Perth Long-term Ocean Outlet Monitoring (PLOOM) Program

Subiaco Water Resource Recovery Facility

2025 – 2026 Annual Report

WATER CORPORATION

Document Management

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Revision	Reviewer	Intent	Date
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Hydrobiology WA Pty Ltd has prepared this report in accordance with our Integrated Management System, in compliance with ISO9001 and ISO45001.

Status

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Acronyms

Acronym	Extension
ANZG	Australia and New Zealand Guidelines
CFU	Colony Forming Unit
CTWWC	Comprehensive Treated Wastewater Characterisation
DO	Dissolved Oxygen
DoH	Western Australian Department of Health
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guidelines
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
EQS	Environmental Quality Standards
HEPA	High Ecological Protection Area
LAC	Light Attenuation Coefficient
LEPA	Low Ecological Protection Area. Referred to as ‘notional’ for the Swanbourne ocean outlet
LoR	Limit of Reporting
MBMMP	Marine Biotoxin Monitoring and Management Plan
mL	Millilitre (0.001 L)
ML	Megalitre (1,000,000 L)
MPN	Most Probable Number
NHMRC	National Health and Medical Research Council
NOEC	No Observed Effect Concentration
OZI	Observed Zone of Influence. These management zones are referred to as ‘notional’ for the Swanbourne ocean outlet
PLOOM	Perth Long-term Ocean Outlet Monitoring
TTC	Thermotolerant Coliforms
TTM	Total Toxicity of the Mixture
TWW	Treated Wastewater
WASQAP	Western Australian Shellfish Quality Assurance Program
WET	Whole of Effluent Toxicity
WRRF	Water Resource Recovery Facility

What do the results in this report mean for our community?

Ocean discharge of treated wastewater is practiced worldwide and is a safe, sustainable and cost-effective way to dispose of wastewater. Wastewater from Perth's Water Resource Recovery Facilities (WRRFs) is treated before being discharged to the ocean via ocean outlets. Treated wastewater is less dense than seawater, so it rapidly rises, mixes and dilutes into the ocean. Ocean discharges are regulated in Western Australia by the Department of Water and Environmental Regulation (DWER).

Water Corporation discharges treated wastewater from the Subiaco WRRF to the ocean via the Swanbourne outlet. A small area around the outlet, measuring 100 metres in radius, is designated as a notional Low Ecological Protection Area (or LEPA). Within this area, the Environmental Protection Authority's (EPA) principle of allowing for changes to marine water quality is applied. Outside the notional LEPA, the EPA states that the surrounding ocean is a High Ecological Protection Area (HEPA), where there should be no detectable change in marine water quality (EPA 2016)

Water Corporation's Perth Long-term Ocean Outlet Monitoring (PLOOM) program involves testing marine water quality around the Swanbourne outlet to confirm it returns to the natural range expected in the HEPA to protect the environment and recreational users (swimmers, boaters and fishers). Water samples are collected within the notional LEPA, at the LEPA/HEPA boundary, and at reference sites representing background conditions and assessed against nationally agreed criteria.

This annual report documents the findings of the 2025-2026 Swanbourne ocean monitoring as part of the PLOOM program. The compliance results are summarised in report card format below and contains colour-coded results with the individual colours representing the extent to which the Environmental Quality Criteria (EQC) were met.

Summary report card legend

Management response[1]	Colour
Monitor: EQG & EQS met (continue monitoring)	
Investigate: EQG not met (investigate against the EQS)	
Action: EQS not met (management response required)	

Notes:

1. The required response following an exceedance of either the Environmental Quality Guideline (EQG) or Environmental Quality Standard (EQS) is shown in parentheses.

Summary of key indicators

The following section provides a summary of the key indicators assessed during the 2025/26 Perth Long-Term Ocean Outlet Monitoring (PLOOM) program at the Subiaco Water Resource Recovery Facility and Swanbourne ocean outfalls. Refer to the main report for a more comprehensive overview.

Ecosystem integrity

Ecosystem Integrity aims to protect the ecosystem from potential impacts from the treated wastewater discharge and maintain the variety and quantity of marine life at a high level. The top indicators we look at that give us an understanding of this are as follows:

Indicator	Indicator purpose	Result	Commentary
Toxicants in treated wastewater (TWW)			
Bioaccumulating toxicants	Cadmium and mercury are toxicants that can build up in the tissues of marine organisms and contaminate seafood. The concentration of these toxicants is measured in undiluted TWW against national guidelines that are designed to protect marine life.		Concentrations of cadmium and mercury were below the national guideline values.
Non-bioaccumulating toxicants	Some low levels of contaminants (e.g. detergents, metals and oils) may persist in wastewater after treatment at the WRRF and are possibly discharged at the outlet. Monitoring confirms they are not directly toxic or likely to accumulate in marine life.		Concentrations of non-bioaccumulating toxicants were below the national guideline values.
Total toxicity of the mixture (TTM)	TTM measures the potential for a combined, or cumulative, effect of ammonia, copper, and zinc in the TWW after it has been diluted into the ocean. It is used as an additional interpretative tool for estimating the potential toxicity of TWW.		The total toxicity of the mixture was below the national guideline value.
Whole of effluent toxicity (WET) testing	WET testing is another tool to test the potential toxicity of the TWW to marine life. WET testing is particularly useful for toxicants that occur in very low concentrations, or for which there are no national guidelines on safe levels. Direct tests on organisms determine the actual toxicity of the TWW demonstrate that the discharge is not harmful to the ocean environment.		The TWW plume is sufficiently diluted to achieve the No Ecological Effects Concentration at the management boundary.
Nutrient enrichment and phytoplankton blooms			
Chlorophyll-*a*	Phytoplankton are a naturally occurring part of the marine environment, but treated wastewater contains nutrients (ammonia, nitrite, nitrate and orthophosphate) that can stimulate phytoplankton growth. Chlorophyll-		Median chlorophyll-*a* concentration within the high ecological protection area (HEPA) did not exceed the

Indicator	Indicator purpose	Result	Commentary
	a (the active constituent in phytoplankton) concentration is used as an indicator for phytoplankton abundance.		80th percentile of reference site concentrations
Light attenuation coefficient (LAC)	Increased phytoplankton can block (attenuate) light from reaching the bottom (impacting seagrass and macroalgae).		LAC did not exceed the 80th percentile of historical reference sites (0.090 m^{-1}). Light transmission to the sea floor was not reduced.
Phytoplankton biomass			
Phytoplankton biomass (measured as chlorophyll-*a*)	Phytoplankton are a naturally occurring part of the marine environment, but TWW contains nutrients (ammonia, nitrite, nitrate and orthophosphate) that can stimulate phytoplankton growth. Chlorophyll-*a* (Chl-*a*; the active constituent in phytoplankton) concentration is used as an indicator for phytoplankton abundance.		Phytoplankton biomass (measured as chlorophyll-*a*) did not exceed three times the reference median on more than one occasion during non-river flow period.
Physical & chemical stressors			
Organic enrichment	Organic matter in TWW is naturally decomposed by bacteria. Dissolved Oxygen (DO) concentration in water is used by the bacteria during the decomposition process. If the bacteria use more DO than they produce, the DO levels fall. Low DO levels can be harmful to marine life. DO concentration is assessed against the Environmental Protection Authority (EPA) guidelines.		DO remained >90% at all times at all sites near the outlet. DO levels near the outlet were similar to those at the reference sites. There was a very low risk of DO levels falling below critical levels.
Salinity	Salinity refers to the 'saltiness' of water. TWW is fresh whereas the ocean is saline. When TWW is discharged to the ocean, salinity will be reduced in an area around the outlet until the fresher water is fully mixed with the saline seawater. Low salinity water may cause stress to marine life.		Measurements of salinity near the outlet were similar to the salinity at appropriate reference sites. Stress to marine life from low salinity is unlikely.

Seafood Safe for Human Consumption

Seafood safe for human consumption aims to confirm that caught or grown seafood remains safe for eating. The top indicators we look at that give us an understanding of this are as follows:

Indicator	Indicator purpose	Result	Commentary
Microbial contaminants			
Thermotolerant coliforms (TTC) near the outlet	The risk from microorganisms to seafood safety is assessed using the indicator organism thermotolerant coliforms.		The relevant concentrations of TTC near the outlet were below the level where they can be detected by the laboratory. The risk to public health from microorganisms via seafood in the vicinity of the outlet was very low.
Shoreline TTC			The relevant concentrations of TTC adjacent the beaches were below the level where they can be detected by the laboratory. The risk to public health from microorganisms via seafood in the vicinity of the beaches was very low.
Algal biotoxins			
Toxic phytoplankton species	In some cases, phytoplankton can contain species than can taint seafood.		Densities of potentially toxic phytoplankton species did not exceed relevant guidelines on any occasion.

Primary and Secondary Contact Recreation

Primary and secondary contact recreation aims to confirm that water quality is suitable for primary (e.g. swimming and diving) and secondary (e.g. fishing and boating) recreation contact activities. The top indicators we look at that give us an understanding of this are as follows:

Indicator	Indicator purpose	Result	Commentary
Faecal indicator			
Enterococci spp. near the outlet	The risk from microorganisms to recreation contact (swimming and boating) is assessed using the indicator organism *Enterococci* spp.		The relevant concentrations of *Enterococci* spp. near the outlet were below the level where they can be detected by the laboratory. The risk to public health from bacteria via recreation in the vicinity of the outlet was very low.
Shoreline *Enterococci* spp.			The relevant concentrations of *Enterococci* spp. adjacent the beaches were below the level where they can be detected by the laboratory. The risk to public health from bacteria via seafood in the vicinity of the beaches was very low.
Algal biotoxins			
Phytoplankton cell concentration	In some cases, phytoplankton can reach concentrations that may harm swimmers (called blooms). The level that defines an algal bloom for recreational purposes is a phytoplankton cell count exceeding 10,000 cells/mL.		The chlorophyll-a based guidelines for phytoplankton are below a level that would be visible as an algal bloom. The highest total phytoplankton cell concentration in the notional HEPA was 266 cells/mL. There were no phytoplankton blooms observed during the monitoring period

Aesthetics

Aesthetics aims to confirm that aesthetic values of the marine environment are protected. The top indicators we look at that give us an understanding of this are as follows:

Indicator	Indicator purpose	Result	Commentary
Aesthetic factors	Perth's coastal waters are aesthetically pleasing, and that aesthetic value needs to be protected. Nuisance organisms (macrophytes, scums, algal mats, blue-green algae and fungus), dead organisms, dirty water, oily films, debris, or objectionable odours have the potential to reduce the aesthetic appeal.		Aesthetic values of Perth coastal waters were maintained and protected.

Executive Summary

This report documents the findings of the 2025-2026 Swanbourne monitoring program. The report outlines the findings of three environmental monitoring programs:

- Compliance Monitoring
- Whole of Effluent Toxicity (WET) testing
- Comprehensive Treated Wastewater Characterisation (CTWWC).

To maintain consistency with other metropolitan ocean outfall monitoring programs, the Swanbourne ocean outlet is part of the Perth Long Term Ocean Outlet Monitoring (PLOOM) program. The ocean monitoring program is consistent with the approach advocated under the State Government's Environmental Quality Management Framework (EQMF), which is applied to Western Australia's coastal waters (EPA 2016). Results are reported in the context of the EQMF described in EPA (2017). Under the EQMF, Water Corporation should annually demonstrate achievement against Environmental Quality Objectives (EQOs):

- Maintenance of Ecosystem Integrity
- Maintenance of Seafood for Human Consumption
- Maintenance of Primary and Secondary Recreation
- Maintenance of Aesthetic Values.

The compliance results for 2025-2026 are summarised in this document which contains colour-coded results with the individual colours representing the extent to which the Environmental Quality Criteria (EQC) were met.

Summary report card legend

Management response[1]	Colour
Monitor: EQG & EQS met (continue monitoring)	
Investigate: EQG not met (investigate against the EQS)	
Action: EQS not met (management response required)	

Notes:

1. The required response following an exceedance of either the Environmental Quality Guideline (EQG) or Environmental Quality Standard (EQS) is shown in parentheses.

Environmental Quality Objective 'Maintenance of Ecosystem Integrity'

There are several EQC relevant to the EQO 'Maintenance of Ecosystem Integrity': the first is assessed based on the constituents of the treated wastewater (TWW) stream and their potential toxicity, while the remainder are based on monitoring of water column nutrients, phytoplankton abundance and physical-chemical stressors in the receiving environment. While nutrient data is collected during each sampling event, these results are not used as primary assessment criteria for the EQO (EPA 2016). Instead, the nutrient data is used to provide contextual information, support further investigation of exceedances triggered by primary productivity indicators, and for comparison with ANZG (2018) trigger values where required.

Toxicants in treated wastewater

There are four Environmental Quality Guidelines (EQGs) for TWW toxicants:

- **EQG 1:** Concentrations of bioaccumulating toxicants (specifically, cadmium and mercury) must be below their respective ANZG (2018) 80% species protection guidelines prior to discharge and dilution with seawater. Concentrations of bioaccumulating toxicants were below their laboratory limits of reporting and the 80% species protection guidelines in all cases, thus meeting the EQG.
- **EQG 2:** Concentrations of non-bioaccumulating contaminants must not exceed the ANZG (2018) 99% species protection guideline at the notional Low Ecological Protection Area (hereafter LEPA) boundary (100 m radius from the diffuser). Initial dilution modelling for conditions on 20 January 2026 found that Swanbourne outlet was achieving a worst-case initial dilution of 1:116. This was sufficient to dilute all contaminants to concentrations below their respective 99% species protection guidelines. The EQG 2 for toxicants in TWW was therefore met.
- **EQG 3:** The total toxicity of the mixture (TTM) for the additive effect of ammonia, copper, and zinc in the diluted TWW plume must be less than 1.0 (ANZG 2018). The TTM following initial dilution was 0.73, which is lower than the guideline and the EQG 3 was met.
- **EQG 4:** The typical dilutions achieved at the LEPA boundary were 1:116. The highest NOEC concentration of TWW recorded across the 1-hour sea urchin fertilisation tests was 25% (equivalent to 1:4 dilutions. As the dilutions achieved at the LEPA (116) was greater than the dilutions required (4), EQG 4 was met.

Water quality monitoring – receiving environment

Ocean sampling was conducted between December 2025 and March 2026 at fixed distance intervals down-current (determined using a drogue) of the outlet. There are six Environmental Quality Guidelines (EQGs) based on chlorophyll-*a* concentration (a measure of phytoplankton biomass), salinity, dissolved oxygen and light attenuation coefficient:

Nutrient enrichment:

- **EQG 1:** The median chlorophyll-*a* concentration in the notional HEPA (i.e., 100 m and greater from the diffuser) during the non-river flow period must not exceed the 80th percentile of historical reference site data. Median chlorophyll-*a* concentration within the high ecological protection area (HEPA; 0.3 µg/L) was lower than the 80th percentile of historical reference site concentrations (0.4 µg/L) and the EQG was met.
- **EQG 2:** The median light attenuation coefficient in the notional HEPA must not exceed the 80th percentile of historical reference site data. Median LAC within the HEPA (0.079 m^{-1}) was lower than the 80th percentile of historical reference sites (0.09 m^{-1}) and the EQG 2 was met

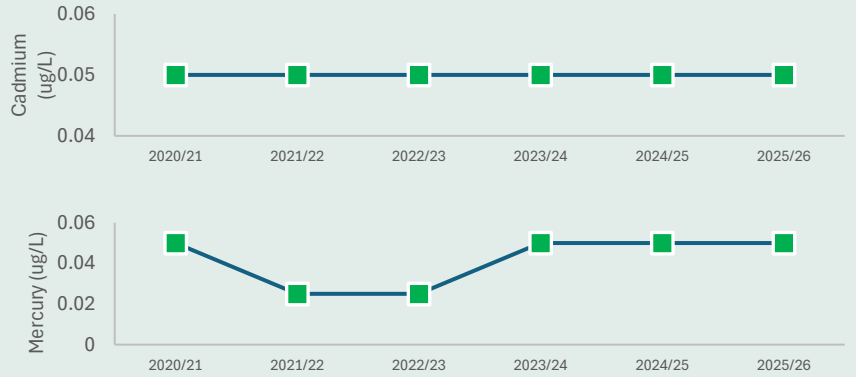
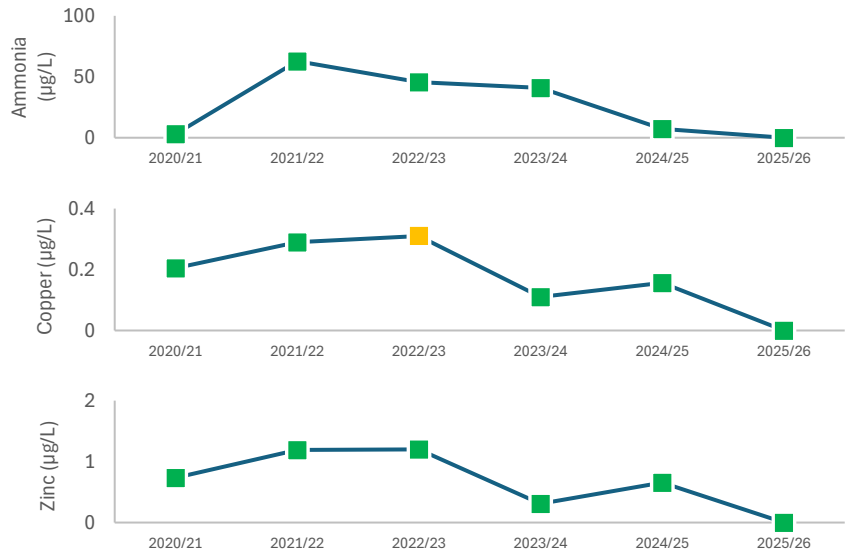
Phytoplankton blooms:

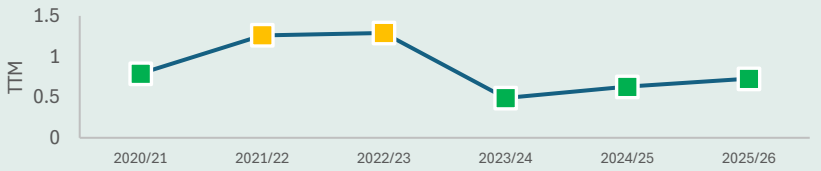
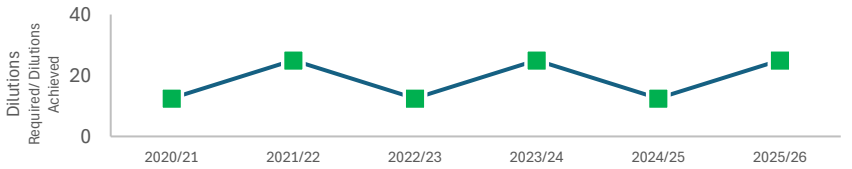
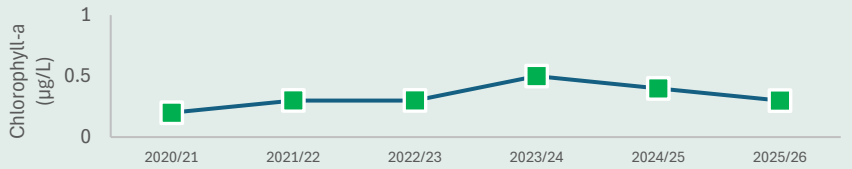
- **EQG 1:** Median phytoplankton biomass, measured as chlorophyll-*a* must not exceed three times the median chlorophyll-*a* concentration of reference sites (0.6 µg/L) on any occasion. Median chlorophyll-*a* concentrations did not exceed this value on any occasion, therefore the EQG 1 was met.
- **EQG 2:** Median phytoplankton biomass measured as chlorophyll-*a* at any site must not exceed three times the median chlorophyll-*a* concentration of historical reference sites (0.6 µg/L), on 25% or more occasions. Phytoplankton biomass, measured as chlorophyll-*a*, did not exceed this value on any (0%) occasion at all four notional HEPA sites, therefore the EQG 2 was met

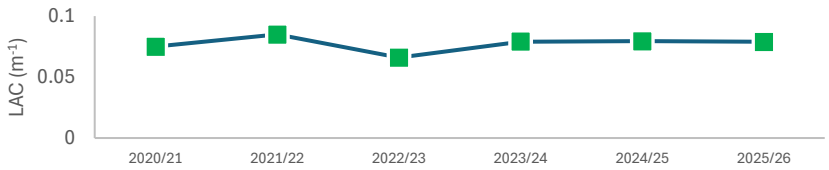
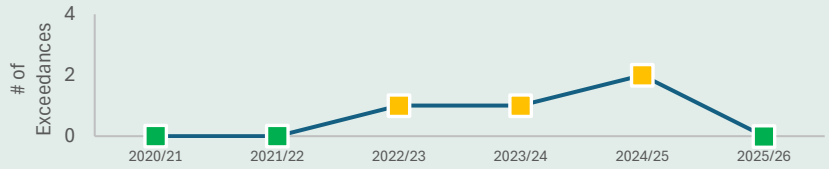
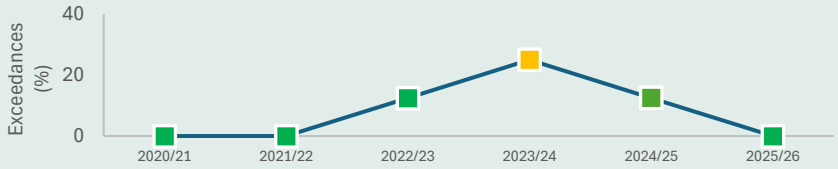
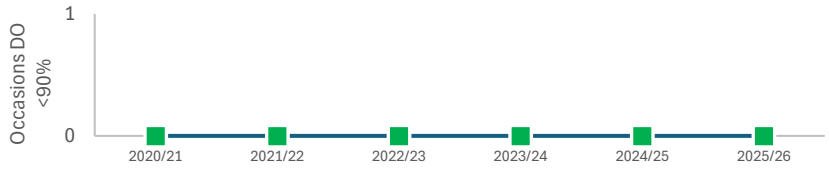
Physical-chemical stressors:

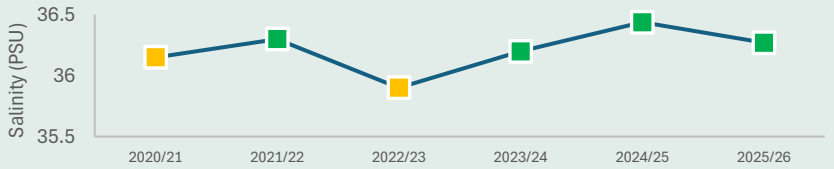
- **EQG 1:** Median dissolved oxygen in bottom waters (0 - 0.5 m above the sediment surface) in the HEPA must be greater than 90% saturation at any site for no less than 6 of the 8 scheduled sampling events during the summer monitoring period. Dissolved oxygen saturation within the notional HEPA was above 90% saturation at all times and the EQG was met.
- **EQG 2:** Median salinity (0.5 m below the water surface) at an individual site over any period is not to deviate beyond the 20th and 80th percentile of natural salinity range over the same period. Median salinity was between the 20th and 80th percentiles of the natural salinity range within the notional HEPA (at 100, 350, 1000, and 1500 m from the outlet) and the EQG 2 was met.

Summary report card for the Environmental Quality Objective 'Maintenance of Ecosystem Integrity'

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
Toxicants in treated wastewater (TWW)	Bioaccumulating toxicants	EQG 1	Concentrations of cadmium and mercury in the undiluted TWW stream were below their limit of reporting (LoR; <0.1 µg/L) and the ANZG (2018) 80% species protection guidelines (36 and 1.4 µg/L, respectively).		
	Non-bioaccumulating toxicants and initial dilution	EQG 2	Initial dilution on 20/01/2026 (1:116) was sufficient to reduce non-bioaccumulating contaminant concentrations to below their ANZG (2018) 99% species protection guidelines.		

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
	Total Toxicity of the Mixture (TTM)	EQG 3	The TTM for the additive effect of ammonia, copper, and zinc after initial dilution (0.73) was below the ANZG (2018) guideline of 1.0		
	Whole of Effluent Toxicity (WET)	EQG 4	The highest NOEC concentration of TWW recorded across the 1-hour sea urchin fertilisation tests was 25% (equivalent to 1:4 dilutions or 1:40 dilutions with application 0.1 assessment factor), which is lower than the worst-case dilutions achieved at the LEPA[2] boundary during the monitoring period (1:116).		
Nutrient enrichment	Chlorophyll-*a*	EQG 1	Median chlorophyll-*a* concentration within the high ecological protection area (HEPA[2]; 0.3 µg/L) was lower than the 80th percentile of historical reference site concentrations (0.4 µg/L).		

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
	Light Attenuation Coefficient (LAC)	EQG 2	Median LAC within the notional HEPA[2] (0.079 m^{-1}) was lower than the 80th percentile of historical reference sites (0.09 m^{-1}).		
Phytoplankton blooms	Phytoplankton biomass (measured as chlorophyll-*a*)	EQG 1	Median chlorophyll-*a* concentrations did not exceed three times the median of reference sites on any occasion.		
		EQG 2	Phytoplankton biomass, measured as chlorophyll-*a*, exceeded three times the median chlorophyll-*a* concentration of historical reference sites (0.6 µg/L) on 0% of occasions.		
Physical-chemical stressors	Organic enrichment	EQG 1	Dissolved oxygen (DO) saturation within the notional HEPA[2] was maintained above 90% saturation at all times.		

Environmental Quality Indicator	EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
Salinity	EQG 2	Median salinity was between the 20th and 80th percentiles of the natural salinity range within the notional HEPA[2] (at 100, 350, 1,000, and 1500 m from the outlet).		

Notes:

1. Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG.
2. LEPA = Low Ecological Protection Area (notional); HEPA = High Ecological Protection Area
3. NOEC = No Observed Effect Concentration; the highest concentration of TWW at which there is no statistically significant observed effect on gamete fertilisation.

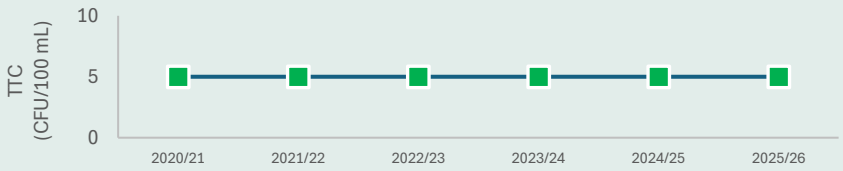
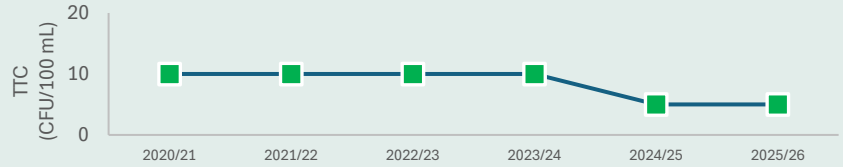
Environmental Quality Objective ‘Maintenance of Seafood Safe for Human Consumption’

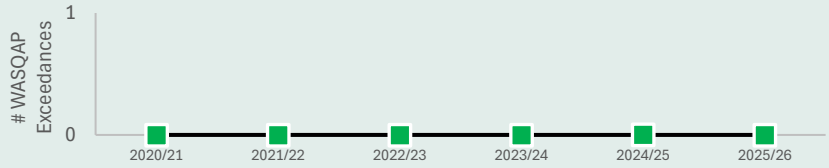
There are two EQC for the EQO 'Maintenance of the Seafood Safe for Human Consumption': the first is based on in water concentrations of thermotolerant coliforms (TTC), and the second is based on in-water concentrations of toxic phytoplankton species (to monitor for algal biotoxins):

- To meet the EQG for TTC at the boundary of the notional Seafood Management Observed Zone of Influence (OZI), median TTC concentrations are not to exceed 14 CFU/100 mL and no more than 10% of TTC concentrations should exceed 21 CFU/100 mL. The median TTC concentration from three sampling seasons (2023-24, 2024-25 and 2025-26)[1] was at the limit of reporting, <10 CFU/100 mL, and below the 14 CFU/100 mL guideline, meeting the EQG. The percentage of samples with TTC concentrations exceeding 21 CFU/100 mL was below the 10% criteria, meeting the EQG.
- Water Corporation conducts additional TTC monitoring along the shoreline. These results are informally assessed against the EQC. To meet the informal EQG for TTC at the shoreline, median TTC concentrations at shoreline monitoring sites should not exceed 14 CFU/100 and no more than 10% of TTC concentrations should exceed 21 CFU/100 mL. The median TTC concentration from two sampling seasons (2024-25 and 2025-26)[1] was at the limit of reporting, <10 CFU/100 mL, and below the 14 CFU/100 mL guideline, meeting the informal EQG. The percentage of samples with TTC concentrations exceeding 21 CFU/100 mL was below the 10% criteria, meeting the informal EQG.
- To meet the EQG for algal biotoxins, concentrations of potentially toxic algae at sites at the boundary of the notional Seafood Management OZI must not exceed the Western Australian Shellfish Quality Assurance Program (WASQAP; DoH 2025) concentrations. There were no exceedances of the relevant WASQAP guidelines on any occasion, meeting the EQG for toxic phytoplankton species.

[1] *NHMRC (2008) guidelines and EPA (2005) suggest that a minimum of 100 samples over the non-river flow period (pooled from multiple years if required) are needed for accurate assessment of microbial water quality EQC.*

Summary report card for the Environmental Quality Objective 'Maintenance of Seafood Safe for Human Consumption'

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)[7]
Microbiological contaminants (outlet sites)	Thermotolerant coliforms (TTC)[2,3]	EQG 1	Median[2] TTC concentrations derived from 120 samples collected over the 2023-24, 2024-25 and 2025-26 sampling seasons was at the limit of reporting[6] (<10 CFU/100 mL) and below the 14 CFU/100 mL criteria.		
			The percentage of TTC samples with concentrations exceeding 21 CFU/100 mL was 6.67%, below the 10% criteria.		
Microbiological contaminants (additional shoreline sites)[5]		EQG 2	Median[2] TTC concentrations derived from 128 shoreline samples collected over the 2024-25 and 2025-26 sampling seasons was at the limit of reporting[6] (<10 CFU/100 mL) and below the 14 CFU/100 mL criteria.		

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)[7]
			The percentage of shoreline TTC samples with concentrations exceeding 21 CFU/100 mL was 2.3%, below the 10% criteria.		
Algal biotoxins	Toxic phytoplankton species	EQG 1	During the 2025-2026 monitoring period, there were no possible instances of toxic phytoplankton exceeding the WASQAP[4].		

Notes:

1. Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber and red symbols represent an exceedance of the EQG or Environmental Quality Standard (EQS), respectively.
2. TTC results below the analytical limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate median value (ANZG 2018).
3. TTC = Thermotolerant coliforms, CFU = colony forming units.
4. Marine Biotoxin Monitoring and Management Plan 2025 version 5: Western Australian Shellfish Quality Assurance Program (WASQAP; DoH 2025)
5. Additional Shoreline Monitoring commenced in the 2011-12 sampling season. Shoreline sites are informally assessed against the EQC.
6. Where results were reported at or below the laboratory Limit of Reporting (LOR), a value of 0.5 × LOR was assigned for analysis.
7. Previous years assessed TTC concentrations as 90th percentiles. From the 2023-24 monitoring period onwards, TTC concentrations are instead assessed as the percentage of samples with concentrations >21 CFU/100 mL.

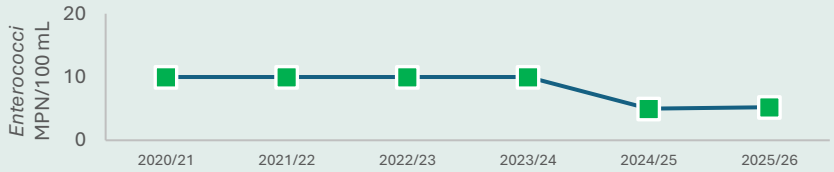
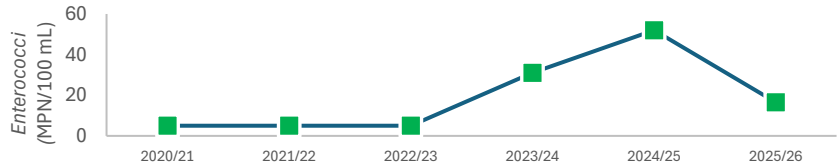
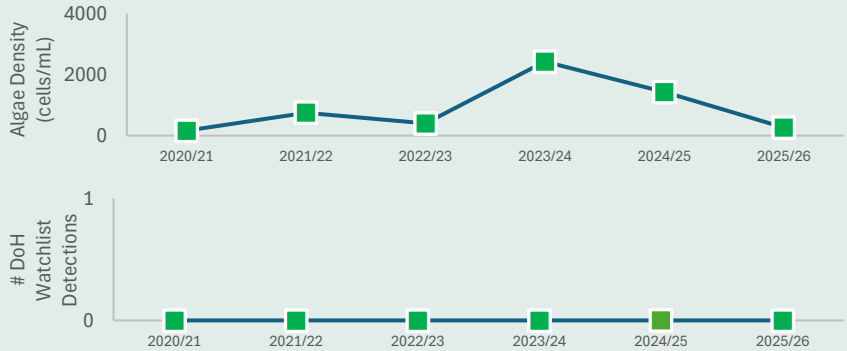
Environmental Quality Objective 'Maintenance of Primary and Secondary Recreation'

There are two EQC for the EQO 'Maintenance of Primary and Secondary Recreation': the first is based on in-water concentrations of faecal indicators (*Enterococci* spp.), and the second is based on in-water measures of total phytoplankton cell densities.

- **EQG 1 and EQG 2:** To meet the faecal indicators EQGs, the 95th percentile value for *Enterococci* spp. concentrations outside the notional Contact Recreation Management OZI boundary must not exceed 200 MPN/100 mL and 2,000 MPN/100 mL for primary and secondary contact recreation, respectively. The 95th percentile of *Enterococci* spp. concentrations based on pooled data from three sampling seasons (2023–2024, 2024–2025 and 2025-2026)[2] was <10 MPN/100 mL, meeting the EQGs for both primary (EQG 1) and secondary (EQG 2) contact recreation.
- **EQG 1 and EQG 2:** Water Corporation conducts additional *Enterococci* spp. monitoring along the shoreline. These results are informally assessed against the EQC. To meet the informal *Enterococci* spp. EQGs, the 95th percentile value of *Enterococci* spp. concentrations along the shoreline must not exceed 200 MPN/100 mL and 2,000 MPN/100 mL for primary and secondary contact recreation, respectively. The 95th percentile of *Enterococci* spp. concentrations at shoreline sites, based on pooled data from two sampling seasons (2024-25 and 2025-26)[2], was 16.5 MPN/100 mL, meeting the EQGs for both primary (EQG 1) and secondary (EQG 2) contact recreation.
- **EQG 1:** To meet the algal biotoxin EQG, total phytoplankton cell concentration at any site must not exceed 10,000 cells/mL during normal plant operating conditions. Additionally, any watch-list species as defined by the Department of Health (DoH; 2022) should not exceed their trigger levels. The highest recorded total phytoplankton cell concentration was 266 cells/mL and the EQG was met. Watch list species did not exceed their respective trigger levels during the monitoring period (DoH; 2022).
- **EQG 2:** To meet the toxic algae EQG 2, there were no reports of skin or eye irritation or potential algal poisoning (via Department of Health) in swimmers considered by a medical practitioner as potentially resulting from toxic algae when less than 10,000 cells/mL is present in the water column. There were no reports during the 2025-26 monitoring period, and EQG 2 was met.

[2] *NHMRC (2008) guidelines and EPA (2005) suggest that a minimum of 100 samples over the non-river flow period (pooled from multiple years if required) are needed for accurate assessment of microbial water quality EQC*

Summary report card for the Environmental Quality Objective 'Maintenance of Primary and Secondary Contact Recreation'

Environmental Quality Indicator		EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
Faecal indicators (outlet sites)	*Enterococci* spp.[3]	EQG 1 EQG 2	The 95th percentile of *Enterococci* spp. concentrations near the outlet sites (<10 MPN/100 mL) was lower than the primary and secondary contact EQGs (200 and 2,000 MPN/100 mL, respectively).		
Faecal indicators (additional shoreline sites)[2]		EQG 1 EQG 2	The 95th percentile of *Enterococci* spp. concentrations at the shoreline (16.5 MPN/100 mL) was lower than the primary and secondary contact EQGs (200 and 2,000 MPN/100 mL, respectively).		
Algal biotoxins	Phytoplankton (cell concentration)	EQG 1	During the 2025-26 monitoring period, there were no phytoplankton cell concentrations exceeding 10,000 cells/mL, and no detections of DoH watch-list species exceeding their guidelines.		

Environmental Quality Indicator	EQC	Comments	Compliance[1]	6-year compliance trend (including current year)
	EQG 2	During the 2025-26 monitoring period[4], there were no reports from the Department of Health to Water Corporation about any skin or eye irritation or potential algal poisoning in swimmers considered by a medical practitioner on any occasion.		

Notes:

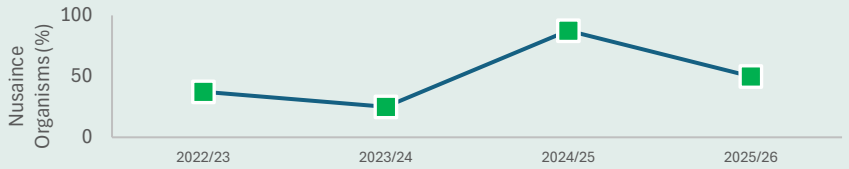
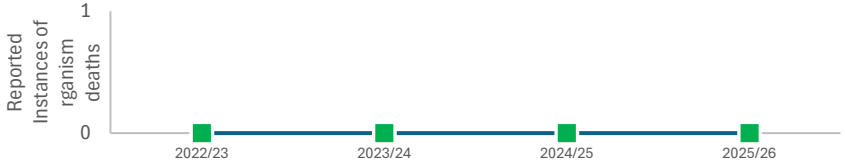
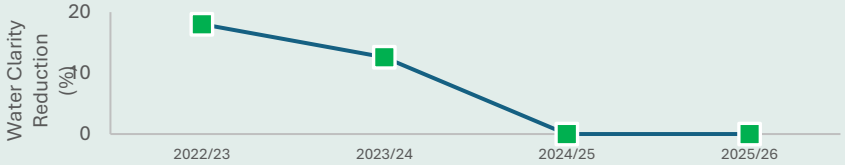
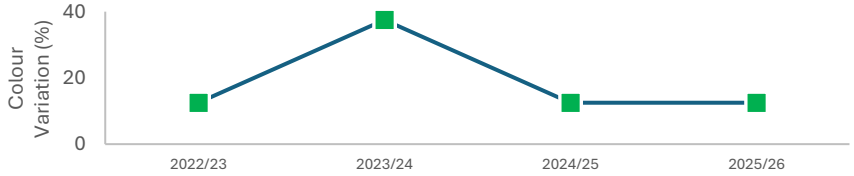
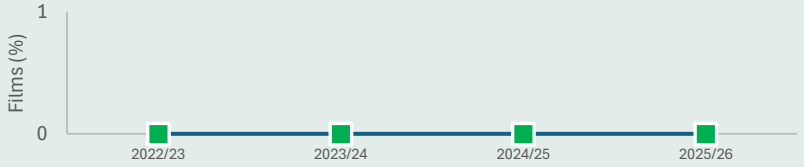
1. Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Additional Shoreline Monitoring commenced in the 2011-12 sampling season. Shoreline sites are informally assessed against the EQC.
3. Monitoring for *Enterococci* spp. concentrations commenced in the 2020-21 sampling season.
4. The Department of Health reports have been included in the compliance trends since the previous monitoring period (2024/25).

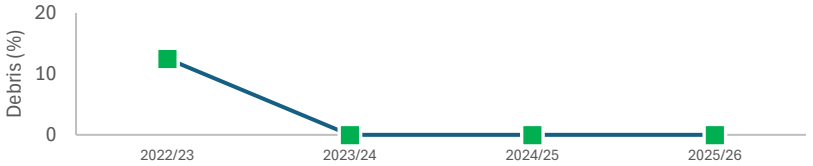
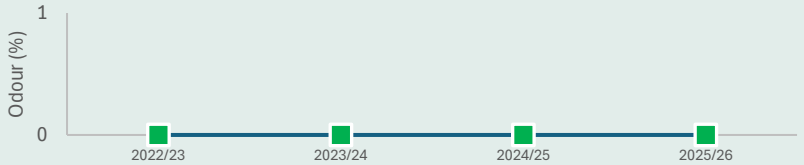
Environmental Quality Objective ‘Maintenance of Aesthetic Values’

The EQO ‘Maintenance of Aesthetic Values’ is to confirm that Perth’s coastal waters are aesthetically pleasing and that the aesthetic value is protected. There are a series of EQGs that confirm this EQO is being met:

- Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, and sewage fungus should not be present in excessive amounts. Seagrass fronds were observed on 4 of the 8 sampling events but were not present in excessive amounts nor considered nuisance organisms at the densities observed by the field scientists. Therefore, the EQG was met.
- There should be no reported incidents of large-scale deaths of marine organisms relating from unnatural causes. There were no instances of dead marine organism observed and the EQG was met.
- The natural visual clarity of the water should not be reduced by more than 20%. Measurements of light attenuation determined that the natural visual clarity of the water was not reduced (0%) (i.e. <20%) and the EQG was met.
- The natural hue of the water should not be changed by more than ten points on the Munsell scale. There was no instances of colour variation recorded for any sampling event. Therefore, the EQG was met.
- Oil and petrochemicals should not be noticeable as a visible film on the water or detectable by odour. No surface films or oil were recorded on any sampling event and the EQG was met.
- Water surfaces should be free of floating debris, dust and other objectionable matter, including substances that cause foaming. No floating debris or matter was visible on the surface on any sampling occasion and the EQG was met.
- There should be no objectionable odour. No noticeable odour was detected on any sampling occasion and the EQG was met

Summary report card for the Environmental Quality Objective 'Maintenance of Aesthetic Values'

Environmental Quality Indicator	EQC	Comments	Compliance[1]	4-year compliance trend (including current year)[2]
Nuisance organisms	EQG	Seagrass fronds were observed on 4 of the 8 sampling events but were not present in excessive amounts nor considered nuisance organisms at the densities observed by the field scientists. Therefore, the EQG was met.		
Faunal deaths	EQG	There were no instances of dead marine organism observed and the EQG was met.		
Water clarity	EQG	Measurements of light attenuation determined that the natural visual clarity of the water was not reduced (0%), which is less than the 20% EQG threshold. The EQG was therefore met.		
Colour	EQG	There was no noticeable colour change recorded on any sampling event. Therefore, the EQG was met.		
Surface films	EQG	No surface films or oil were recorded on any sampling event.		

Environmental Quality Indicator	EQC	Comments	Compliance[1]	4-year compliance trend (including current year)[2]
Surface debris	EQG	No floating debris or matter was visible on the surface on any sampling occasion.		
Odour	EQG	No noticeable odour was detected on any sampling occasion.		

Notes:

1. Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Aesthetic Monitoring commenced in the 2022-23 sampling season.

1 Introduction

1.1 Document purpose

This annual report documents the findings of the 2025-2026 Swanbourne ocean monitoring program, completed as part of the Perth Long-term Ocean Outfall Monitoring (PLOOM) Program. Monitoring was completed according to Western Australia's Environmental Quality Management Framework (EQMF; EPA 2016).

1.2 Wastewater treatment plant infrastructure and discharge

The Subiaco Water Resource Recovery Facility (WRRF) treats predominantly domestic wastewater from the central Perth area. The treated wastewater (TWW) comprises ~95% domestic wastewater and less than 5% industrial wastewater. The Subiaco WWRF discharges ~56 ML/day of secondary TWW to the ocean through a sub-marine ocean outlet (~11 m depth) offshore from Swanbourne Beach (Figure 1).

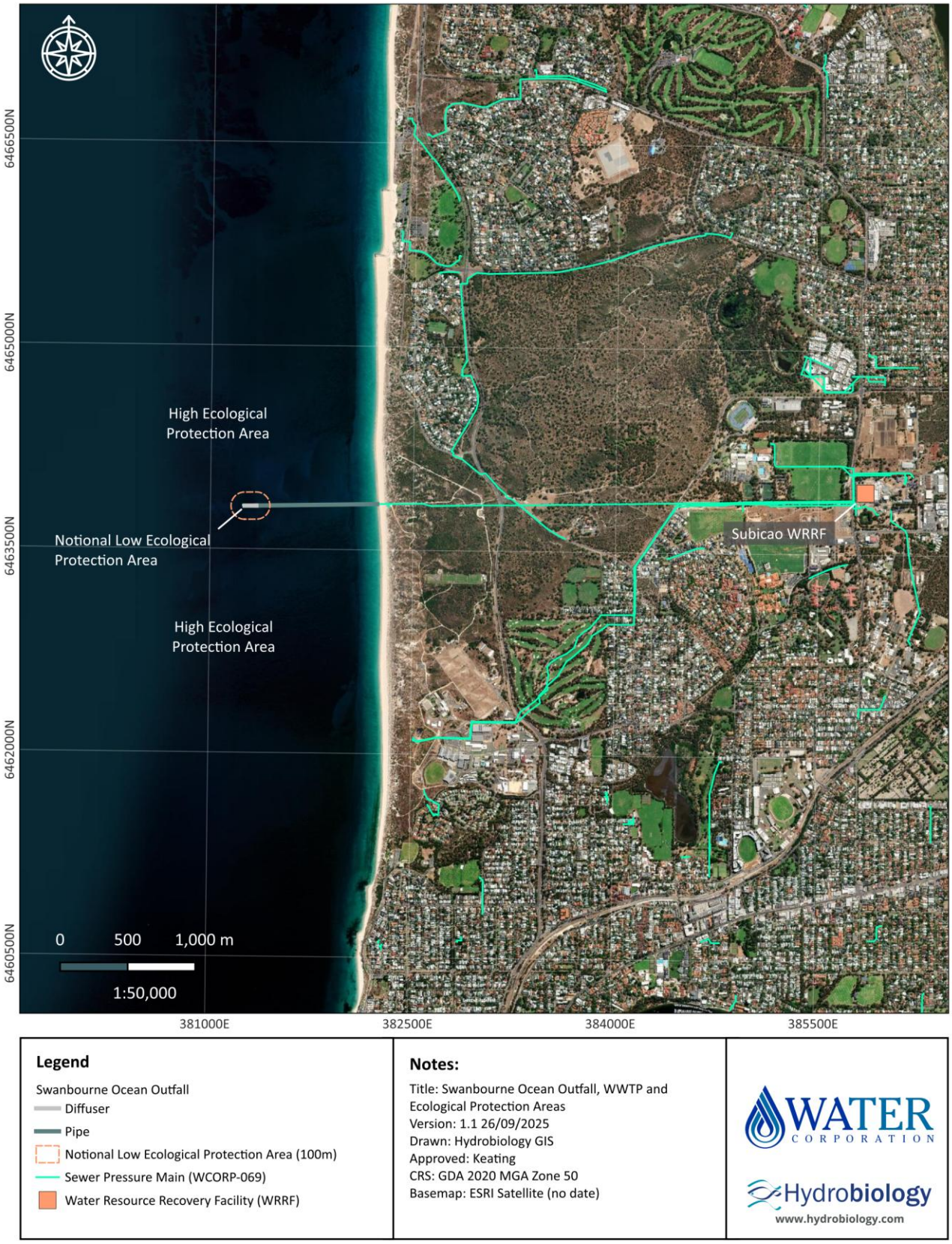


Figure 1 Location of the Subiaco WRRF and Swanbourne ocean outlet.

1.3 Potential stressors in treated wastewater

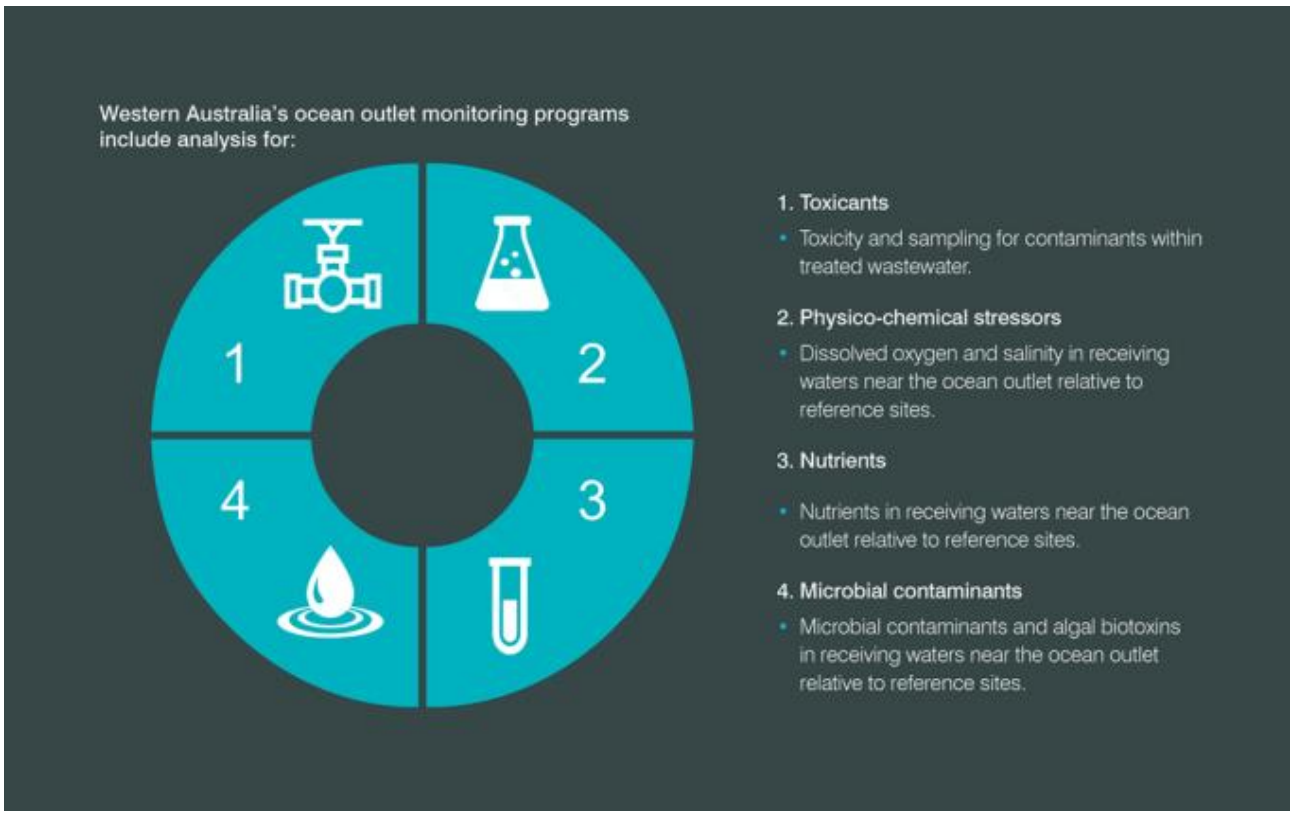


Figure 2 Potential stressors in treated wastewater

1.3.1 Toxicants

Metals and persistent organic compounds may be directly toxic to marine biota and/or may accumulate in marine biota at concentrations sufficient to pose a risk to humans if consumed. Under the PLOOM program, TWW is screened for bioaccumulating and non-bioaccumulating toxicants, and the concentrations are compared to relevant EPA guidelines. To account for the synergistic effects of multiple toxicants and toxicants without guidelines, the overall toxicity of the TWW is determined using whole effluent toxicity (WET) testing.

1.3.2 Physio-chemical stressors

TWW contains organic matter, the decomposition of which by microorganisms uses oxygen. If more dissolved oxygen (DO) is consumed than is produced, DO levels decline. Measurements of DO saturation in receiving waters near the outlets, relative to measurements at reference sites, provide an indication of the risk posed by deoxygenation.

Reduced salinity near the outlets, resulting from freshwater in the TWW plume, may cause osmotic stress in marine biota. Measurements of salinity in receiving waters near the outlets are compared to the salinity at appropriate reference sites. The comparison allows evaluation of whether salinity near the outlets is within the range of natural variation.

1.3.3 Nutrients

TWW contains elevated concentrations of biologically available nutrients such as ammonia, nitrite, nitrate and orthophosphate. At times, the addition of nutrients may stimulate phytoplankton growth beyond natural levels, which can lead to shading of photosynthetic organisms such as seagrasses and/or macroalgae. The potential for shading is measured using in-water measures of chlorophyll-*a* (a proxy for phytoplankton biomass) and light attenuation (a measure for water clarity).

Although most algal blooms are harmless, some contain species that produce toxins that may be harmful to swimmers (via ingestion or skin contact) or contaminate seafood. Phytoplankton species composition and cell concentrations are monitored to confirm concentrations are within acceptable limits.

Nutrient concentrations are monitored in each sampling season however these are not presented within the report unless required as supporting evidence if primary productivity indicators are exceeded or require further investigation. This data also serves as a backup, allowing comparison against ANZG (2018) default trigger values if primary productivity samples are unavailable or compromised.

1.3.4 Microbial contaminants

Disease-causing organisms in the TWW pose a risk to humans if exposed during primary and/or secondary contact activities (i.e. swimming and boating). The same organisms, if ingested by marine fauna, may reduce their suitability for human consumption. To assess the risk, concentrations of indicator organisms are routinely compared to the Environmental Protection Authority's (EPA's) criteria for primary and secondary contact, and the criteria for seafood safe for human consumption.

1.4 Environmental management approach

To maintain consistency with other metropolitan ocean outlet monitoring programs, the Swanbourne ocean outlet (Figure 3) is part of the Perth Long-term Ocean Monitoring (PLOOM) Program.



Figure 3 Aerial image of Swanbourne ocean outlet

1.5 Environmental Quality Management Framework (EQMF)

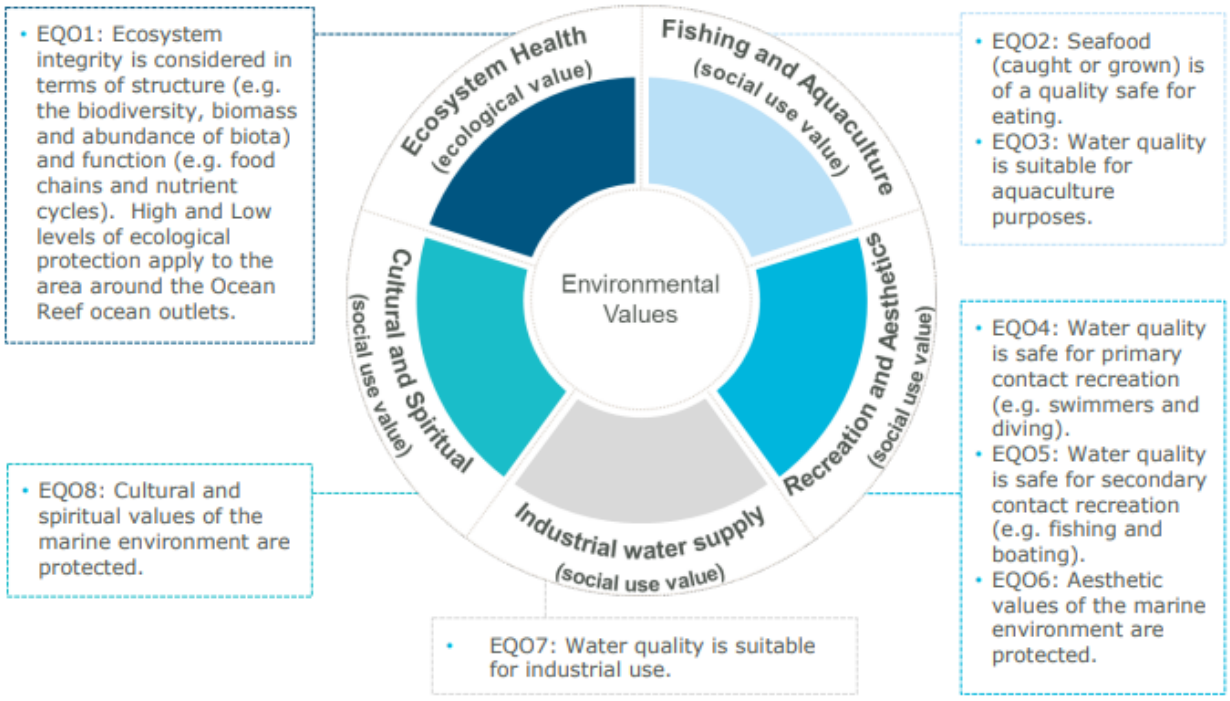
The ocean monitoring program is consistent with the approach advocated under the State Government's EQMF, which is applied to Western Australia's coastal waters (EPA 2016).

The EQMF is based on:

- Identifying Environmental Values (EVs; Figure 4).
- Establishing and spatially defining Environmental Quality Objectives (EQOs) that need to be maintained to ensure the associated EVs are protected (Figure 4).
- Monitoring and managing to ensure the EQOs are achieved and/or maintained in the long-term in the areas they have been designated.
- Establishing Environmental Quality Criteria (EQC), which are quantitative benchmarks or 'guidelines' against which monitoring results can be compared.

There are two levels of EQC:

1. **Environmental Quality Guidelines (EQGs)** are quantitative investigative guidelines which, if met, indicate there is a high degree of certainty that the associated EQO has been achieved. If the guideline is not met a more detailed assessment against the EQS is triggered.
2. **Environmental Quality Standards (EQSs)** are management guidelines which, if exceeded, signify that the EQO is at risk of not being met and that a management response may be required.



Source: EPA (2016)

Figure 4 Environmental Values and Environmental Quality Objectives (EQO) for the marine waters of Western Australia.

The compliance results for 2025-26 are summarised in Report Card format (Table 1). The report card contains colour-coded results with the individual colours representing the extent to which the Environmental Quality Criteria (EQC) were met.

Table 1 Report card legend

Management response[1]	Colour
Monitor: EQG & EQS met (continue monitoring)	
Investigate: EQG not met (investigate against the EQS)	
Action: EQS not met (management response required)	

Notes:

1. The required response following an exceedance of either the Environmental Quality Guideline (EQG) or Environmental Quality Standard (EQS) is shown in parentheses.

1.5.1 Maintenance of Ecosystem Integrity EQO

The intent of this EQO is to maintain a healthy and diverse ecosystem. There are four levels of ecological protection, with each applied depending on the designated level required: low, moderate, high or maximum (Figure 5). A notional Low Ecological Protection Area (LEPA) has been established around the Swanbourne outlet, as per technical guidance (EPA 2016). The notional LEPA occupies the area within a 100 m radius of the diffuser (Figure 6). Waters outside the notional LEPA are designated a High Ecological Protection Area (HEPA; Figure 6).

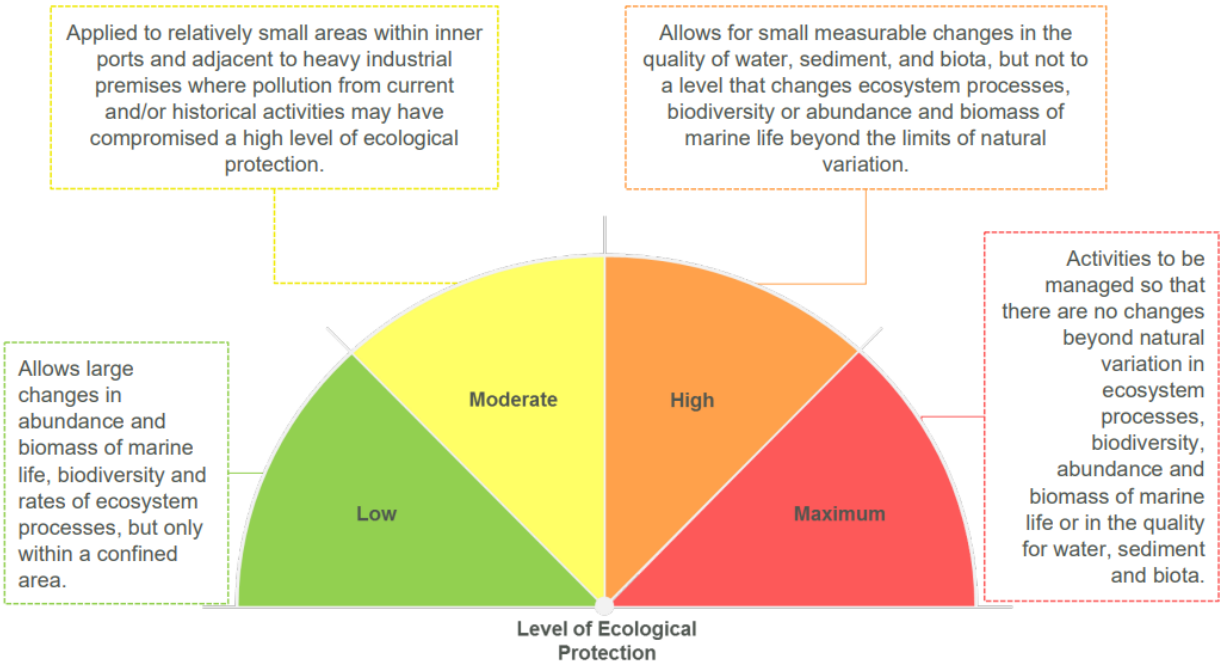


Figure 5 Levels of Ecological Protection

1.5.2 Maintenance of Seafood Safe for Human Consumption EQO

The intent of this EQO is to maintain seafood safe for human consumption (a social value) outside a small area surrounding the ocean outlets where EQO 2 may not be achieved, and seafood may be unsafe to eat.

Formal management zones have not been established for the Swanbourne outlet. However, a notional Seafood Management Observed Zone of Influence (OZI) has been established based on microbiological data from ten years of historical monitoring records (Figure 6). The Seafood Management OZI represents the area where microbiological organism concentrations are most likely to exceed the EPA's criteria for seafood safe for human consumption under worst-case conditions.

1.5.3 Maintenance of Primary and Secondary Contact Recreation EQOs

The primary and secondary contact EQOs support swimming and boating activities, respectively. The EQOs apply throughout Perth's coastal waters except for areas immediately surrounding the ocean outlet, where water quality may not be suitable for swimming. A notional Contact Recreation Management Observed Zone of Influence (OZI) has been developed for the Swanbourne outlet encompassing the management area for primary and secondary contact recreation (Figure 6). As the EQO for maintenance of primary contact recreation uses a higher water quality standard than secondary contact recreation, it is assumed that if the primary contact criteria are met, then the secondary contact criteria are also met by default.

1.5.4 Maintenance of Aesthetic Value EQO

The objective of this EQO is to ensure that the aesthetic value of Perth's coastal waters is protected. To confirm this EQO is being met, monitoring routinely assesses the quality of the surface water appearance.

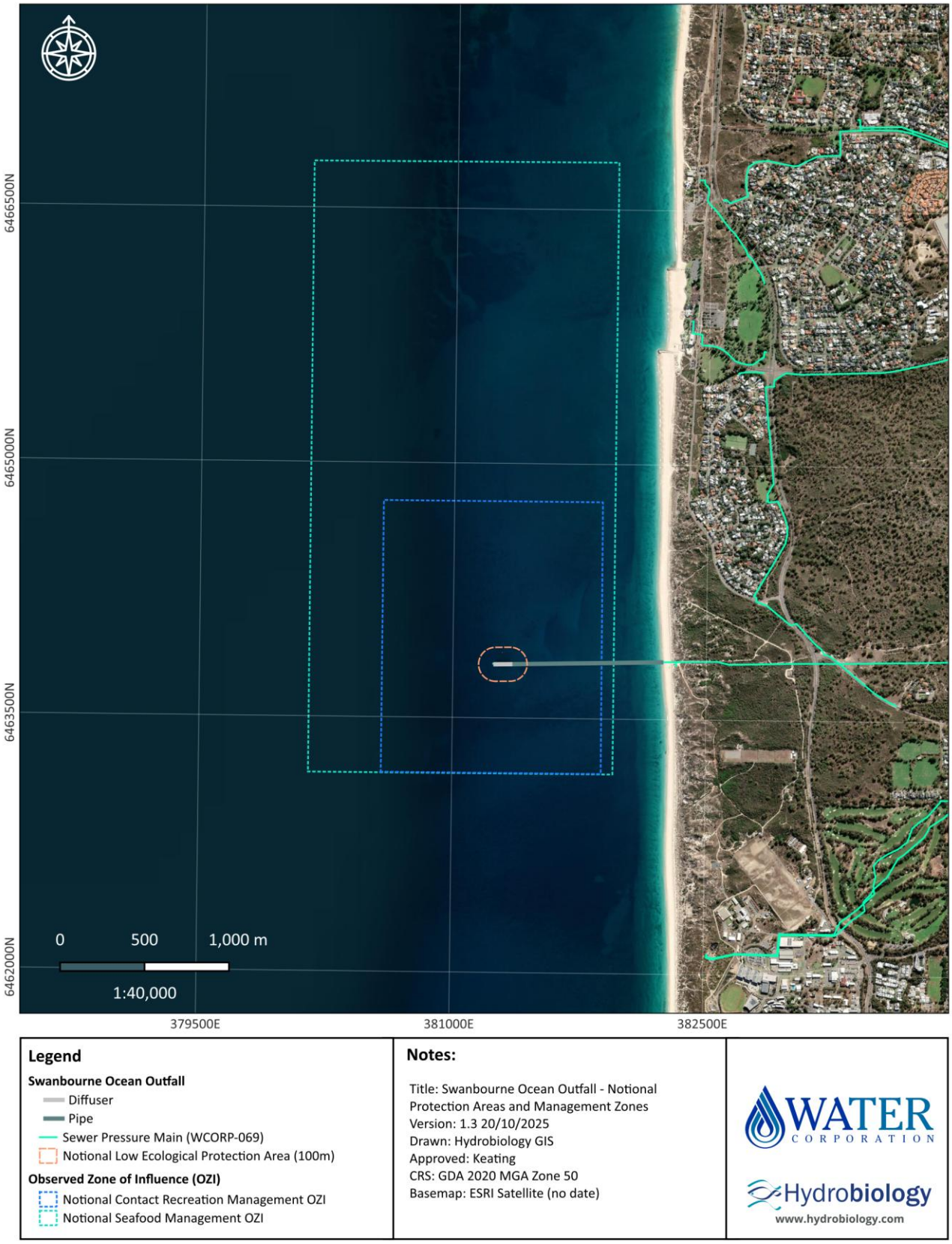


Figure 6 Swanbourne ocean outlet notional protection area and management zones

2 Toxicants in treated wastewater

2.1 Comprehensive treated wastewater characterisation (CTWWC)

Treated wastewater (TWW; final effluent) from the Subiaco WRRF was analysed for a suite of potential contaminants of concern (Figure 7):

- nutrients (total nitrogen, ammonia, nitrate + nitrite [NO_x], total phosphorus, orthophosphate)
- microbiological contaminants (thermotolerant coliforms and *Enterococci* spp.)
- bioavailable metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc)
- pesticides and herbicides (organophosphate pesticides, organochlorine pesticides, triazine herbicides)
- polyaromatic hydrocarbons
- phthalates
- polychlorinated biphenyls
- benzene, toluene, ethylbenzene, and xylenes
- petroleum hydrocarbons
- surfactants
- dissolved organic carbon.

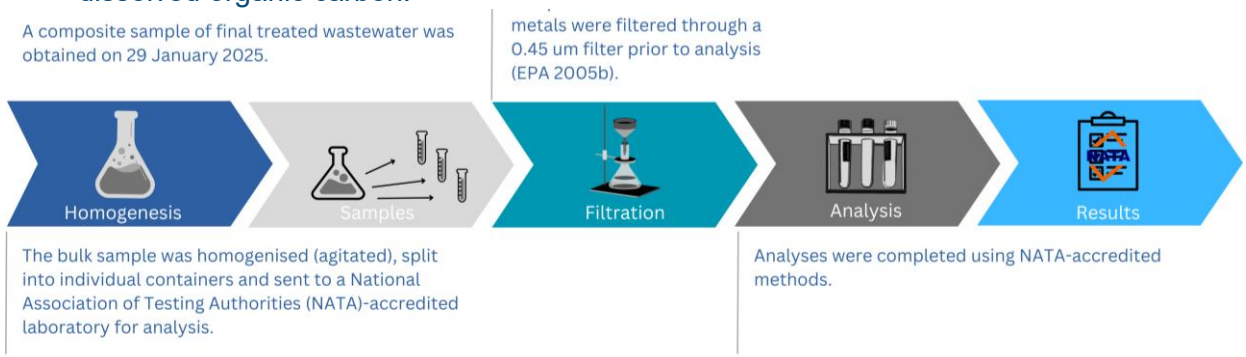


Figure 7 Treated wastewater sampling and analysis process

2.1.1 Bioaccumulating toxicants

Concentrations of bioaccumulating toxicants, cadmium and mercury, in the undiluted TWW sample were both below the limit of reporting (LoR; 0.1 µg/L) and the EQG concentrations for cadmium and mercury as bioaccumulating toxicants (36 and 1.4 µg/L, respectively) were met (Table 3).

Concentrations of bioaccumulating toxicants in the discharge have been consistent since 2007/08 (Figure 8)

Table 2 Environmental Quality Guideline (EQG) for bioaccumulating toxicants

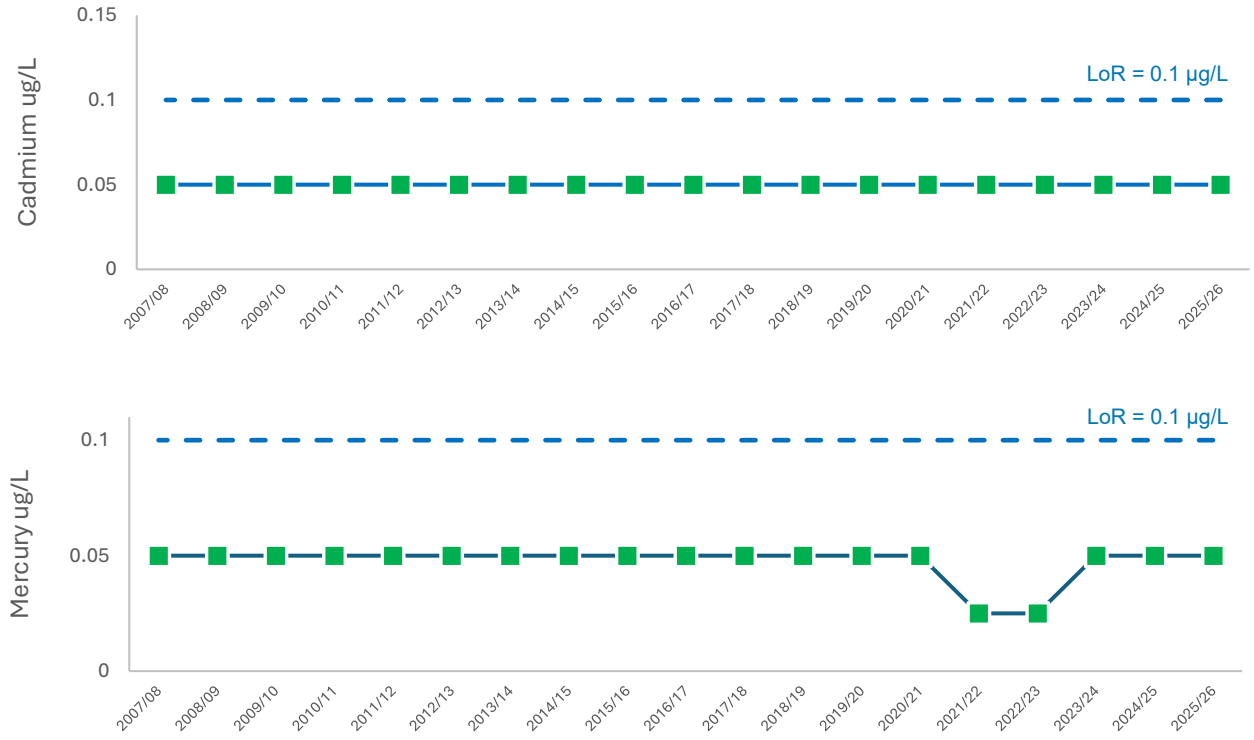
EQG[1]	Concentrations of bioaccumulating contaminants in the treated wastewater stream will not exceed the ANZG (2018) 80% species protection guidelines.

Notes:
1. EQG = Environmental Quality Guideline

Table 3 Bioaccumulating toxicants in the Swanbourne treated wastewater stream

Toxicant	Swanbourne TWW[3] concentration (µg/L)	Value used for assessment (half the LoR)[3,4]	ANZG (2018) 80% species protection guideline (µg/L)[2]	Compliance (EQC)[1]
Cadmium	<0.1	0.05	36	
Mercury	<0.1	0.05	1.4	

Notes:
1. Green symbols indicate the Environmental Quality Criteria (EQC) were met
2. Assessment against ANZG (2018) guidelines. The bioaccumulating toxicants cadmium and mercury must meet the 80% species protection guidelines at the diffuser (*i.e.* prior to initial dilution), and therefore a diluted concentration was not calculated.
3. TWW = Treated wastewater, LoR = Limit of Reporting
4. Cadmium and mercury concentrations below the detection limit of 0.1 µg/L are assigned a value of 0.05 µg/L (half the LoR) for reporting purposes.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Cadmium and mercury concentrations below the detection limit are assigned a value half that of the laboratory Limit of Reporting (LoR) for reporting purposes (i.e. concentrations below the detection limit of 0.1 µg/L are assigned a value of 0.05 µg/L).
3. The LoR for mercury in the 2021/22 and 2022/23 monitoring seasons (0.05 µg/L; with half the LoR = 0.025 µg/L) was different to previous years (0.1 µg/L) due to a change in laboratory.
4. Blue dashed line = Limit of reporting (LoR = 0.1 µg/L).
5. The use of half the LoR represents a conservative assumption that cadmium and mercury may be present at low concentrations despite being below the analytical limit of reporting.

Figure 8 Historical compliance of concentrations of bioaccumulating toxicants, cadmium and mercury

2.1.2 Non-bioaccumulating toxicants

Initial dilution model is used to estimate dilution rates of treated wastewater (TWW) surrounding the low and high ecological protection areas. From the discharge point on the seabed, the TWW plume becomes increasingly diluted as it rises towards the surface. The highest concentration of TWW plume at the surface (corresponding to the minimum dilution) is used to assess compliance.

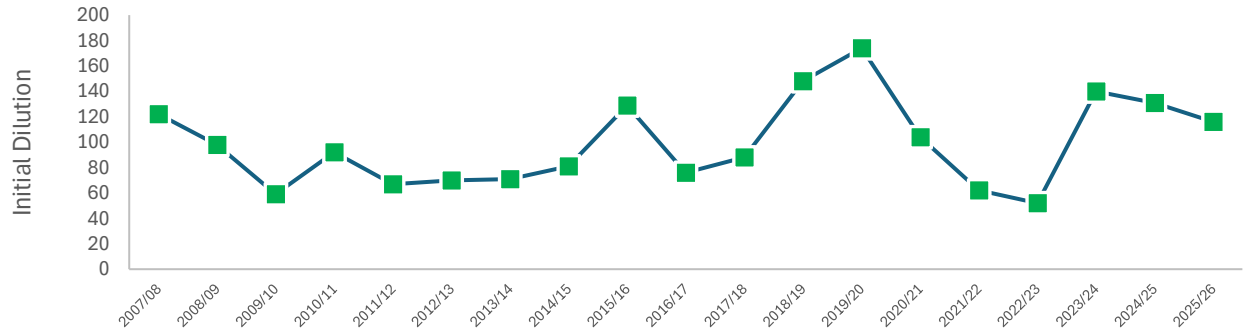
Modelling predicted an average initial dilution of 1:116, based on metocean conditions observed on the 20th March 2026, as a conservative estimate of the dilution expected at the notional LEPA boundary; as applied to the 2025/26 results for ammonia, copper and zinc (Figure 10). Contaminant concentrations after the initial dilution (1:116) were below the EPA (2017) 99% species protection guidelines (Table 4), and the EQG for non-bioaccumulating toxicants was met (Table 4). Historical initial dilution predictions are provided in Figure 9. Variability over time can be attributed to changes in the physical properties of the effluent and/or local metocean conditions.

Historical compliance of concentrations of the highest risk (concentration relative to guidelines) non-bioaccumulating toxicants are presented in Figure 10.

Table 4 Environmental Quality Guideline for non-bioaccumulating toxicants

EQG[1]	Treated wastewater contaminant concentration corrected for minimum dilution at the notional LEPA[1] boundary will ensure the ANZG (2018) 99% species protection guidelines for toxicants are being achieved at the boundary of the LEPA[1] (i.e. a high level of protection is met beyond a 100 m radius of the diffuser).

Notes:
1. EQG = Environmental Quality Guideline; LEPA = Low Ecological Protection Area (notional)



Notes:
1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.

Figure 9 Initial dilution modelling predictions, reported for each monitoring period (2007/08 – 2025/26)

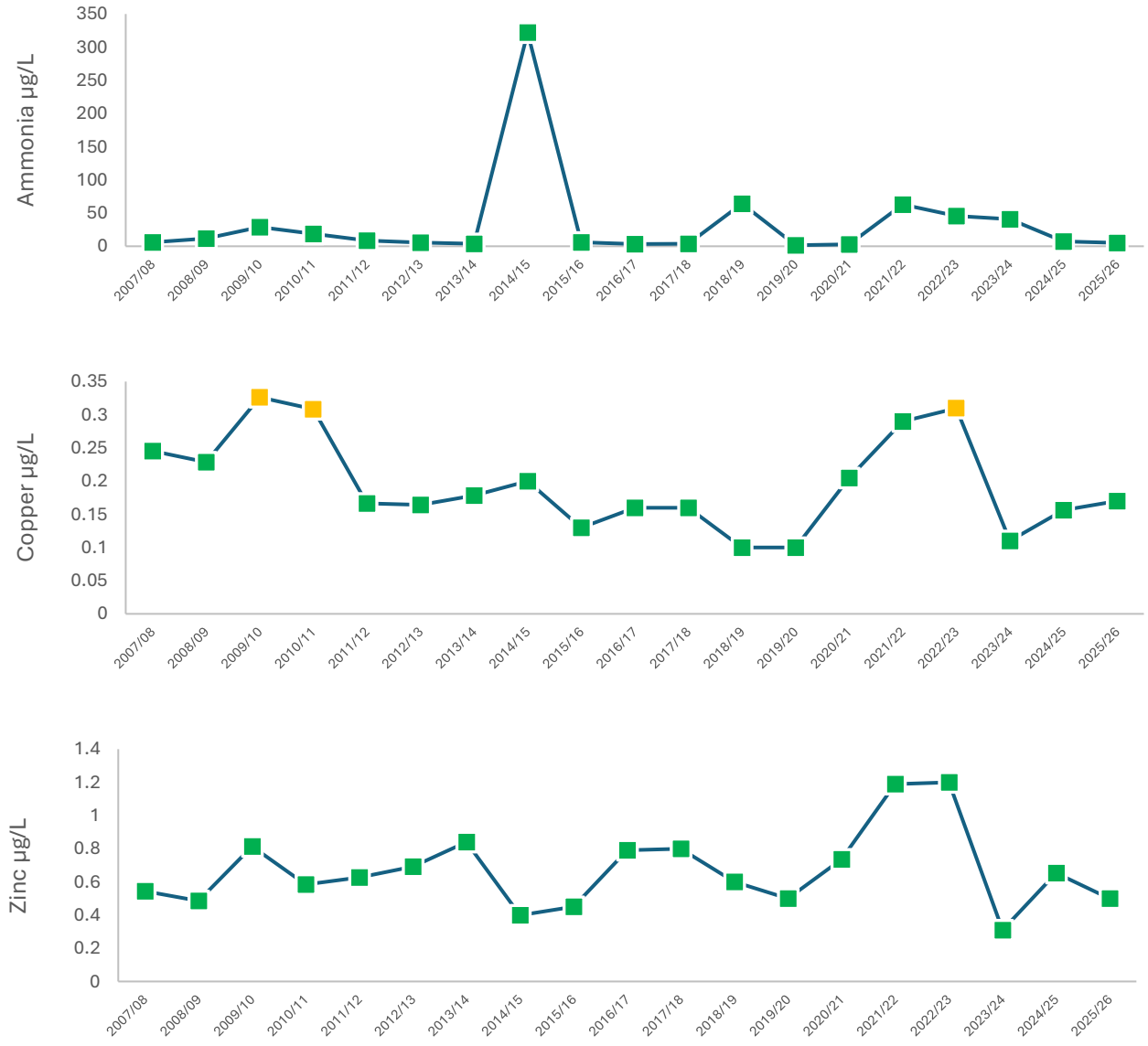
Table 5 Non-bioaccumulating toxicants in the Swanbourne treated wastewater stream compared with relevant guideline levels after initial dilution

Toxicant	TWW[3] concentration (µg/L)	Concentration after initial dilution (µg/L)[2,4]	ANZG (2018) 99% species protection guideline (µg/L)[2,5]	Compliance (EQG)[1,2]
Nutrients				
Ammonia-N	440.0	5.28	500	■
Dissolved metals (0.45 µm filtered)				
Chromium VI*	<1.0	-	0.14 (Cr VI)	-
Copper*	11.0	0.17	0.3	■
Lead*	<1.0	-	2.2	-
Nickel*	2.0	0.017	7	■
Silver*	<1.0	-	0.8	-
Zinc*	41.0	0.50	3.3	■
Organophosphate pesticides				
Chlorpyrifos[5]	<0.02	-	0.0005	-
Organochlorine pesticides				
Endrin	<0.01	-	0.004	-
Endosulfan sulfate[6]	<0.01	-	0.005	-
BTEX				
Benzene	<1	-	500	-
Polyaromatic hydrocarbons (PAHs)				
Naphthalene	<0.02	-	50	-
Benzo(a)pyrene	<0.005	-	0.1	-

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) were met. '-' indicates where compliance is not applicable.
2. Assessment against EPA (2017) 99% species protection guidelines was undertaken only for those toxicants where guideline levels were available.
3. TWW = Treated wastewater
4. Initial dilution = 1:116 (predicted average value for Swanbourne outlet). Contaminant dilution calculations were not performed (–) on any toxicants where TWW concentrations were below the analytical limit of reporting.
5. The trigger values for non-bioaccumulating toxicants are from ANZG (2018). The EPA has provided advice that in WA waters where a high level of protection applies, the 99% species protection levels should be used.
6. Analytical limits for Chlorpyrifos were not low enough to confirm exceedance of, or compliance with, the ANZG (2018) guidelines. Until detection limits required for direct comparison can be attained by commercial laboratories, WET testing will provide a test of the toxicity of the treated wastewater stream.
7. Trigger values are for endosulfan, not endosulfan sulfate (ANZG 2018)

* = dissolved metals 0.45 µm filtered.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG.
2. Ammonia, Copper and Zinc have historically been the contaminants with the highest concentrations relative to their guidelines.
3. ANZG (2018) 99% species protection guidelines for Ammonia = 500 µg/L, Copper = 0.3 µg/L and Zinc = 3.3 µg/L.
4. Contaminant dilution calculations were applied to these toxicants in line with the annual predictions presented in Table 5
5. Values are reported after the initial dilution and have therefore been corrected to account for the minimum dilution expected at the LEPA boundary.

Figure 10 Historical compliance of concentrations of the highest risk non-bioaccumulating toxicants following initial dilution

2.1.3 Total toxicity of the mixture

The total toxicity of the mixture (TTM) is an indicator of the potential for cumulative toxic effects on marine organisms (Table 6).For the combined effect of ammonia, copper and zinc (historically the contaminants with the highest concentrations relative to their guidelines) following dilution, the TTM (0.73, Table 7) was less than the ANZG (2018) guideline value of 1.0, and the EQG for TTM (Table 6) was met. Total toxicity of the mixture has exceed the EQG criteria on five occasions (Table 6 and Figure 11).

The TTM EQG has been exceeded on five occasions since 2009/10, but there was no evidence of an increasing trend over time (Figure 11)

Table 6 Environmental Quality Guideline for Whole of Effluent Toxicity testing

EQG	The total toxicity of the mixture (TTM)[1,2,3] for the additive effect of ammonia, copper and zinc, calculated as per ANZG (2018), will not exceed the trigger value of 1.0

Notes:

1. EQG = Environmental Quality Guideline; TTM = total toxicity of the mixture.
2. TTM = Σ(Ci/EQGi) where Ci is the concentration of the relevant component (i) in the mixture and its associated EQG for that component.
3. Assessment is based on bioavailable concentrations of metals in the treated wastewater (i.e. concentrations after filtering through a 0.45 µm filter).

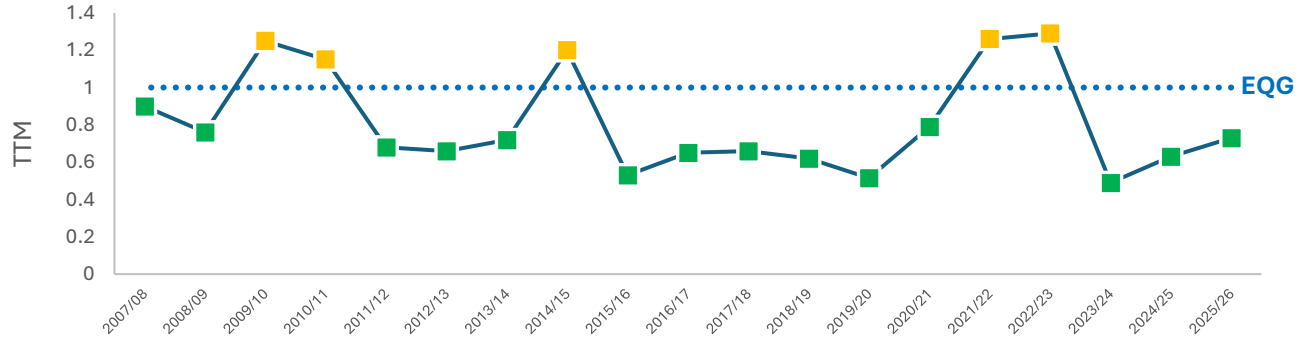
Table 7 Total toxicity of treated wastewater at the edge of the initial mixing zone associated with the Swanbourne ocean outlet

Toxicant	TWW[4,5] concentration (µg/L)	Background concentration (µg/L)[2]	Dilution	Concentration after dilution (µg/L)[6]	Contaminant concentration/guideline (µg/L)[3]	TTM[4]	Compliance (EQC)[1]
Ammonia	440	1.5	1:116	5.28	0.012	0.73	
Copper[4]	11.0	0.08		0.17	0.57		
Zinc[4]	41.0	0.15		0.50	0.15		

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) were met.
2. Background concentrations for copper and zinc from McAlpine et al. (2005); Perth marine waters (pp.19). Surface background concentrations for ammonia calculated as median of reference site data from 2003–2023.
3. Guideline values are from Table 5.
4. TTM = total toxicity of the mixture = [ammonia]/guideline + [copper]/guideline + [zinc]/guideline, TWW = treated wastewater
5. Assessment is based on bioavailable concentrations of metals in the treated wastewater (i.e. concentrations after filtering through a 0.45 µm filter).
6. The formula used to correct chemicals for dilution is:

$$[After\ dilution] = \frac{[undiluted] + (dilution\ factor - 1) \times [background]}{dilution\ factor}$$



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG.
2. The blue dotted line represents the EQG limit of 1. TTM values must be below 1 to be considered compliant the EQG.

Figure 11 Historical compliance of total toxicity of the mixture

2.2 Whole of Effluent Toxicity (WET) testing

WET testing is useful for assessing the toxicity of potential contaminants without guidelines, or where the effects may be cumulative. Fertilisation success in sea urchins (*Heliocidaris tuberculata*) exposed to a series of dilutions (1.0, 1.6, 3.1, 6.3, 12.5, 25, 50 and 100%) of TWW was used to calculate a No Observed Effect Concentration (NOEC; the highest concentration where no significant effect is observed. All test dilutions of TWW were salt-adjusted (using artificial sea salts) to achieve marine salinities to ensure that only the toxicity due to the presence of contaminants is examined and not the toxic effect of freshwater on the marine organisms (Table 8).

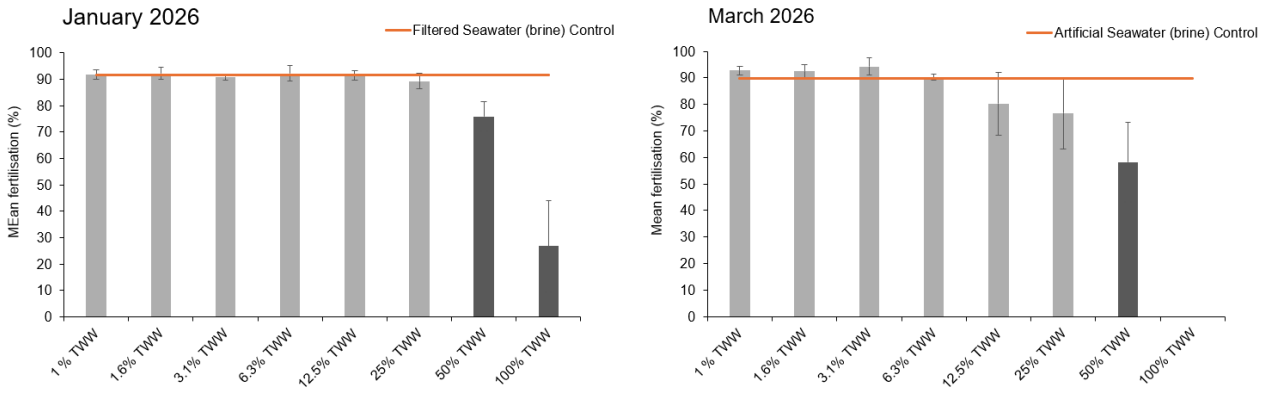
In January 2026, sea urchin fertilisation was significantly lower in samples exposed to 50% and 100% TWW dilutions compared to the artificial seawater control (Figure 12). In March 2026, sea urchin fertilisation was significantly lower in samples exposed to 50% and 100% TWW dilutions compared to the filtered seawater control (Figure 12). For both sampling events, the highest NOEC concentration of TWW recorded across 1-hour sea urchin fertilisation tests was 25% (equivalent to 1:4 dilutions). As the dilutions achieved at the LEPA (1:116) was greater than the dilutions required (1:4), the EQG was met (

Table 9). Historically, the dilutions achieved has only been less than the dilutions required after the application of a 0.1 assessment factor on one occasion (Figure 13).

Table 8 Environmental Quality Guideline for whole of effluent toxicity testing

EQG[1]	The EQG[1] for WET[1] will be exceeded where: $$\frac{DRNOEC}{TDA} \leq 1.0$$ Where TDA[1] is Typical Dilutions Achieved (constant based on 200-fold dilution) and DRNOEC[1] is the number of Dilutions Required to achieve the NOEC[1]. Where this EQG[1] is breached an investigation into the EQS[1], comprising of the full suite of WET[1] tests (minimum of five species from four other tropic groups), will be triggered.

1. EQG = Environmental Quality Guideline; EQS = Environmental Quality Standard; WET = Whole of Effluent Toxicity; TDA = Typical Dilutions Achieved; DRNOEC = Dilutions Required to achieve the No Observed Effects Concentration; NOEC = No Observed Effects Concentration.



Notes:

1. Error bars represent ± 1 standard deviation.
2. TWW = treated wastewater.
3. Light grey bars represent concentrations of TWW at which there is no observed significant effect on fertilisation.
4. Dark grey bars represent a significantly lower percentage fertilised eggs compared with the ASW Control (Dunnett's Test, 1-tailed, p = 0.05)

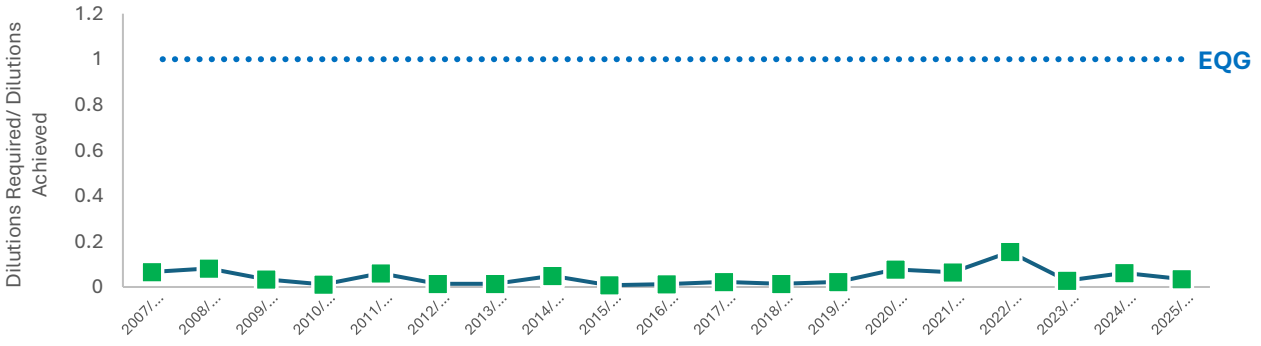
Figure 12 Comparison of whole effluent toxicity TWW dilution to artificial seawater control for Swanbourne treated wastewater

Table 9 Calculated parameters from Whole of Effluent Toxicity tests

Indicator	January 2026	March 2026	Compliance (EQC)[1]
NOEC[2] (%)	25	25	
Dilutions required to meet the NOEC[2]	4	4	
Dilutions required / dilution achieved	0.03	0.03	
Under ≤1	Yes	Yes	

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) were met.
2. NOEC = No Observed Effect Concentration, AF = Assessment Factor



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. NOEC = No Observed Effect Concentration\, LEPA = Low Ecological Protection Area
3. Blue dotted line indicates the EQG. To meet the EQG, dilutions required/ dilutions achieved must be ≤1

Figure 13 Historical compliance of required dilutions to achieve the NOEC against dilutions achieved at the LEPA boundary

3 Water quality monitoring – Receiving Environment

Nutrients, phytoplankton biomass and physical and chemical stressors were monitored on eight occasions from early December 2025 to late March 2026 (coinciding with the summer non-river flow period) along a down-current gradient away from the diffuser (Table 10). Wind direction, strength, current grid direction and cloud cover were recorded on the day of sampling (Table 11).

Table 10 Water quality monitoring dates for the Swanbourne ocean outlet between December 2025 and March 2026.

Sampling Event	Sampling Month	Date
1	December	4/12/2025
2	December	18/12/2025
3	January	15/01/2026
4	January	21/01/2026
5	January	30/01/2026
6	February	18/02/2026
7	March	4/03/2026
8	March	20/03/2026

Table 11 Weather and current grid during water quality monitoring near the Swanbourne ocean outlets

Date	Wind Direction[1,2,3]	Wind Strength (knots)[3]	Cloud cover (%)	Current grid[2]
4/12/2025	SW	13 to 15	0	NE
18/12/2025	S	12 to 14	10	NW
15/01/2026	E	10 to 12	0	SW
21/01/2026	ENE	18	0	SW
30/01/2026	SSW	8 to 10	30	NE
18/02/2026	E	10 to 12	0	W
4/03/2026	E	12 to 14	0	N
20/03/2026	NW	0 to 1	50	S

Notes:

1. NW = north west, E = east, ENE = east north east, S = south, SW = south west, SSW = south south west,
2. Winds are designated by the direction they come from while currents are designated by the direction they flow to.
3. Wind direction and strength are obtained from field observations.

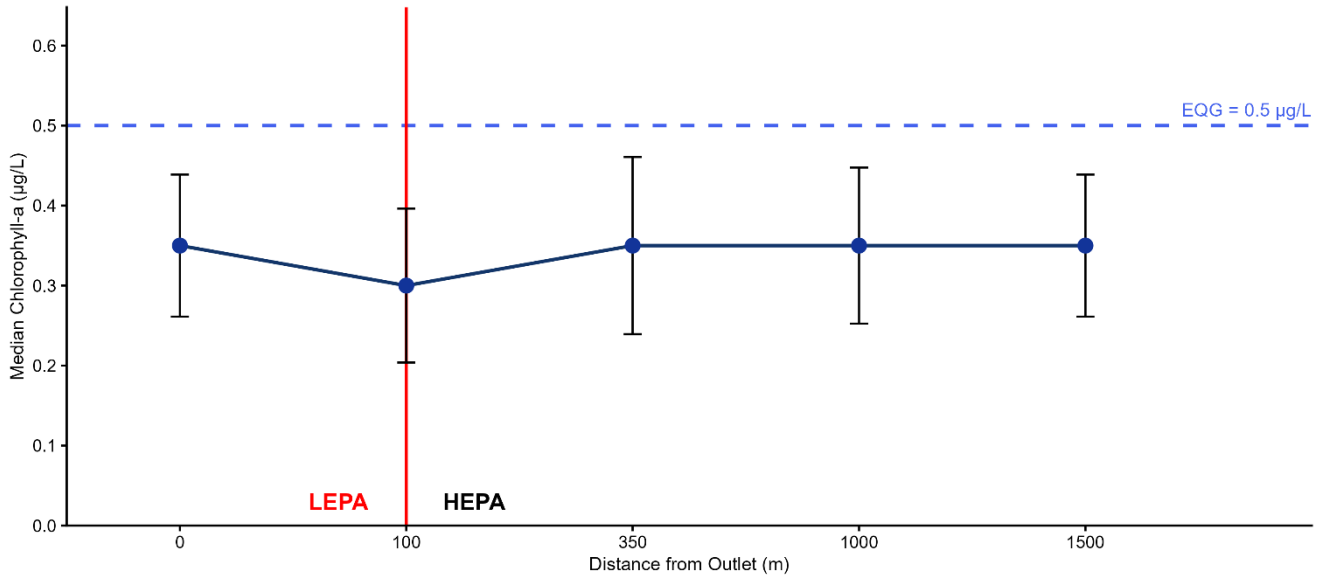
3.1 Nutrient enrichment

Median chlorophyll-*a* concentrations within the Swanbourne notional HEPA (100, 350, 1,000 and 1,500 m from the outlets) in 2025-26 (0.3 µg/L) did not exceed the 80th percentile of historical reference site concentrations 0.4 µg/L) and the EQG was met (Table 12, Figure 14 and Figure 15).

Table 12 Environmental Quality Guideline for nutrients

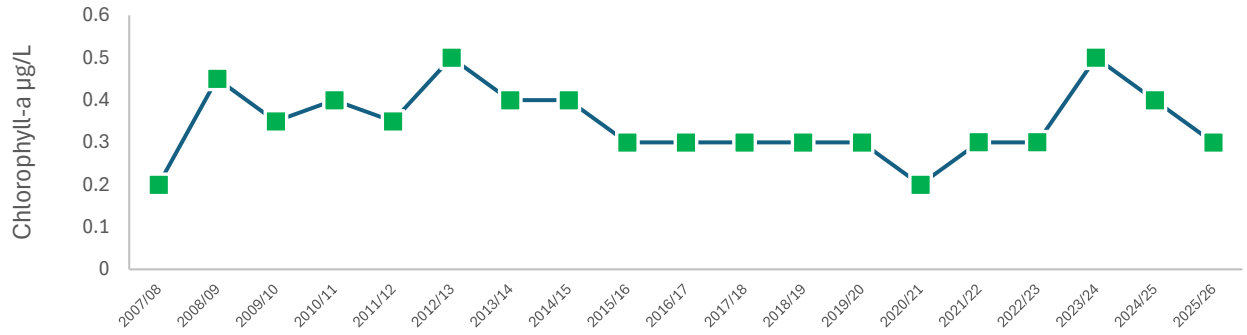
EQG[1]1	The median chlorophyll–*a* concentration in the HEPA[1] (100 m and greater from the diffuser) during the non-river flow period is not to exceed the 80th percentile of reference site data.
EQG[1]2	The median light attenuation coefficient in the notional HEPA[1] during the non-river flow period is not to exceed the 80th percentile of reference site data.

Notes:
1. EQG = Environmental Quality Guideline; HEPA = High Ecological Protection Area



Notes:
1. Error bars represent ± 95% confidence intervals; n = 8.
2. Blue dashed line = Environmental Quality Guideline (EQG) is the 80th percentile of historical reference site data (0.5 µg/L chlorophyll-*a*).
3. LEPA = Low Ecological Protection Area (notional); HEPA = High Ecological Protection Area
4. Data were pooled across eight sampling days (n = 8) over December 2025–March 2026.

Figure 14 Median chlorophyll-*a* concentrations down-current of the Swanbourne outlets during the summer monitoring period

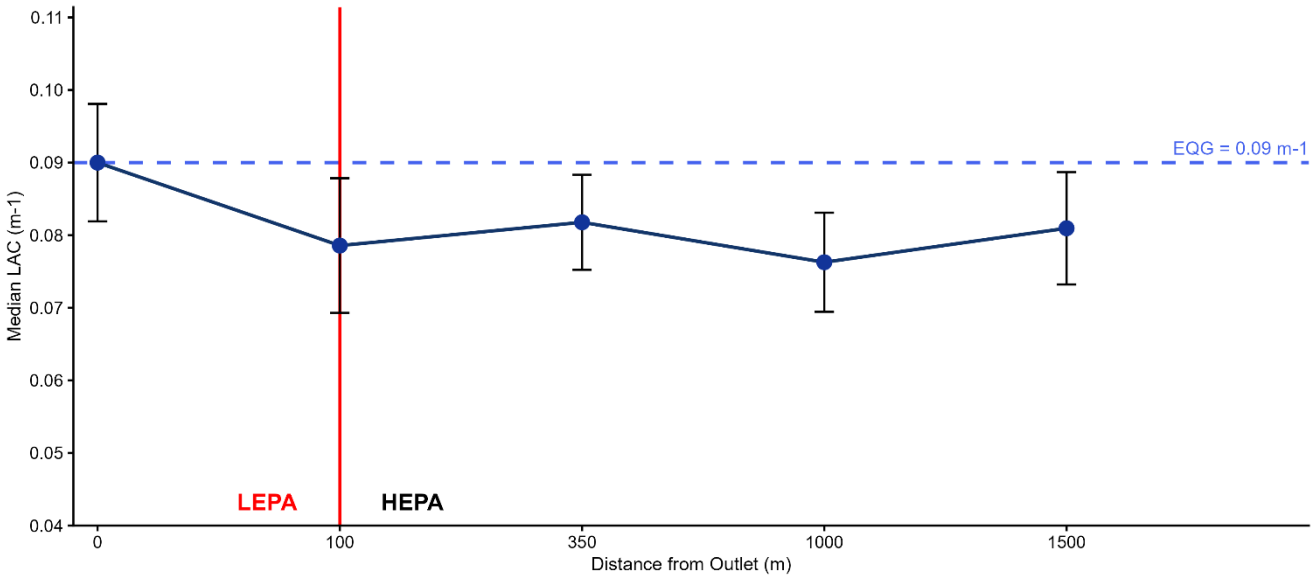


Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met. To meet the EQG, median chlorophyll-*a* (µg/L) must not exceed the 80th percentile of reference site data.
2. HEPA = High Ecological Protection Area

Figure 15 Historical compliance assessment of the median chlorophyll-*a* concentration at HEPA sites over time

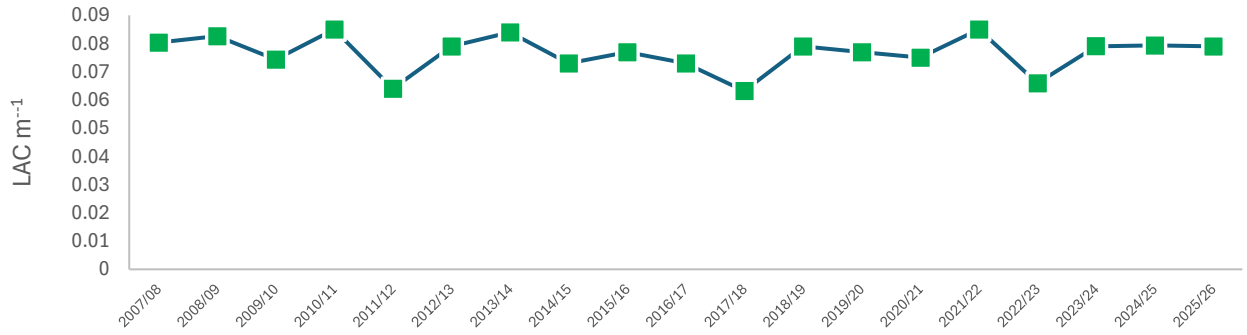
Median light attenuation coefficient (LAC) in the Swanbourne notional HEPA (100, 350, 1,000 and 1,500 m from the outlets) in 2025/26 (0.079 m^{-1}) was below the the 80th percentile of reference site data (0.09 m^{-1}) and the EQG 2 was met (Table 12, Figure 16 and Figure 17).



Notes:

1. Error bars represent ± 95% confidence intervals; n = 8.
2. Blue dashed line = Environmental Quality Guideline (EQG) is the 80th percentile of reference site data (0.09 m^{-1}).
3. LEPA = Low Ecological Protection Area (notional); HEPA = High Ecological Protection Area
4. Data were pooled across eight sampling days (n = 8) over December 2025–March 2026.

Figure 16 Median light attenuation coefficient at fixed distances down current of the Swanbourne outlets during the summer monitoring period



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met. To meet the EQG, median light attenuation coefficient must not exceed the 80th percentile of reference site data.
2. HEPA = High Ecological Protection Area

Figure 17 Historical compliance assessment of the median light attenuation coefficient at HEPA sites over time

3.2 Phytoplankton biomass

Median phytoplankton biomass (measured as chlorophyll-*a*) within the notional HEPA did not exceed three times the median of reference sites (0.6 µg/L; Figure 18) on any occasion during the summer monitoring period and therefore EQG1 was met (Table 13; Figure 19).

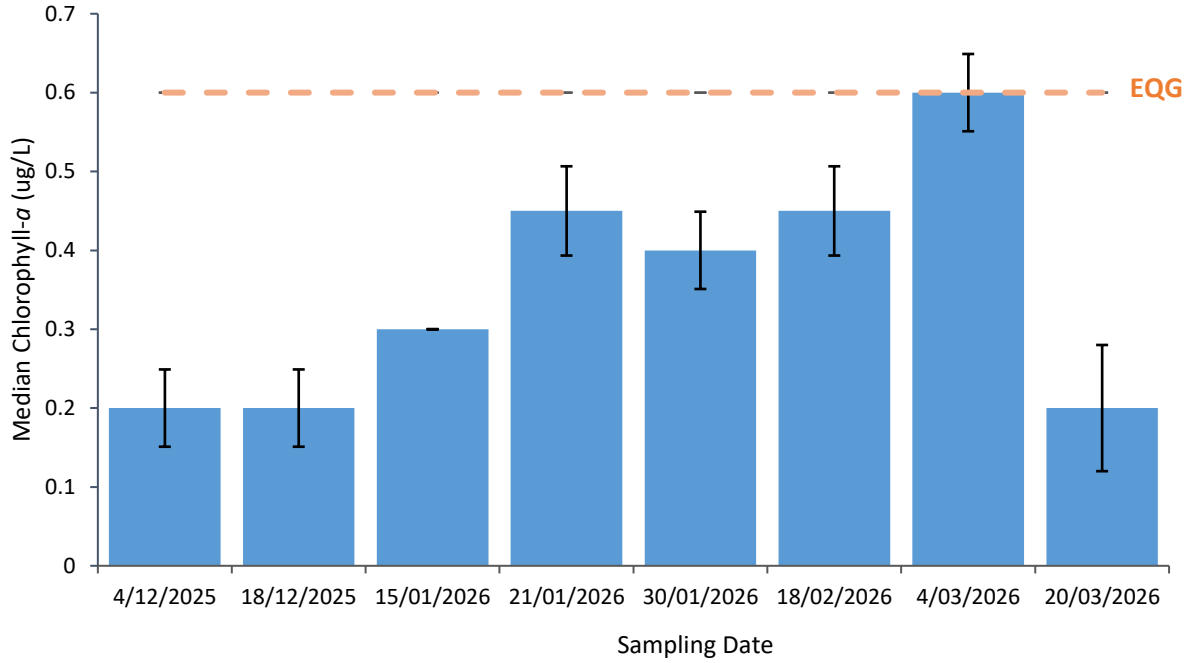
Median phytoplankton biomass (measured as chlorophyll–*a*) did not exceed 3 times the median of reference sites on 25% or more occasions at any site during the non-river flow period, and therefore EQG2 was met (Table 13; Figure 20).

Table 13 Environmental Quality Guidelines for phytoplankton biomass in receiving waters

EQG[1] 1	Median phytoplankton biomass, measured as chlorophyll–*a* is not to exceed 3 times the median chlorophyll–*a* concentration of reference sites, on any occasion during the non-river flow period.
EQS[1] 1	Median phytoplankton biomass measured as chlorophyll–*a* does not exceed three times median chlorophyll–*a* concentration of reference sites, on more than one occasion during non-river flow period and in two consecutive years.
EQG[1] 2	Phytoplankton biomass measured as chlorophyll–*a* at any site does not exceed 3 times the median chlorophyll–*a* concentration of reference sites, on 25% or more occasions during the non-river flow period.
EQS[1] 2	Phytoplankton biomass measured as chlorophyll–*a* at any site does not exceed three times the median chlorophyll–*a* concentration of reference sites, on 25% or more occasions during the non-river flow period and in two consecutive years.

Notes:

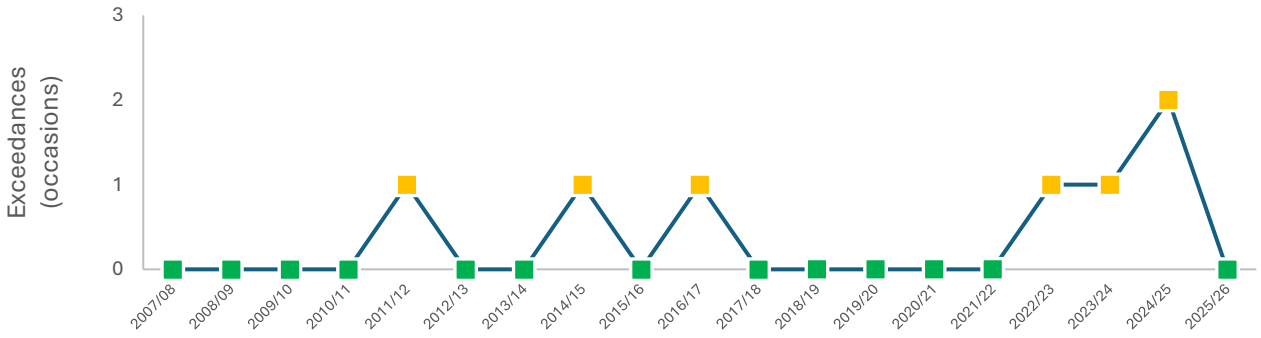
1. EQG = Environmental Quality Guideline; EQS = Environmental Quality Standard.



Notes:

1. Error bars represent ±95% confidence intervals; n = 4 for every date.
2. LEPA = low ecological protection area; HEPA = high ecological protection area. The HEPA (100 m – 1500 m) was utilised for all sampling events.
3. Amber dashed line = Environmental Quality Guideline (EQG) is 3-times the median chlorophyll-*a* concentration of reference site data (0.6 µg/L chlorophyll-*a*).
4. Data pooled from fixed sites ≥ 100 m down-current of the outlets. Concentrations at 0 m are not included in the figure or EQC assessment, as the 0 m site is situated directly above the outlets within the notional Low Ecological Protection Area (LEPA).

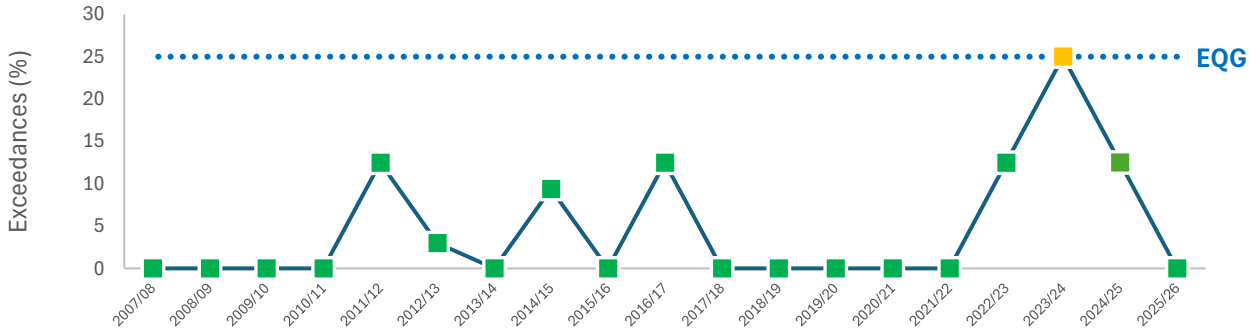
Figure 18 Median phytoplankton biomass during the 2025-26 summer monitoring period



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG. To meet the EQG, the median phytoplankton biomass (measured as chlorophyll-*a*) at the HEPA sites must not exceed three times the reference site median on any occasion.

Figure 19 Historical exceedances of three times the median chlorophyll-*a* concentrations of reference sites on any occasion



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG.
2. Blue dotted line indicates the EQG. To meet the EQG, phytoplankton biomass (measured as chlorophyll-*a*) cannot exceed three times the reference median on 25% or more of occasions over the summer monitoring period.

Figure 20 Historical compliance with the EQG, based on the percentage of monitoring occasions where chlorophyll-*a* concentrations exceeded three times the reference site median

3.3 Physical-chemical stressors

3.3.1 Dissolved oxygen (DO)

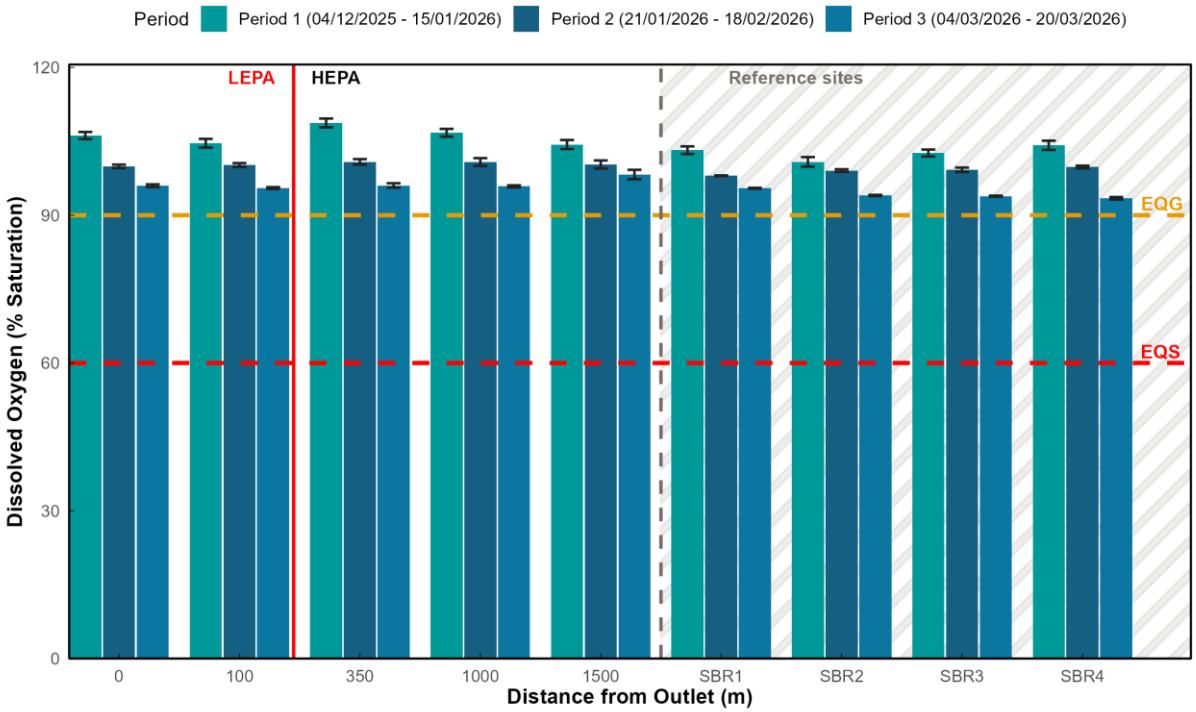
The median of bottom (0 - 0.5 m) dissolved oxygen saturation at HEPA sites (100, 350, 1000 and 1500m from the outlets) was >90% at all sites and times throughout the summer survey period (Figure 21), and the EQG (Table 14) was met. Historically, DO has not fallen below 90% for any 6-week period at any time (Figure 22).

Table 14 Environmental Quality Guideline for dissolved oxygen

EQG[1]	Median dissolved oxygen in bottom waters (0 - 0.5 m above the sediment surface) must be greater than 90% saturation at any site for a defined period of not more than 6 weeks during the non-river flow period.
EQS[1]	Median dissolved oxygen in bottom waters (0 - 0.5 m above the sediment surface) must be greater than 60% saturation at any site for a defined period of not more than 6 weeks during the non-river flow period.

Notes:

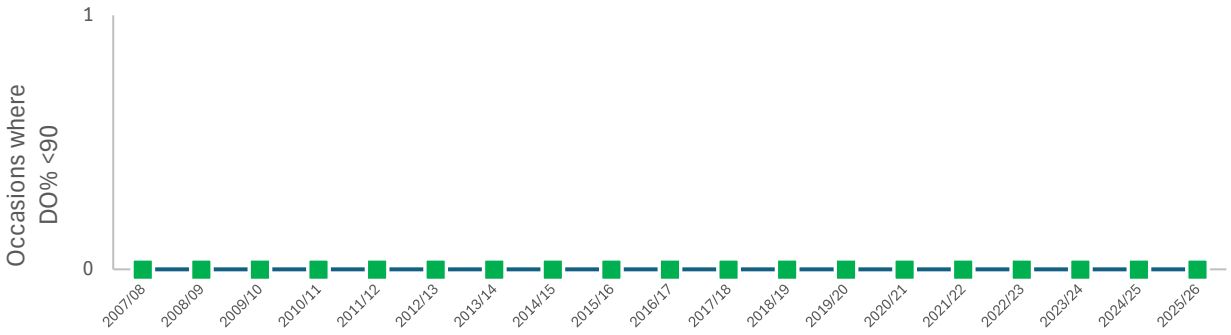
1. EQG = Environmental Quality Guideline; EQS = Environmental Quality Standard



Notes:

1. Error bars ±95% confidence intervals [n = 8 for each site]
2. Dissolved oxygen (DO) measured 0–0.5 m above the seabed
3. Yellow dashed line = Environmental Quality Guideline (EQG) = 90% DO saturation
4. Red dashed line = Environmental Quality Standard (EQS) = 60% DO saturation.
5. LEPA = Low Ecological Protection Area (notional); HEPA = High Ecological Protection Area (notional).
6. Plot shaded grey to indicate reference sites. Reference site data (SB1–SB4) are compared against EQG for contextual purposes only.

Figure 21 Median dissolved oxygen for defined periods of <6 weeks during the summer monitoring period



Notes:
1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met

Figure 22 Historical exceedances of defined periods (<6 weeks) where DO was below 90%

3.3.2 Salinity

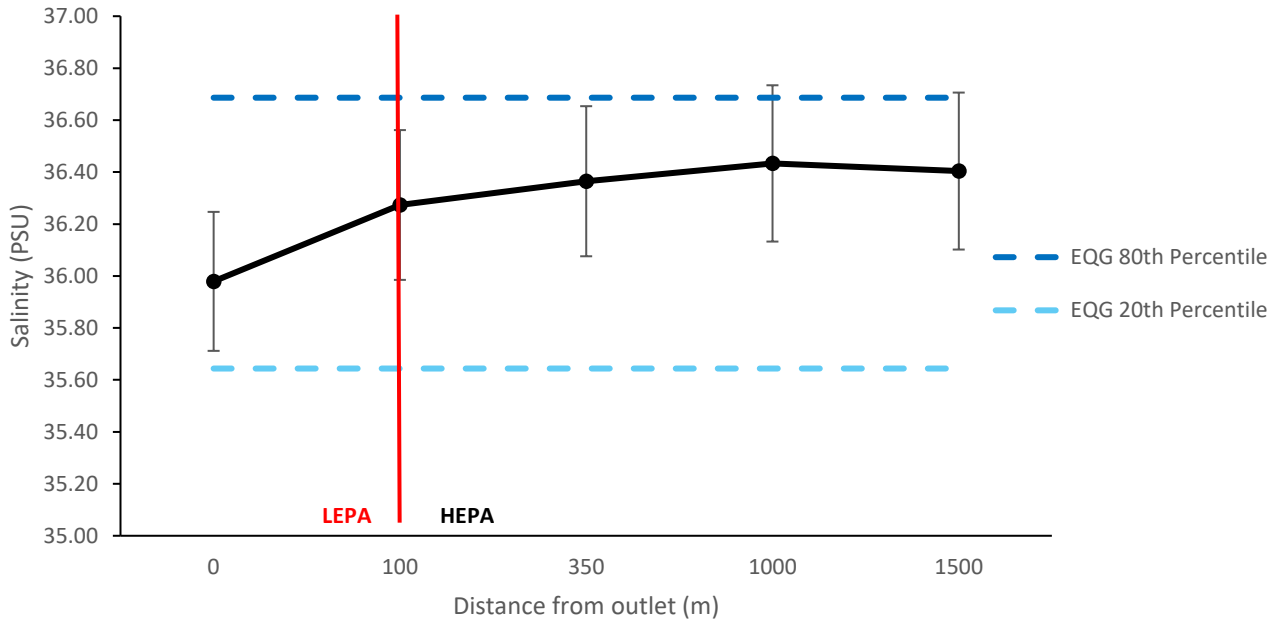
Median salinity was between the 20th and 80th percentile of the natural salinity range (35.64 and 36.69 PSU, respectively) at all HEPA sites (100, 350, 1,000 and 1,500m from the outlets) across the summer monitoring period, meeting the EQG (Table 15; Figure 23).

In the past, median salinity has deviated beyond the 20th and 80th percentile of the natural salinity range for the same period on four occasions (Figure 24).

Table 15 Environmental Quality Guideline for salinity

EQG[1]	Median salinity (0.5 m below the water surface) at an individual site over any period is not to deviate beyond the 20th and 80th percentile of the natural salinity range[2] over the same period.

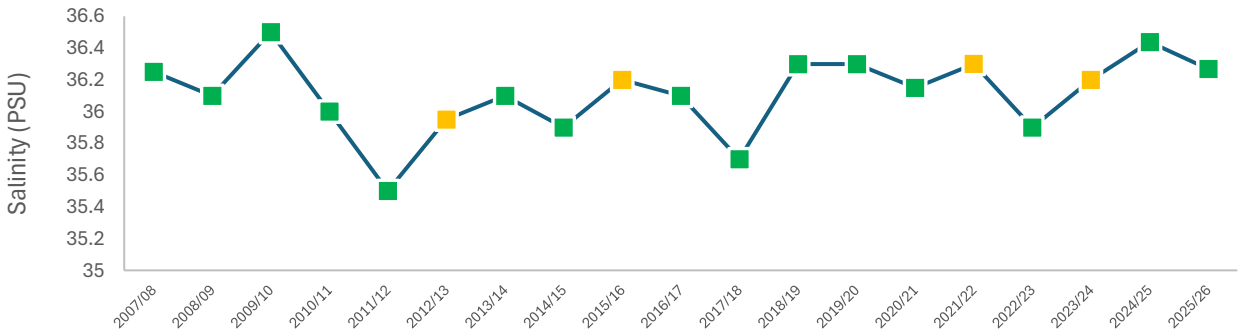
Notes:
1. EQG = Environmental Quality Guideline
2. Natural salinity range refers to the salinity of the reference sites over the same period.



Notes:

1. Error bars ± 95% confidence intervals; n = 8.
2. Salinity measured ~0.5 m below the sea surface (closest measurement to 0.5 m depth taken for each distance, for each trip December 2025 – March 2026).
3. Dark blue dashed line = 80th percentile of reference sites over the same period; light blue dashed line = 20th percentile of reference sites over the same period.
4. LEPA = Low Ecological Protection Area (notional); HEPA = High Ecological Protection Area

Figure 23 Median salinity compared to the 20th and 80th percentile of reference site salinity during the extended summer monitoring period



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; and amber symbols represent an exceedance of the EQG.
2. The median salinity values presented are the overall median salinity for the HEPA sites each survey. Compliance with the EQG is determined from the median salinity at individual HEPA sites relative to the 20th and 80th percentile of reference site salinity. Therefore, EQG symbols are shown in amber where one or more HEPA sites recorded an EQG deviated from beyond the 20th or 80th percentile during the corresponding survey.

Figure 24 Historical median salinity down current of the Swanbourne outlets

4 Microbiological contaminants and algal biotoxins

4.1 Thermotolerant coliforms (TTC)

TTC were sampled eight times over the 2025-26 summer period at the boundary of the notional Seafood Management Observed Zone of Influence (OZI), yielding a total of 40 samples. The notional Seafood Management OZI defines the boundary where TTC concentrations are most likely to exceed the EPA's criteria for seafood safe for human consumption under worst-case conditions, based on 10 years of long-term monitoring data. This boundary has been monitored in this report to determine whether compliance can be maintained (Table 16).

The National Health and Medical Research Council (NHMRC 2008) and EPA (2005) guidelines require a minimum of 100 samples for accurate assessment of the EQC. Data from multiple years can be pooled where there are < 100 samples provided local pollution conditions have not changed (NHMRC 2008). Assuming conditions have not changed, data collected over three summers (2023-24, 2024-25 and 2025-26) were pooled to yield 120 samples.

The median concentration of TTC derived from three years of pooled samples was equal to the limit of reporting (<10 CFU/100 mL), and less than the 14 CFU/100 mL criteria, meeting the EQG (Table 17). Median concentration of TTC has never exceeded the limit of reporting (Figure 25).

Over the three sampling periods, there were 8 instances where TTC concentration exceeded 21 CFU/100 mL, representing 6.67% of samples, noting that these 8 instances were recorded in the 2023-24 and 2024-25 sampling periods, with no TTC concentrations exceeding 21 CFU/100 mL during the current (2025-26) monitoring program (Table 18). As <10% of samples exceeded 21 CFU/100 mL, the EQG (Table 16) was met.

The percentage of samples exceeding 21 CFU/100 mL has never exceeded the 10% criteria for the past three monitoring seasons in which it has been assessed (Figure 26).

Table 16 Environmental Quality Guideline for Thermotolerant Coliforms (TTC)

EQG[1]	Median TTC[2] concentrations (rolling median consisting of 100 samples) at sites at the boundary of the notional Seafood Management OZI[2] are not to exceed 14 CFU[2]/100 mL, with no more than 10% of the samples exceeding 21 CFU[2]/100 mL, as measured using the membrane filtration method during normal plant operating conditions.

Notes:

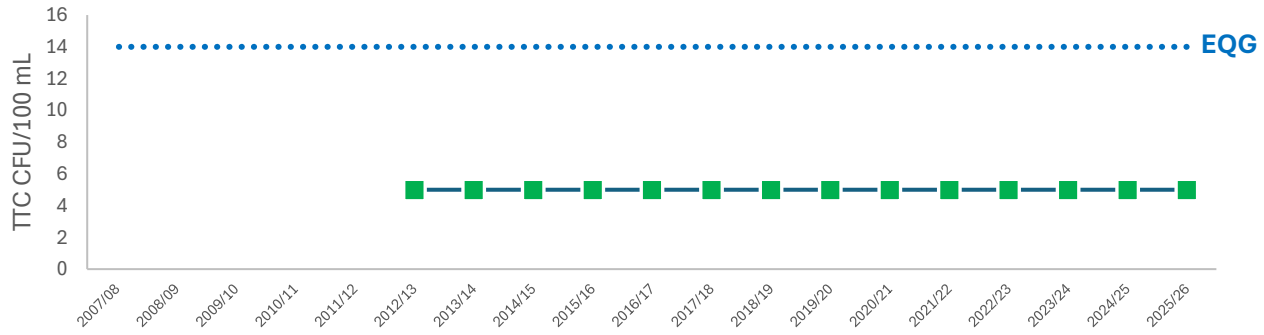
1. EQG = Environmental Quality Guideline.
2. OZI = Observed Zone of Influence; TTC = thermotolerant coliforms; CFU = Colony Forming Units

Table 17 Median thermotolerant coliform concentrations sampled at the fixed monitoring sites at the notional Seafood Management OZI for the Swanbourne outlets pooled from the 2023-26 period and comparison to the EQC

Sampling period	Median[2]	Compliance[1,3]
Dec 2023 - Mar 2024 Dec 2024 - Mar 2025 Dec 2025 - Mar 2026	<10 CFU/100 mL	■

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. Thermotolerant coliform results below the analytical limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate the median and 90th percentile.
3. Environmental Quality Criteria are based on EPA (2017).
4. OZI = Observed Zone of Influence



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Thermotolerant coliform results below the analytical limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate the median.
3. Sampling of thermotolerant coliforms commenced in the 2011-12 sampling season.
4. Blue dotted line represents the EQG. To meet the EQG, median thermotolerant coliform (TTC) concentration must not exceed 14 CFU/100 mL
5. OZI = Observed Zone of Influence

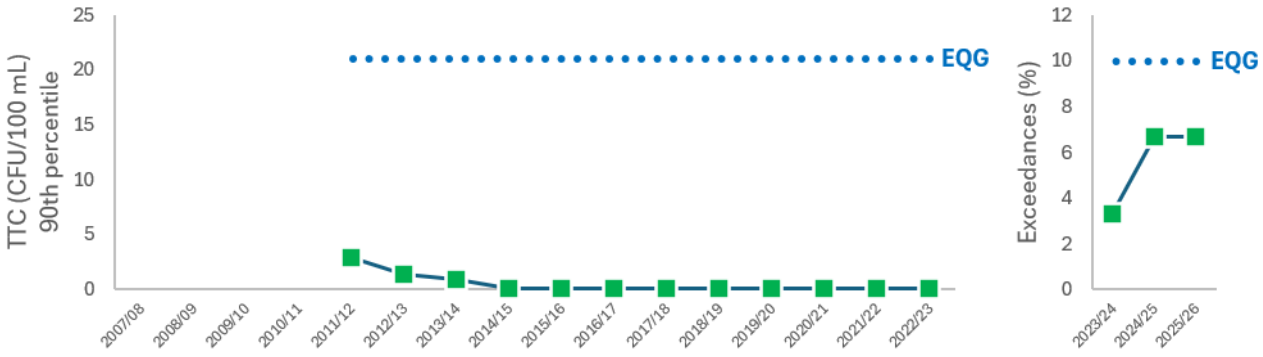
Figure 25 Historical compliance of median thermotolerant coliform concentrations at the boundary of the notional Seafood Management OZI

Table 18 Thermotolerant coliforms on the boundary of the Seafood Management Zone for Swanbourne outlet over 2023–2026 summer sampling periods that exceed 21 CFU/100 mL

Sampling season[3]	Date	Site	TTC concentration (CFU/100 mL)[2]	Compliance[1]
Dec 2023 – Mar 2024	11/01/2024	SB22	30	
		SB23	60	
		SB24	100	
		SB25	70	
Dec 2024 – Mar 2025	4/12/2024	SB18	100	
		SB19	100	
		SB31	210	
		SB32	80	
Dec 2025 – Mar 2026	-	-	-	
Percentage of total samples (n = 120) > 21 CFU/100 mL = 6.67%				

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. TTC = thermotolerant coliforms; CFU = colony forming units
3. No TTC concentrations >21 CFU/100 mL was recorded during the 2025-26 summer monitoring period.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. Thermotolerant coliform results below the analytical limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate the median and 90th percentile.
3. Previous reporting of 90th percentile monitoring of thermotolerant coliforms commenced in 2011/12.
4. .Assessment of the percentage of samples with TTC concentrations >21 CFU/100 mL commenced in the 2023/24 monitoring period.
5. Blue dotted line indicates the EQG. To meet the EQG (left, 2011/12-2022/23), the 90th percentile for thermotolerant coliform (TTC) concentrations must not exceed 21 CFU/100 mL. To meet the EQG (right, 2023/24-2025/26), less than 10% of samples are to exceed 21 CFU/100 mL.

Figure 26 Historical compliance of 90th percentile thermotolerant coliform concentrations (left, 2011/12 – 2022/23) and percentage exceedances (right, 2023/24 – 2025/26; refer to EQG 1)

4.2 *Enterococci* spp.

Samples were collected at the boundary of the notional Contact Recreation Management Observed Zone of Influence (OZI) eight times over the 2025-26 summer monitoring period (yielding a total of 40 samples) for faecal indicator analyses (measured as *Enterococci* spp.). NHMRC (2008) guidelines and EPA (2005) require a minimum of 100 samples over the monitoring period for accurate assessment of the EQC. Data from multiple years can be pooled where there are less than 100 samples provided local pollution conditions have not changed (NHMRC 2008). Assuming conditions have not changed data from the past three summers (2023-24, 2024-25, and 2025–26) were pooled to yield 120 samples. The EQG for primary and secondary contact recreation are outlined in Table 19.

During the current (2025-26) monitoring period, the 95th percentile of *Enterococci* spp. concentrations at the boundary of the notional Contact Recreation Management OZI for the Swanbourne ocean outlet was below the limit of reporting (<10 MPN/100mL). Therefore, both primary (<200 MPN/100 mL) and secondary (<2,000 MPN/100 mL) contact recreation EQGs for faecal indicators (Table 20) in the water were met. The 95th percentile *Enterococci* spp. concentrations have not exceeded the EQGs historically (Figure 27).

Table 19 Environmental Quality Guidelines (*Enterococci* spp.) for primary and secondary contact recreation

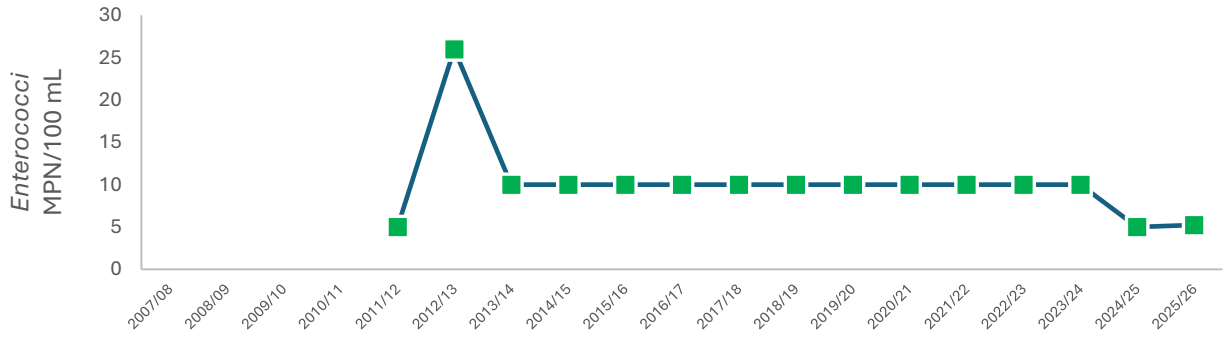
Primary[1]	**EQG[3] 1**	The 95th percentile bacterial content (*Enterococci* spp.) of marine waters should not exceed 200 MPN/100 mL.
Secondary[2]	**EQG[3] 2**	The 95th percentile bacterial content (*Enterococci* spp.) of marine waters should not exceed 2,000 MPN/100 mL.

Notes:
1. Primary contact recreation = activities where humans are in direct contact with the water (e.g. swimming, snorkelling and diving).
2. Secondary contact recreation = activities where humans are in secondary contact with the water (e.g. boating and fishing).
3. EQG = Environmental Quality Guideline; MPN = most probable number of *Enterococci* spp.

Table 20 The 95th percentile of *Enterococci* spp. concentrations at the boundary of the notional Contact Recreation Management OZI for the Swanbourne ocean outlets

Sampling period	95th percentile[2,3]	Compliance[1,4]	
		Primary contact	Secondary contact
Dec 2023 - Mar 24 Dec 2024 - Mar 25 Dec 2025 - Mar 26	<10 MPN/100 mL	■	■

Notes:
1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. MPN = most probable number of *Enterococci* spp.
3. *Enterococci* spp. concentrations below the analytical limit of reporting (<10 *Enterococci* spp. MPN/100 mL) were halved (= 5 MPN/100 mL) to calculate the 95th percentile.
4. Environmental Quality Criteria (EQC) based on EPA (2017) water quality guidelines for recreation waters.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. OZI = Observed Zone of Influence; MPN = most probable number of *Enterococci* spp.
3. Sampling of *Enterococci* spp. commenced in the 2011-12 sampling season.
4. To meet the EQG for primary contact, The 95th percentile *Enterococci* spp. concentration must be <200 MPN/100mL

Figure 27 Historical compliance of the 95th percentile *Enterococci* spp. concentrations at the notional Contact Recreation Management OZI boundary

4.3 Toxic phytoplankton species

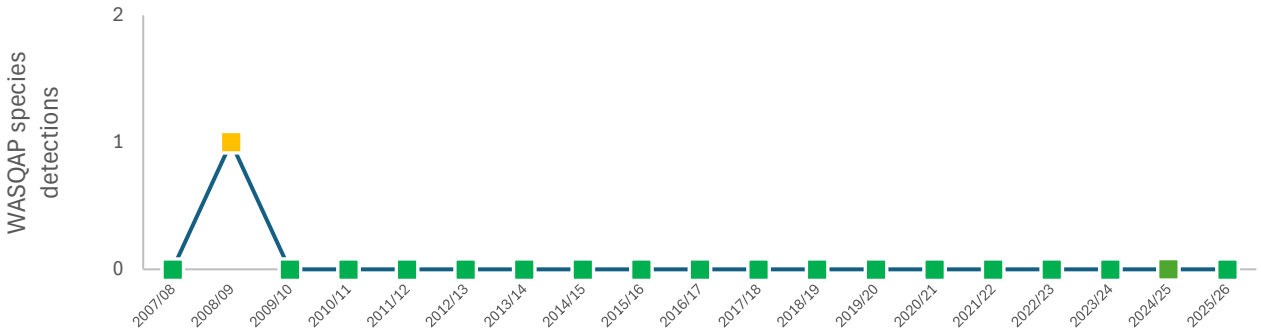
The EQG for toxic phytoplankton species states that concentrations of potentially toxic algae are not the exceed the WASQAP Marine Biotoxin Monitoring and Management Plan (MBMMP; DoH 2025) guideline concentrations in any sample at the notional Seafood Management OZI boundary (sites SB-17 to SB-32). Table 21 lists the phytoplankton species known to produce toxins that may be concentrated in shellfish and their WASQAP (DoH 2025) guideline concentrations (alert level to initiate flesh testing) for all sites.

Phytoplankton sampling was undertaken on 8 occasions over the 2025-26 summer monitoring period at one of the notional Seafood Management OZI fixed monitoring sites, and the date and site for each occasion are presented in Table 22. There were no exceedances recorded during the 2025-26 summer monitoring period (Table 22). Toxic phytoplankton exceeding WASQAP concentrations have been present on 1 occasion historically (Figure 28).

Table 21 Environmental Quality Guideline for toxic phytoplankton species

EQG[1,2,]	Concentrations of potentially toxic algae in any sample at the notional Seafood Management OZI boundary are not to exceed the WASQAP[4] guideline concentrations for any of the following during normal plant operating conditions: Paralytic shellfish poison: • *Alexandrium catenella*[5] (100 cells/L) • *Alexandrium minutum*[5] (100 cells/L) • *Alexandrium ostenfeldii*[5] (100 cells/L) • *Alexandrium tamarense*[5] (100 cells/L) • *Gymnodinium catenatum* (1,000 cells/L) Diarrhoetic shellfish poison: • *Dinophysis acuminata* (1,000 cells/L) • *Dinophysis acuta*[3] (1,000 cells/L) • *Dinophysis caudata* (1,000 cells/L) • *Dinophysis fortii*[3] (1,000 cells/L) • *Prorocentrum lima* (500 cells/L) • *Prorocentrum rathymum*[10] Amnesic shellfish poison: • *Psuedo-nitzschia seriata* group[6,7] (500,000 cells/L) • *Pseudo-nitzschia delicatissima* group[6,8] (500,000 cells/L) Neurotoxic shellfish poison: • *Karenia* cf. *brevis* (1,000 cells/L) • *Karenia*, *Karlodinium* and *Gymnodinium* group[9] (250,000 cells/L)
EQS[1,2]	Following an exceedance of the EQG, sentinel mussels will be deployed at sites along the notional Seafood Management Observed Zone of Influence (OZI) boundary. The shellfish tissue concentration of the following algal toxins will be assessed: • Paralytic shellfish poison (0.8 mg Saxitoxin eq/kg) • Diarrhoetic shellfish poison (0.2 mg/kg) • Neurotoxic shellfish poison (200 mouse units/kg) • Amnesic shellfish poison (domoic acid; 20 mg/kg) Yessotoxins (1 mg Yessotoxin eq./kg)

Notes:
1. EQG = Environmental Quality Guideline; EQS = Environmental Quality Standard
2. If this EQG is exceeded, assessment of sentinel mussel tissues against the EQS will be conducted.
3. The cell levels within each toxin group are cumulative (e.g. 600 cells/L of both *D. acuta* and *D. fortii* in the diarrhoetic shellfish poison group are totalled to 1,200 cells/L, exceeding the critical level to initiate flesh testing).
4. Western Australian Shellfish Quality Assurance Program (WASQAP); Marine Biotoxin Monitoring and Management Plan (MBMMP; DoH 2025).
5. *Alexandrium* species may be difficult to identify when numbers are low, and they are being treated as potentially toxic.
6. Species within the *Pseudo-nitzschia* groups are difficult to identify, and they are being treated as potentially toxic.
7. The *Pseudo-nitzschia seriata* group includes: *P. australis, P. pungens* and *P. multiseries*.
8. The *Pseudo-nitzschia delicatissima* groups includes *P. turgidula, P. fraudulenta, P. delicatissima, P. pseudodelicatissima* and *P. multistriata*.
9. The *Karenia, Karlodinium* and *Gymnodinium* group includes *Karenia bidigitata, Karenia brevisulcata, Karenia mikimotoi, Karenia papilionacea, Karenia selliformis, Karlodinium micrum* and *Gymnodinium impudicim*.
10. Trigger levels have not been established for *P. rathymum*, but presence and cell density are to be reported.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG. To meet the EQG, concentrations of potentially toxic algae in any sample at the notional Seafood Management Observed Zone of Influence (OZI) boundary are not to exceed the WASQAP (DoH 2025) guideline concentrations
2. WASQAP = Western Australian Shellfish Quality Assurance Program

Figure 28 Historical compliance of concentrations of potentially toxic phytoplankton species

Table 22 Estimated cell densities of phytoplankton species known to produce toxins.

Date	Site[3,3]	Species	Estimated density (cells/L)[4]	WASQAP Guideline (cells/L)[5]	Compliance[1,3]
04/12/2025	**SB-19**	GK Complex (*Gymnodinium-Karenia* Complex)	240	250,000	
	SB-5	GK Complex (*Gymnodinium-Karenia* Complex)	320	250,000	-
	SBR2	*Pseudo-nitzschia* "*delicatissima*" group	640	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	480	250,000	
18/12/2025	**SB-26**	GK Complex (*Gymnodinium-Karenia* Complex)	240	250,000	
	SBR3	GK Complex (*Gymnodinium-Karenia* Complex)	240	250,000	-
	SB-10	GK Complex (*Gymnodinium-Karenia* Complex)	160	250,000	-
15/01/2026	**SB-29**	*Pseudo-nitzschia* "*delicatissima*" group	400	500,000	
		Pseudo-nitzschia "*seriata*" group	320	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	160	250,000	
	SB-13	*Pseudo-nitzschia* "*delicatissima*" group	640	500,000	-
	SBR3	*Pseudo-nitzschia* "*delicatissima*" group	1,520	500,000	-
		Pseudo-nitzschia "*seriata*" group	320	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	400	250,000	
21/01/2026	SBR3	*Pseudo-nitzschia* "*delicatissima*" group	12,640	500,000	-
		Pseudo-nitzschia "*seriata*" group	2,720	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	480	250,000	
		Karlodinium spp.	80	250,000	
	SB-13	*Pseudo-nitzschia* "*delicatissima*" group	2,240	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	480	250,000	
	SB-29	*Pseudo-nitzschia* "*delicatissima*" group	720	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	400	250,000	
		Karlodinium spp.	80	250,000	
30/01/2026	SB-5	*Pseudo-nitzschia* "*delicatissima*" group	640	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	560	250,000	
	SB-19	*Pseudo-nitzschia* "*delicatissima*" group	240	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	800	250,000	
	SBR3	*Pseudo-nitzschia* "*delicatissima*" group	880	500,000	-
		Pseudo-nitzschia "*seriata*" group	1,520	500,000	

Date	Site[3,3]	Species	Estimated density (cells/L)[4]	WASQAP Guideline (cells/L)[5]	Compliance[1,3]
		GK Complex (*Gymnodinium-Karenia* Complex)	640	250,000	
		Karlodinium spp.	240	250,000	
18/02/2026	**SB-28**	*Pseudo-nitzschia* "*delicatissima*" group	6,160	500,000	
		Pseudo-nitzschia "*seriata*" group	720	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	640	250,000	
		Karlodinium spp.	160	250,000	
	SBR4	*Pseudo-nitzschia* "*delicatissima*" group	18,560	500,000	-
		Pseudo-nitzschia "*seriata*" group	640	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	400	250,000	
		Karlodinium spp.	80	250,000	
	SB-11	*Pseudo-nitzschia* "*delicatissima*" group	17,120	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	240	250,000	
04/03/2026	SBR2	*Pseudo-nitzschia* "*delicatissima*" group	28,240	500,000	-
		Pseudo-nitzschia "*seriata*" group	400	500,000	
		Karlodinium spp.	80	250,000	
	SB-8	*Pseudo-nitzschia* "*delicatissima*" group	65,440	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	800	250,000	
	SB-24	*Pseudo-nitzschia* "*delicatissima*" group	47,600	500,000	
		Pseudo-nitzschia "*seriata*" group	160	500,000	
		GK Complex (*Gymnodinium-Karenia* Complex)	560	250,000	
20/03/2026	SBR3	*Pseudo-nitzschia* "*delicatissima*" group	160	500,000	-
	SB-15	*Pseudo-nitzschia* "*delicatissima*" group	80	500,000	-
		GK Complex (*Gymnodinium-Karenia* Complex)	320	250,000	-

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) were met. '-' indicates that a site was not a part of the Seafood Management OZI boundary and therefore not used in the compliance assessment.
2. For each sampling event, samples were analysed for one monitoring OZI boundary site, one Primary Contact site and one reference site per sampling occasion.
3. Compliance to the EQG only applies for OZI boundary sites (SB-17 to SB-32). Results for reference sites (SBR1 to SBR4) and Primary Contact management zone sites (SB-1 to SB-16) are not applicable to compliance assessment but are provided for comparison. The bolded site name indicates the OZI monitoring site analysed on each occasion.
4. Limit of reporting = 80 cells/L
5. Western Australian Shellfish Quality Assurance Program (WASQAP) Marine Biotoxin Monitoring and Management Plan (MBMMP; DoH 2025).

4.4 Phytoplankton cell concentrations

The concentrations of phytoplankton cells are compared to the EQC for toxic algae in marine recreational water. Table 23 presents the specific EQC values for toxic algae in marine recreational water as outlined in EPA (2017). Phytoplankton sampling was undertaken on eight occasions over the 2025-26 summer monitoring period at one of the notional Contact Recreation Management Observed Zone of Influence (OZI) fixed monitoring sites; the date and sampling site for each occasion are provided in Table 24.

During the 2025-26 monitoring period, the densities of phytoplankton at the individual monitoring sites remained below 10,000 cells/mL (Table 24). The EQG 1 for phytoplankton concentrations (Table 23) was therefore met. Historically, algal cell density has not exceeded 10,000 cells/mL at any site (Figure 29).

While no DoH (2022) watchlist species were recorded in exceedance of their trigger levels across the monitoring season, there was one incidence of *Lyngbya* spp. detected on 18/02/2026 at the reference site SBR4 (0.32 cell/mL; Table 25). The DoH (2022) watch list includes *Lyngbya majuscule* with 'any detection' as a trigger level and the action level corresponds to widespread visual observation of algal filaments, however the sample collected could not be identified below genus level (Table 23; Figure 30).

Additionally, Water Corporation did not receive any reports from DoH concerning skin or eye irritation, or potential algal poisoning in swimmers at Swanbourne during the monitoring period, thus meeting the EQG 2 (Table 23 and Figure 31).

Table 23 Environmental Quality Guideline for phytoplankton cell count

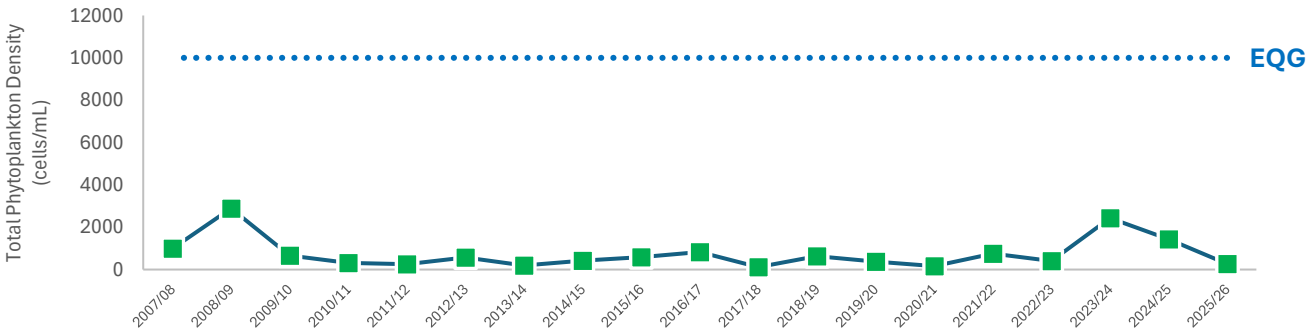
EQG[1] 1	The phytoplankton cell count from a single site should not exceed 10,000 cells/mL; or detect the Department of Health (DoH) watch list species exceeding their trigger levels: Cyanobacteria • *Lyngbya majuscula* (any detection) • *Trichodesmium* spp. (≥ 5,000 cells/mL) Dinoflagellates • *Alexandrium* spp. (≥ 1 cells/mL) • *Karenia brevis* (≥ 5 cells/mL) • *Karenia* spp. (≥ 50 cells/mL) • *Pfiesteria* spp. (any detection)
EQG[1] 2	There should be no reports of skin or eye irritation or potential algal poisoning in swimmers considered by a medical practitioner as potentially resulting from toxic algae when less than 10,000 cells/mL is present in the water column.

Notes:
1. EQG = Environmental Quality Guideline.

Table 24 Estimated phytoplankton total cell densities collected at fixed monitoring sites for contact recreation down-current of the Swanbourne outlets

Date	Site	Total density (cells/mL)[2]	Compliance[1]
04/12/2025	SB5	19	
18/12/2025	SB10	12	
15/01/2026	SB13	164	
21/01/2026	SB13	93	
30/01/2026	SB5	63	
18/02/2026	SB11	266	
4/03/2026	SB8	135	
20/03/2026	SB15	24	

Notes:
1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. Cell density has been converted from cells/L used in laboratory reports to cells/mL for assessment against the guidelines.



Notes:
1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Blue dotted line represents 10,000 cells/mL. Total phytoplankton cell count per survey must not exceed 10,000 cells/mL to meet the EQG.
3. Cell density has been converted from cells/L used in laboratory reports to cells/mL for assessment against the guidelines

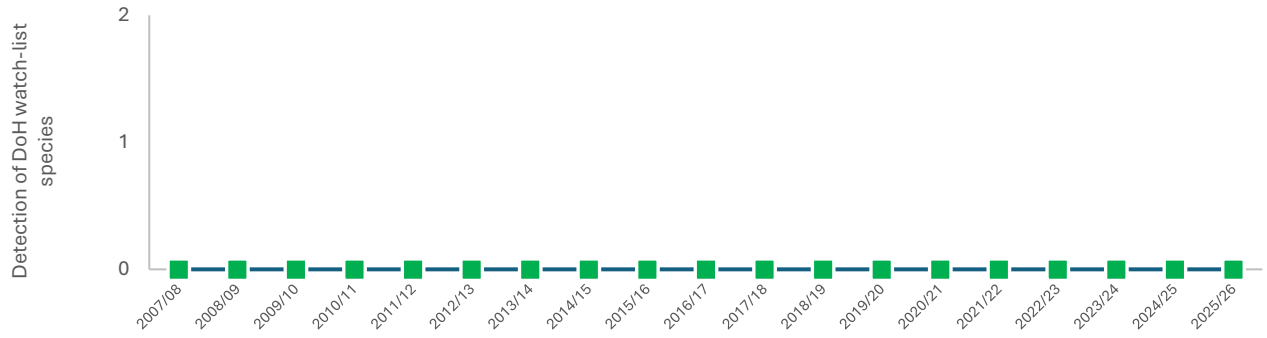
Figure 29 Historical compliance of total phytoplankton cell densities

Table 25 Estimated cell densities of DoH (2022) watch-list phytoplankton species at Swanbourne outfall sites

Date[2]	Site[2]	Species[3]	Estimated density (converted to cells/mL)[4,5]	DoH Guideline[3] (cells/mL)	Compliance[1]
4/12/2025	N/A	No watch-list species detected.	-	-	
18/12/2025	N/A	No watch-list species detected.	-	-	
15/01/2026	SB-29	*Trichodesmium erthraeum*	0.16	5,000	
	SB-13	*Trichodesmium erthraeum*	0.08	5,000	
21/01/2026	SB-13	*Trichodesmium erthraeum*	0.08	5,000	
	SB-29	*Trichodesmium erthraeum*	0.08	5,000	
30/01/2026	SB-5	*Trichodesmium erthraeum*	0.08	5,000	
18/02/2026	SB-28	*Trichodesmium erthraeum*	0.08	5,000	
	SBR4	*Lyngbya* spp.	0.32	-	
4/03/2026	SB-24	*Trichodesmium erthraeum*	0.16	5,000	
20/03/2026	N/A	No watch-list species detected.	-	-	

Notes:

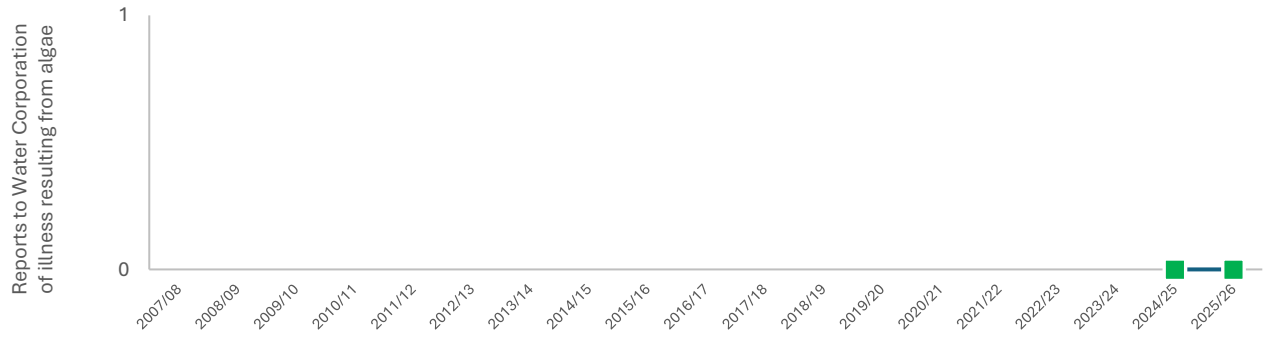
1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. Samples were analysed for one monitoring site and one reference site per sampling occasion.
3. Department of Health watch-list species (DoH 2022).
4. Cell density has been converted from cells/L used in laboratory reports to cells/mL for assessment against the guidelines.
5. Limit of reporting = 80 cells/L (0.08 cells mL)



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG. To meet the EQG, DoH (2022) watch-list phytoplankton species concentrations must not be detected at concentrations exceeding their trigger levels:

Figure 30 Historical compliance of concentrations of watch-list phytoplankton species



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met. To meet the EQG, there should be no reports of skin or eye irritation or potential algal poisoning in swimmers considered by a medical practitioner as potentially resulting from toxic algae when less than 10,000 cells/mL is present in the water column
2. Monitoring for this EQC commenced in the 2024-25 summer monitoring period.
3. Reports are received via the Department of Health

Figure 31 Reports from DoH of skin or eye irritation, or potential algal poisoning in swimmers (when less than 10,000 cells/mL is present in the water column).

Shoreline Monitoring

5.1 Thermotolerant coliforms (TTC)

Water Corporation conducts TTC monitoring additional to that required by the MMP along the shoreline, as these sites are located outside the observed zone of influence (OZI). These results are informally assessed against the EQC (Table 26).

TTC were sampled at eight shoreline monitoring sites eight times over the 2025-26 summer period (yielding a total of 64 samples). NHMRC (2008) guidelines and EPA (2005) recommend that a minimum of 100 samples is required for accurate assessment of the EQG. Data from multiple years can be pooled where there are <100 samples, provided local pollution conditions have not changed (NHRMC 2008). Assuming conditions have not changed, data collected over two summers (summer 2024-25 and 2025-26) were pooled to yield 128 samples.

Table 26 Informal Environmental Quality Guideline for Thermotolerant Coliforms at shoreline monitoring sites

EQG[1]	Median TTC[2] concentrations at the shoreline monitoring sites for the Swanbourne outlet are not to exceed 14 CFU[2]/100 mL, with no more than 10% of the samples exceeding 21 CFU[2]/100 mL as measured using the membrane filtration method during normal plant operating conditions.

Notes:
1. EQG = Environmental Quality Guideline.
2. TTC = thermotolerant coliforms; CFU = Colony Forming Units

The shoreline sites are not formally assessed against the EQC, but the median TTC concentrations derived from 128 samples were at the limit of reporting (<10 CFU/100 mL; Table 27) and less than the 14 and 21 CFU/100 mL criteria, respectively meeting the EQG criteria (Table 26,).

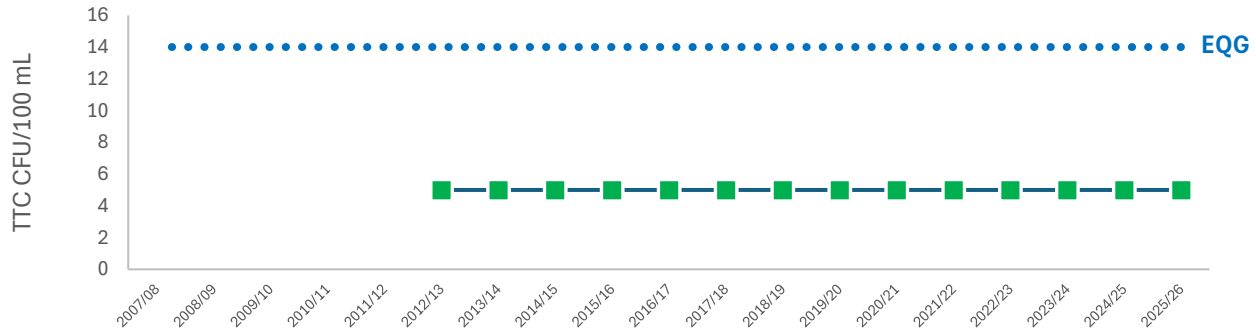
Median thermotolerant coliforms in shoreline samples have exceeded 14 CFU/100 mL on one occasion since shoreline monitoring commenced in 2012-13 (Figure 32). There were 3 incidences where TTC concentrations exceeded 21 CFU/100 mL, representing 2.3% of samples and therefore below the 10% exceedance criteria (Table 28), noting that all 3 incidences of TTC exceeding 21 CFU/100 mL occurred in the previous monitoring season (2024-25). There were no incidences of TTC >21 CFU/100 mL at the shoreline sites in the current monitoring survey (2025-26; Table 28).

Since 2020-21, TTC concentrations exceeding 21 CFU/100 mL were below the 10% criteria at all times (Figure 33)

Table 27 Median thermotolerant coliform concentrations at the shoreline monitoring sites for the Swanbourne outlet pooled over for 2024–26 sampling periods

Sampling period	Median[2,3]	Compliance (EQG)[1,4]
Dec 2024 – Mar 25 Dec 2025 – Mar 26	<10 CFU/100 mL	■

Notes:
1. Green symbols indicate the Environmental Quality Guideline (EQG) was met. Noting that shoreline sites are not formally assessed against the EQG
2. CFU = Colony Forming Unit
3. Thermotolerant coliform results below the limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate the median.
4. Environmental Quality Criteria are based on EPA (2017).



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met; amber symbols represent an exceedance of the EQG.
2. Thermotolerant coliform results below the limit of reporting (<10 CFU/100 mL) were halved (= 5 CFU/100 mL) to calculate the median.
3. TTC = thermotolerant coliforms; CFU = Colony Forming Unit
4. Shoreline monitoring first assessed in 2012-13.
5. Blue dotted line indicates 14 CFU/100 mL. To meet the EQG, median TTC concentration must not exceed 14 CFU/100 mL, noting that the shoreline sites are not formally assessed against the EQG.

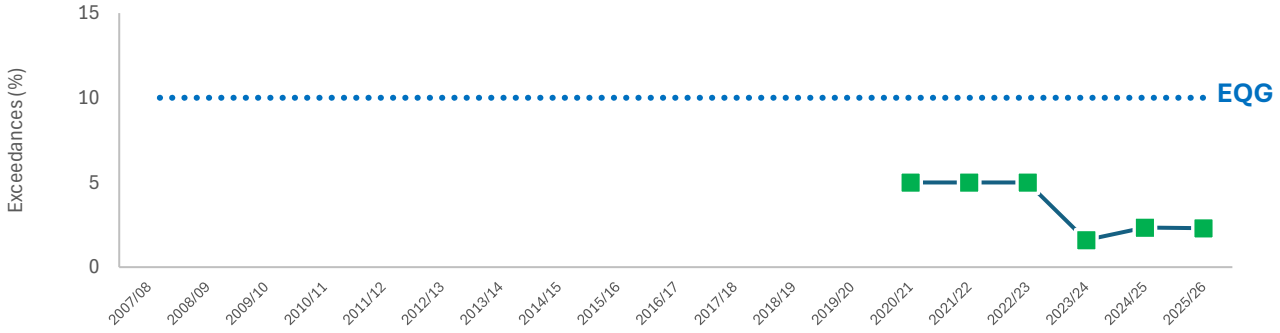
Figure 32 Historical compliance of median thermotolerant coliform concentrations at the shoreline monitoring sites

Table 28 Thermotolerant coliforms at the shoreline monitoring sites for the Swanbourne outlet over 2025–2026 summer sampling periods that exceed 21 CFU/100 mL

Sampling season	Date	Site	TTC concentration (CFU/100 mL)[2,3]	Compliance[1]
Dec 2024 – Mar 2025	4/12/2024	SBSL2	30	
		SBSL3	310	
		SBSL4	100	
Dec 2025 – Mar 2026	-	-	-	
% total samples (n= 128) >21 CFU/100 mL = 2.3%				

Notes:

1. Green symbols indicate the Environmental Quality Criteria (EQC) was met.
2. TTC = thermotolerant coliforms; CFU = colony forming units
3. No TTC concentrations >21 CFU/100 mL was recorded during the 2025-26 summer monitoring period.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Shoreline monitoring first assessed in 2020-21.
3. Blue dotted line indicates the EQG. To meet the EQG, no more than 10% of samples are to exceed 21 CFU/100 mL, noting that the shoreline sites are not formally assessed against the EQG.

Figure 33 Historical compliance of percentage of samples exceeding 21 CFU/100mL of thermotolerant coliform concentrations at the shoreline monitoring sites

5.2 *Enterococci* spp.

Water Corporation conducts faecal indicator (*Enterococci* spp.) monitoring additional to that required by the MMP along the shoreline. These results are informally assessed against the EQC (Table 29).

Samples were collected eight times at eight shoreline monitoring sites over the 2025-26 summer monitoring period (yielding a total of 64 samples) for analysis of faecal indicators. NHMRC (2008) guideline and EPA (2005) recommend that a minimum of 100 samples over the monitoring period are required for accurate assessment of the EQC. Data from multiple years can be pooled where there are <100 samples provided local pollution conditions have not changed (NHRMC 2008). Assuming conditions have not changed, data collected over two summers (2024–25 and 2025-26) were pooled to yield 128 samples.

Shoreline sites are not formally assessed against the EQC, however over the 2024–26 summer monitoring period, the 95th percentile of *Enterococci* spp. concentrations at the shoreline monitoring sites for the Swanbourne ocean outlet was 16.5 MPN/100 mL (Table 30), and below both the primary and secondary (<200 and <2,000 MPN/100 mL, respectively) contact recreation EQGs (Table 29; Figure 34).

Table 29 Informal Environmental Quality Guideline for *Enterococci* spp. at shoreline monitoring sites

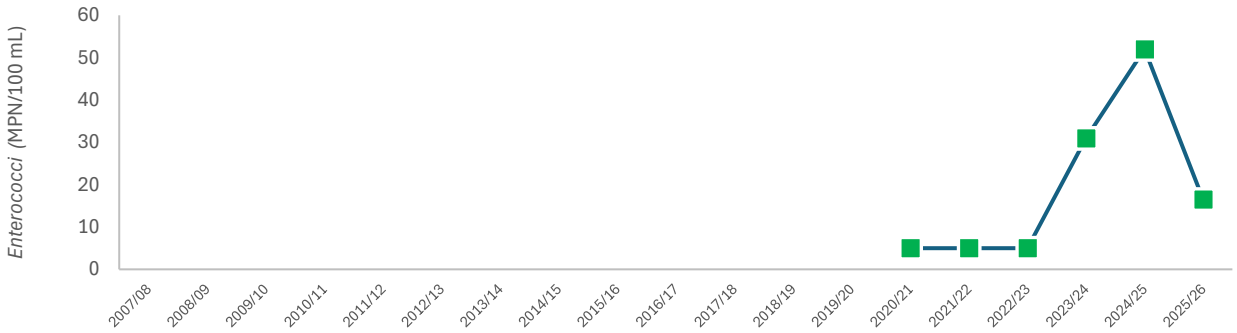
Primary[2]	**EQG[1]1**	The 95th percentile bacterial content (*Enterococci* spp.) of marine waters should not exceed 200 MPN/100 mL.
Secondary[3]	**EQG[1]1**	The 95th percentile bacterial content (*Enterococci* spp.) of marine waters should not exceed 2,000 MPN/100 mL.

Notes:
1. EQG = Environmental Quality Guideline.
2. Primary contact recreation = activities where humans are in direct contact with the water (e.g. swimming, snorkelling and diving).
3. Secondary contact recreation = activities where humans are in secondary contact with the water (e.g. boating and fishing).

Table 30 The 95th percentile of *Enterococci* spp. concentrations at the shoreline monitoring sites for the Swanbourne ocean outlet pooled over the 2024–2026 sampling periods

Sampling period	95th percentile[2,3]	Informal comparison to the criteria[1,4]	
		Primary contact	Secondary contact
Dec 2024 – Mar 25 Dec 2025 – Mar 26	16.5 MPN/100 mL	■	■

Notes:
1. Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. MPN = most probable number of *Enterococci* spp.
3. *Enterococci* spp. concentrations below the limit of reporting (<10 *Enterococci* spp. MPN/100 mL) were halved (= 5 MPN/100 mL) to calculate the 95th percentile.
4. Environmental Quality Criteria (EQC) based on EPA (2017) water quality guidelines for recreation waters.



Notes:

1. Environmental Quality Criteria (EQC): Green symbols indicate the Environmental Quality Guideline (EQG) was met.
2. Shoreline monitoring commenced in the 2020-21 sampling season
3. To meet the EQG, the 95th percentile *Enterococci* spp. concentrations must be <200 MPN/100 mL(primary contact) and <2,000 MPN/100 mL (secondary contact) noting that shoreline sites are not formally assessed against the EQG.

Figure 34 Historical compliance of the 95th percentile *Enterococci* spp. concentrations at the shoreline monitoring sites

6 Aesthetics

Aesthetic quality was assessed on each field sampling event via a questionnaire completed by field personnel on eight occasions during the non-river flow period (Table 31; Table 32). On each occasion, the questionnaire was completed at one location on the recreation contact boundary down-current of the outlet. Water clarity around the outlet (mean LAC at 350 m from the diffuser, pooled from all days) was compared against water clarity at a greater distance from the outlet (mean LAC at 1,500 m from the diffuser from all days pooled) to assess whether aesthetic differences exist. Water Corporation also maintains a complaints register for the Swanbourne PLOOM program.

The results of the aesthetic monitoring are presented in Table 32. The field surveys found algae/plant material visible on the surface on four (50% of sampling events) occasions. No dead marine organisms were visible on any occasion. There was no noticeable colour variation on any occasion. There were no films or oil on the surface, noticeable odour or floating debris on any sampling occasion. There was no overall decrease in the aesthetic water quality values of Swanbourne and therefore the EQG for aesthetics (Table 31) was met.

Mean LAC at 1,500 m from the ocean outlet was the same as at 350 m (0.083 m^{-1}), suggesting no difference in light attenuation between these distances (Table 33). Overall water clarity had no difference (0%) and therefore the EQG that the natural visual clarity of the water should not be reduced by more than 20% was met (Table 31).

Table 31 Environmental Quality Criteria for Recreation and Aesthetics

Indicator	Environmental Quality Criteria for Aesthetic Quality	
	EQG	**EQS**
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae and sewage fungus should not be present in excessive amounts.	There should be no overall decrease in the aesthetic water quality values of the marine receiving environment using direct measures of the community's perception of aesthetic value.
Faunal deaths	There should be no reported incidents of large-scale deaths of marine organisms relating from unnatural causes.	
Water clarity	The natural visual clarity of the water should not be reduced by more than 20%.	
Colour	The natural hue of the water should not be changed by more than ten points on the Munsell scale.	
Surface films	Oil and petrochemicals should not be noticeable as a visible film on the water or detectable by odour.	
Surface debris	Water surfaces should be free of floating debris, dust and other objectionable matter, including substances that cause foaming.	
Odour	There should be no objectionable odour.	

Notes:

1. EQG = Environmental Quality Guideline; EQS = Environmental Quality Standard

Table 32 Aesthetic observations and measurements near the Swanbourne ocean outlets from December 2025 to March 2026.

Date	Site[1]	Algae/plant material?	Dead marine organisms?	Secci depth (m)	Colour variation?	Oil or other films?	Floating debris?	Odour?	Cotton buds?
4/12/2025	SB5	No	No	6.0	No	No	No	No	No
18/12/2025	SB10	No	No	11.5	No	No	No	No	No
15/01//2026	SB13	No	No	6.0	No	No	No	No	No
21/01/2026	SB14	No	No	7.7	No	No	No	No	No
30/01/2026	SB5	Yes (seagrass/wrack)	No	7.5	No	No	No	No	No
18/02/2026	SB11	Yes (seagrass)	No	9.8	No	No	No	No	No
4/03/2026	SB7	Yes (seagrass/wrack)	No	7.3	No	No	No	No	No
20/03/2026	SB15	Yes (seagrass)	No	10.8	No	No	No	No	No

Notes:

1. Aesthetic observations are taken at one of the fixed Primary Contact Management Zone sites each survey

Table 33 Light attenuation coefficient at sites 350 m and 1500 m from the Swanbourne ocean outlets from December 2025 to March 2026.

Date	Light attenuation coefficient (LAC; m^{-1})	
	350 m (site SBT 350 m)	1,500 m (site SBT 1,500 m)
4/12/2025	0.079	0.092
18/12/2025	0.079	0.073
15/01/2026	0.076	0.075
21/01/2026	0.099	0.094
30/01/2026	0.085	0.087
18/02/2026	0.085	0.073
4/03/2026	0.094	0.098
20/03/2026	0.071	0.070
Average	**0.083**	**0.083**

7 References

ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

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DoH (2025) Marine Biotoxin Monitoring and Management Plan version 5: Western Australian Shellfish Quality Assurance Program (WASQAP). Department of Health, Perth, Western Australia, April 2025.

EPA (2005) Manual of Standard Operating Procedures – For Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria (2003–2004) – A supporting document to the State Environmental (Cockburn Sound) Policy 2005. Environmental Protection Authority, Report No. 21, Perth, Western Australia, January 2005

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EPA (2017) Environmental Quality Criteria Reference Document for Cockburn Sound – A supporting document to the State Environmental (Cockburn Sound) Policy 2015. Environmental Protection Authority, Perth, Western Australia, April 2017

McAlpine KW, Wenziker KJ, Apte SC, Masini RJ (2005) Background quality for coastal marine waters of Perth, Western Australia. Department of Environment, Report No. 117, Perth, Western Australia, March 2005

NHMRC (2008) Guidelines for Managing Risks in Recreational Water. National Health and Medical Research Council, Canberra, Australian Capital Territory, February 2008

8 Appendices

The following Appendices are available from Water Corporation on request:

Appendix A. Methods

Appendix B. Monitoring Sites

Appendix C. Field Sheets

Appendix D. Nutrient Results

Appendix E. Microbiological Sites

Appendix F. Algal Taxonomy Results

Appendix G. DoH Toxic Algae Guidelines (2022)

Appendix H. DoH WASQAP MBMMP (2025)

Appendix I. MAFRL Physical Profiling

Appendix J. TWW Characterisation Chemistry Results

Appendix K. TWW Ecotoxicity Results

Appendix L. Initial Dilution Modelling