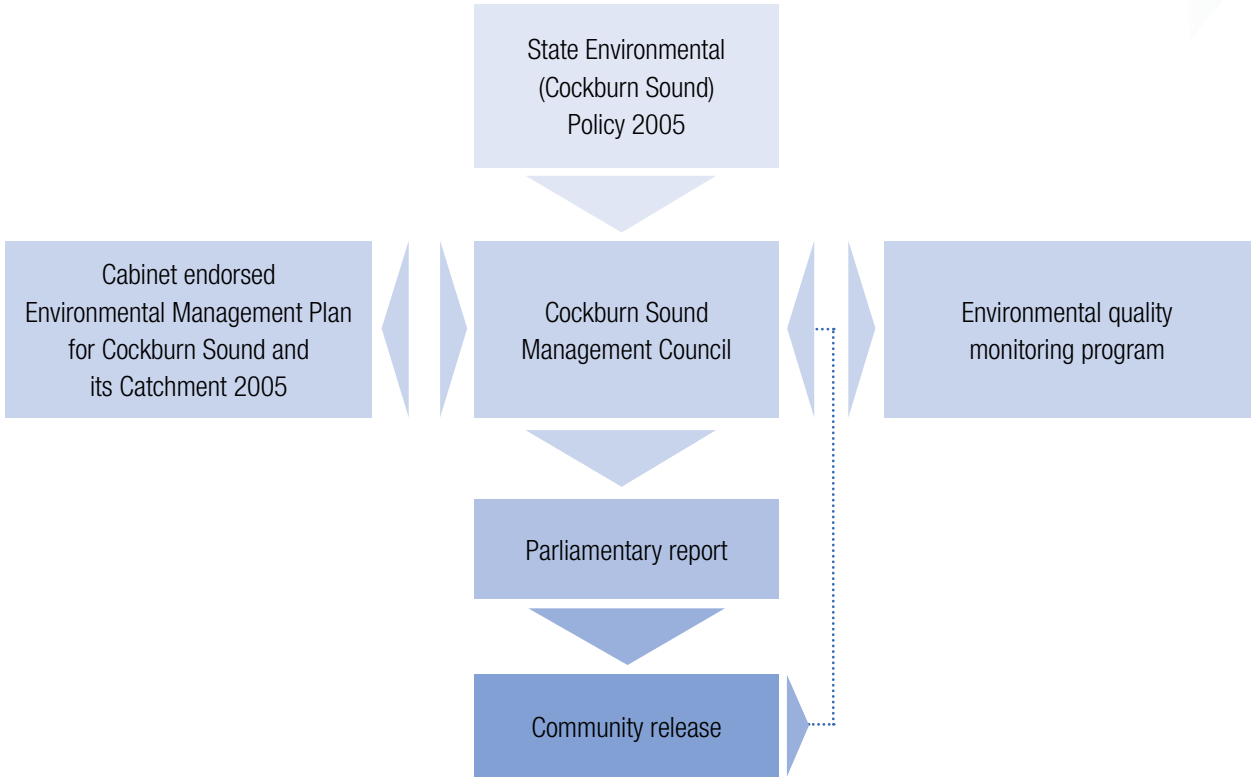
State of Cockburn Sound report 2014

Cockburn Sound Management Council

June 2015

The role of the Cockburn Sound Management Council in implementing the State Environmental (Cockburn Sound) Policy 2005.
This report was endorsed by the Cockburn Sound Management Council on 6 March 2015.



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Foreword

The Cockburn Sound Management Council is charged with the responsibility of protecting the health of Cockburn Sound by overseeing, coordinating and reporting on monitoring programs under the State Environmental Policy (Cockburn Sound) 2005.

Cockburn Sound is a beautiful marine embayment fringed by islands and reefs, stretching from the beaches of Cockburn, Kwinana and Rockingham westwards to the shores of Garden Island and northwards towards Fremantle. Cockburn Sound is remarkable, not only for its natural beauty but also because it represents an outstanding example of the harmonious co-existence of multiple and diverse intensive uses.

With the Department of Defence and heavy industry sharing the area with tourist operators, mussel growers, fishers and recreational swimmers and boaters, Cockburn Sound is under intense pressure. While monitoring results over the past decade indicate environmental stability across most of the Sound, the pressures will continue to increase as a result of new developments and rapid population growth along its shores.

This document includes Report Cards that provide the Cockburn Sound Management Council's assessment of the environmental health of Cockburn Sound based on the results of monitoring programs carried out in 2014.

It is with pleasure that I present the 2014 State of Cockburn Sound report.

Emeritus Professor Kateryna Longley
Chair, Cockburn Sound Management Council

23 February 2015

Executive summary

The Cockburn Sound Management Council (CSMC) reports annually to the Minister for Environment, Parliament, the Environmental Protection Authority (EPA) and the wider public on the health of Cockburn Sound and on whether the environmental values and objectives established for the Sound are being met. These objectives are defined in the State Environmental (Cockburn Sound) Policy 2005 (SEP) and associated supporting documents and reflect the community's long-term aspirations for the Sound.

The 2013–14 monitoring data are largely in line with the broad trend observed since the implementation of the SEP, indicating that the environmental quality of Cockburn Sound is improving over time. However, seagrass health indicators are mixed. The data suggest that meadows in relatively shallow waters at a number of sites are thinning while seagrass at depth is doing well. Given that seagrass health is a key indicator of ecosystem health in Cockburn Sound, it has been given special attention in this year's State of Cockburn Sound Report.

Water quality in most parts of Cockburn Sound, including waters along the eastern shore of Garden Island, within Careening Bay, and along the mainland coastline, met the relevant guidelines. However, the southern section of Cockburn Sound continues to show signs of nutrient enrichment. Both Chlorophyll ***a*** and light attenuation guidelines were exceeded in this part of the Sound, and dissolved oxygen concentration was also below guideline levels on a number of occasions.

The reduced water quality in the southern part of Cockburn Sound is generally assumed to be a result of poor water circulation. It provided the rationale for splitting up the previous High Protection Area into a northern (HPA-N) and southern section (HPA-S) last year (see Figure 1). The split prevents the water quality of HPA-N masking that of HPA-S. It is thought that as water quality continues to improve within Cockburn Sound as a whole, the southern section should improve accordingly.

On a smaller spatial scale, water quality in Jervoise Bay Northern Harbour continues to be poor. All relevant nutrient enrichment indicators failed in meeting the criteria. Phytoplankton biomass exceeded the environmental quality standard for the eleventh consecutive reporting period.

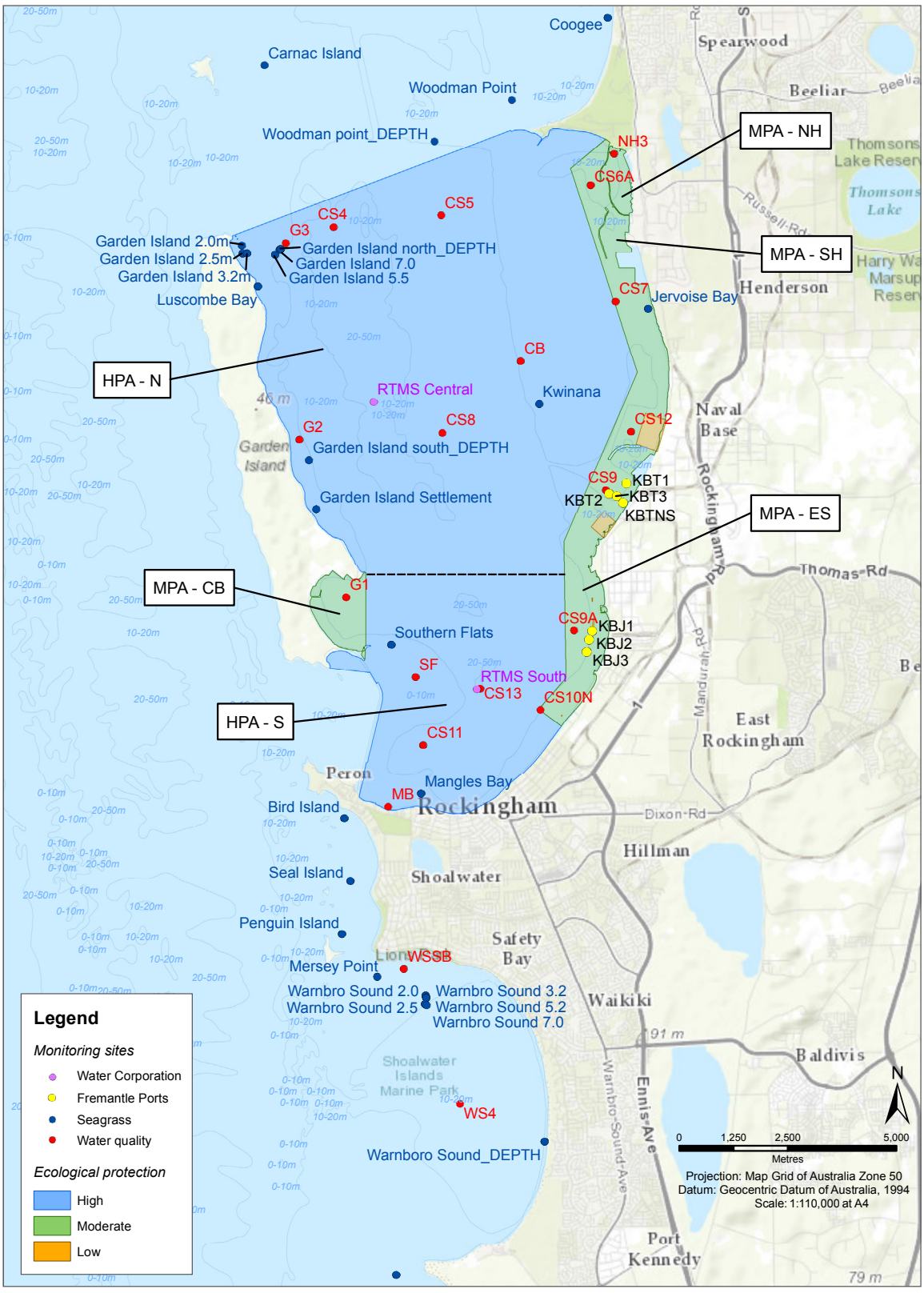
The CSMC coordinated a multi-stakeholder Working Group to produce a Management Action Plan (MAP, CSMC, 2012) identifying a range of options for improving water quality in Jervoise Bay Northern Harbour. CSMC will seek reconsideration of the recommendations in the MAP by the relevant stakeholders..

The state of seagrass health in Cockburn Sound is more difficult to determine. The data indicate that seagrass is thriving at depth and is extending into deeper waters. This result is consistent with the expected response to an increase in light penetration associated with the improvement in water quality over time. However, seagrass shoot density (i.e. the main indicator of seagrass health) appears to be trending down at a number of sites across Cockburn Sound. Negative trends at three of these sites were statistically significant in 2013. While the cause of the observed trend is unclear, the CSMC is pursuing several research opportunities in order to gain a better understanding of the issue and identify the potential cause.

Seafood caught and grown in Cockburn Sound is generally expected to be safe for human consumption. Seafood and water samples collected around commercial mussel growing areas and at 'risk' sites near jetties and ship-loading facilities (e.g. the Kwinana Grain Terminal, Kwinana Bulk Jetty and the Kwinana Bulk Terminal) met the guidelines without exception.

Water quality at recreational beaches and boating areas in Cockburn Sound met human health guidelines at all sites and on all occasions (Figure 9). There was also no evidence of challenges to aesthetic values during the 2013–14 reporting period.

Figure 1: The zones and locations of seagrass health and water quality monitoring sites in Cockburn Sound and the locations of reference sites in Warnbro Sound. Note that three levels of ecological protection have been established in Cockburn Sound, which allows the long-term environmental quality aspirations for each defined area to be set at an appropriate level. As depicted in this figure, the majority of Cockburn Sound is enclosed by High Protection Area North (HPA-N) and High Protection Area South (HPA-S). The criteria for these areas are aimed at maintaining environmental quality at near natural levels. In Careening Bay (Moderate Protection Area Careening Bay or 'MPA-CB') and along the eastern margin of the Sound (Moderate Protection Area Eastern Sound or 'MPA-ES'), where use of marine waters for waste disposal and other societal uses preclude a high level of ecological protection, criteria for a moderate level of ecological protection apply. Within each harbour/marina a moderate level of ecological protection also applies. For several small areas immediately adjacent to specific industrial outfalls a low level of ecological protection is applied, allowing a larger deviation from background.



2014 report cards

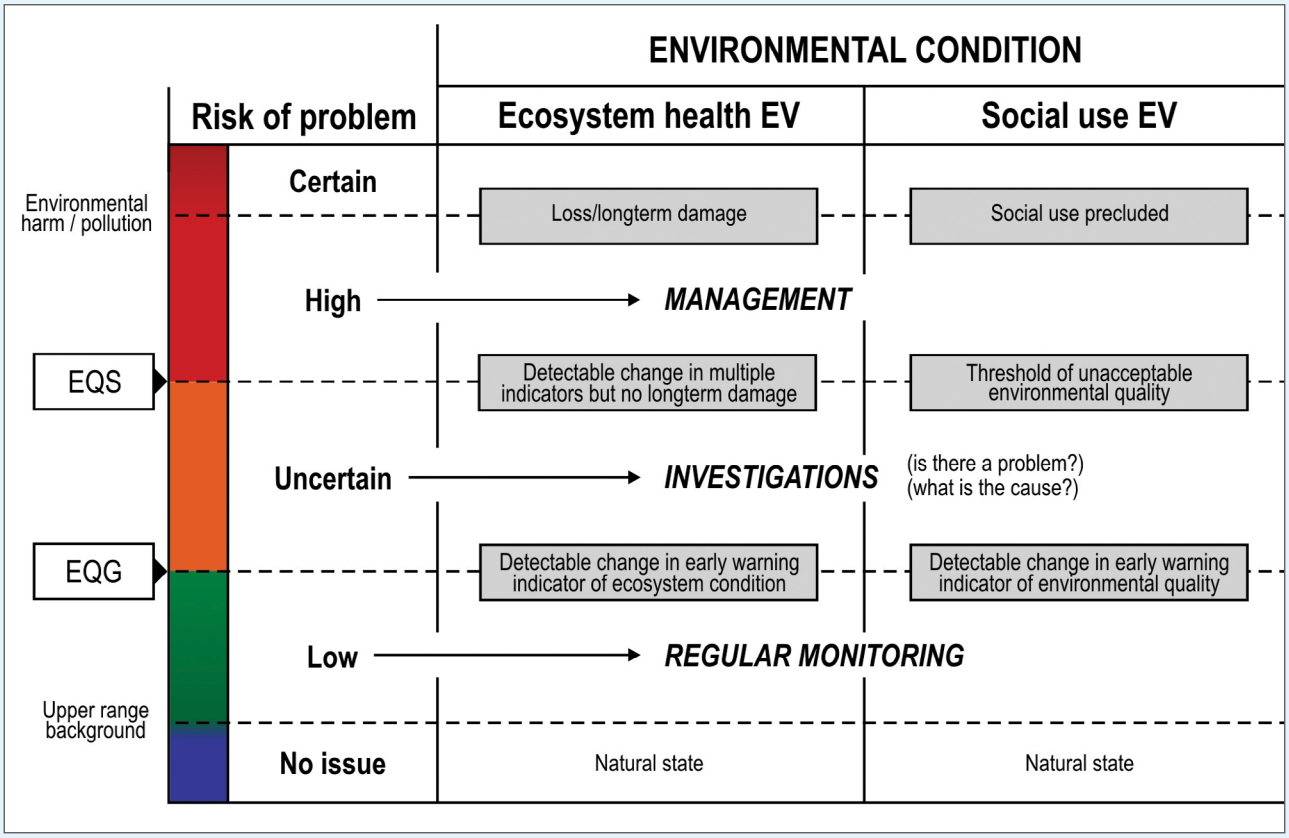
Introduction

The Cockburn Sound Management Council (CSMC) is responsible for implementing the State Environmental (Cockburn Sound) Policy 2005 (SEP) and the Environmental Management Plan for Cockburn Sound and its catchment. This includes coordinating and undertaking a range of environmental monitoring programs to assess the environmental health of the Cockburn Sound marine ecosystem on an annual basis.

Each year the CSMC collaborates with a number of stakeholders to ensure the various annual monitoring programs are in place across Cockburn Sound (see Figure 1 for a selection of existing monitoring sites). The environmental data generated by these programs are analysed in order to assess whether the environmental quality objectives established for the Sound are achieved and, hence, whether it's environmental values are protected. The 2014 State of Cockburn Sound Report provides a summary of the relevant results, which are presented in more detail in the Cockburn Sound Environmental Quality Assessment Report 2013–14 (available on the CSMC website).

The results are presented in the form of report cards, whereby the colour of the report card generally indicates the result of the assessment against the environmental quality criteria (EQC) (Figure 2).

Figure 2: A conceptual diagram showing the relationship between the two types of EQC on the left with the associated environmental conditions on the right. The relevant report card for a parameter is coloured green when the 'early warning indicator' known as the Environmental Quality Guideline (EQG) is met, orange when only the more robust Environmental Quality Standard (EQS) is met; and red when both criteria are exceeded. (Source: EPA Draft Environmental Assessment Guideline for Protecting the Quality of Western Australia's Marine Environment).



The purpose of the report cards is to provide a snapshot of how the environmental quality of Cockburn Sound is tracking in terms of the values and objectives that were established for Cockburn Sound consistent with the community's long-term aspirations (Table 1).

Table 1: Environmental values and environmental quality objectives for the marine waters of Cockburn Sound.

Environmental values	Environmental quality objecties
Ecosystem health	• Maintain ecosystem integrity
Recreation and aesthetics	• Water quality is safe for recreation (e.g. swimming and boating) • Aesthetic values of the marine environment are protected
Fishing and aquaculture	• Seafood (caught or grown) is of a quality safe for eating • Water quality is suitable for aquaculture purposes
Industrial water supply	• Water quality is suitable for industrial use.

The 2014 report pertains to the state of Cockburn Sound over the 12-month period from July 2013 to June 2014.

Ecosystem health - water and sediment quality

Water quality in Cockburn Sound has improved markedly over the past 30 years and meets the environmental quality guidelines (EQG) in general. All relevant EQG were met throughout the northern section of the Sound and along both the Garden Island and mainland shores. However, the southern section continues to show signs of nutrient enrichment with exceedances of both the Chlorophyll *a* and light attenuation EQG (Figure 3). The new guideline for dissolved oxygen was also not met on a number of occasions in this part of the Sound, although it is unclear at this stage whether this was caused by a natural seasonal occurrence, an ongoing issue or whether it reflects a more recent development.

Water quality continues to be poor within Jervoise Bay Northern Harbour, where eutrophication is an ongoing problem. Phytoplankton biomass exceeded the guideline value 94 percent of the time in 2012–13 and 69 per cent of the time in 2013–14, which meant the environmental quality standard (EQS) was exceeded for the eleventh consecutive reporting period. The CSMC coordinated a multi-stakeholder Working Group to produce a Management Action Plan (MAP, CSMC, 2012) identifying a range of options for improving water quality in Jervoise Bay Northern Harbour. CSMC will seek reconsideration of the recommendations in the MAP by the relevant stakeholders.

With respect to toxicants, no major surveys have been conducted since 2006–07 (toxicants in sediments) and 2008 (toxicants in water). All parameters monitored during these surveys at all 21 sites met the relevant guidelines. Since then, most treated wastewater from industrial sources within the Cockburn Sound catchment has been diverted for offshore discharge (through the Sepia Depression Ocean Outlet Landline), so it is generally expected that levels of toxicants in water and sediment currently meet guideline criteria across most of Cockburn Sound, with the possible exception of very small areas directly surrounding jetties, outfalls and/or stormwater drains. There are, therefore, no broad and ongoing toxicant-focussed environmental monitoring programs in place in Cockburn Sound. Only Fremantle Ports annually undertakes some targeted sampling around the Kwinana Bulk Terminal (KBT) and the Kwinana Bulk Jetty (KBJ)-both of which are located within the moderate ecological protection area enveloping the eastern section of the Sound. At both locations all EQG were met during the 2013–14 monitoring period (Figure 4).

Figure 3: The report cards for water quality–physical/chemical parameters. Data from all water quality monitoring sites were grouped for each zone and assessed against the relevant criteria. Each zone was arbitrarily given a colour based upon the results of the assessments. HPA-S was deemed orange as guidelines for Chlorophyll a concentration, light attenuation and dissolved oxygen were exceeded. The situation at MPA-NH was more severe, particularly given that the phytoplankton biomass standard continues to be exceeded and was deemed red.

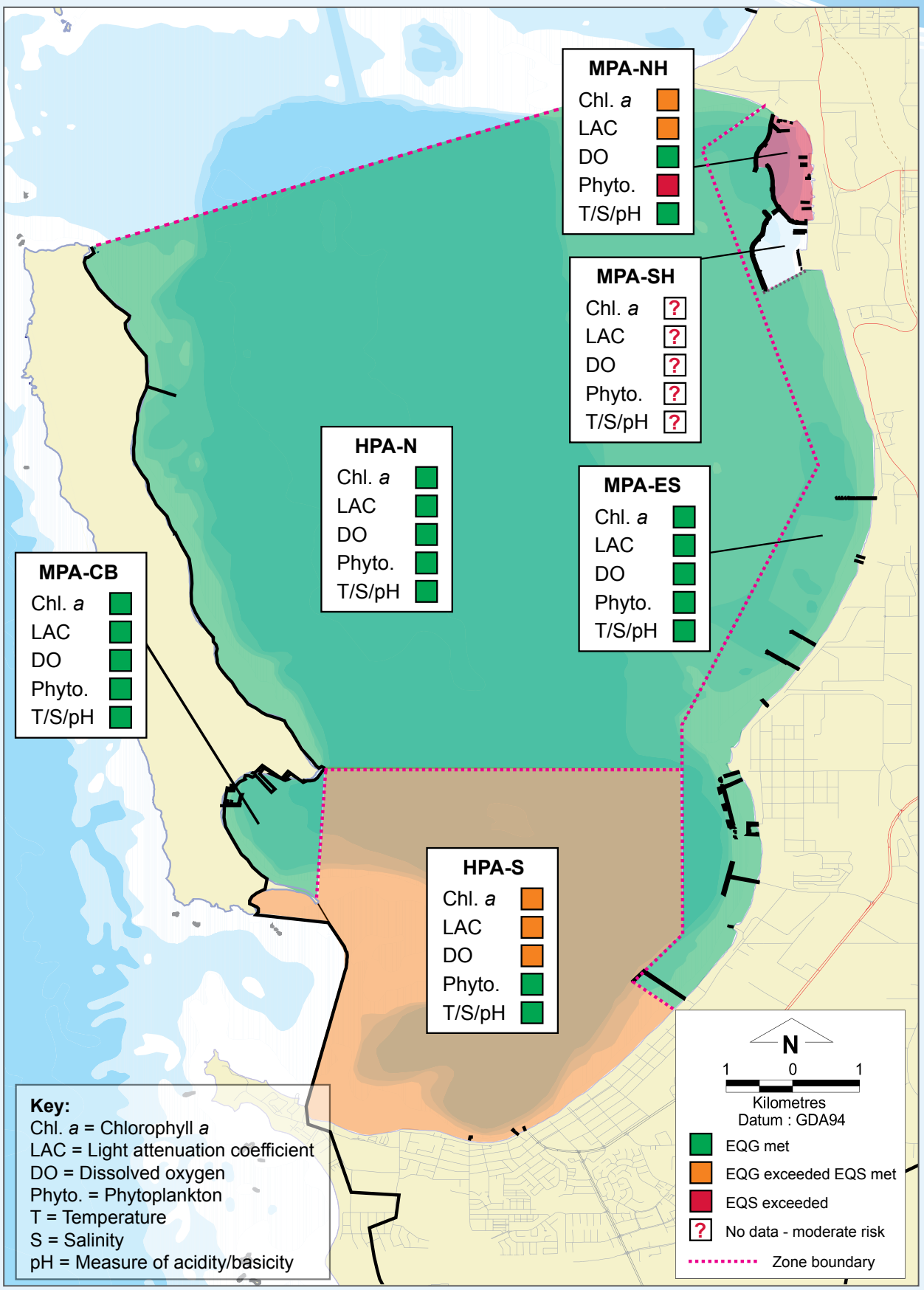
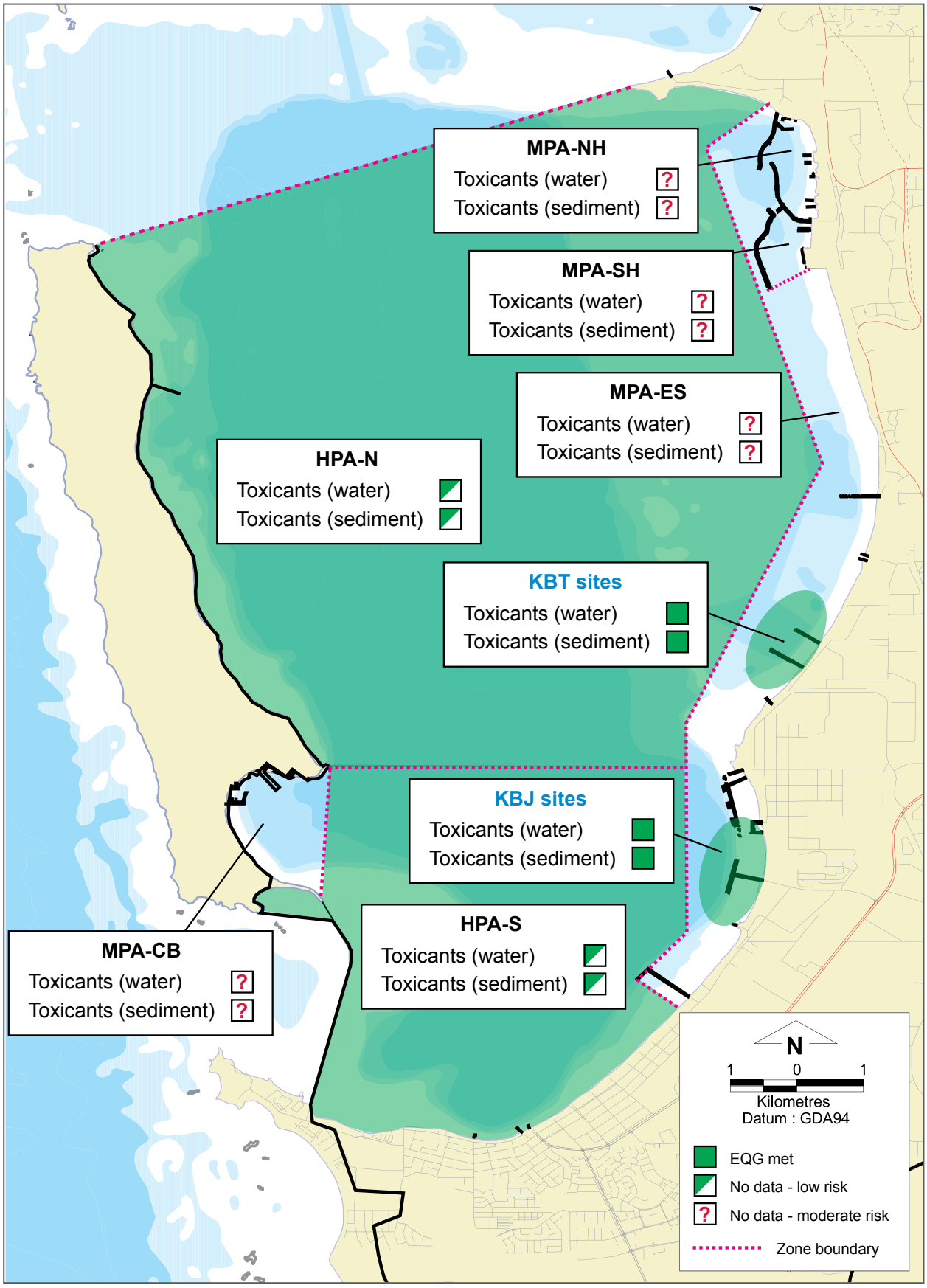


Figure 4: The report cards for water quality–toxicants. Note that toxicant-relevant data were only collected by Fremantle Ports around the KBT and KBJ site. However, this figure also indicates that it may be expected that levels of toxicants in water and sediments meet guideline criteria across most of the Sound, with the possible exception of very small areas directly surrounding jetties, outfalls and/or stormwater drains. There is a higher risk of such localised contamination within the MPA's.



Ecosystem health - seagrass health

A critical issue that has received a lot of attention over the past few years is seagrass health, a key indicator of ecosystem health in the Sound. Seagrass health is predominantly assessed by comparing seagrass shoot densities at each of 11 seagrass sites within Cockburn Sound against shoot densities measured at comparable reference sites in Warnbro Sound within the Shoalwater Islands Marine Park. However, as initially noted in a review of the environmental quality management framework for Cockburn Sound by the WA Auditor General in 2010 (OAG 2010), seagrass meadows appear to be thinning at three of the Warnbro Sound reference sites. This has had the effect of lowering the standard against which seagrass shoot density in Cockburn Sound is assessed and, potentially, of masking seagrass health declines.

A review of the seagrass monitoring program (Lavery and McMahon 2011) and an assessment of long-term trends in Cockburn and Warnbro sounds (Mohring and Rule 2013), both conducted since the release of the Auditor General's report, have shed some light on this issue and enabled the CSMC and the Office of the Environmental Protection Authority (OEPA) to make several informed changes in the way seagrass shoot density monitoring data are analysed and results interpreted.

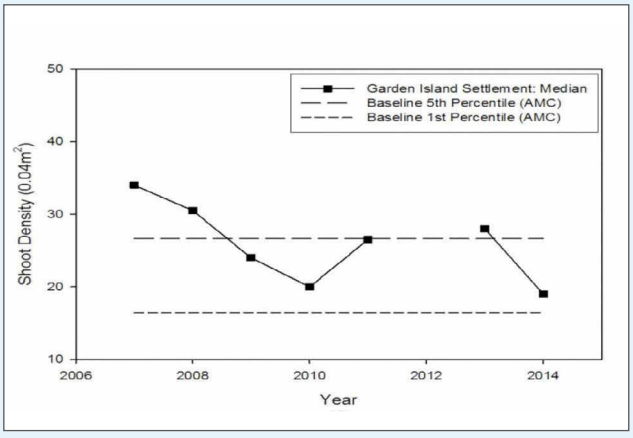
For example, Mohring and Rule (2013) established that downward trends in seagrass health at a number of Cockburn Sound sites were statistically significant and recommended trend analyses, as also suggested by the Auditor General, to augment the assessment of seagrass health data against the criteria. This recommendation has been adopted and the 2013 trends for each site were presented and discussed in the Environmental Quality Assessment Report 2013–14, available on the CSMC website www.csmc.wa.gov.au. A summary of that discussion is provided in the sections below.

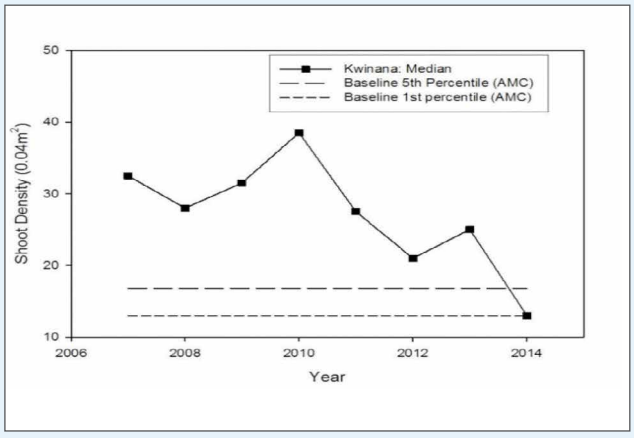
Another crucial change has been the introduction of 'absolute minimum' criteria, based on baseline (i.e. 'static') seagrass shoot density values, as measured at the Warnbro Sound reference sites during the first four years of monitoring (i.e. 2003–2006). These criteria prevent the seagrass health standards from declining to a point where they would allow the Cockburn Sound system to reach a point of no return without a management response being triggered. They are set out in detail in the Draft Revised Environmental Quality Criteria Reference Document for Cockburn Sound (EPA 2014), prepared by the OEPA and endorsed by the EPA and stakeholders.

Cockburn Sound

Seagrass health assessments against the criteria (including the new 'absolute minimum' criteria) and also trend assessments at individual sites are presented in the Environmental Quality Assessment Report 2013–14. The results of the trend analysis show that, despite the marked improvement in water quality in Cockburn Sound over the past three decades, seagrass remains under pressure at a number of sites. Worst affected appear to be the seagrass meadows at two sites off the northern end of Garden Island (GI 3.2m and GI 5.5m), where downward trends were found to be statistically significant in 2013, and at the Kwinana and Garden Island Settlement sites, where median seagrass shoot density has now fallen below the absolute minimum criterion value based on the fifth baseline percentile (Figure 5).

Figure 5: Seagrass shoot density (annual median) trends for the Garden Island Settlement (top) and Kwinana (bottom) sites in Cockburn Sound relative to the baseline fifth and first percentiles. Note that for both these sites the baseline fifth percentile is the 'absolute minimum' criterion not to be exceeded in two consecutive years.





These results are not in line with trends observed at the three 'depth transect sites' in Cockburn Sound where the edges of the respective meadows have extended into deeper water (Mohring and Rule 2014), presumably in response to improved light availability at depth afforded by better water quality. It is therefore clear that the observed seagrass shoot density declines are not explained by the established nutrient enrichment pressure-response pathway (See Topic Box 1: Nutrient enrichment and seagrass health for more detail). This is further illustrated by the fact that most of the nutrient enrichment report cards (presented in Figure 6) are green, an indication that nutrient enrichment guidelines (based on water quality criteria for Chlorophyll *a* concentration and light attenuation) were met. Figure 7, on the other hand, presents report cards based solely on the significance of the downward trend in seagrass shoot density at each site and clearly suggests seagrass shoot density to be in decline at a number of sites.

The fact that this apparent thinning of seagrass meadows in Cockburn Sound cannot be readily explained by the established nutrient enrichment pressure-response pathway is concerning and requires investigation.

Warnbro Sound

The introduction of the new absolute minimum criteria has highlighted the extent of the seagrass health declines in Warnbro Sound. No less than half the 'traditional' seagrass criteria, based on four year rolling 20th and fifth percentiles at the Warnbro Sound reference sites, have now fallen below fifth and first 'baseline' percentiles, respectively (Table 2). While the cause of the declining trends at these sites is not clear at this point, the correlation with an observed increase in Chlorophyll *a* at the WS4 site in Warnbro Sound over the same time period cannot be ignored and may be an indication that nutrient enrichment due to urban development around Warnbro Sound has begun to put pressure on the marine environment here.

Table 2: Comparisons of the current four-year rolling 20th (HPA) and fifth (MPA) percentile values at each of the Warnbro Sound reference sites against the relevant absolute minimum value, based on the baseline fifth and first percentiles, respectively, as measured at the same site in the first four years of monitoring (EPA 2013). Values are in number of shoots per square meter.

	WS 2.0m		WS 2.5m		WS 3.2m		WS 5.2m		WS 7.0m	
	HPA	MPA	HPA	MPA	HPA	MPA	HPA	MPA	HPA	MPA
2014 four–year rolling percentile value	**595**	**95**	600	313	210	**50**	**225**	**75**	100	50
Absolute minimum value	666	412	500	275	171	100	419	324	59	25

Figure 6: The results of the nutrient enrichment assessment discussed in detail in the Cockburn Sound Environmental Quality Assessment Report 2013–14. A report card has been presented for each combination of a seagrass site and nearest water quality monitoring site. The established nutrient enrichment pressure-response pathway that forms the basis of this assessment links an increase in nutrient input through an increase in phytoplankton biomass and associated increase in light attenuation (i.e. a reduction in light penetration) to a potential decrease in seagrass shoot density. Note that in the event the water quality parameters meet the guideline, an assessment of seagrass health against the standard is not technically required and the result is a green report card. Unfortunately, a potential consequence of this approach is that it is possible for seagrass health issues (that are not caused by a decrease in available light), to persist and deteriorate over time without the problem being identified and management action being triggered. This issue has been addressed by the decision to additionally present report cards for seagrass health trend at each site (Figure 7).

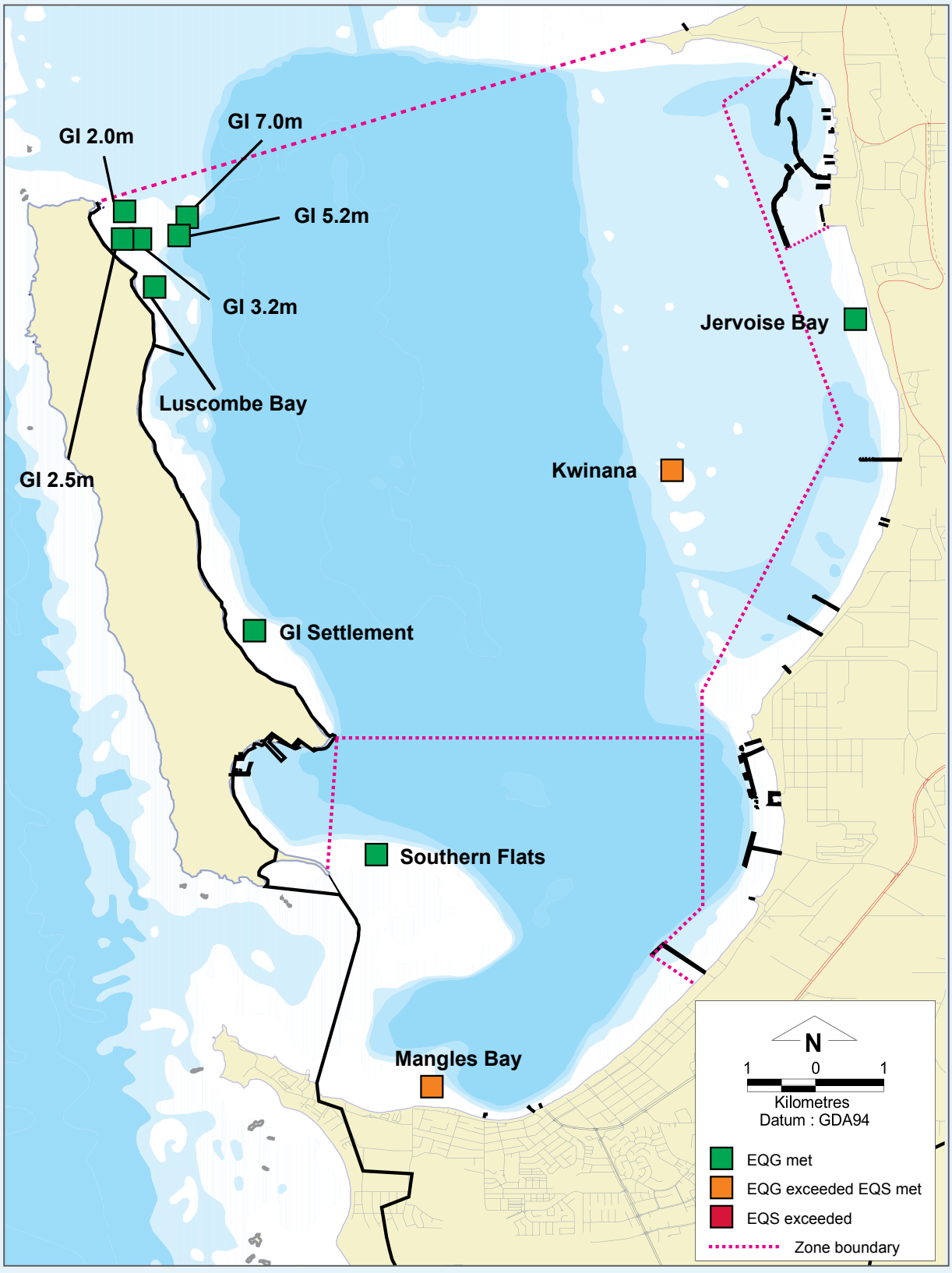
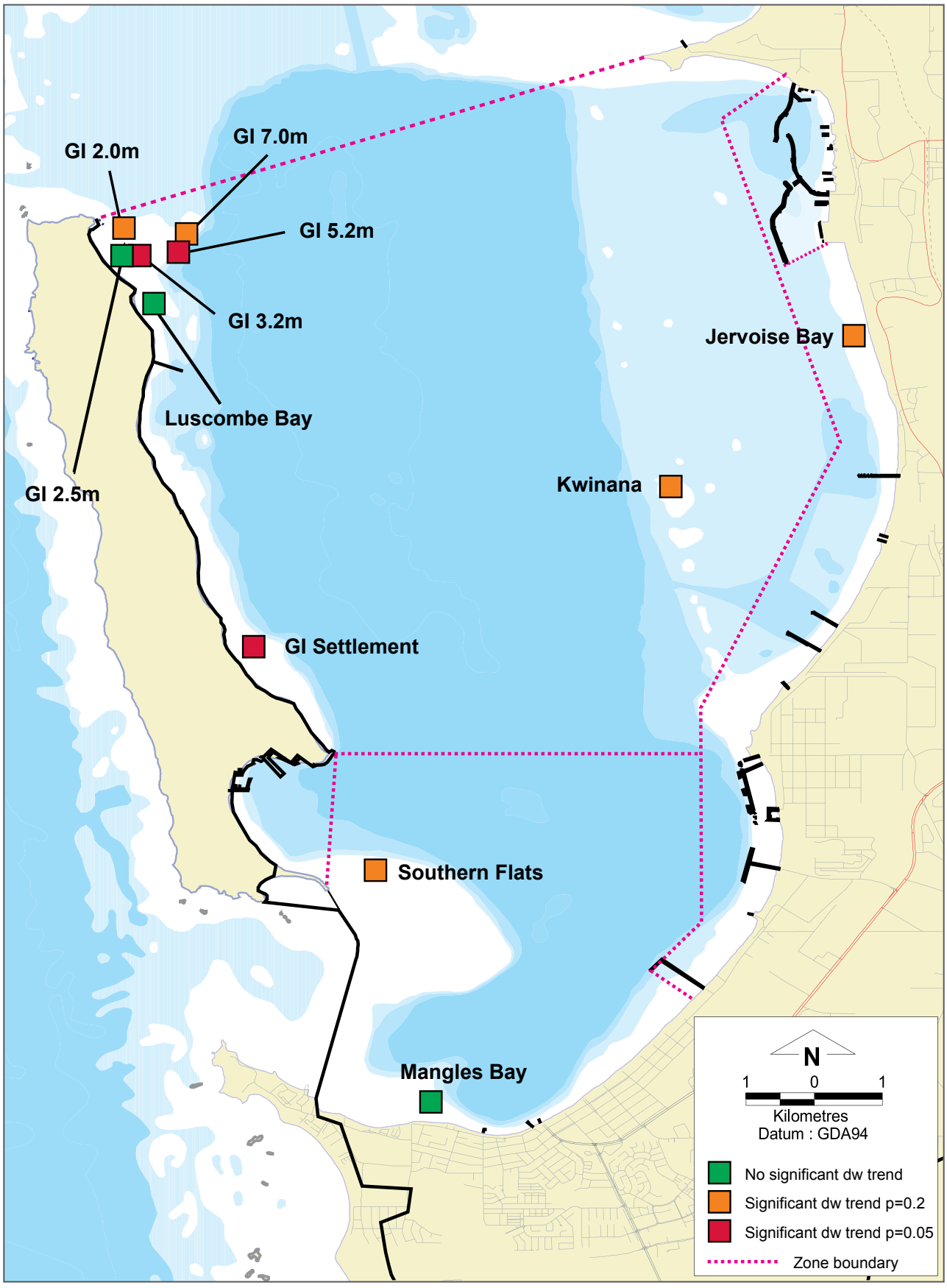


Figure 7: The results of the trend analysis for each seagrass site following the 2012–13 monitoring period, as discussed in Mohring and Rule (2013). Note that statistical analyses were not conducted following the 2013–14 monitoring period. Declining trends in seagrass shoot density, which, in 2013, were statistically significant at p=0.20 were deemed orange, while statistically significant downward trends at p=0.05 were assigned a red colour. When compared with Figure 6, these results clearly indicate that the seagrass health issues in Cockburn Sound do not appear to be caused by reduced light availability.



Now that statistically significant downward trends in seagrass density have been observed at three out of five reference sites (Mohring and Rule 2013) and half the traditional criteria have fallen below the absolute minimum criteria, the validity of the Warnbro Sound reference sites is brought into question. Alternative reference sites have been established in two locations, and options for incorporating these sites in the calculation of effective and appropriate annual seagrass shoot density criteria for Cockburn Sound sites should be discussed as a matter of priority (see topic box 2: A reference site for the reference site? for more detail).

Fishing and aquaculture values

Seafood caught in Cockburn Sound is generally expected to be safe for human consumption. Concentrations of faecal pathogens and potentially toxic algae in water and concentrations of ***Escherichia coli*** and toxicants (i.e. chemicals and metals) in seafood flesh, met the guidelines at all sites that were regularly sampled (Figure 8).

Seafood sampled from around commercial mussel growing areas met the aquaculture guidelines without exception, although the number of parameters for which data was available was limited. While seafood from seafood growers in the Sound is considered safe to eat, it should be noted that shellfish harvested recreationally elsewhere in the Sound is not monitored for quality and the community should remain aware of the risk of eating seafood collected near jetties, piers, harbours and port-related infrastructure.

Recreational and aesthetic values

Water quality at recreational beaches and boating areas in Cockburn Sound met human health guidelines at all sites and on all occasions (Figure 9). There was also no evidence of challenges to aesthetic values during 2013–14.

Industrial water supply value

A set of water quality criteria for ensuring the ongoing and uninhibited operation of the Perth Seawater Desalination Plant has been proposed by the OEPA and can be found in the Draft Revised EQC Reference Document for Cockburn Sound (EPA 2013). However, no targeted monitoring was undertaken during the 2013–14 period and no issues have been reported by the Water Corporation. It is therefore expected that these criteria are currently being met.

Figure 9: The report cards for recreation water quality.

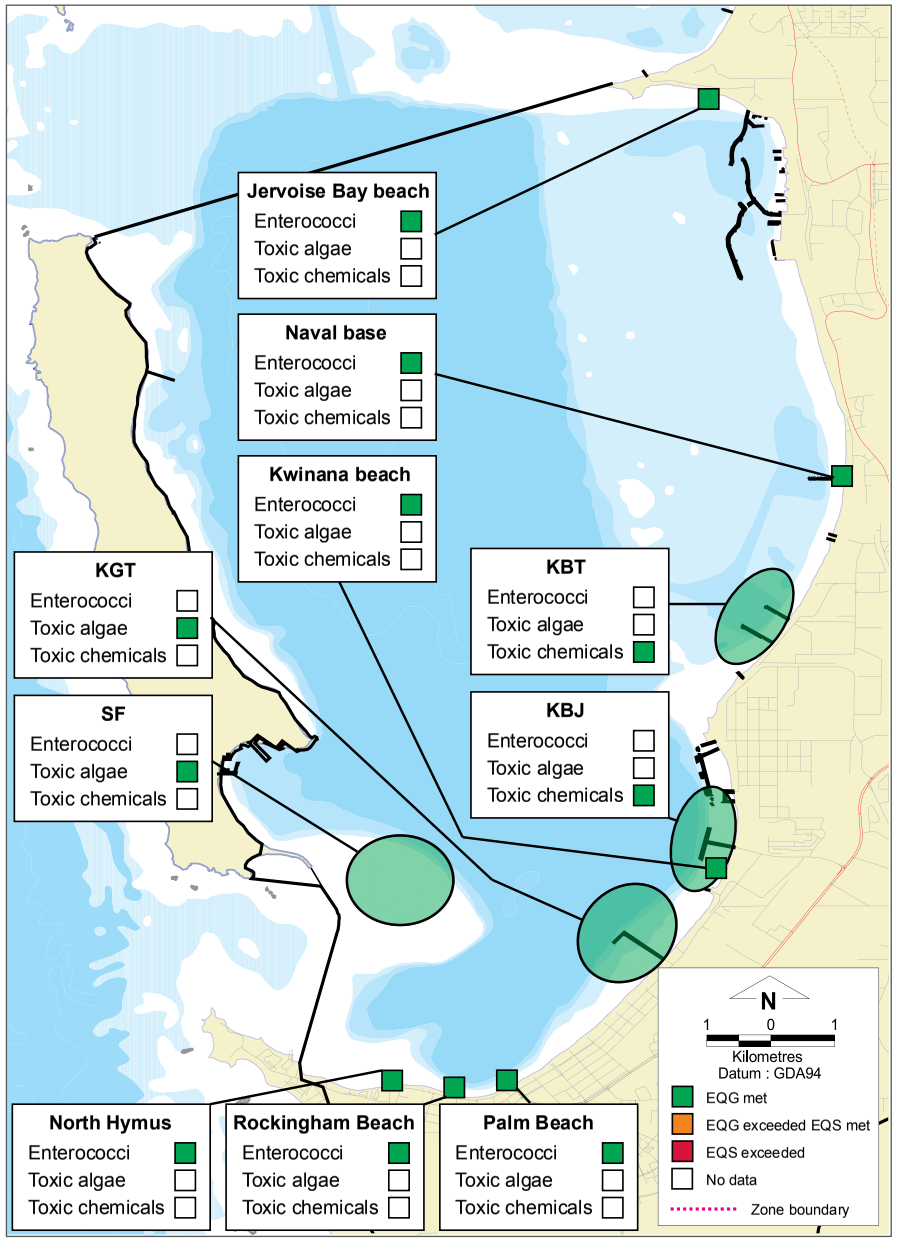
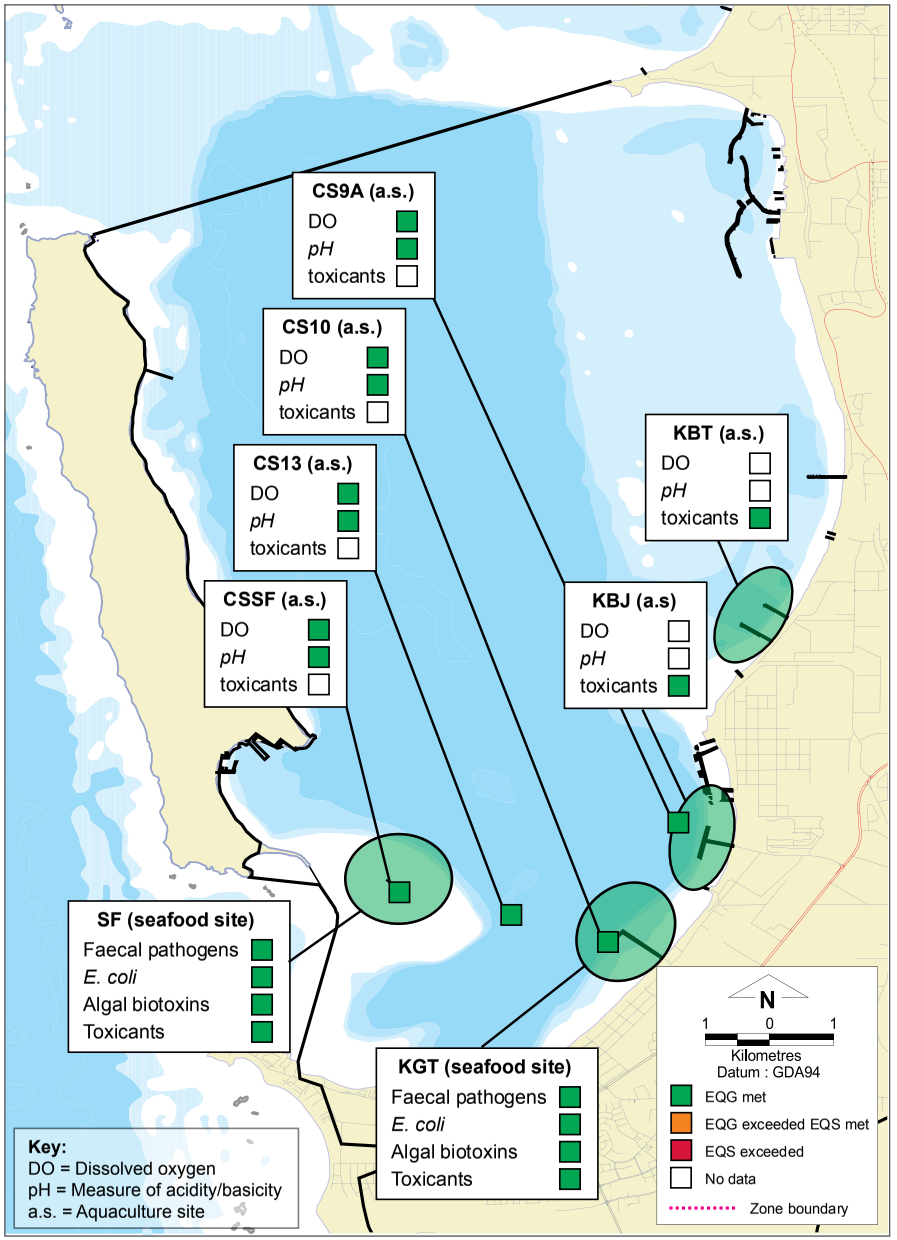


Figure 8: The report cards for seafood quality and aquaculture water quality.



Topic box 1

Nutrient enrichment and seagrass health

About 85 per cent of the seagrass once present in Cockburn Sound has been lost. Most of this loss dates back to the 1970s and 80s and it is well-established that nutrient enrichment of the Sound has been largely responsible for the decline. The pressure-response pathway through which an increase in nutrient input may affect seagrass health is equally well-established and summarised as follows:

When nutrients are added to a system they stimulate the growth of microscopic phytoplankton and other small primary producers such as epiphytes, allowing these organisms to rapidly increase in number (Figure T1). Phytoplankton and epiphytes absorb light and an increase in their biomass results in less light being available to plants such as seagrass, which rely on sunlight to survive and grow. If light availability reduces below critical levels for prolonged periods, seagrasses can suffer and die. For species such as ***Posidonia sinuosa,*** a reduction in health tends to be first expressed as a thinning of the meadow, which is measured as a reduction in seagrass shoot density. The pressure of a reduction in light penetration is more acutely felt at depth where light availability is a limiting factor. Monitoring data suggest, in line with expectations, that as water quality is improving in Cockburn Sound, seagrass is extending into deeper waters.

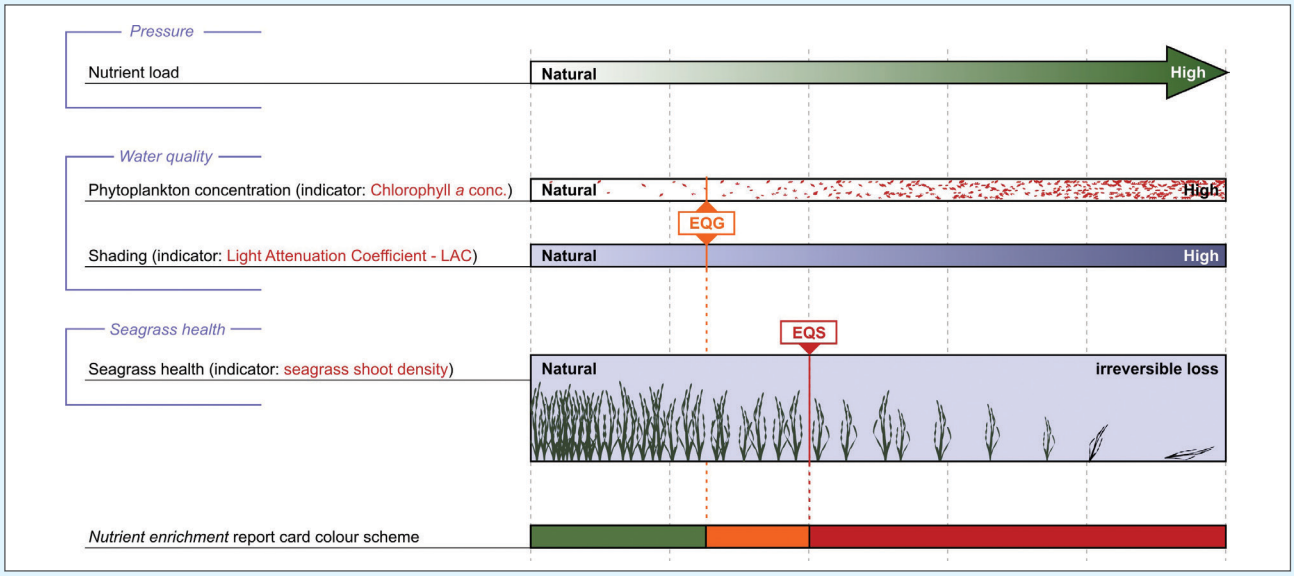
Not all is well, however. There is growing evidence that, despite the improvements in water quality, seagrass shoot density at a number of sites across the Sound is trending down, suggesting seagrass health is being impacted through a different pathway.

One hypothesis, suggested by a team of scientists led by Professor Gary Kendrick of the University of Western Australia (UWA), is that poor sediment quality may be playing a role in the declines observed in Cockburn Sound. The suggestion is that elevated levels of organic carbon in the sediment, possibly caused by **in situ** seagrass thinning or mortality over time or during a single event (such as a sudden shedding of leaves during a marine heat wave event), can lead to reduced oxygen availability in the sediment and kick off a negative feedback loop that affects seagrass health over a longer period.

If future findings support this hypothesis, then this pathway may be able to explain the seagrass health declines witnessed in Cockburn Sound and also be of use in forecasting future trends and likely responses to management strategies (e.g. with respect to seagrass restoration projects).

The CSMC is collaborating with UWA to commence a preliminary investigation into sediment quality this year, which will help focus research in 2016.

Figure T1: A conceptual diagram of the nutrient enrichment pressure-response pathway in Cockburn Sound (excluding the effect of a nutrient-associated increase in epiphyte biomass for which criteria have not been developed to date). Monitoring programs aimed at identifying and managing areas under pressure from nutrient enrichment measure: (i) water quality indicators such as Chlorophyll **a** *concentration (indicative of phytoplankton concentration) and light attenuation coefficient (i.e. a measure of the degree of shading in the water column) as 'early warning' indicators; and (ii) seagrass shoot density as the indicator for seagrass health, which is 'further down' the pressure-response pathway. When these are assessed together (as 'multiple lines of evidence'), we can be confident about what is actually happening in the marine environment and increase our ability to make pre-emptive and informed management decisions to prevent unacceptable risk to the environment.*



Topic box 2

A reference site for the reference site?

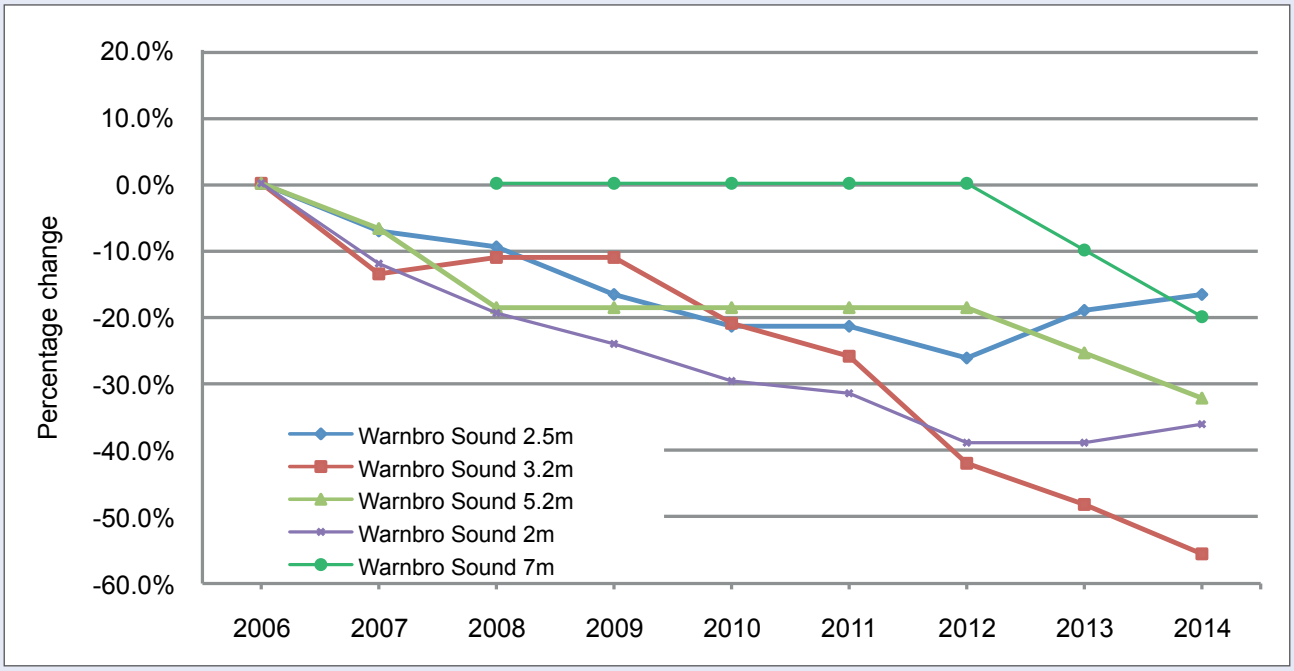
The main indicator used to assess the health of ***Posidonia sinuosa*** seagrass meadows is 'seagrass shoot density'. This is measured by counting the number of seagrass shoots in a series of fixed squares, called quadrats, on the seabed at a site. In order to assess seagrass health at 'impact' sites in Cockburn Sound in a consistent manner, the median value (i.e. the 'middle number') of all measurements undertaken at that site (i.e. at all quadrats) is compared with measurements undertaken at an appropriate 'reference' site.

The reference sites established for this assessment are in Warnbro Sound, and it is crucial that they represent the un-impacted natural state of seagrass meadows in the area including Cockburn Sound. Warnbro Sound has not suffered from the same pollution-related legacy issues as Cockburn Sound, is not currently thought to be under serious pressure from nutrient enrichment and appears to be an appropriate place to establish reference sites. Yet, observations over the past few years suggest that seagrass health at the monitored reference sites in Warnbro Sound is in decline (Figure T2.1). In fact, the observed declines at three of the five Warnbro Sound reference sites have not only been statistically significant but have been so severe that recent data should no longer be used to derive criteria for use in assessing seagrass health in Cockburn Sound (see section Warnbro Sound and Table 2 of this report for further detail). In order to determine whether the sites in Warnbro Sound are still valid reference sites, four relevant potential scenarios will need to be considered:

- Scenario 1: Same regional cause. Warnbro Sound and Cockburn Sound seagrass health is in decline due to environmental changes on a broad spatial scale over either the medium term (e.g. due to natural multi-decadal variability) or long term (e.g. due to global climate change).
- Scenario 2: Same local cause. Warnbro Sound and Cockburn Sound seagrass health declines have the same, relatively local, cause(s);
- Scenario 3: Different local cause. Warnbro Sound and Cockburn Sound health declines have a different, relatively local, cause; or
- Scenario 4: Artefact of sampling methodology. Seagrass shoot densities measured within the quadrats are not representative of shoot densities within the meadow.

If the observations are explained by Scenario 1, then the reference sites are doing exactly what they are supposed to be doing, i.e. representing the 'natural state' of the area including Cockburn Sound. The reference sites should be kept in place and it should be determined whether a management response, if possible, is required. If the data support either Scenario 2 or

Figure T2.1: Percentage change of the four-year rolling median for each of the five reference sites in Warnbro Sound.



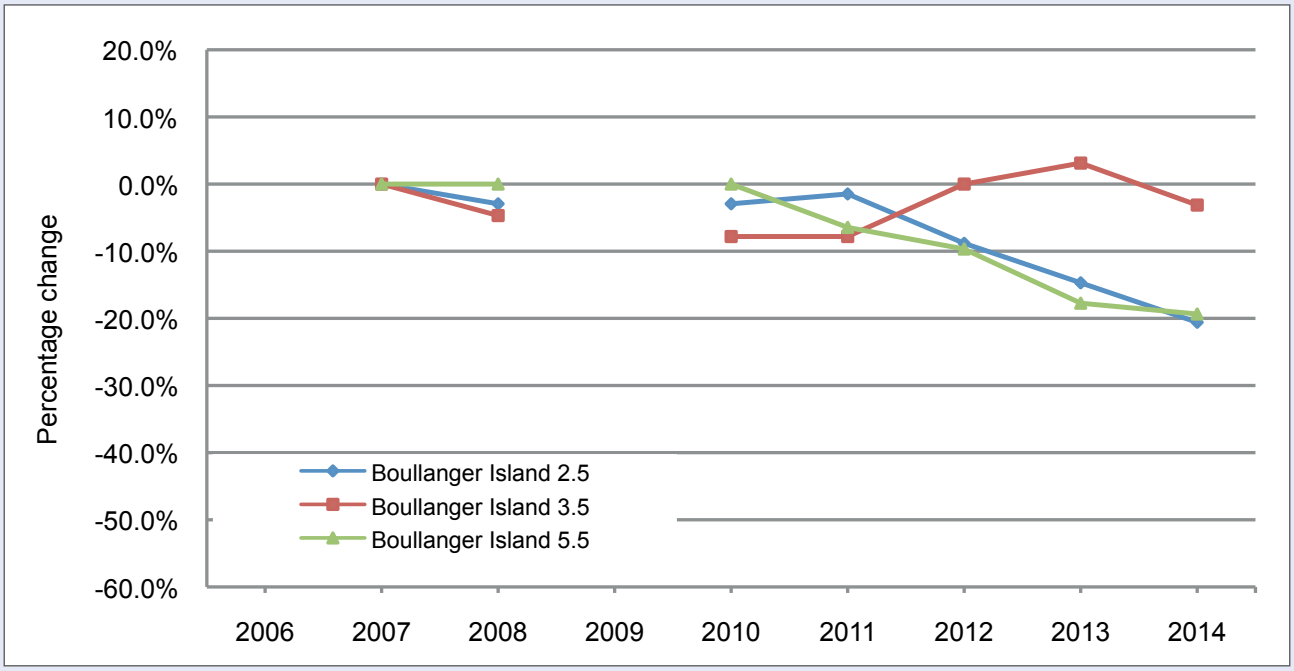
3 and the cause appears to be anthropogenic then the validity of the reference site is called into question. Finally, if there is evidence to support Scenario 4, then the current state of seagrass health in Cockburn and Warnbro sounds is unknown and may need to be investigated using alternative quadrats while seagrass within the existing quadrats is allowed to recover.

The Cockburn Sound Management Council (CSMC), in collaboration with DPaW's Marine Science Program (MSP), UWA and the Department of Defence, has commenced addressing this issue by:

- Initiating a preliminary trend analysis of seagrass health at the alternative reference sites set up at Boullanger Island near Jurien Bay. A first glance at the monitoring data suggests, that two out of three sites at this location appear to be trending down. While the jury is out on the significance of these trends at Boullanger Island, ongoing declines at these sites would be consistent with Scenario 1, i.e. the hypothesis that seagrass within the whole region is under pressure, hence the cause is not a local one and that a management response may not be feasible (Figure T2.2). This requires further investigation.
- Establishing several new transects at several sites where transects have been lost due to erosion/sand accumulation processes. This was an MSP initiative that will allow the hypothesis to be tested as to whether these processes may have affected the seagrass shoot density counts at these sites. This work has specific relevance to scenarios 3 and 4.
- Contacting the City of Rockingham, Department of Water and Water Corporation in order to identify, obtain and analyse all relevant available data on nutrient input into Warnbro Sound. This work has relevance to scenarios 3 and 4.
- Providing support to UWA-proposed research looking into the potential impact of elevated organic carbon content in the sediment on seagrass health (as discussed in Topic Box 1). This work also has relevance to Scenario 3.
- Initiating a preliminary study at one or more of the worst affected sites to investigate whether the declines observed within the quadrats reflect declines within the meadow or may be an artefact of the sampling methodology. This work has relevance to Scenario 4.

In the interim, the CSMC will consider the various options of incorporating data collected at alternative reference sites (i.e. the Boullanger Island sites and/or the more recently established sites in Shoalwater Islands Marine Park) in the calculation of appropriate annual seagrass shoot density criteria for this year's assessments.

Figure T2.2: Percentage change of the four-year rolling median for each of three potential reference sites at Boullanger Island.



Report card trends 2003–14

Figure 10: Indicative report card trends for the period 2003–14. Please note that this figure is only intended to provide a broad overview of environmental quality trends in Cockburn Sound. For a number of parameters the assessment against the criteria is done individually for each site or for a particular sampling occasion, which does not allow a single report card to be easily derived for the whole of the Sound (or a zone) per year. The report cards presented in this figure are, therefore, ambiguous. Moreover, data for some parameters are collected only sporadically or even just on a single occasion (or at a single site) per year and/or sampling sites may have changed over time – making direct comparisons between years problematic.

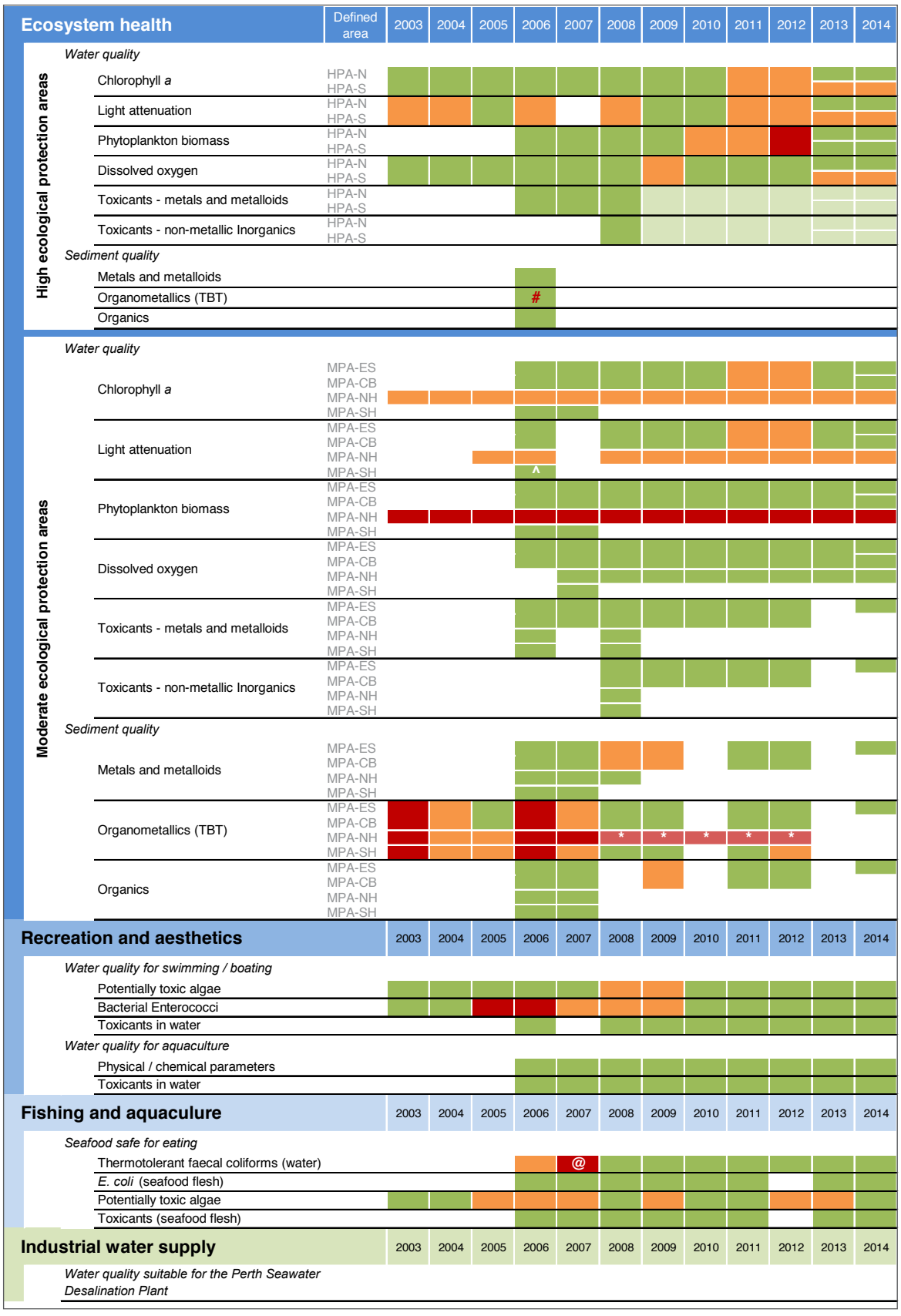


Figure 10 Notes: # The guidelines (based on TBT concentration in the sediment) were met at all sites. Note that the standard (based on the incidence of imposex in the marine snail **Thais orbita** *was not met at Woodman Point, which may have been an effect of prior contamination. ^ All but one site in Southern Harbour met the guidelines. @ All samples taken from commercial mussel harvesting areas met the guideline. However, one sample from a non-commercial site at the Jervoise Bay boat ramp exceeded both the guideline and standard, triggering a red report card. * TBT concentration in the sediment exceeded the guideline and the most recent occasion during which imposex incidence was determined the standard was exceeded (i.e. in 2006).*

References and further reading

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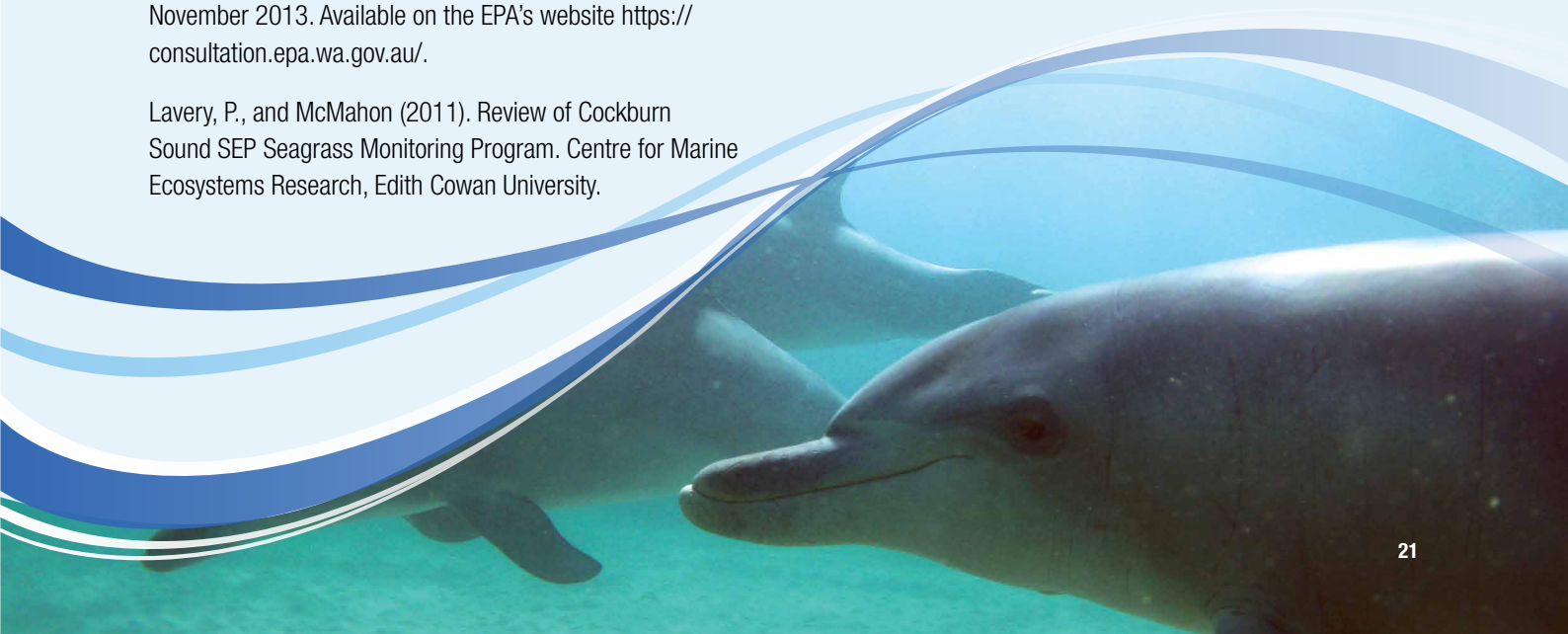
All reports are available on, or can be accessed via, the CSMC website unless noted otherwise.



Glossary

CS	Cockburn Sound monitoring site
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSMC	Cockburn Sound Management Council
DER	Department of Environment Regulation
DO	Dissolved oxygen
DPaW	Department of Parks and Wildlife
EMP	Environmental Management Plan for Cockburn Sound and its Catchment 2005
EPA	Environmental Protection Authority
EQC	Environmental quality criteria
EQG	Environmental quality guideline
EQMF	Environmental quality monitoring framework
EQO	Environmental quality objectives
EQS	Environmental quality standard
EV	Environmental values
GI	Garden Island monitoring site
HPA-N	High protection area North
HPA-S	High protection area South
KBJ	Kwinana Bulk Jetty monitoring site
KBT	Kwinana Bulk Terminal monitoring site
KIC	Kwinana Industries Council
LAC	Light attenuation coefficient
MPA-CB	Moderate protection area Careening Bay
MPA-ES	Moderate protection area Eastern Sound
MPA-NH	Moderate protection area Northern Harbour
MPA-SH	Moderate protection area Southern Harbour
MSP	Marine Science Program, Department of Parks and Wildlife
OAG	Office of the Auditor General
OEPA	Office of the Environmental Protection Authority
SEP	State Environmental (Cockburn Sound) Policy 2005
SF	Southern Flats monitoring site
TBT	Tributyltin (ingredient in anti-fouling paint pre 1992 for recreational vessels and 2003 for commercial vessels)
WASQAP	Western Australian Shellfish Quality Assurance Program
WS	Warnbro Sound monitoring site

Appendix: CSMC Membership

Member	Designation	Representation	Occupation
Professor Kateryna Longley	Chair	Independent	Emeritus Professor Murdoch University
Vacant	Member	Community	
John Polglaze	Member	Community	Environmental Consultant
Bart Houwen	Member	Community-Com Net Inc	Business Manager Bendigo Bank
John Smedley	Member	Cockburn Powerboat Association	Community member
Professor David Harries	Member	Conservation Council	President CCWA Adjunct Professor School of Electrical, Electronic and Computer Engineering University of Western Australia
Vacant	Member	Recfishwest	
Glenn Dibbin	Member	Western Australian Fishing Industry Council	Mussel farmer
Chris Oughton	Member	Kwinana Industries Council	Director – Kwinana Industries Council
Cr Carol Reeve-Fowkes	Member	City of Cockburn	Councillor – City of Cockburn
Cr Ruth Alexander	Member	City of Kwinana	Councillor – City of Kwinana
Cr Ron Pease	Member	City of Rockingham	Councillor – City of Rockingham
Jarrad Scott	Member	Dept of Defence	Senior Environment Manager, WA
Ian Briggs	Member	Dept of Mines and Petroleum	General Manager Strategic Policy
Kelly Faulkner	Member	Dept Environment Regulation	Executive Director Licensing & Approvals
Stefan De Haan	Member	Dept of Parks and Wildlife	Regional Manager Swan Region
Rae Burrows	Member	Dept of Fisheries	Principal Management Officer
Vivienne Panizza	Member	Dept of Planning	Planning Manager, Policy Coordination
Jim Dodds	Member	Dept of Health	Director of the Environmental Health Directorate
Leon Brouwer	Member	Dept of Water	Regional Manager, Kwinana Peel
Gordon Groth	Member	Water Corporation	Environmental Operations Manager
Gino Valenti	Member	Fremantle Ports	General Manager Strategy and Planning
Dr John Keesing	Member	CSIRO	Head of Marine Research CSIRO

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COCKBURN SOUND MANAGEMENT COUNCIL

State of Cockburn Sound Report 2014

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