NSW GOVERNMENT

DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

State of the beaches 2019–2020

Hunter region

Beachwatch

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Front cover: Leggy Point loop walking track, Glenrock State Conservation Area (John Spencer/DPIE)

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Contents

Recreational water quality has been monitored in the Hunter region since 1996 by Hunter Water Corporation as a requirement of Environment Protection Licences, and by Port Stephens Council and Lake Macquarie City Council under the Department of Planning, Industry and Environment's Beachwatch Partnership Program. This report summarises the performance of 24 swimming sites in the Hunter region of New South Wales, providing a long-term assessment of how suitable a site is for swimming. Monitored sites include ocean beaches and estuarine areas in Port Stephens.

In 2019–2020, 96% of swimming sites in the Hunter region were graded as Good or Very Good. These sites were suitable for swimming for most or almost all of the time. This is an excellent result, similar in performance to the previous year, and reflects the very dry conditions over spring and early summer.

Hunter region summary 2019–2020

Beach monitoring in NSW

Little Beach
Photo: Beachwatch/EES, DPIE

The water quality of beaches and other swimming locations is monitored under the NSW Government's Beachwatch programs to provide the community with accurate information on the cleanliness of the water and to enable individuals to make informed decisions about where and when to swim. Routine assessment also measures the impact of pollution sources, enables the effectiveness of stormwater and wastewater management practices to be assessed and highlights areas where further work is needed.

Swimming sites in New South Wales are graded as Very Good, Good, Fair, Poor or Very Poor in accordance with the National Health and Medical Research Council's 2008 *Guidelines for Managing Risks in Recreational Waters*. These Beach Suitability Grades provide a long-term assessment of how suitable a beach is for swimming. The grades are determined from the most recent 100 water quality results (two to four years' worth of data depending on the sampling frequency) and a risk assessment of potential pollution sources.

See the section on **Quality assurance** in the Statewide Summary for results of the quality assurance program.

Recreational water quality has been monitored in the Hunter region by Hunter Water Corporation since 1996 and Port Stephens Council since 2004.

A **quality assurance** program ensures the information collected and reported by Beachwatch and its partners is accurate and reliable.

Rainfall impacts

During 2019–2020, 24 swimming sites were monitored including ocean beaches and estuarine areas in Port Stephens.

Rainfall is the major driver of pollution to recreational waters, generating stormwater runoff and triggering untreated discharges from the wastewater treatment and transport systems. Changes in rainfall patterns are reflected in beach water quality over time due to variation in the frequency and extent of stormwater and wastewater inputs.

The Beach Suitability Grades for 2019–2020 are based on water quality data collected over the last two to four years. Rainfall over this period has been diverse:

- 2016–2017: the wettest March on record for many coastal areas and intense storm activity over summer

- 2017–2018: prolonged dry weather periods broken by heavy rainfall at times
- 2018–2019: relatively dry weather conditions, with a few wet months and occasional heavy falls
- 2019–2020: average to below average rainfall, except for a wet February and a few isolated rain events.

See the section on **How to read this report** on page 44 for an explanation of the graphs, tables and Beach Suitability Grades.

Winter rainfall totals on the Hunter Coast were close to average in 2019. Heavy rain events occurred on several occasions in June 2019 and late in August 2019. Swansea recorded its highest August rainfall total since 1998, with 200 mm of rainfall for the month.

The Hunter Coast received above average rainfall in September 2019, but with most of the rain falling over two days in the middle of the month.

Very dry conditions followed in spring and early summer with well below average rainfall recorded from October 2019 to January 2020. Nelson Bay and Swansea recorded their lowest December total rainfall with 6 mm and 4 mm of rainfall respectively.

Heavy rain fell during February and March 2020, with above average rainfall totals recorded on the Hunter Coast. Nelson Bay and Swansea received more than double the long-term monthly average rainfall for February, recording 317 mm and 307 mm respectively.

Marine algal blooms

Marine algal bloom present in the water
Photo: Chad Weston/NPWS, DPIE

Water NSW reported an occurrence of marine algal bloom at Hunter beaches in 2019–2020. An algal bloom of the genus *Trichodesmium* was reported at some Newcastle ocean beaches in February 2020. Marine algae advisories were issued on the Beachwatch and Water NSW websites.

The appearance of **marine algae** is sometimes mistaken for **sewage contamination** or **oil slicks**, due to a strong odour and red or brown discolouration in the water caused by the blooms.

As a precaution, direct contact with algae should be avoided as it can cause skin and eye irritations. The marine algal blooms dissipated with changes in tide and wind conditions.

Beachwatch issues daily **beach pollution forecasts** to enable beach goers to make informed decisions about where and when to swim.

Pollution forecasts for the Hunter beaches can be accessed via the Beachwatch website, email subscription, Twitter and Facebook.

Health risks

Contamination of recreational waters with faecal material from animal and human sources can pose significant health problems to beach users owing to the presence of pathogens (disease-causing micro-organisms) in the faecal material. The most common groups of pathogens found in recreational waters are bacteria, protozoans and viruses.

Exposure to contaminated water can cause gastroenteritis, with symptoms including vomiting, diarrhoea, stomach-ache, nausea, headache and fever. Eye, ear, skin and upper respiratory tract infections can also be contracted when pathogens come into contact with small breaks and tears in the skin or ruptures of the delicate membranes in the ear or nose.

Certain groups of users may be more vulnerable to microbial infection than others. Children, the elderly, people with compromised immune systems, tourists, and people from culturally and linguistically diverse backgrounds are generally most at risk.

Beach Suitability Grades for Hunter region

Swimming site	Site type	Beach Suitability Grade	Change
Port Stephens Council			
Zenith Beach	Ocean beach	VG	●
Box Beach	Ocean beach	VG	●
Fingal Beach	Ocean beach	VG	▲
One Mile Beach	Ocean beach	VG	●
Birubi Beach	Ocean beach	VG	●
Little Beach	Estuarine	G	●
Dutchmans Beach	Estuarine	G	●
Bagnalls Beach	Estuarine	G	▲
Georges Reserve	Estuarine	G	●
Lemon Tree Passage Tidal Pool	Estuarine	G	●
Karuah Tidal Pool	Estuarine	G	●
City of Newcastle Council			
South Stockton Beach	Ocean beach	VG	●
Nobbys Beach	Ocean beach	VG	●
Newcastle Beach	Ocean beach	VG	●
Bar Beach	Ocean beach	VG	●
Merewether Beach	Ocean beach	VG	●
Burwood North Beach	Ocean beach	VG	●
Burwood South Beach	Ocean beach	VG	●
Lake Macquarie City Council			
Glenrock Lagoon Beach	Ocean beach	VG	●
Dudley Beach	Ocean beach	VG	●
Redhead Beach	Ocean beach	VG	▲
Blacksmiths Beach	Ocean beach	VG	●
Swansea Heads Little Beach	Ocean beach	P	▼

Swimming site	Site type	Beach Suitability Grade	Change
Lake Macquarie City Council (continued)			
Caves Beach	Ocean beach	VG	●

Beach Suitability Grade					Change		
VG	G	F	P	VP	↑	●	↓
Very Good	Good	Fair	Poor	Very Poor	Improved	Stable	Declined

Port Stephens Council

Overall results

100%
swimming sites graded Good or Very Good

All 11 swimming sites were graded as Very Good or Good in 2019–2020. This is an excellent result and an improvement from the previous year.

Percentage of sites graded as Very Good or Good:

- 2019–2020: 100%
- 2018–2019: 91%
- 2017–2018: 91%
- 2016–2017: 82%.

See the section on **How to read this report** on page 44 for an explanation of the graphs, tables and Beach Suitability Grades.

Eleven swimming sites were monitored in the Port Stephens local government area.

Four locations were monitored by Hunter Water Corporation as a requirement of Environment Protection Licences. Samples were collected every sixth day throughout the year.

Seven locations were monitored by Port Stephens Council. Samples were collected weekly between October and March. Sampling and laboratory analysis was fully funded by council.

Best beaches

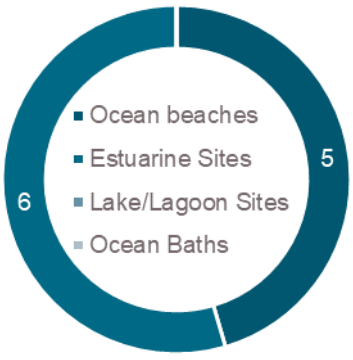
Zenith Beach, Box Beach, Fingal Beach, One Mile Beach and Birubi Beach.

These sites had excellent water quality and were suitable for swimming almost all of the time.

Swimming sites monitored in the Port Stephens region include ocean beaches and estuarine areas in Port Stephens, with each site type having a different response to rainfall-related impacts.

In general, estuarine swimming sites did not perform as well as ocean beaches, due to lower levels of flushing to disperse and dilute pollution inputs, taking longer to recover from stormwater events.

As a general precaution swimming should be avoided during and for at least one day after heavy rain at ocean beaches, and for up to three days in estuarine areas, or if there are signs of stormwater pollution such as discoloured water or floating debris.



Site types in Port Stephens Council

Ocean beaches

Beach Suitability Grades for Port Stephens Council ocean beaches

All five ocean beaches were graded as Very Good in 2019–2020: Zenith Beach, Box Beach, Fingal Beach, One Mile Beach and Birubi Beach. Water quality at these sites was suitable for swimming almost all of the time.

Fingal Beach was upgraded to Very Good from a Good grade in 2018–2019. The microbial water quality at this site has continued to improve over the past four years, with enterococci levels frequently suitable for swimming.

Swimming should be avoided for 24 hours after rainfall at ocean beaches, or if signs of pollution are present such as discoloured water or flowing stormwater drains.

Estuarine beaches

Beach Suitability Grades for Port Stephens Council estuarine beaches

All six estuarine beaches in Port Stephens were graded as Good: Little Beach, Dutchmans Beach, Bagnalls Beach, Georges Reserve, Lemon Tree Passage Tidal Pool and Karuah Tidal Pool. Water quality at these sites is mostly suitable for swimming during dry weather conditions but may be susceptible to pollution for up to three days after rainfall.

Bagnalls Beach improved to Good from a Poor grade in 2018–2019. While microbial water quality at this site has improved over the past five years, it remains close to the threshold between Good and Poor grades. Enterococci levels often exceeded the safe swimming limit in dry weather conditions and after low levels of rainfall. Swimming should be avoided at this site during and for at least three days following rainfall, or if signs of pollution are present such as discoloured water or flowing stormwater drains.

Lemon Tree Passage Tidal Pool
Photo: Beachwatch/EES, DPIE

Management

Patrolled ocean beach
Photo: Beachwatch/EES, DPIE

A **Coastal Management Program** (CMP) outlines a long-term strategy for managing the coast, in line with the *Coastal Management Act 2016*.

The NSW Government provides guidance and funding through the Coastal and Estuary Grants Program for local councils to prepare and implement CMPs.

Under the previous *Coastal Protection Act 1979*, councils developed a **Coastal Zone Management Plan** (CZMP) to address coastal issues. Councils can continue to implement priority actions from certified CZMPs with funding assistance from the NSW Government's Coastal and Estuary Grants Program until 2021.

Port Stephens Council

Port Stephens Council is preparing a coastal management program (CMP) for the Port Stephens estuary and open coast, using funding received from the NSW Government's Coastal and Estuary Grants Program. The CMP will identify the priority coastal hazards, issues and risks to the Port Stephens coastal zone and will yield a range of short, medium and long-term management options for the area. While the CMP is expected to focus on the management of coastal hazards within the Port Stephens LGA, catchment influences on water quality and beach amenity are also being considered throughout the CMP development.

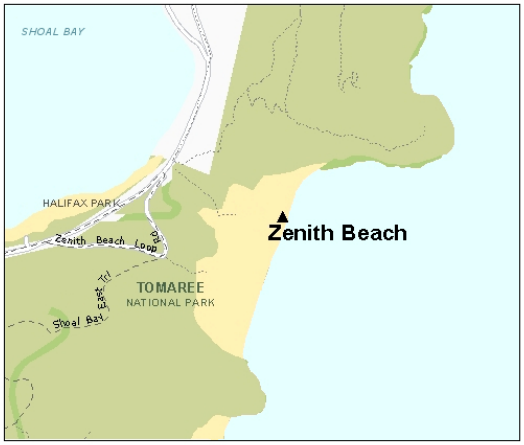
Port Stephens Council responds to reports of suspected algal contamination, stormwater and sewage pollution by managing swimming areas to minimise the risk to swimmers. Council utilises various methods to communicate information to the public including council's website and social media. If sewage or stormwater contamination is suspected, the swimming area may be closed and further water quality testing is undertaken until samples indicate that water quality is suitable for swimming.

There are more than 4800 onsite sewage management systems in the Port Stephens Council area, many of which are located in semi-rural villages and rural areas. Potential environmental and health impacts are managed by the council through routine inspections, application assessment and management, and an 'approval to operate' database.

Sampling sites and Beach Suitability Grades in Port Stephens Council

Zenith Beach

Beach grade: VG



See ‘How to read this report’ for key to map.

Zenith Beach is 400 metres long and is within Tomaree National Park. The beach is not patrolled by lifeguards.

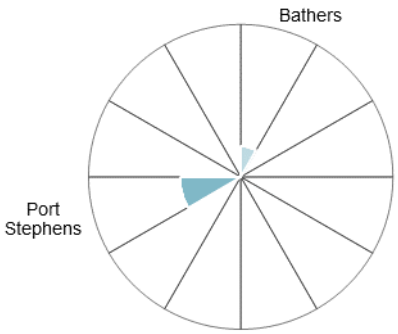
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with very few potential sources of faecal contamination.

Enterococci levels had little response to rainfall and generally remained below the safe swimming limit across most rainfall categories.

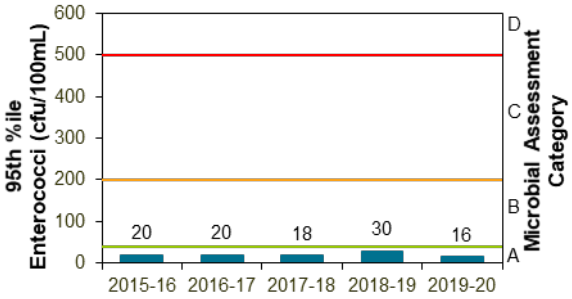
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	98%	100	Stable

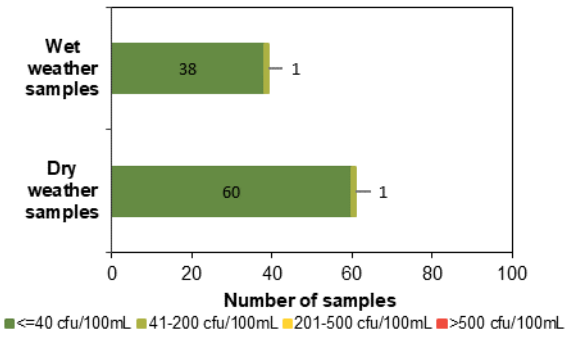
Sanitary inspection: Low



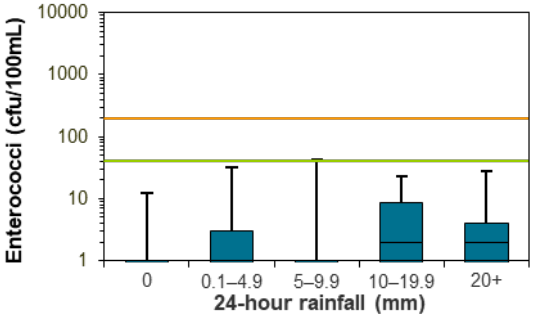
Microbial Assessment Category: A



Dry and wet weather water quality

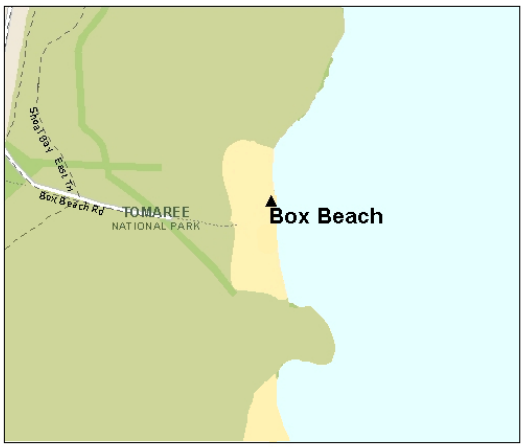


Water quality in response to rainfall



Box Beach

Beach grade: VG



See ‘How to read this report’ for key to map.

Box Beach is 350 metres long and within Tomaree National Park. The beach is not patrolled by lifeguards.

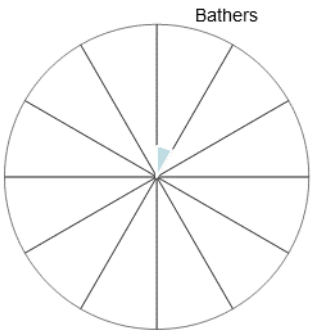
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with only one potential source of faecal contamination.

Enterococci levels had very little response to rainfall and generally remained well below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	98%	100	Stable

Sanitary inspection: Very low



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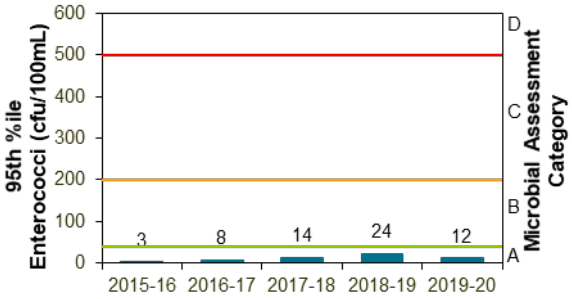
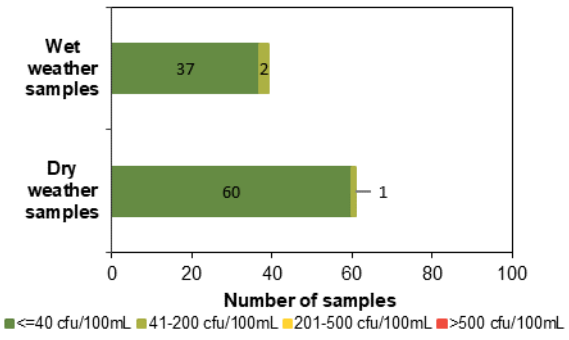
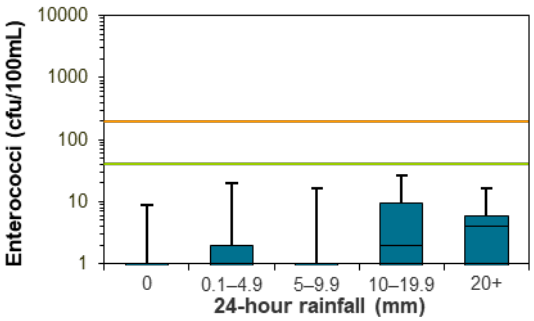


Dry and wet weather water quality



Water quality in response to rainfall



Fingal Beach

Beach grade: VG

See 'How to read this report' for key to map.

Fingal Beach is approximately 2.7 kilometres long and within Fingal Bay. The beach is patrolled from September to April.

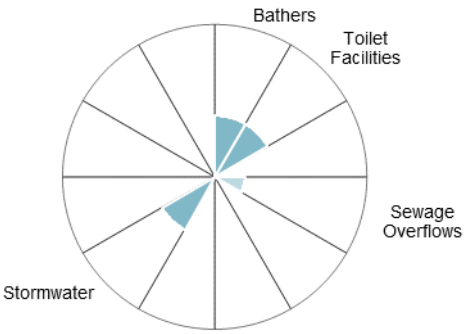
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after light rain.

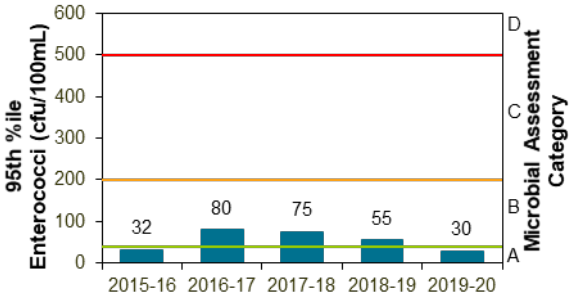
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	95%	100	Improved

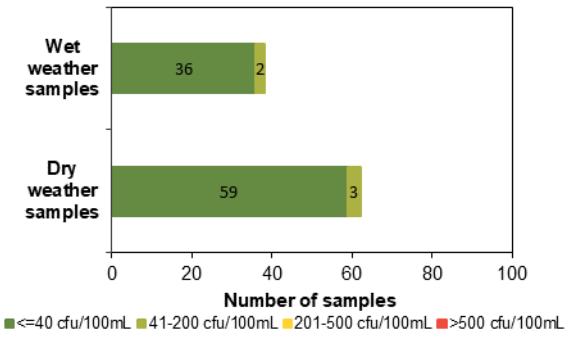
Sanitary inspection: Low



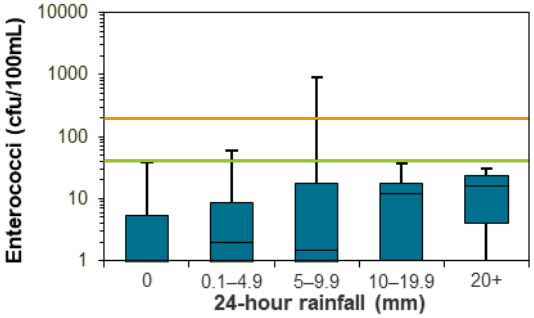
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



One Mile Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

This 1.3 kilometre stretch of beach is at the southern end of Anna Bay and is patrolled from September to April.

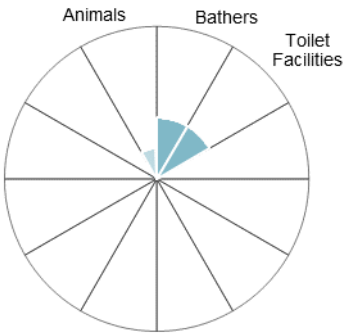
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall but generally remained below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	98%	100	Stable

Sanitary inspection: Low



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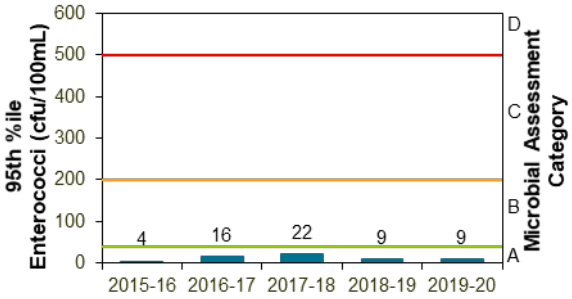
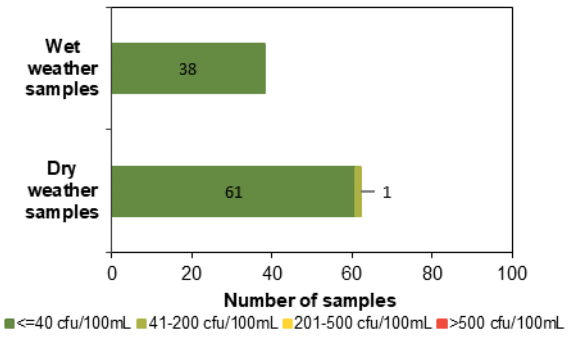
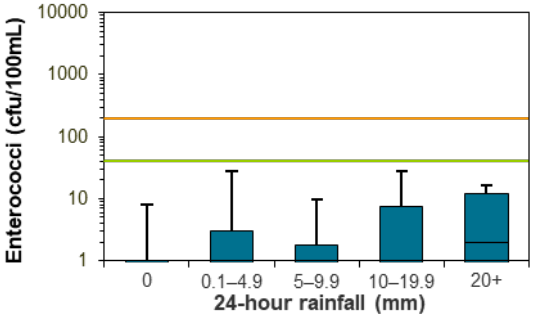


Dry and wet weather water quality

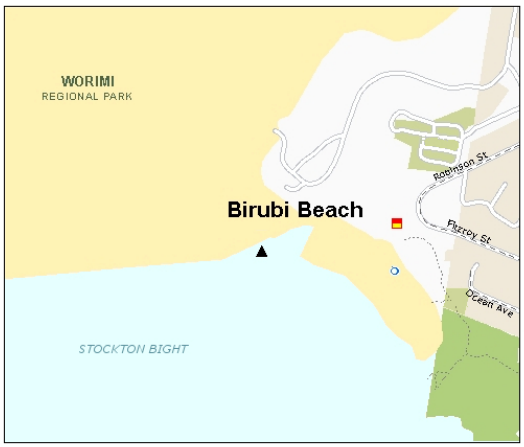


Water quality in response to rainfall



Birubi Beach

Beach grade: VG



See ‘How to read this report’ for key to map.

Birubi Beach lies among rocky outcrops at the northern end of Stockton Bight and is patrolled from September to April.

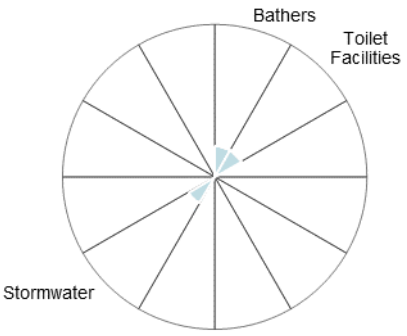
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels had little response to rainfall and generally remained below the safe swimming limit across all rainfall categories.

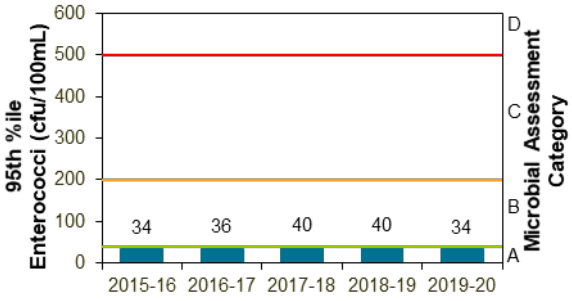
The site has been monitored since 2004.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Dec 2016 to Mar 2020	97%	100	Stable

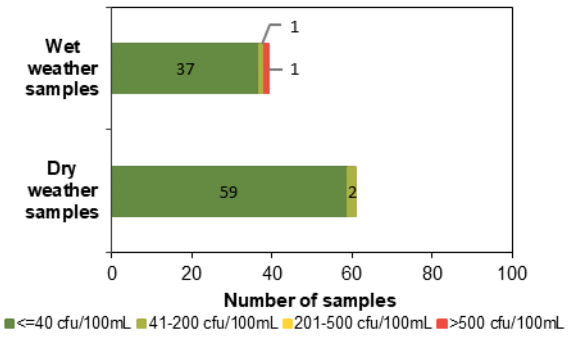
Sanitary inspection: Low



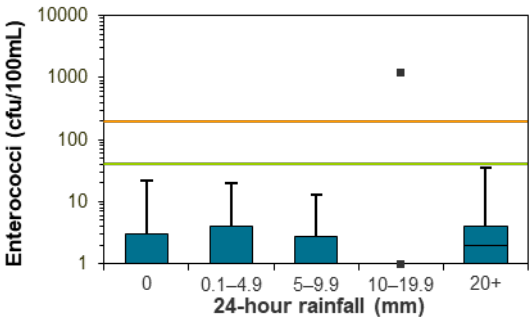
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Little Beach

Beach grade: G

See ‘How to read this report’ for key to map.

Little Beach is a netted swimming enclosure located on the southern shore of Port Stephens.

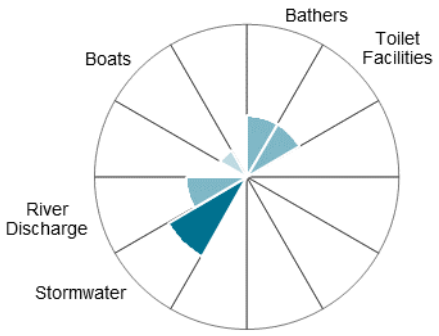
The Beach Suitability Grade of Good indicates microbial water quality is considered suitable for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including stormwater.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after little or no rain, and often after 5 mm or more.

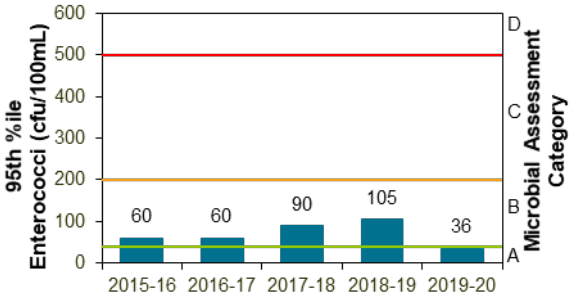
The site has been monitored since 2004.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	89%	100	Stable

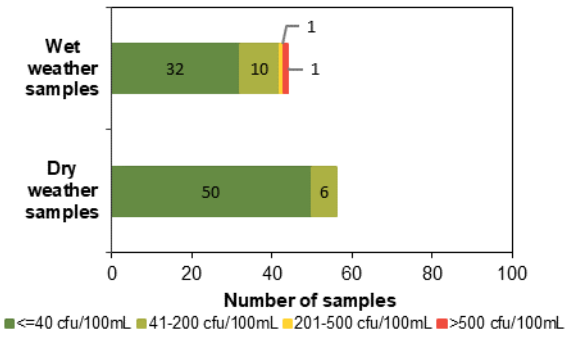
Sanitary inspection: Moderate



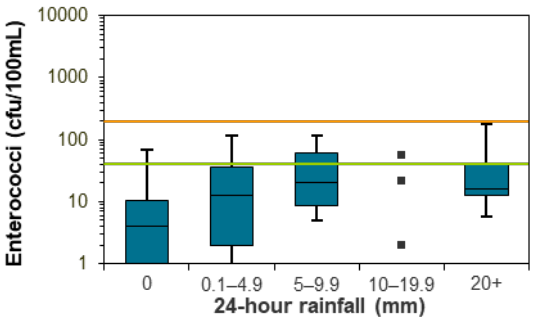
Microbial Assessment Category: A



Dry and wet weather water quality

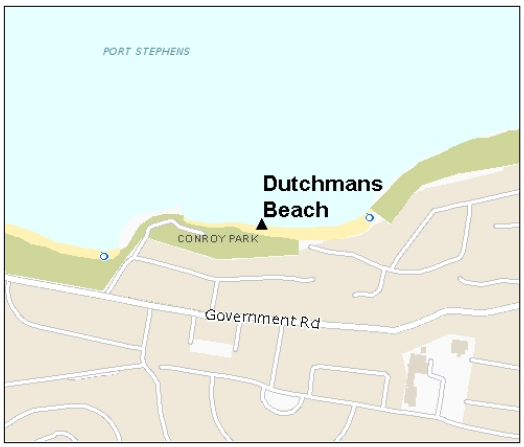


Water quality in response to rainfall



Dutchmans Beach

Beach grade: G



See ‘How to read this report’ for key to map.

Dutchmans Beach (also known as Dutchies Beach) is on the southern shore of Port Stephens.

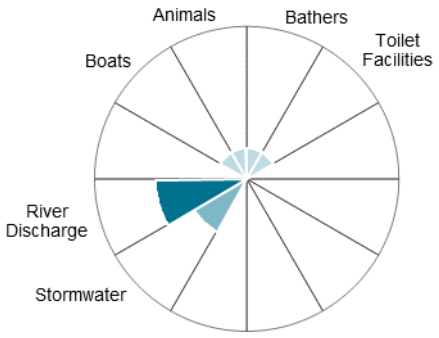
The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including river discharge.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after little or no rain, and regularly after 20 mm or more.

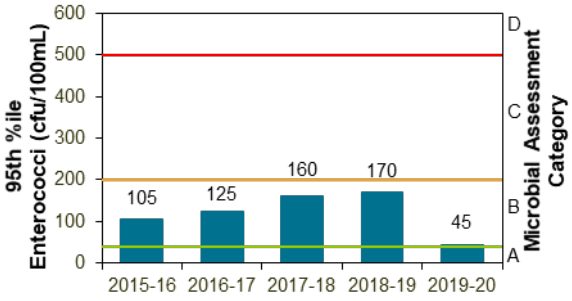
The site has been monitored since 2006.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	79%	100	Stable

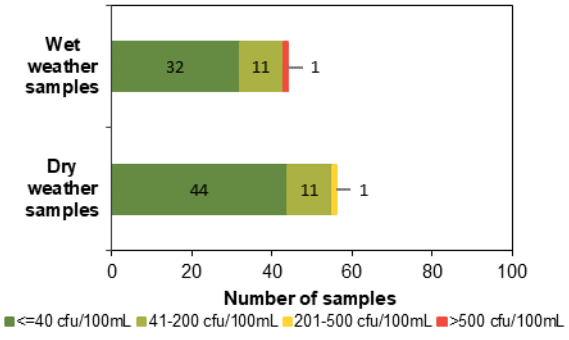
Sanitary inspection: Moderate



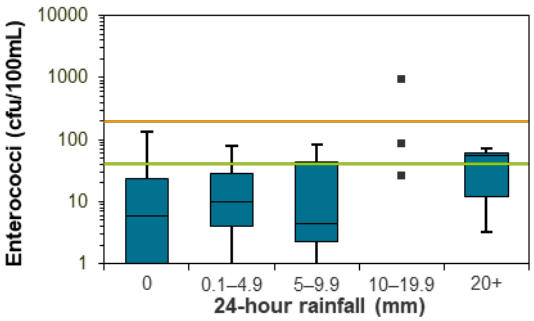
Microbial Assessment Category: B



Dry and wet weather water quality



Water quality in response to rainfall



Bagnalls Beach

Beach grade: G

See ‘How to read this report’ for key to map.

Bagnalls Beach is located on the southern shore of Port Stephens.

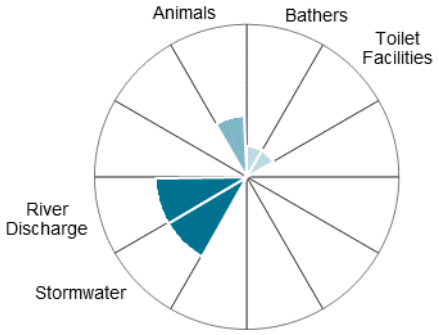
The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including river discharge and stormwater.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to little or no rain.

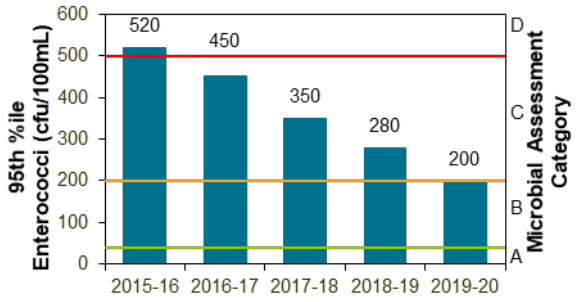
The site has been monitored since 2004.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	68%	100	Improved ↑

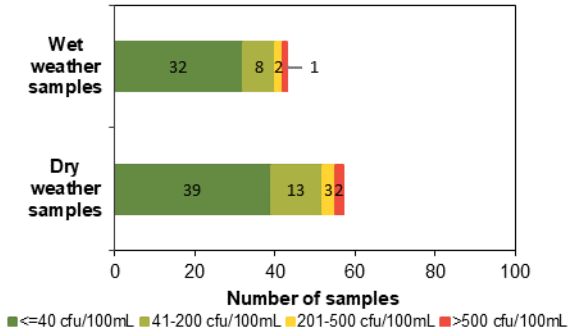
Sanitary inspection: Moderate



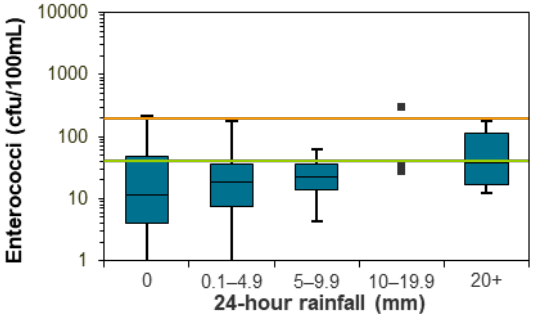
Microbial Assessment Category: B



Dry and wet weather water quality



Water quality in response to rainfall



Georges Reserve

Beach grade: G

See ‘How to read this report’ for key to map.

Georges Reserve is a *narrow* sandy beach located on the southern shore of Port Stephens.

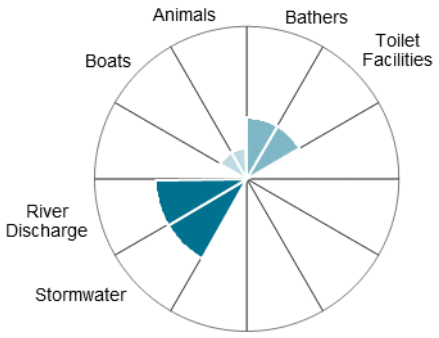
The Beach Suitability Grade of Good indicates microbial water quality is considered suitable for swimming most of the time but may susceptible to faecal pollution after rain, with several potential sources of faecal contamination including river discharge and stormwater.

Enterococci levels increased slightly with increasing rainfall, often exceeding the safe swimming limit in response to little or no rain, and regularly after 20 mm or more.

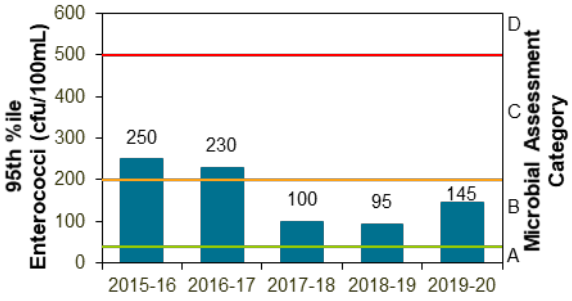
The site has been monitored since 2005.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	72%	100	Stable

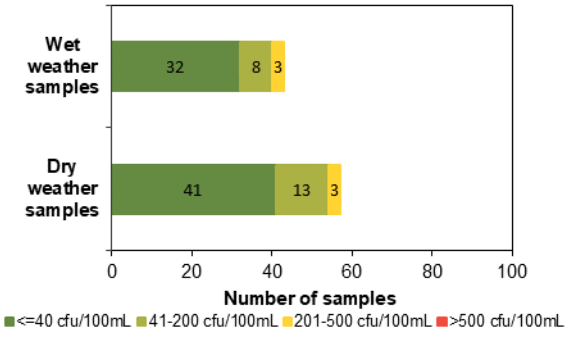
Sanitary inspection: Moderate



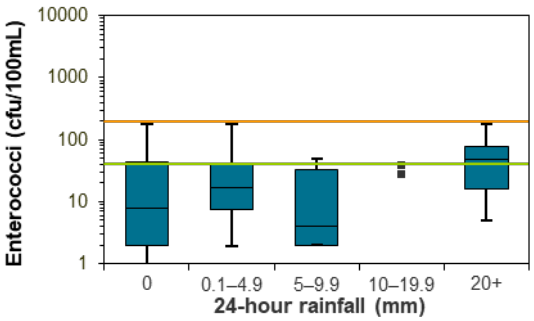
Microbial Assessment Category: B



Dry and wet weather water quality



Water quality in response to rainfall



Lemon Tree Passage Tidal Pool

Beach grade: G

See 'How to read this report' for key to map.

Lemon Tree Passage Tidal Pool is a netted swimming enclosure located in a shallow arm of Port Stephens.

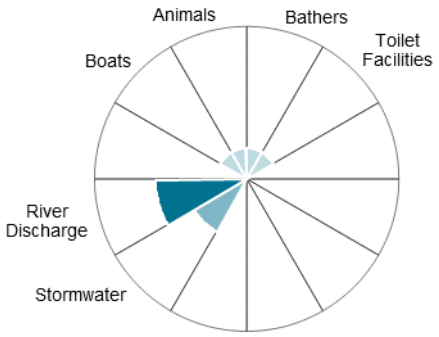
The Beach Suitability Grade of Good indicates microbial water quality is considered suitable for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including river discharge.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after little or no rain, and regularly after 20 mm or more.

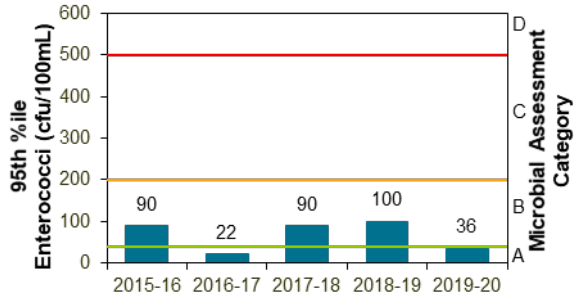
The site has been monitored since 2004.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	91%	100	Stable

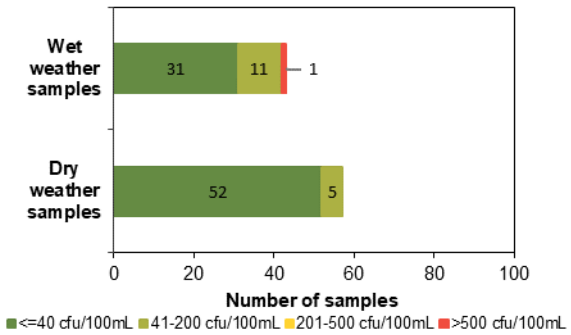
Sanitary inspection: Moderate



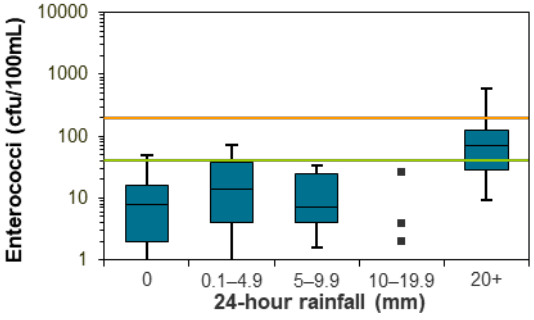
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Karuah Tidal Pool

Beach grade: G

See ‘How to read this report’ for key to map.

Karuah Tidal Pool is a netted swimming enclosure located in the lower reaches of the Karuah River leading to Port Stephens.

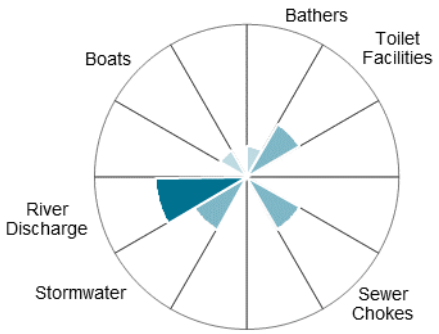
The Beach Suitability Grade of Good indicates microbial water quality is considered suitable for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including river discharge.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after little or no rain, and regularly after 20 mm or more.

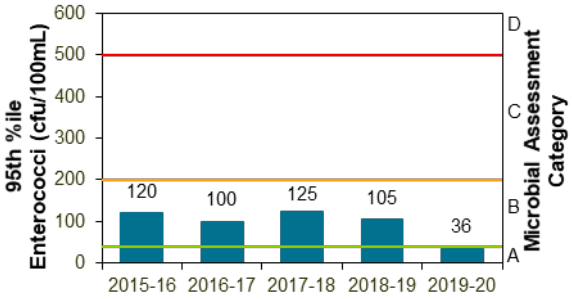
The site has been monitored since 2004.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2016 to Mar 2020	88%	100	Stable

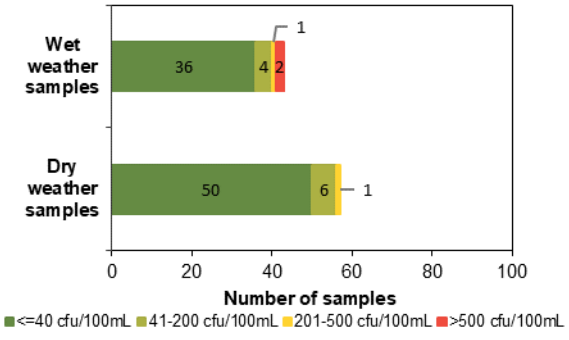
Sanitary inspection: Moderate



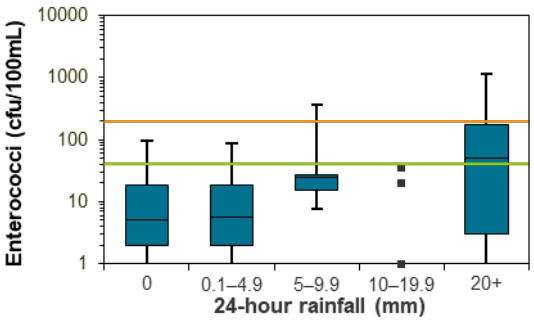
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



City of Newcastle Council

Overall results

100%
swimming sites graded Good or Very Good

All seven swimming sites were graded as Very Good in 2019–2020. Excellent results have also been recorded in previous years.

Percentage of sites graded as Very Good or Good:

- 2019–2020: 100%
- 2018–2019: 100%
- 2017–2018: 100%
- 2016–2017: 100%.

See the section on **How to read this report** on page 44 for an explanation of the graphs, tables and Beach Suitability Grades.

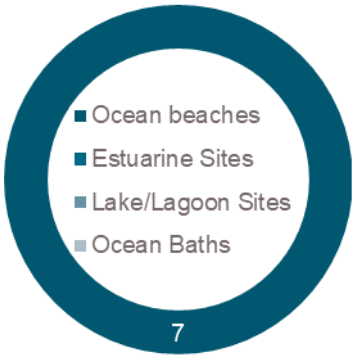
Seven swimming sites were monitored in the Newcastle local government area.

All locations were monitored by Hunter Water Corporation as a requirement of Environment Protection Licences. Samples were collected every sixth day throughout the year and every third day during the swimming season at four sites.

Best beaches

South Stockton Beach, Nobbys Beach, Newcastle Beach, Bar Beach, Merewether Beach, Burwood North Beach and Burwood South Beach.

These sites had excellent water quality and were suitable for swimming almost all of the time.



Site types in City of Newcastle Council

Ocean beaches were the only site type monitored in the Newcastle region.

As a general precaution swimming should be avoided during and for at least one day after heavy rain at ocean beaches, or if there are signs of stormwater pollution such as discoloured water or floating debris.

Ocean beaches

Beach Suitability Grades for City of Newcastle Council ocean beaches

All seven ocean beaches were graded as Very Good: South Stockton Beach, Nobbys Beach, Newcastle Beach, Bar Beach, Merewether Beach, Burwood North Beach and Burwood South Beach. Water quality at these sites has been consistently excellent for many years and is suitable for swimming almost all of the time.

Management

Patrolled ocean beach
Photo: Beachwatch/EES, DPIE

City of Newcastle Council

City of Newcastle Council has completed the Scoping Study component of the Newcastle Coastal Management Program (CMP), with funding provided by the NSW Government's Coastal and Estuary Grants Program. Additionally, council has drafted the Stockton component of the CMP, which will soon be submitted for certification. The CMP will consider catchment pressures and potential management initiatives to manage issues relating to coastal and estuary health. Water quality management actions such as stormwater infrastructure improvements and strategic land-use planning may be considered during the process. This CMP is expected to be completed in 2021.

City of Newcastle Council, in collaboration with Maitland Council and Port Stephens Council, also previously developed the Hunter Estuary CZMP, which focuses on the ecological health and water quality of the Hunter River. Development of a Hunter Estuary CMP has yet to commence with both the Newcastle and Port Stephens councils currently focusing on CMPs for their open coast and lower estuary areas.

City of Newcastle Council manages over 400 water quality devices in the local government area to reduce and recycle stormwater, helping mitigate its impact on waterways and beaches. Council mostly uses primary pollution control devices to remove coarse sediment and rubbish from stormwater, however some areas receive additional treatment to further remove fine sediments, nutrients and heavy metals.

Stormwater quality targets are set for new developments through council's Development Control Plan.

City of Newcastle's own water quality solutions in coastal areas typically focus on complete treatment train approaches, often culminating in infiltration back to the groundwater table and using vegetation to recycle stormwater and nutrients. In recent years council has built several new water sensitive stormwater pollution control devices that provide tertiary treatment or infiltrations in the beachside areas of Stockton, Bar Beach, Dixon Park and Merewether.

City of Newcastle Council undertakes regular ocean bath cleaning, street sweeping, beach grooming, litter patrols and waste management actions to reduce the impact of stormwater pollution on beaches. Council's environmental compliance and stormwater education programs encourage stormwater pollution prevention actions such as sediment and erosion controls on building sites and picking up of dog poo by owners. Interpretive environmental signage has been installed in conjunction with city renewal to increase knowledge amongst beach visitors and users of the coastline's natural and historic value.

City of Newcastle Council has facilitated a range of community education activities focusing on increased appreciation of coastal environments and the impacts of human interactions. January 2020 school holidays activities showcased the importance and complexities of our rock platforms and beaches. During February and March 2020 over 2000 people participated in marine plastic education through the Ocean Action Pod activities and beach games. The incorporation of education programs into established events such as the Australian Boardriders Battle, Newcastle Show and Surfest, provided an avenue to access a more diverse audience and demographic than would participate in targeted stand-alone activities. This greatly improved the exposure and reach of the key messages.

Council monitors the water quality at its two ocean baths in accordance with the National Health and Medical Research Council's guidelines for managing risks in recreational water (NHRMC 2008). In 2020, many public spaces along the

A **Coastal Management Program** (CMP) outlines a long-term strategy for managing the coast, in line with the *Coastal Management Act 2016*.

The NSW Government provides guidance and funding through the Coastal and Estuary Grants Program for local councils to prepare and implement CMPs.

Under the previous *Coastal Protection Act 1979*, councils developed a **Coastal Zone Management Plan** (CZMP) to address coastal issues. Councils can continue to implement priority actions from certified CZMPs with funding assistance from the NSW Government's Coastal and Estuary Grants Program until 2021.

coast were closed due to COVID-19, in keeping with health guidance from the NSW and Federal governments.

Hunter Water

Hunter Water completed a $13 million upgrade to its wastewater system in Adamstown in 2012. The new pumping station and 4.5 km of piping operates in periods of heavy rain to remove wastewater faster and greatly reduce the potential for overflows in the area.

Burwood South Beach
Photo: Beachwatch/EES, DPIE

Hunter Water has an ongoing program of testing for illegal stormwater connections to ensure excess water does not enter the wastewater system in wet weather.

Although water quality is of a high standard at Merewether, Bar, Burwood North and Burwood South beaches, a health risk assessment completed by Hunter Water in 2010 indicated there was a small risk that the effluent plume from Burwood Beach wastewater treatment plant (WWTP) could be driven back to the coast under certain combinations of wind and current. In March 2017 Hunter Water upgraded the WWTP with a UV disinfection system, at a cost of $13 million, to address the small health risk identified in the study. Since its commissioning, monitoring of the UV system has shown a reduction in pathogen concentrations in the effluent, meeting Environment Protection Authority (EPA) requirements. The risk from the WWTP has been lowered in the sanitary inspections for these beaches as a result of the upgrade.

Sampling sites and Beach Suitability Grades in City of Newcastle Council

South Stockton Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

South Stockton Beach is at the southern end of a 32 kilometre stretch of beach and is patrolled from September to April.

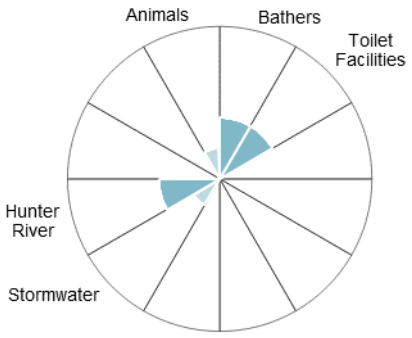
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of significant faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after 5 mm or more of rain.

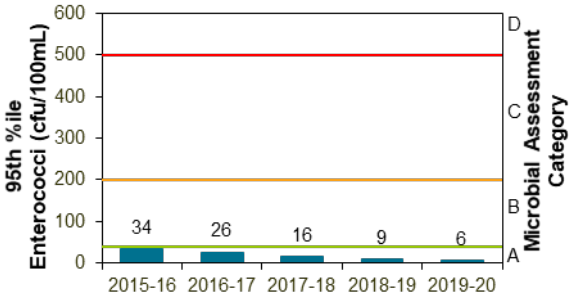
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Aug 2018 to Apr 2020	97%	100	Stable

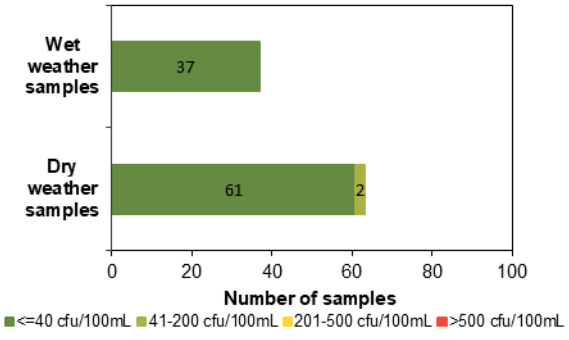
Sanitary inspection: Low



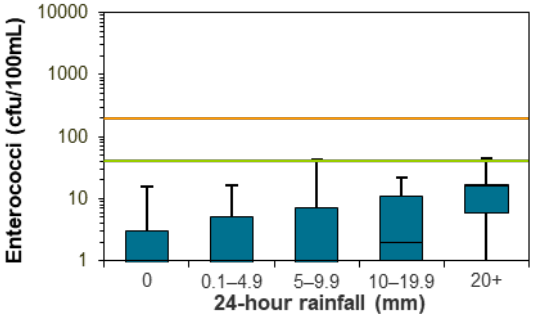
Microbial Assessment Category: A



Dry and wet weather water quality

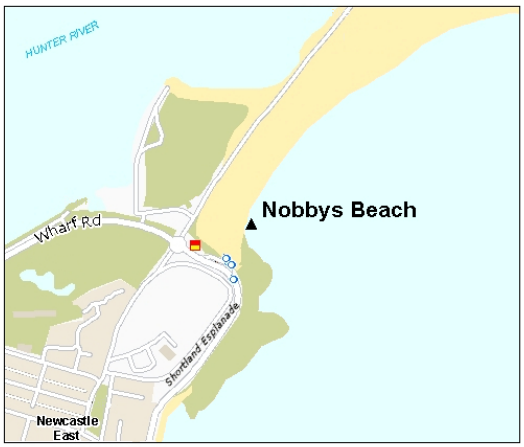


Water quality in response to rainfall



Nobbys Beach

Beach grade: VG



See ‘How to read this report’ for key to map.

Nobbys Beach is one kilometre long and is patrolled year round.

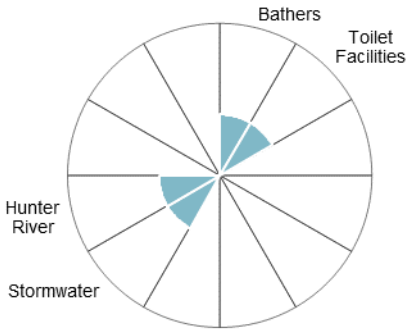
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after 10 mm or more of rain.

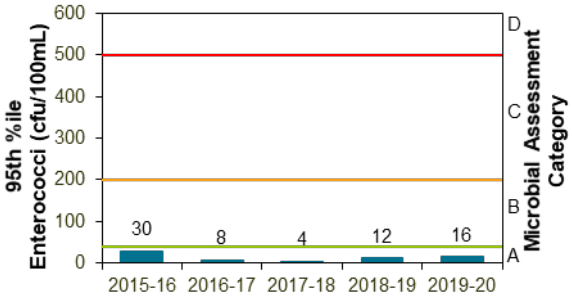
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Aug 2018 to Apr 2020	98%	100	Stable

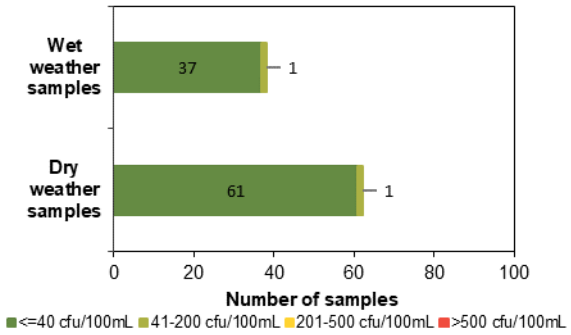
Sanitary inspection: Low



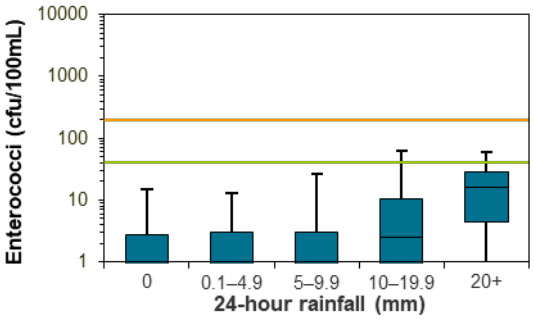
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Newcastle Beach

Beach grade: VG

Newcastle Beach is approximately 650 metres long and is patrolled from September to April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

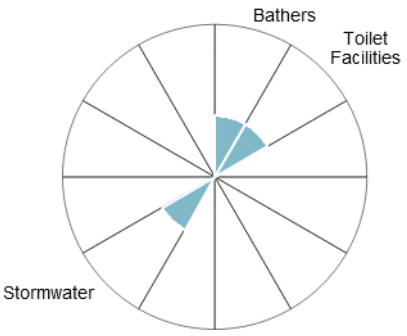
Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming after 5 mm or more of rain.

The site has been monitored since 1996.

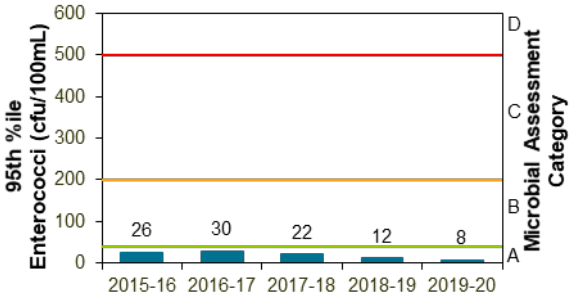
See ‘How to read this report’ for key to map.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	100%	100	Stable

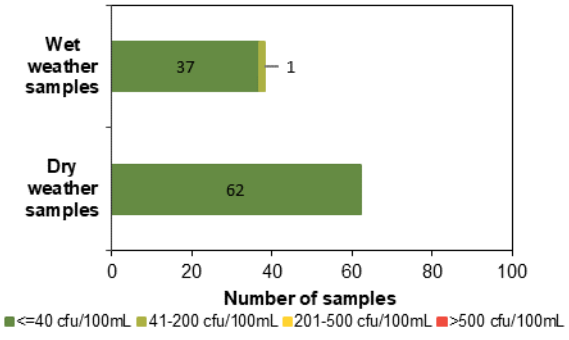
Sanitary inspection: Low



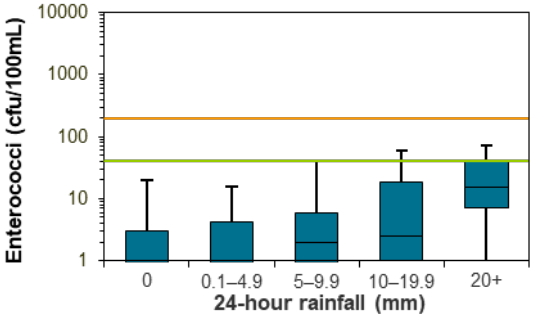
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Bar Beach

Beach grade: VG

Bar Beach is approximately 500 metres long and is patrolled all year round.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

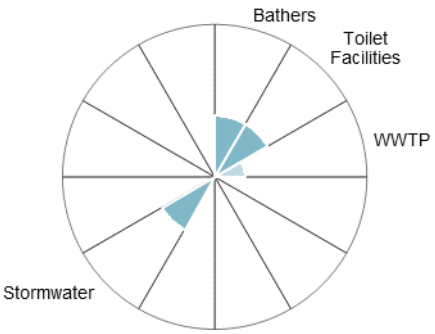
Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10 mm or more of rain.

The site has been monitored since 1996.

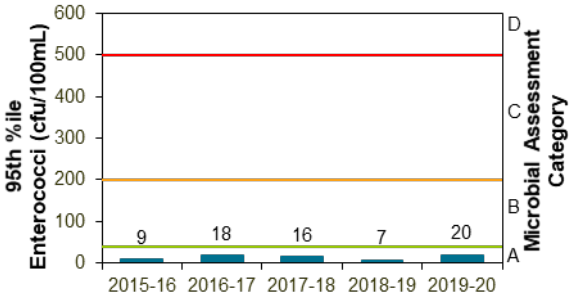
See 'How to read this report' for key to map.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Apr 2019 to Apr 2020	100%	100	Stable

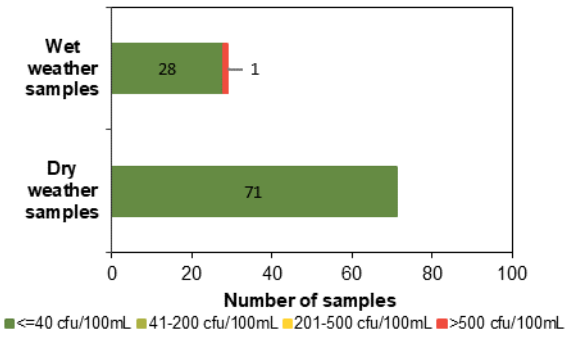
Sanitary inspection: Low



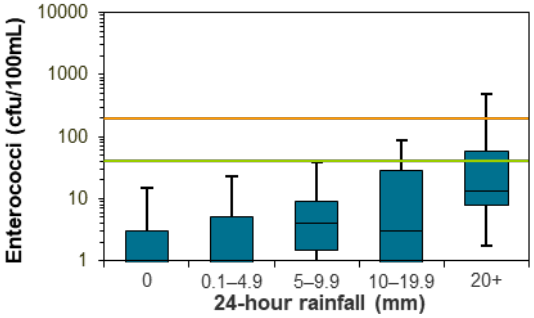
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Merewether Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

Merewether Beach is at the southern end of a 900 metre stretch of beach and is patrolled year round.

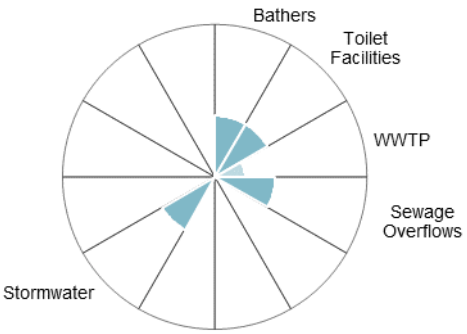
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time with few potential sources of significant faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit after light rain, and often after 20 mm or more.

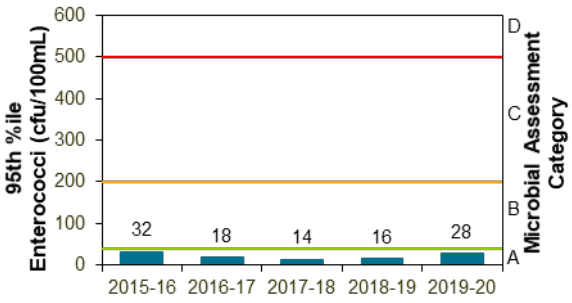
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Apr 2019 to Apr 2020	100%	100	Stable

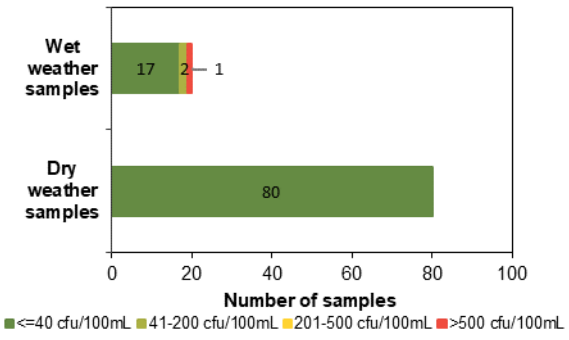
Sanitary inspection: Low



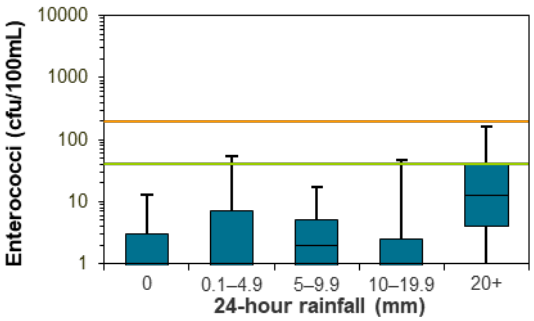
Microbial Assessment Category: A



Dry and wet weather water quality

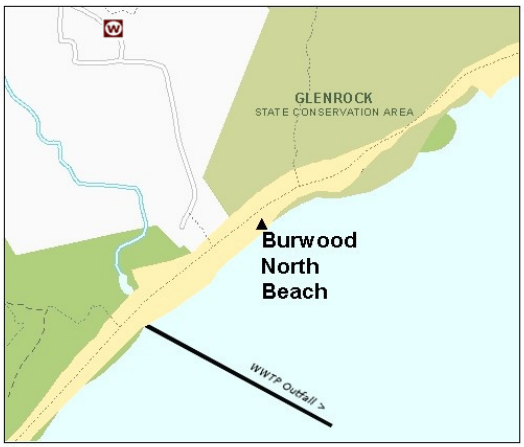


Water quality in response to rainfall



Burwood North Beach

Beach grade: VG



See ‘How to read this report’ for key to map.

Burwood North Beach is at the northern end of an 800 metre stretch of beach and is not patrolled by lifeguards.

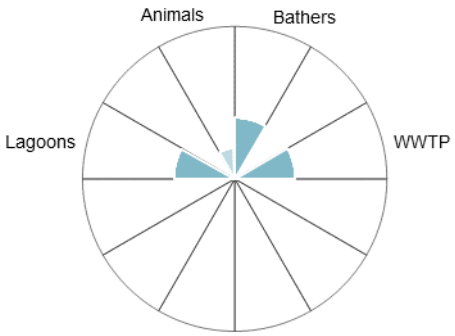
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10 mm or more of rain.

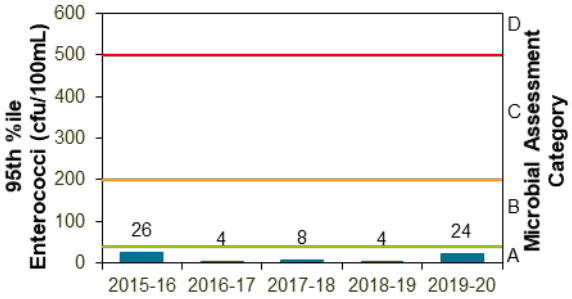
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Apr 2019 to Apr 2020	100%	100	Stable

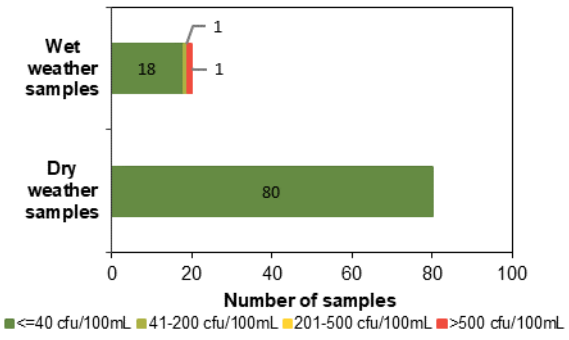
Sanitary inspection: Low



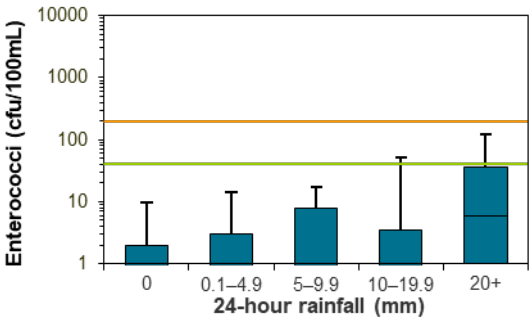
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Burwood South Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

Burwood South Beach is located at the southern end of an 800 metre stretch of beach and is not patrolled by lifeguards.

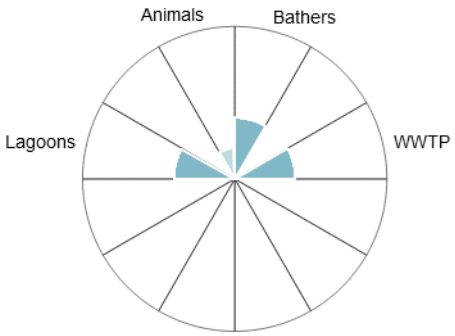
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10 mm or more of rain.

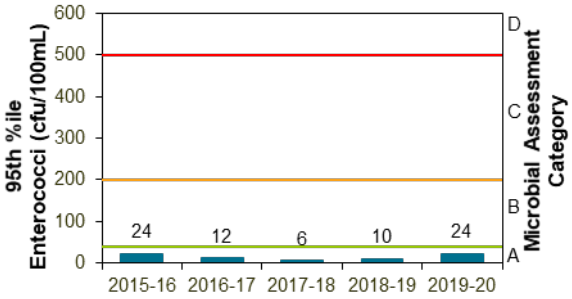
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Apr 2019 to Apr 2020	100%	100	Stable

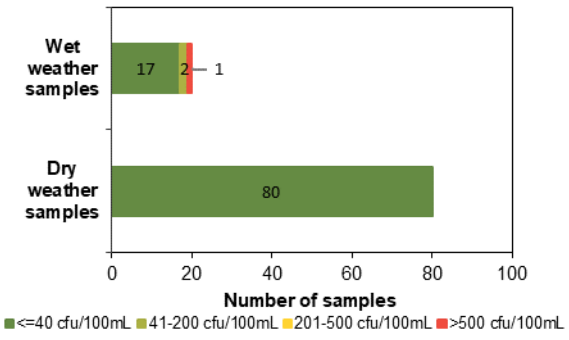
Sanitary inspection: Low



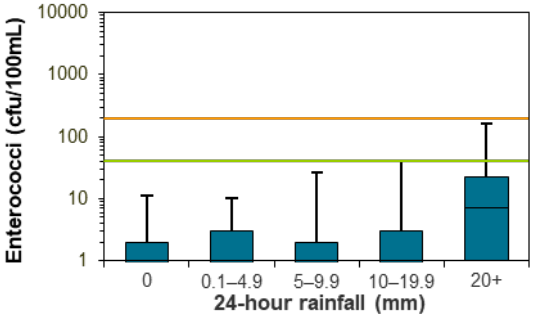
Microbial Assessment Category: A



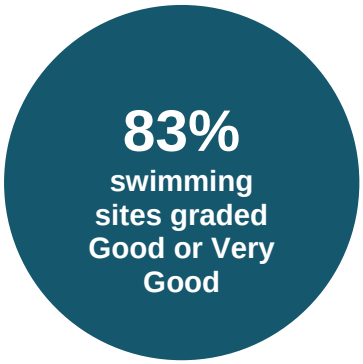
Dry and wet weather water quality



Water quality in response to rainfall



Lake Macquarie City Council



Overall results

Five of the six swimming sites were graded as Very Good in 2019–2020, which is a decline in overall performance from the previous year.

Percentage of sites graded as Very Good or Good*:

- 2019–2020: 83%
- 2018–2019: 100%
- 2017–2018: 75%
- 2016–2017: 70%.

*Percentages of sites graded as Very Good or Good prior to 2018–2019 are not comparable with the following years, due to changes in the monitoring program in October 2018 with 14 designated swimming areas in the Lake Macquarie no longer monitored under the Beachwatch Partnership Program.

Six swimming sites were monitored in the Lake Macquarie local government area.

All locations were monitored by Hunter Water Corporation as a requirement of Environment Protection Licences. Samples were collected every sixth day throughout the year.

See the section on **How to read this report** on page 44 for an explanation of the graphs, tables and Beach Suitability Grades.

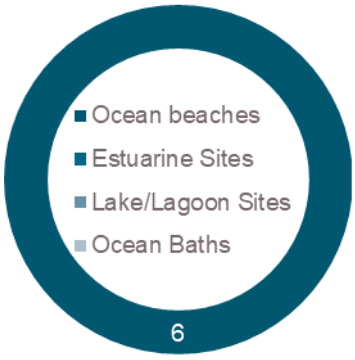
Best beaches

Glenrock Lagoon Beach, Dudley Beach, Redhead Beach, Blacksmiths Beach and Caves Beach.

These sites had excellent water quality and were suitable for swimming almost all of the time.

Ocean beaches were the only site type monitored in the Lake Macquarie region.

As a general precaution swimming should be avoided during and for at least one day after heavy rain at ocean beaches, or if there are signs of stormwater pollution such as discoloured water or floating debris.



Site types in Lake Macquarie City Council

Ocean beaches

Beach Suitability Grades for Lake Macquarie City Council ocean beaches

Five of the six ocean beaches were graded as Very Good in 2019–2020: Glenrock Lagoon Beach, Dudley Beach, Redhead Beach, Blacksmiths Beach and Caves Beach. The water quality at these beaches is suitable for swimming almost all of the time.

Redhead Beach improved to Very Good from a Good grade in the previous year. Microbial water quality has shown improvement over the last three years, with enterococci levels most often suitable for swimming.

Swansea Heads Little Beach was graded Poor, a decline from Good in the previous year. Microbial water quality has declined over recent years and crossed the threshold between Good and Poor. The decline in water quality reflects a slightly higher proportion of samples collected during wet weather compared to the 2018–2019 assessment period. Enterococci levels occasionally exceeded the safe swimming limit in dry weather conditions and often following light rainfall.

Swansea Heads Little Beach is located at the entrance of Lake Macquarie in a 100 metre long bay bordered by a rock platform and breakwall, which may reduce flushing and dilution of contaminants compared to other nearby open ocean beaches. Further investigation is required to show the scale and extent of the problem, and the source of microbial contamination.

Management

Patrolled ocean beach
Photo: Beachwatch/EES, DPIE

A **Coastal Management Program** (CMP) outlines a long-term strategy for managing the coast, in line with the *Coastal Management Act 2016*.

The NSW Government provides guidance and funding through the Coastal and Estuary Grants Program for local councils to prepare and implement CMPs.

Under the previous *Coastal Protection Act 1979*, councils developed a **Coastal Zone Management Plan** (CZMP) to address coastal issues. Councils can continue to implement priority actions from certified CZMPs with funding assistance from the NSW Government's Coastal and Estuary Grants Program until 2021.

Lake Macquarie City Council

Council coordinates the development and implementation of the Lake Macquarie Coastal Zone Management Plan (CZMP). The plan covers Lake Macquarie's coastline, estuary, and Swansea Channel. It contains actions to manage coastal hazards, improve the health of the coastal zone, and improve community access to coastal areas. This plan is currently being reviewed and updated to a coastal management program (CMP) in accordance with NSW coastal reform requirements. The CMP is expected to be completed in 2021.

With funding from the NSW Government's Coastal and Estuary Grants Program, council is currently undertaking a number of priority actions identified in the CZMP, including the removal of weeds from coastal dunes (especially bitou bush), reshaping of dunes, wetland and saltmarsh rehabilitation, revegetation works, the installation of stormwater treatment devices in priority locations, as well as completing works to stabilise eroding streambanks and foreshore areas around the lake and on the coastal dunes. Council and the Department of Planning, Industry and Environment (DPIE) collaborate to undertake an integrated coastal zone monitoring program that considers water quality, seagrass habitat and coastal dunes to help inform future rehabilitation works. These projects aim to maintain and improve the ecological health of the Lake Macquarie estuary and surrounding beaches.

Lake Macquarie City Council continues to invest significant resources to improve water quality, especially within the Lake Macquarie estuary. Council currently manages and maintains over 350 stormwater quality improvement devices (including gross pollutant traps, constructed wetlands and bioretention basins). Council also requires that all new development complies with strict criteria for water quality discharges to the estuary, coast and other receiving waters.

Hunter Water

Over the last 10 years, Hunter Water has invested more than $50 million in wastewater system upgrades around Lake Macquarie to cater for population growth and reduce wet weather overflows. The upgrade of regional wastewater pump station infrastructure in Belmont by 2016, at a cost of more than $9 million, further reduces wet weather overflows in the north-east of Lake Macquarie.

Wastewater system upgrades in Glenrock State Conservation Area were completed in 2010 and 2016 by Hunter Water to reduce wastewater overflows to the

environment. The cost of the works was in excess of $5 million. Recent analysis of the current system performance indicates a reduction in the frequency and volume of wet weather overflows since the upgrades were implemented.

Caves Beach
Photo: Beachwatch/EES, DPIE

Although water quality was of a high standard at Glenrock Lagoon Beach, a health risk assessment completed by Hunter Water in 2010 indicated there was a small risk that the effluent plume from Burwood Beach WWTP could be driven back to the coast under certain combinations of wind and current. In March 2017 Hunter Water upgraded the WWTP with a UV disinfection system, at a cost of $13 million, to address the small health risk identified in the study. Since its commissioning, monitoring of the UV system has shown a reduction in pathogen concentrations in the effluent, meeting EPA requirements. The risk from the WWTP has been lowered in the sanitary inspection for Glenrock Lagoon Beach as a result of the upgrade.

Sampling sites and Beach Suitability Grades in Lake Macquarie City Council

Glenrock Lagoon Beach

Beach grade: VG

See 'How to read this report' for key to map.

Glenrock Lagoon Beach is 300 metres long and is located at the southern end of Burwood Beach. The beach is not patrolled by lifeguards.

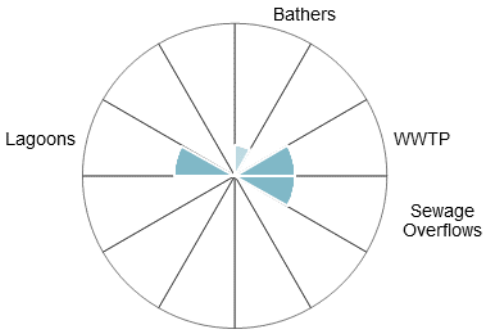
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after 20 mm or more of rain.

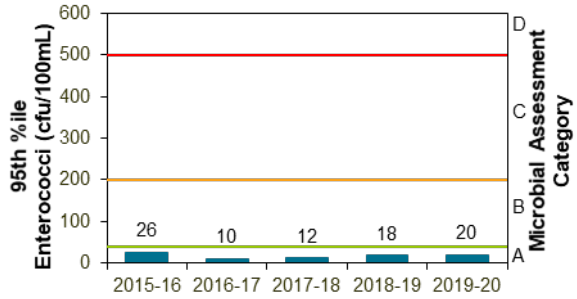
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	99%	100	Stable

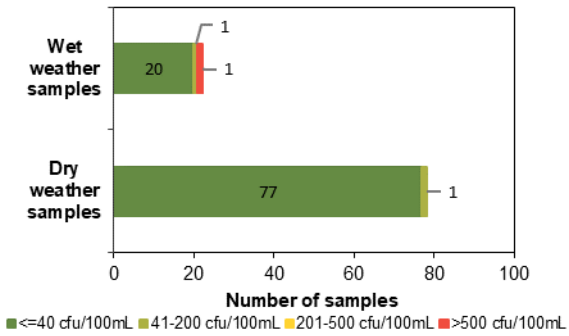
Sanitary inspection: Low



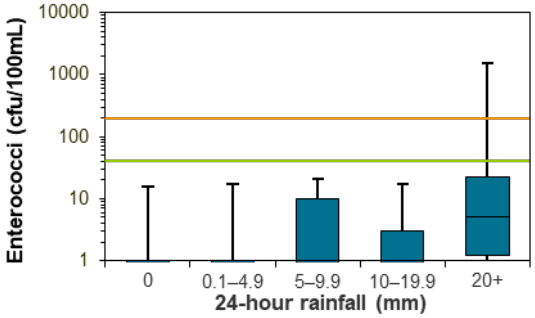
Microbial Assessment Category: A



Dry and wet weather water quality

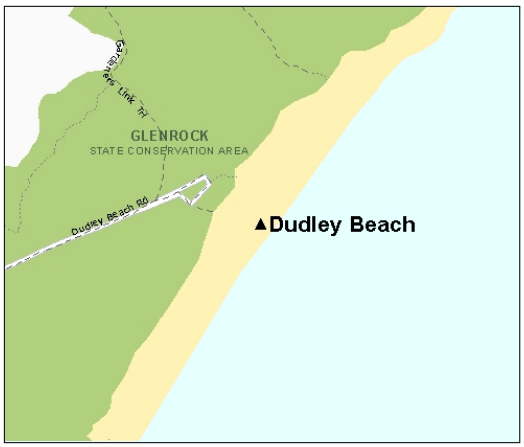


Water quality in response to rainfall



Dudley Beach

Beach grade: VG



Dudley Beach is one kilometre long and is not patrolled by lifeguards.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

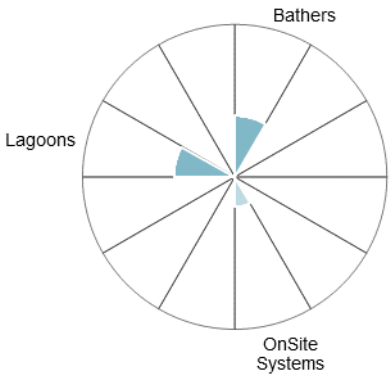
Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20 mm or more of rain.

The site has been monitored since 1996.

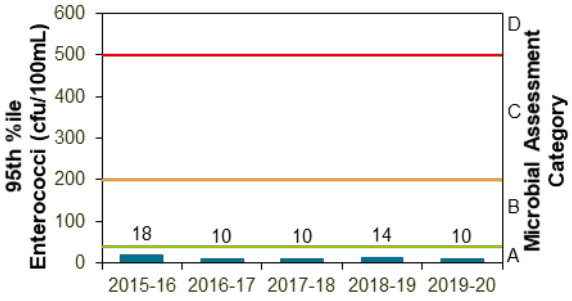
See ‘How to read this report’ for key to map.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	97%	100	Stable

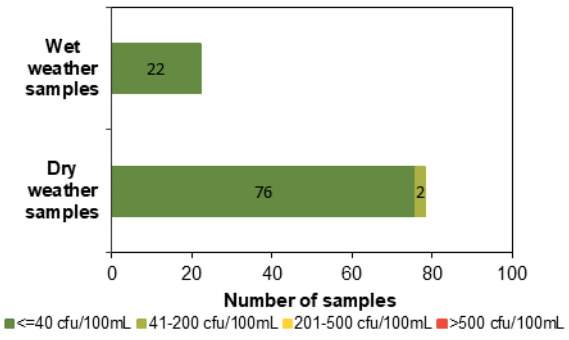
Sanitary inspection: Low



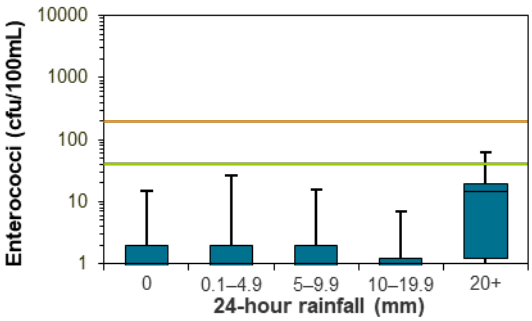
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Redhead Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

Redhead Beach is located at the northern end of a 10 kilometre stretch of beach and is patrolled between September and April.

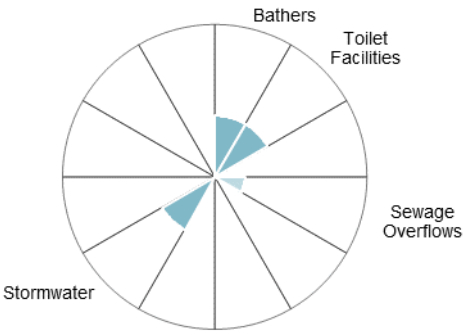
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels generally increased with increased rainfall, occasionally exceeding the safe swimming limit after light rain, and often after 20 mm or more.

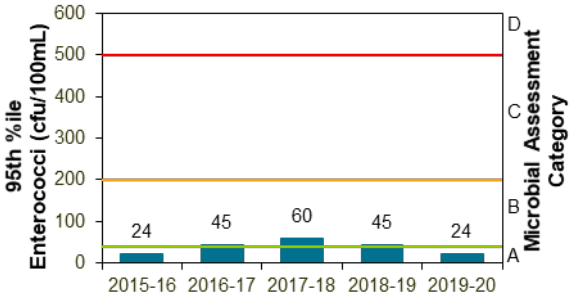
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	98%	100	Improved ↑

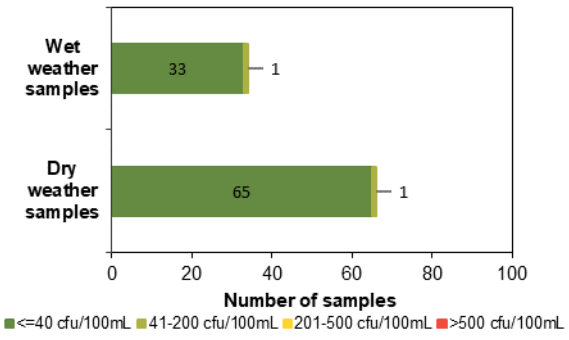
Sanitary inspection: Low



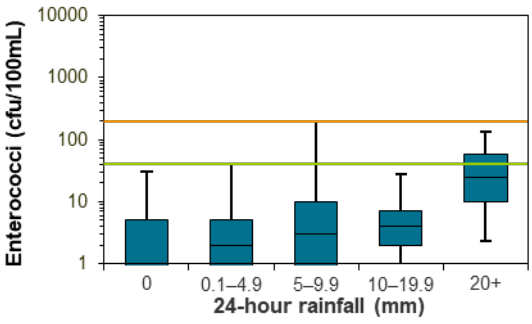
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



Blacksmiths Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

Blacksmiths Beach is at the southern end of a 10 kilometre stretch of beach and is patrolled between September and April.

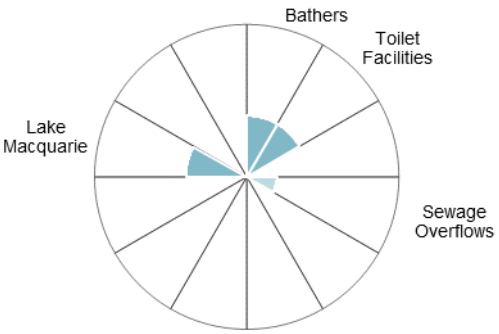
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20 mm or more of rain.

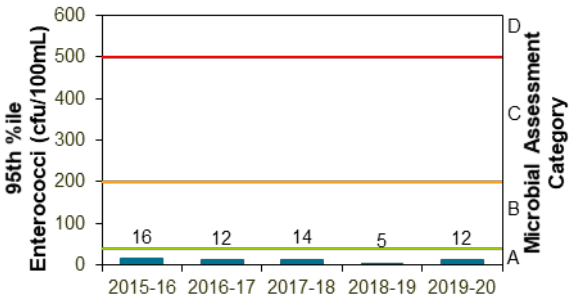
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	97%	100	Stable

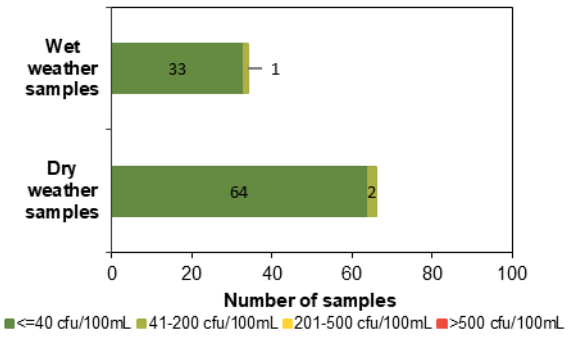
Sanitary inspection: Low



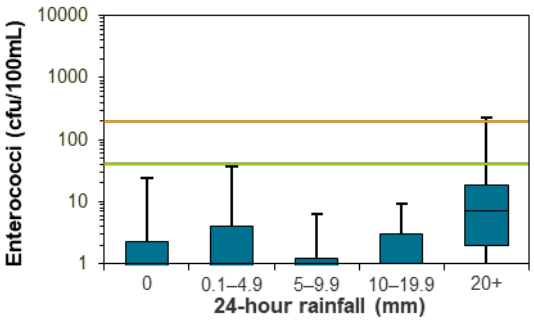
Microbial Assessment Category: A



Dry and wet weather water quality

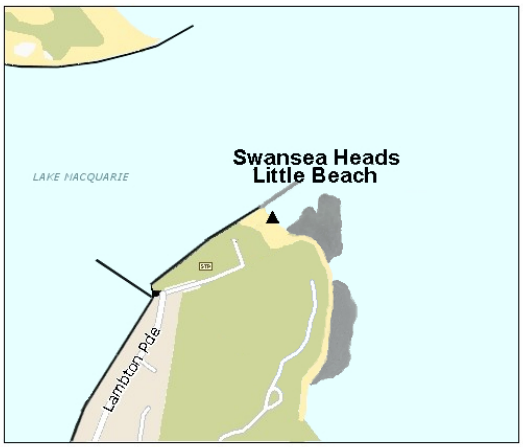


Water quality in response to rainfall



Swansea Heads Little Beach

Beach grade: P



See ‘How to read this report’ for key to map.

Swansea Heads Little Beach is 60 metres long and located on the southern side of the entrance to Lake Macquarie. The beach is patrolled from September to April.

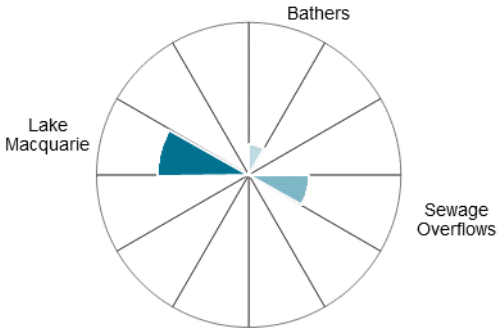
The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination including outflow from Lake Macquarie.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit across all rainfall categories.

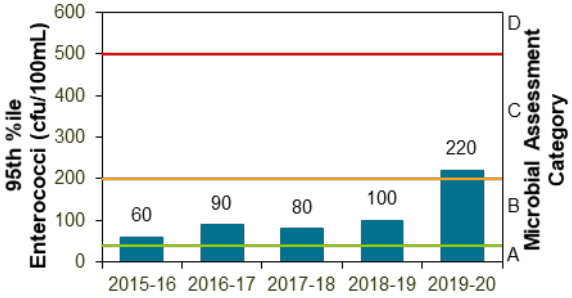
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	86%	100	Declined

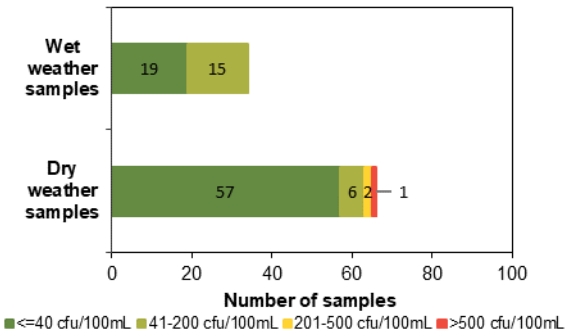
Sanitary inspection: Moderate



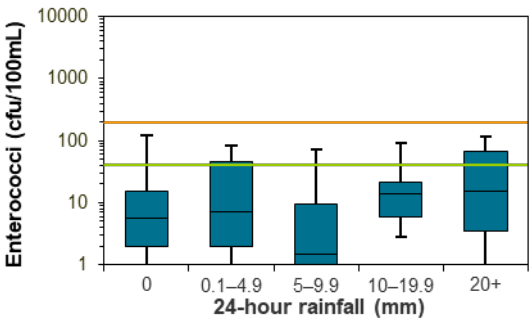
Microbial Assessment Category: C



Dry and wet weather water quality



Water quality in response to rainfall



Caves Beach

Beach grade: VG

See ‘How to read this report’ for key to map.

Caves Beach is located at the southern end of a 1.8 kilometre beach and is patrolled between September and April.

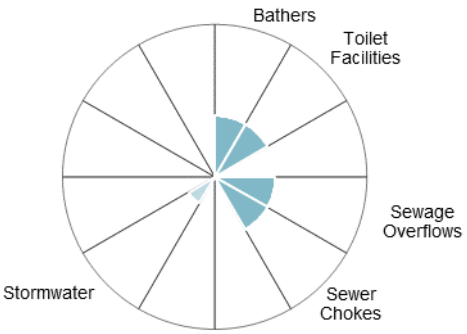
The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of significant faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after light rain, and often after 20 mm or more.

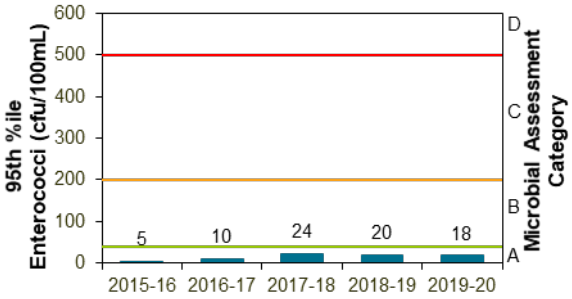
The site has been monitored since 1996.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Ocean beach	Sep 2018 to Apr 2020	95%	100	Stable

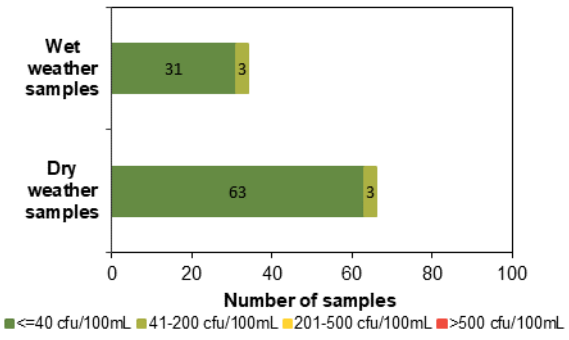
Sanitary inspection: Low



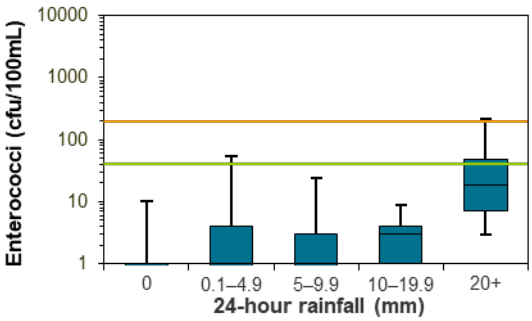
Microbial Assessment Category: A



Dry and wet weather water quality



Water quality in response to rainfall



How to read this report

Beach Suitability Grades

Beach Suitability Grades provide an assessment of the suitability of a swimming location for recreation over time and are based on a combination of sanitary inspection (identification and rating of potential pollution sources at a beach) and microbial assessment (water quality measurements gathered over previous years). There are five grades ranging from Very Good to Very Poor:

VG **Very Good**

Location has generally excellent microbial water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming almost all of the time

G **Good**

Location has generally good microbial water quality and water is considered suitable for swimming most of the time. Swimming should be avoided during and for up to one day following heavy rain at ocean beaches and up to three days at estuarine sites

F **Fair**

Microbial water quality is generally suitable for swimming, but because of the presence of significant sources of faecal contamination, extra care should be taken to avoid swimming during and for up to three days following rainfall or if there are signs of pollution such as discoloured water or odour or debris in the water

P **Poor**

Location is susceptible to faecal pollution and microbial water quality is not always suitable for swimming. During dry weather conditions, ensure that the swimming location is free of signs of pollution, such as discoloured water, odour or debris in the water, and avoid swimming at all times during and for up to three days following rainfall

VP **Very Poor**

Location is very susceptible to faecal pollution and microbial water quality may often be unsuitable for swimming. It is generally recommended to avoid swimming at these sites almost all of the time

Some of the Beach Suitability Grades in this report are **provisional**, as the information required for the analysis is incomplete due to limited bacterial data or limited information on potential pollution sources in a beach catchment.

The guidelines

The National Health and Medical Research Council's *Guidelines for managing risks in recreational water*[1] were adopted for use in New South Wales in May 2009. These guidelines have been adopted in all Australian states and territories and are supported by guidance notes developed by the Department of Health Western Australia[2].

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[1]NHMRC 2008, *Guidelines for managing risks in recreational water*, National Health and Medical Research Council, Australian Government Publishing Service, Canberra, ACT.

[2]Department of Health, Western Australia 2007, *Microbial quality of recreational water guidance notes in support of chapter 5 of the National Health and Medical Research Council guidelines for managing risks in recreational water, 2006*, Department of Health, Western Australia and The University of Western Australia, October 2007, available at ww2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications, accessed on 10/06/20.

Enterococci

The national guidelines advocate the use of enterococci as the single preferred faecal indicator in marine waters.

These bacteria are excreted in faeces and are rarely present in unpolluted waters. Enterococci have shown a clear dose–response relationship to disease outcomes in marine waters in the northern hemisphere. In accordance with the guidelines, Beachwatch tests for enterococci only. The enterococci density in water samples is analysed in the laboratory using method AS/NZS 4276.9:2007.

AS/NZS 4276.9:2007, *Water microbiology Method 9: Enterococci – Membrane filtration method (ISO 7899-2:2000, MOD)*, Standards Australia International Ltd, Sydney and Standards New Zealand, Wellington.

Enterococci are measured in colony forming units per 100 mL of sample (cfu/100 mL).

Beach Suitability Grades are determined by using the following matrix:

		Microbial Assessment Category			
		A	B	C	D
Sanitary Inspection Category	Very Low	Very Good	Very Good	Follow Up	Follow Up
	Low	Very Good	Good	Follow Up	Follow Up
	Moderate	Good	Good	Poor	Poor
	High	Good	Fair	Poor	Very Poor
	Very High	Follow Up	Fair	Poor	Very Poor

Using the Beach Suitability Grade classification matrix, sites assigned a moderate Sanitary Inspection Category can only be rated as Good or Poor, with no option of Fair grades. This can create the impression of a large change in water quality when in fact there need only be a slight increase in bacterial counts to push it over the threshold, with no significant increase in the risk to public health.

Microbial Assessment Category (MAC)

There are four Microbial Assessment Categories (A to D) and these are determined from the 95th percentile of an enterococci dataset of at least 100 data points. Each MAC is associated with a risk of illness determined from epidemiological studies. The risks of illness shown below are not those associated with a single data point but are the overall risk of illness associated with an enterococci dataset with that 95th percentile[1].

Risk of illness associated with Microbial Assessment Categories

Category	Enterococci (cfu/100 mL)	Illness risk*
A	≤40	GI illness risk: <1% AFR illness risk: <0.3%
B	41–200	GI illness risk: 1–5% AFR illness risk: 0.3–1.9%
C	201–500	GI illness risk: >5–10% AFR illness risk: >1.9–3.9%
D	>500	GI illness risk: >10% AFR illness risk: >3.9%

* GI = gastrointestinal illness; AFR = acute fever and rash

Calculating the MAC

The 95th percentile is a useful statistic for summarising the distribution of enterococci data at a site. It embodies elements of both the location of the distribution (how high/low the enterococci counts are) and the scale of the distribution (how variable the enterococci counts are).

The 95th percentile values for each of the four Microbial Assessment Categories were determined by the World Health Organization using enterococci data collected from swimming locations across Europe. These values will represent different probabilities of illness if the distribution of enterococci data from swimming locations in New South Wales differs from the European distribution.

[1] Wyer MD, Kay D, Fleisher JM, Salmon RL, Jones F, Godfree AF, Jackson G and Rogers A 1999, An experimental health related classification for marine waters, *Water Research*, vol.33(3), pp.715–722.

In recognition of this issue, Dr Richard Lugg (Department of Health, Western Australia) has developed a Microsoft® Excel tool for calculating a modified 95th percentile that takes into account the distribution of data. This tool has been used to calculate the 95th percentile values presented in this report and has been adopted for use by other state governments in Australia.

The tool can be downloaded from the WA Government's Environmental waters publications webpage, under *Forms and templates* [accessed 10/06/20].

Sanitary Inspection Category (SIC)

More information about the **sanitary inspection** process is available on the DPIE webpage:

Sanitary inspection of beaches

The aim of a sanitary inspection is to identify all sources of faecal contamination that could affect a swimming location and assess the risk to public health posed by these sources. It is an assessment of the likelihood of bacterial contamination from identified pollution sources and should, to some degree, correlate with the bacterial water quality results obtained from sampling.

The main sources of faecal contamination considered in the sanitary inspection are: bathers, toilet facilities, wastewater treatment plants (WWTPs), sewage overflows, sewer chokes, onsite systems, wastewater re-use, stormwater, river discharge, lagoons, boats and animals.

Rivers, lakes and estuaries themselves can be potential sources of faecal contamination to sites located in these waterbodies, with contaminated water from upstream or surrounding areas impacting water quality at the swimming location. This source is captured in river discharge or lagoon category, and shown as the waterbody in the sanitary inspection charts.

Through the sanitary inspection process, beaches are categorised to reflect the overall likelihood of faecal contamination. There are five categories: Very Low, Low, Moderate, High and Very High.

Stormwater at Coogee Beach
Photo: Beachwatch/EES, DPIE

Stormwater in urban areas often contains sewage from leakages, overflows or sewer chokes when the sewerage system fails.

Sewage overflows can occur in wet weather when the network has exceeded capacity due to rainwater entering the system. The mix of sewage and rainwater discharges from designated overflow points and drains to waterways, usually via the stormwater system. Overflows from the sewerage system can also occur in dry weather due to mechanical failure or power outage.

Sewer chokes occur due to blockages in the pipes usually due to tree roots, oil, grease or debris. This causes sewage to back up and escape via sewer inspection points, designed overflow structures or cracks in the pipes, then drain to waterways, usually via the stormwater system.

Explanation of tables

Each region contains tables listing all monitored swimming sites including site type, beach grade and change in grade from the previous year.

The following symbols are used to show the change in beach grade from the previous year:

- Stable
- Improved
- Declined

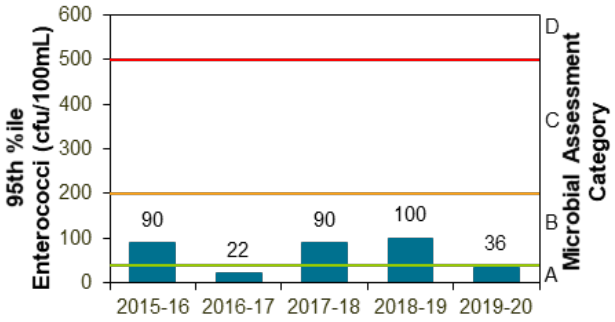
A provisional grade indicates the assessment is based on limited data collected during the assessment period and should not be compared to the beach grade from the previous year.

Explanation of graphs, charts, and information bars on beach pages

Microbial Assessment Category (MAC) chart

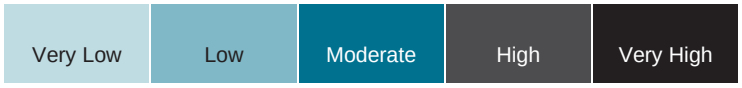
On each beach page, the MACs for the last five years are displayed on a simple bar chart. The MAC for the current year is based on enterococci data collected during the assessment period. The bars are labelled with the 95th percentile value for each year and the thresholds dividing the

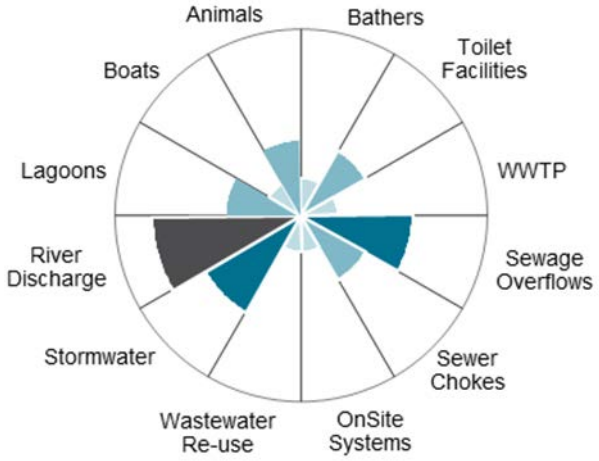
A, B, C and D categories are marked in green, amber and red for reference.



Sanitary Inspection Category (SIC) chart

The results of the sanitary inspection for each swimming location are presented in a radar pie chart. The chart shows the likelihood that each identified pollution source will contribute to faecal contamination at a swimming site, as indicated by the size and colour of the segment, ranging from very low (lightest colour) to very high (darkest colour) as shown below. The sum of these contributions is the overall likelihood, or Sanitary Inspection Category.

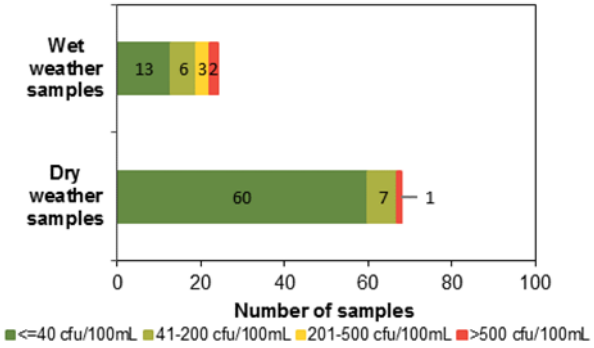




Wet and dry weather water quality chart

Enterococci levels in wet and dry weather conditions are presented for each swimming location as a bar graph. All data collected during the assessment period is included in the analysis. Dry weather is defined as no rainfall recorded in the previous 24 hours. Each bar is colour coded to show the number of enterococci results up to 40 cfu/100 mL, between 41 and 200 cfu/100 mL, between 201 and 500 cfu/100 mL

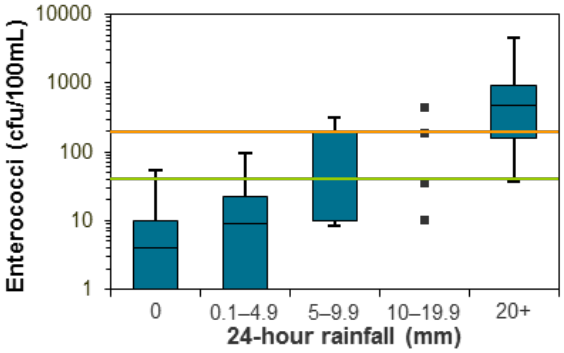
and greater than 500 cfu/100 mL. These categories reflect the Microbial Assessment Category thresholds and are coloured on the graph as dark green, light green, amber and red respectively.



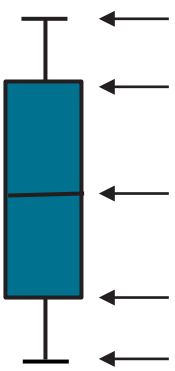
It is expected that swimming sites with lower levels of flushing will show some elevated bacterial results in dry weather samples (no rainfall in the previous 24 hours) due to the longer time needed to recover from a rainfall event. At some estuarine and lake/lagoon swimming locations the impacts of stormwater pollution on beach water quality may be detected up to three days after rainfall.

Water quality in response to rainfall

Trends in enterococci levels in response to rainfall are shown using a box plot. For reference, enterococci levels of 40 cfu/100 mL and 200 cfu/100 mL are indicated with a green and orange line, respectively. The 40 cfu/100 mL level is referred to as the ‘safe swimming limit’. The enterococci data were obtained from the last five years of monitoring. Rainfall data were obtained from rain gauges situated close to the sample site and are 24-hour totals to 9am on the day of sampling. If there are fewer than five enterococci data points in a rainfall category, individual data points are presented instead of a box plot. At sites where many results are below the detection limit (1 cfu/100 mL), only the upper portion of the box plots will be visible.



Each part of the box plot represents a significant percentile value of the sample population:



95% of the samples lie below the top whisker

75% of the samples lie below the top of the box

half the samples are on each side of the middle line of the box (median or 50%ile)

25% of the samples lie below the bottom of the box

5% of the samples lie below the bottom whisker.

Information bars

Information bars on each beach page provide a summary of details about the swimming site.

The **assessment period** shows the timeframe in which the water samples were collected. The NHMRC guidelines state beach grades should be determined from the most recent 100 water quality results collected within a five-year period. The assessment period varies between sites depending on sampling frequency.

Dry weather samples suitable for swimming (**dry weather swimmability**) shows the percentage of water samples with enterococci levels below 40 cfu/100 mL. Dry weather is defined as no rainfall in the previous 24 hours. Swimming sites with lower levels of flushing often have a lower percentage of dry weather samples within the safe swimming limit due to the impacts of rainfall detected up to three days after the event.

Explanation of maps

A map of individual swimming locations is presented on each beach page. The scale of the maps is 1:10,000. Each map shows the location of the sampling site, land use and features such as surf lifesaving clubs. Potential pollution sources such as stormwater drains, sewage pumping stations, wastewater treatment plants, lagoons, rivers and creeks, are shown where accurate data is held.