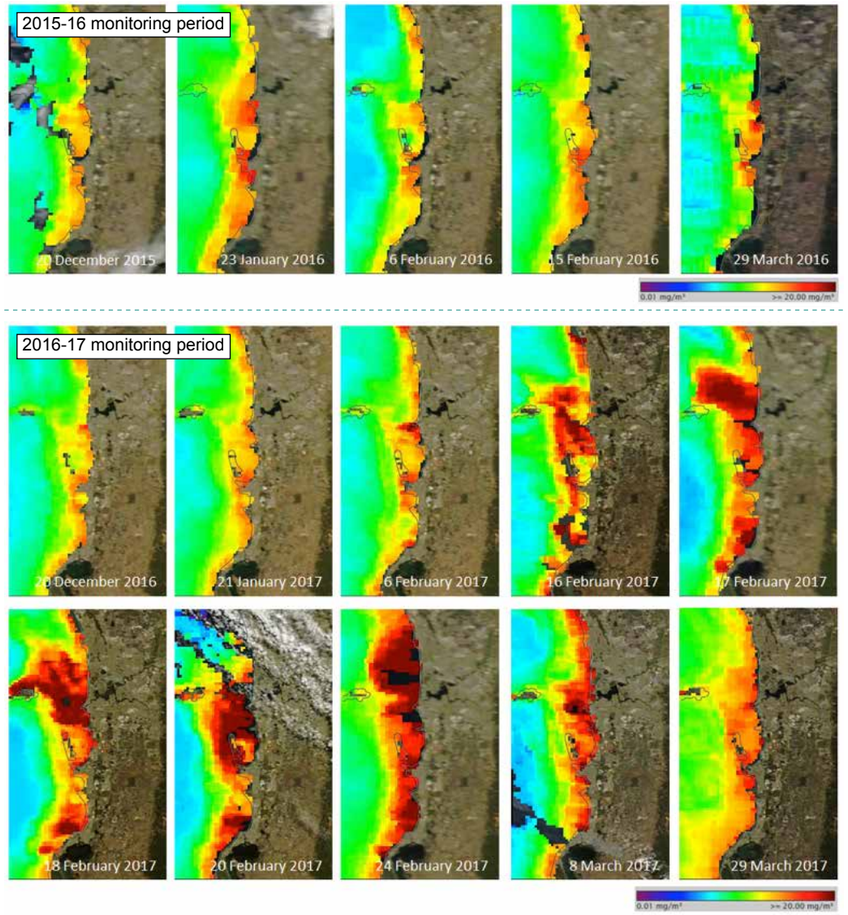
12 Bureau of Meteorology (2017). *Special Climate Statement 60—heavy rainfall and flooding in southwest Western Australia.* Australian Government, Bureau of Meteorology.

13 Bureau of Meteorology (2017). *Monthly Climate Summary for Perth. Perth in February 2017: Wettest February for decades.* Australian Government, Bureau of Meteorology.

Figure 4: Tannins and sediment from the Avon Catchment flowing through the Swan River mouth into Perth's coastal waters and extending into Cockburn Sound

Reproduced by permission of the Western Australian Land Information Authority (Landgate) 2017

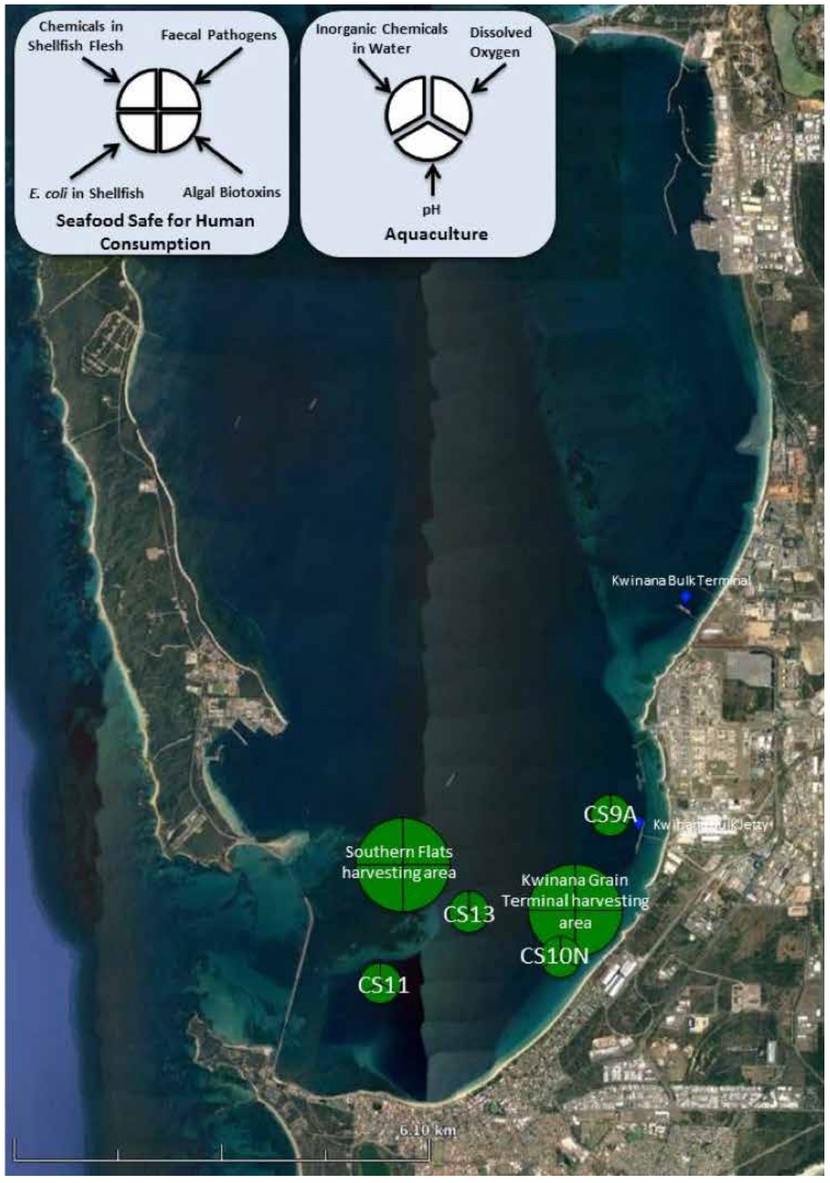
Figure 5: Chlorophyll *a* concentrations in Perth's coastal waters, including Cockburn Sound, over the 2015–16 and 2016–17 monitoring periods



Source: NASA Worldview (https:worldview.earthdata.nasa.gov)

Environmental Value: Fishing and Aquaculture
Environmental Quality Objective: Maintenance of Seafood Safe for Human Consumption

Figure 6: Assessment against the environmental quality criteria for the maintenance of seafood safe for human consumption and the maintenance of aquaculture



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

Note: Under the conditions of the Kwinana Grain Terminal harvesting area, while in the open status, all the guidelines and standards were met.

The achievement of this environmental objective is assessed, in accordance with the *Environmental Quality Criteria Reference Document for Cockburn Sound* (Environmental Protection Authority 2017), on the basis of results from monitoring of:

- biological contaminants; and
- chemical concentrations in seafood flesh.

The environmental quality criteria set a level of environmental quality that will ensure there is a low risk of any effect on the health of human consumers of seafood.

Biological Contaminants (Figure 6)

Background

The primary threats to human consumers of seafood relate to contamination of filter feeding shellfish by faecal pathogens (for example bacteria), the accumulation of biotoxins from toxic algae and/or the accumulation of toxic chemicals in the flesh of the shellfish.

The Western Australian Shellfish Quality Assurance Program (WASQAP) sets out the requirements for bacteriological monitoring (water and shellfish), phytoplankton and shellfish biotoxin monitoring in the shellfish growing areas in Cockburn Sound.

The results were assessed against the criteria for the maintenance of seafood safe for human consumption.

Key findings

Faecal pathogens

The guideline for faecal pathogens in water was met in the Kwinana Grain Terminal and Southern Flats harvesting areas.

Escherichia coli (*E. coli*) in shellfish flesh

The standard for *Escherichia coli (E. coli)* in shellfish flesh was met in the Kwinana Grain Terminal and Southern Flats harvesting areas.

Algal biotoxins

The phytoplankton levels for *Pseudo-nitzschia*[14] that trigger management action were triggered on five occasions in the Southern Flats harvesting area and on four occasions in the Kwinana Grain Terminal harvesting area over the 2016–17 monitoring period. This triggered shellfish flesh testing for amnesic shellfish poisoning (ASP) biotoxin. All the results of testing for ASP were negative.

The results of routine monthly biotoxin screening for both harvesting areas were negative for ASP, diarrhoetic shellfish poisoning (DSP) and paralytic shellfish poisoning (PSP) biotoxins.

14 Marine phytoplankton containing some species which produce the neurotoxin domoic acid which is responsible for the neurological disorder amnesic shellfish poisoning.

Chemical Concentrations in Seafood Flesh (Figure 6)

Background

WASQAP sets out the requirement for testing for chemical contaminants in shellfish from shellfish growing areas in Cockburn Sound. Shellfish were analysed for metals, organochlorine and organophosphate pesticides and polychlorinated biphenyls (PCBs).

Mussels were also collected at the Kwinana Bulk Terminal and Kwinana Bulk Jetty and analysed for metals, organotins and polycyclic aromatic hydrocarbons (PAHs).

The results were assessed against the criteria for the maintenance of seafood safe for human consumption.

Key findings

The concentrations of chemicals (metals, organochlorine and organophosphate pesticides and PCBs) in mussel flesh from the Kwinana Grain Terminal and Southern Flats harvesting areas were below the criteria.

The concentrations of metals in mussels collected at the Kwinana Bulk Terminal and Kwinana Bulk Jetty were below the criteria. The concentrations of tributyltin (TBT) and PAHs were below the limits of reporting.

Environmental Quality Objective: Maintenance of Aquaculture Production

The maintenance of aquaculture production is assessed, in accordance with the *Environmental Quality Criteria Reference Document for Cockburn Sound* (Environmental Protection Authority 2017), on the basis of results from monitoring of:

- physico-chemical stressors; and
- toxicants.

The environmental quality criteria set a level of environmental quality to maintain the health and productivity of aquaculture species.

Physico-chemical Stressors (Figure 6)

Background

Dissolved oxygen, pH and non-metallic inorganic chemicals (ammonia and nitrate–nitrite) were measured at four water quality monitoring sites close to the shellfish growing areas in Cockburn Sound on 16 occasions over the 2016–17 non river-flow period (December to March).

The results were assessed against the guidelines for the maintenance of aquaculture production.

Key findings

The guidelines for dissolved oxygen concentration and pH in surface waters and at the approximate depth of the mussel lines were met at the four sites on all sampling occasions.

Toxicants (Figure 6)

The concentrations of the non-metallic inorganic chemicals at the four sites were below the guidelines.

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

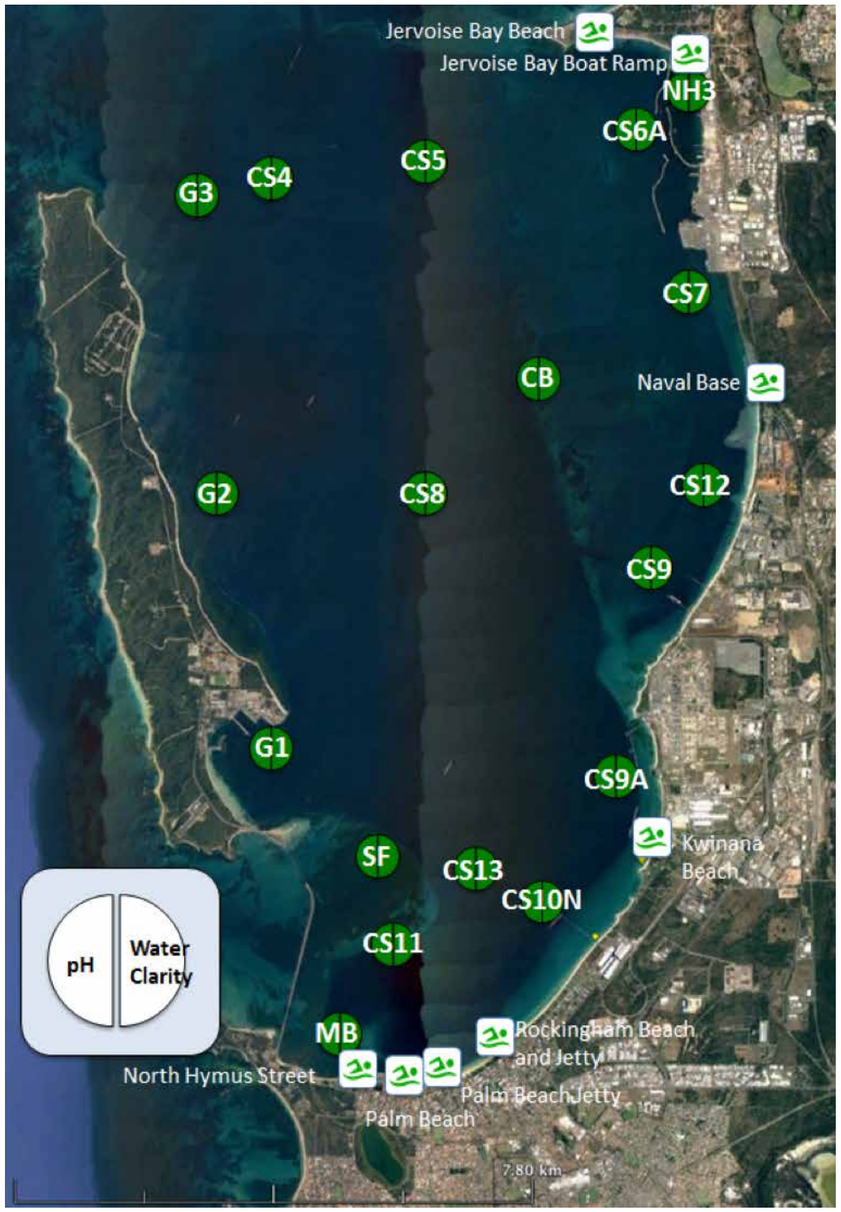
Based on the results of the 2016–17 monitoring programs there is a high degree of certainty that the environmental quality objectives have been achieved in the shellfish harvesting areas in southern Cockburn Sound.

Accredited quality assurance monitoring programs, based on the requirements of WASQAP, are currently conducted for shellfish harvesting areas in southern Cockburn Sound where shellfish are grown commercially for the food market. The same level of monitoring is not conducted outside of the shellfish harvesting areas. 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.[15]

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

Environmental Value: Recreation and Aesthetics
Environmental Quality Objective: Maintenance of Primary Contact and Secondary Contact Recreation Values

Figure 7: Assessment against the environmental quality criteria for the maintenance of primary and secondary contact recreation



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

The achievement of these environmental quality objectives is assessed, in accordance with the *Environmental Quality Criteria Reference Document for Cockburn Sound* (Environmental Protection Authority 2017), on the basis of results from monitoring of:

- faecal pathogens;
- physical indicators; and
- toxic chemicals.

The environmental quality criteria set a level of environmental quality to protect people undertaking primary contact recreation activities (for example, swimming, water skiing, wind surfing and diving) or secondary contact recreation activities (for example, boating, canoeing and fishing) from ill effects caused by poor water quality.

Faecal Pathogens (Figure 7)

Background

Bacterial water quality sampling was undertaken at popular recreational beaches around Cockburn Sound between November 2016 and early May 2017. This is the time when most people participate in recreational activities.

The results were assessed against the criteria for the maintenance of primary and secondary contact recreation.

Key findings

The guidelines for faecal pathogens for primary and secondary contact recreation were met at all the beaches monitored.

Physical Indicators (Figure 7)

Key findings

Water clarity and pH met the criteria for primary and secondary contact recreation at the 18 water quality monitoring sites in Cockburn Sound over the 2016–17 non river-flow period (December to March).

Toxic Chemicals

Key findings

In general, the levels of toxicants required to impact on the health of people recreating in marine waters are greater than the levels necessary to protect ecosystem health. The toxicant concentrations met the ecosystem health criteria and the waters of Cockburn Sound can therefore also be considered safe for human recreation.

Concentrations of perfluoroalkyl and polyfluoroalkyl (commonly referred to as PFAS) were below the Australian Government's recreational water quality health based guidance values[16] (see PFAS water quality sampling fact sheet).

Aesthetics

Observations of aesthetic quality over the 2016–17 non river-flow period (December to March) included:

- Grain was observed on the water surface at CS10N adjacent to the Kwinana Grain Jetty on seven occasions.
- Odours were reported at sites adjacent to the industrial area on the eastern margin of Cockburn Sound on eight occasions.

Associated with the high rainfall events in January and February 2017, a plume of riverine, tannin-stained water was observed extending west to Carnac Island and south into Cockburn Sound. Algal blooms were also observed at most sites in Cockburn Sound in January through to March, with impacts on water clarity and water colour also reported.

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 2016–17 monitoring programs there is a high degree of certainty that the environmental quality objectives have been achieved and the waters are safe for recreational activities.

16 Australian Government (2017). *Health Based Guidance Values for PFAS for Use in Site Investigations in Australia. Department of Health,* Canberra.

Environmental Value: Industrial Water Supply
Environmental Quality Objective: Maintenance of Water Quality for Industrial Use

The Perth Seawater Desalination Plant is an important source of potable water for the Perth metropolitan region, producing 18% of Perth's water supply. The Desalination Plant is located in the industrial zone along the eastern shore of Cockburn Sound and takes seawater from the Sound. The environmental quality criteria set a level of environmental quality for the intake water that will ensure the efficacy of the desalination process is maintained and the potability of the desalinated water is protected.

Key findings

The results from the 2016–17 monitoring of the intake seawater from Cockburn Sound into the Perth Seawater Desalination Plant indicate that there were minor exceedances in two parameters:

- Concentrations of total suspended solids were higher than the guideline in October–November 2016. The pre-treatment process is automated to adjust to variability in the total suspended solids.
- Concentrations of boron were slightly higher than the guideline on three occasions. Boron is removed by the reverse osmosis process.

All the other parameters monitored met the guidelines or Water Corporation limits.

Has the Environmental Quality Objective 'Maintenance of Water Quality for Industrial Use' been achieved?

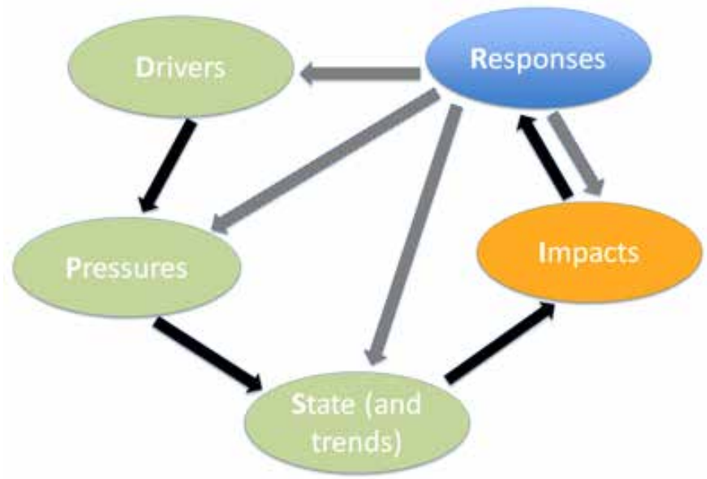
The Water Corporation advised that it did not report a significant reduction in efficiency of the desalination process or a significant increase in the maintenance requirements caused by the reported variance in intake seawater quality. There is therefore a high degree of certainty that the environmental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

What Have We Done in 2016-17?

1. A Drivers–Pressures–State–Impacts–Responses assessment of Cockburn Sound.

The last pressure-state-response assessment of Cockburn Sound was undertaken in 2001. Since that time a number of current and emerging issues have led to questions about the pressures and impacts on Cockburn Sound and the state of the Sound. This project will provide an assessment of the current and emerging driving forces and pressures on Cockburn Sound, the Sound's current condition and trends, impacts and management responses (Figure 8). This assessment will help to identify, plan for and manage existing and emerging risks so that the environmental values of Cockburn Sound are protected and maintained in the future.

Figure 8: Assessment framework



2. Seagrass mapping in Cockburn Sound.

This project will map the distribution and extent of seagrass (and other benthic habitats) in Cockburn Sound using remote sensing and field validation. The project will provide information on the current Cockburn Sound-wide distribution of seagrass and, in conjunction with historical information, will provide information on changes in seagrass extent and distribution over time.

3. A Review of the Cockburn Sound monitoring programs.

Nutrient-related water quality in Cockburn Sound has been measured through summer surveys of chlorophyll *a* concentrations and light attenuation since 1977. The present program commenced in 1982–83. A suite of physical-chemical parameters (salinity, temperature, dissolved oxygen) have also been measured since that time. The CSMC convened an independent Expert Advisory Panel to review and provide advice and recommendations on the long-term summer (non river-flow) water quality monitoring program as well as the other monitoring programs that are undertaken in Cockburn Sound.

These studies are currently underway and further information will be published on the website as the projects are completed.

About the Cockburn Sound Management Council

The CSMC was originally established in 2000 as a Committee of the Board of the Water and Rivers Commission under the *Water and Rivers Commission Act 1995* for the purpose of maintaining the value of Cockburn Sound as a multiple-use marine area.

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 local, State and Federal Government and industry, as well as recreational user groups, conservation interests and the community.

In September 2015, the Minister for Environment agreed to new Terms of Reference for the CSMC. Under its Terms of Reference the CSMC is responsible for:

- facilitating and coordinating stakeholder and community input into the environmental management of Cockburn Sound;
- providing advice to the Minister for Environment on the environmental management of Cockburn Sound; and
- reporting to the Minister for Environment and the community on the state of the environment Cockburn Sound,

particularly with respect to the protection and maintenance of water quality and the associated environmental values for the Cockburn Sound marine area.

The CSMC also has a role in the oversight and coordination of environmental monitoring and research studies in Cockburn Sound.

Between July 2016 and June 2017, the full Council met four times and the Executive met once. Summaries of CSMC meetings are published on the CSMC website.

The CSMC has established two working groups to progress key projects:

- the Communications Plan Working Group to develop and oversee the implementation of the CSMC Communications Plan; and
- the Research Priorities Working Group to identify priority research and investigative studies for the Cockburn Sound marine area.




For more information, please contact the Cockburn Sound Management Council:

Phone: 6364 7000

Email: CSMC@dwer.wa.gov.au

Or visit Cockburn Sound Management Council