**Local government area description**

Gosford City Council is located on the Central Coast of New South Wales between Sydney in the south and Wyong in the north. It covers an area of 1028 square kilometres and supports a population of more than 154,000.

Gosford has an array of natural resources from coastal beaches, natural bushland, estuaries, waterways, plateaus and wetlands, with the Brisbane Water estuary a predominant feature.

**Program outline**

Twenty-two sites were monitored by Gosford Council, including three ocean beaches, one estuarine swimming location, eight lagoon sites and 10 tidal pools.

At 10 locations, faecal coliform samples were routinely collected between October 2004 and April 2005 to assess compliance with NHMRC (1990) swimming water quality guidelines. It should be noted that the required five samples were not collected in some months at some sites. Where four samples were collected, the closest sample in time from an adjacent month was ‘borrowed’ to provide the five samples for the compliance calculation. Where only three samples were collected, guideline compliance could not be determined.

At 12 sites faecal coliform samples were collected fortnightly. Compliance with NHMRC (1990) swimming guidelines could not be determined at these locations.

**Ocean beaches**

Water quality samples were collected from Forresters, Wamberal and Umina beaches on a fortnightly basis between October 2004 and April 2005.

Levels of faecal coliforms were generally low over the monitoring period, providing no evidence of sewage contamination.

**Lagoons and estuarine waters**

**Guideline compliance**

Water quality samples were collected from Cockrone, Bulbararing, Terrigal and Wamberal lagoons to assess compliance with NHMRC (1990) swimming guidelines. Two sites were located in Terrigal Lagoon (Terrigal Paddleboats and Terrigal Sailboards) and two sites were located in Avoca Lake (Bulbararing and Avoca Lake).

Monitoring of Bulbararing, Terrigal and Wamberal lagoons took place over all seven months of the 2004–2005 summer swimming season, and all five locations complied in six of the seven months (Figure 8). Failures at all locations except Bulbararing were recorded in October 2004, when heavy rainfall resulted in elevated bacterial levels. Bulbararing failed to comply with the swimming guidelines in March 2005.

In Cockrone Lagoon compliance could only be assessed in January, February and March 2005, and the site complied with the swimming guidelines in all three months.

**Response to rainfall**

Elevated levels of faecal coliforms were recorded in Bulbararing, Terrigal and Wamberal lagoons over the 2004–2005 summer swimming season, with particularly high levels recorded in response to heavy rainfall.

Faecal coliform levels in Cockrone Lagoon were generally low throughout the monitoring period.

**Other monitoring**

Water quality samples were collected from Davistown Baths, Ettalong Channel, Pearl Beach Lagoon, Pretty Beach Baths, Umina Lagoon, Woy Woy Baths and Yattalunga Baths on a fortnightly basis between October 2004 and April 2005.

Levels of faecal coliforms were generally low over the monitoring period at Davistown Baths, Ettalong Channel, Pretty Beach Baths, Woy Woy Baths and Yattalunga Baths.

Slightly elevated bacterial levels were often recorded at Pearl Beach Lagoon, whereas levels in Umina Lagoon were elevated on most sampling occasions.
Rockpools

Guideline compliance

Compliance with NHMRC (1990) swimming guidelines was assessed at Terrigal, Avoca, McMasters and Copacabana rockpools in January, February and March 2005. All four locations complied with the swimming guidelines in all three months (Figure 8).

Response to rainfall

Faecal coliform levels displayed little response to rainfall in the rockpools, with generally low levels recorded over the monitoring period. A single elevated value was recorded at each of Terrigal, Avoca and McMasters rockpools on a single occasion and this was not related to rainfall.

Other monitoring

Water quality samples were collected from Killcare and Pearl Beach rockpools on a fortnightly basis between October 2004 and April 2005. Faecal coliform levels were consistently low over the monitoring period, providing no evidence of sewage contamination.

Figure 8: Summary of compliance with NHMRC (1990) microbiological guidelines for swimming at Gosford City Council swimming sites over the 2004–2005 summer season
Wamberal Lagoon

Description
The sampling site is a sandy area located near the mouth of the lagoon and is a popular picnic and swimming area for children. The lagoon is intermittently open to the ocean, and flows to Wamberal Beach.

Pollution Sources
Much of the immediate foreshore of the lagoon is parkland and nature reserve. However, in the upper catchment there is mixture of urban, light industrial and semi-rural properties that could contribute poor quality stormwater following heavy rain.

Compliance
Wamberal Lagoon complied with NHMRC (1990) guidelines in six of the seven months of the 2004–2005 summer swimming season. The site failed in October 2004 owing to elevated levels of faecal coliforms.

Compliance with NHMRC (1990) swimming guidelines at Wamberal Lagoon

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Timeseries plots
Elevated levels of faecal coliforms were occasionally recorded during the 2004–2005 summer swimming season, with particularly high values recorded in response to heavy rainfall in October 2004 and March 2005.
Cockrone Lagoon

Description
The sampling site is a shallow sandy area located near the mouth of the lagoon at MacMasters Beach. The site is adjacent to a wetland and coastal reserve. Parts of the lagoon are known to contain nuisance amounts of aquatic plants. The lagoon is intermittently open to the ocean.

Pollution Sources
Much of the immediate catchment contains urban development, with waste management facilities, remnant bushland and nature reserves located in the upper catchment. The lagoon is known to suffer from the effects of high loads of nutrients, which have led to environmental problems, such as excess weed-growth and fish kills in recent years. Stormwater may contain both high levels of nutrients and sewage contamination.

Compliance
Cockrone Lagoon complied with NHMRC (1990) guidelines in January, February and March 2005, the three months in which sufficient samples were collected to calculate compliance.

Compliance with NHMRC (1990) swimming guidelines at Wamberal Lagoon

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- no result.

* only four samples were collected in this month. An additional data point was borrowed from an adjacent month to calculate compliance.

** insufficient samples to calculate compliance were collected in this month.

Timeseries plots
Faecal coliform levels were generally low during the 2004–2005 summer swimming season, rarely exceeding the median guideline value.

See page 100 for key to map
**Terralig Sailboards**

**Description**
The sampling site is located in Terrigal Lagoon, adjacent to the Terrigal Lagoon Reserve near Willoughby Road. The lagoon is intermittently open to the ocean, and flows to Terrigal Beach. There is a commercial watercraft rental business operating in summer months near the site, which is popular with children.

**Pollution Sources**
Most of the immediate foreshore is parkland and sporting fields, and there is a golf course at the northern extremity of the waterway. Stormwater runoff from the mainly urban residential catchment is a potential pollution source. The catchment also contains some rural land and remnant bushland as well as two caravan parks.

**Compliance**
Terralig Sailboards complied with NHMRC (1990) guidelines in six of the seven months of the 2004–2005 summer swimming season. The site failed in October 2004 owing to elevated levels of faecal coliforms.

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**Timeseries plots**
Elevated levels of faecal coliforms were occasionally recorded during the 2004–2005 summer swimming season, with particularly high values recorded in response to heavy rainfall in October 2004 and March 2005.
Terrigal Paddleboats

Description
The sampling site is located in Terrigal Lagoon near the opening of the lagoon to the ocean. The lagoon is intermittently open to the ocean, and flows to Terrigal Beach. There is a commercial watercraft rental business operating in summer months near the site, which is popular with children.

Pollution Sources
Most of the immediate foreshore is parkland and sporting fields, and there is a golf course at the northern extremity of the waterway. Stormwater runoff from the mainly urban residential catchment is a potential pollution source. The catchment also contains some rural land and remnant bushland as well as two caravan parks.

Compliance
Terrigal Paddleboats complied with NHMRC (1990) guidelines in six of the seven months of the 2004–2005 summer swimming season. The site failed in October 2004 because of elevated levels of faecal coliforms.

Compliance with NHMRC (1990) swimming guidelines at Terrigal Paddleboats

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Timeseries plots
Elevated levels of faecal coliforms were recorded on several occasions during the 2004–2005 summer swimming season, with a particularly high value recorded in response to heavy rainfall in October 2004.
**Terrigal Rockpool**

**Description**
The rockpool is located at the foot of bluffs at the southern end of Terrigal Beach and is an extremely popular swimming site for families with young children. The pool is situated close to the retail and tourism centre of Terrigal and receives a large number of visitors each summer.

**Pollution Sources**
Runoff from roads and pavements adjacent to the commercial district of Terrigal ends up in stormwater drains that discharge to the beach near the pool. Stormwater runoff from the adjacent recreational areas can transport litter to the pool during rainfall.

**Compliance**
Terrigal Rockpool complied with NHMRC (1990) guidelines in January 2005, February 2005 and March 2005, the three months in which sufficient samples were collected to calculate compliance.

**Compliance with NHMRC (1990) swimming guidelines at Terrigal Rockpool**

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* no result.

* only four samples were collected in this month. An additional data point was borrowed from an adjacent month to calculate compliance.

**Timeseries plots**
Slightly elevated levels of faecal coliforms were recorded during the monitoring period, with values remaining below the median guideline limit on all but one occasion.
Avoca Lake

Description
The sampling site is located in Avoca Lake, just south of Bareena Island. This area of the lake is shallow and sandy, and adjacent to a picnic area and park, which is a popular area for families with small children. The lagoon is intermittently open to the ocean, and flows to Avoca Beach.

Pollution Sources
Most of the immediate foreshore is parkland and reserves, with some remnant bushland in places. Stormwater runoff from the mainly urban residential catchment is a potential pollution source. The catchment also contains some semi-rural land and two caravan parks.

Compliance
Avoca Lake complied with NHMRC (1990) guidelines in six of the seven months of the 2004–2005 summer swimming season.

Compliance with NHMRC (1990) swimming guidelines at Avoca Lake

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Timeseries plots
Slightly elevated levels of faecal coliforms were recorded throughout much of the 2004–2005 summer swimming season, with values exceeding the median guideline limit on a number of occasions in October 2004.
Bulbararing

Description
The sampling site is located in Avoca Lake near the opening to the ocean. This area of the lake is shallow and sandy and backs on to Avoca Beach. The area is popular with families with small children, and the lagoon is intermittently open to the ocean.

Pollution Sources
Most of the immediate foreshore is parkland and reserves, with some remnant bushland in places. Stormwater runoff from the mainly urban residential catchment is a potential pollution source. The catchment also contains some semi-rural land and two caravan parks.

Compliance
Bulbararing complied with NHMRC (1990) guidelines in six of the seven months of the 2004–2005 summer swimming season. The site failed in March 2005 owing to elevated levels of faecal coliforms.

Compliance with NHMRC (1990) swimming guidelines at Bulbararing

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Timeseries plots
Slightly elevated levels of faecal coliforms were recorded throughout much of the 2004–2005 summer swimming season. Values exceeded the median guideline limit in response to heavy rainfall and also on a number of occasions in March 2005.
Avoca Rockpool

Description
The rockpool is located at the foot of cliffs at the southern end of Avoca Beach and is an extremely popular swimming site for families with young children. The pool is situated close to the surf club and receives a large number of visitors each summer.

Pollution Sources
Runoff from roads and pavements adjacent to the pool may affect the water quality during heavy rain, although the catchment is very small. The water quality of Avoca Beach also influences pool water quality.

Compliance
Sufficient samples to calculate compliance were collected in February, March and April 2005. Avoca Rockpool complied with NHMRC (1990) guidelines in all three months.

Compliance with NHMRC (1990) swimming guidelines at Avoca Rockpool

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- no result.
* only four samples were collected in this month. An additional data point was borrowed from an adjacent month to calculate compliance.
** insufficient samples to calculate compliance were collected in this month.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, with an elevated value recorded on one occasion in April 2005.

See page 100 for key to map

See page 4 for key to graph
**McMasters Rockpool**

**Description**  
McMasters Rockpool is located at the foot of cliffs at the southern end of McMasters Beach close to the surf club. The beach is backed by a carpark and residential area. The pool is an extremely popular swimming site for families with young children and receives a large number of visitors each summer.

**Pollution Sources**  
Runoff from roads and pavements adjacent to the pool may affect the water quality during heavy rain, although the catchment is very small. The water quality of McMasters Beach also influences pool water quality.

**Compliance**  
Sufficient samples to calculate compliance were collected in January, February, and March 2005. McMasters Rockpool complied with NHMRC (1990) guidelines in all three months.

| Compliance with NHMRC (1990) swimming guidelines at McMasters Rockpool |
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- no result.

* only four samples were collected in this month. An additional data point was borrowed from an adjacent month to calculate compliance.

** Timeseries plots**  
Levels of faecal coliforms were generally low over the monitoring period, with an elevated value recorded on one occasion in February 2005.
Copacabana Rockpool

Description
Copacabana Rockpool is a naturally occurring series of shallow pools in a rockshelf at the northern end of Copacabana Beach. Conditions in the pools depend on tide height and wave energy, but when calm the pools are very popular with families with young children. A surf club, carpark and amenities are located nearby.

Pollution Sources
The pools are backed by parkland reserve, which contains remnant bushland. Runoff from roads and pavements adjacent to the beach may affect the water quality during heavy rain, and outflow from Cockrone Lagoon may at times be a source of pollution.

Compliance
Sufficient samples to calculate compliance were collected in January, February, and March 2005. Copacabana Lagoon complied with NHMRC (1990) guidelines in all three months.

Compliance with NHMRC (1990) swimming guidelines at McMasters Rockpool

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- no result.
* only four samples were collected in this month. An additional data point was borrowed from an adjacent month to calculate compliance.
** insufficient samples to calculate compliance were collected in this month.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.
Davistown Baths

**Description**
These tidal baths are netted and are located in the channel between Brisbane Water and the Kincumber Broadwater. The baths are adjacent to a foreshore park and picnic area that are used often in summer by families with small children.

**Pollution Sources**
The foreshore in the vicinity is predominantly parks and reserves although much of the catchment is urbanised. There are numerous waterfront residences nearby, and the waterway is a popular boating area. During heavy rain, water quality at this location could be affected by stormwater pollution from both upstream and downstream of the baths, depending on the tidal flow.

**Timeseries plots**
Levels of faecal coliforms were generally low over the monitoring period, with elevated values recorded on only two occasions.

See page 4 for key to graph
Ettalong Channel

Description
This estuarine beach is not netted, and is situated in the main channel of Brisbane Water, near the entrance to Broken Bay. The beach is adjacent to a foreshore park and picnic area and is popular for sailboarding.

Pollution Sources
The foreshore in the vicinity is predominantly urban parkland, although much of the catchment is urbanised, and large stormwater drains discharge to the beach near swimming areas. During heavy rain, water quality at this location could also be affected by stormwater pollution.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, only just exceeding the median guideline limit on one occasion.
Forresters Beach

Description
Forresters Beach is approximately 1.5 kilometres long. It is often not safe for swimming and is patrolled during the summer season. The beach is very popular with surfers owing to the presence of a reef along much of its length. A car park and ammenities are located towards the middle of the beach.

Pollution Sources
There are few sources of pollution at the beach, although stormwater runoff from the nearby roads and urban areas may affect water quality in heavy rain. The foreshore of the beach is composed of Wyrrabalong National Park and nature reserve.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.

See page 100 for key to map

See page 4 for key to graph
Killcare Rockpool

Description

Killcare Rockpool is a small, naturally occurring shallow pool at the southern end of Putty Beach that has been enhanced. Conditions in the pool depend on tide height and wave energy, but when calm it is very popular with families with young children. The pool is situated close to the surf club and receives a large number of visitors each summer.

Pollution Sources

There are few sources of pollution, although stormwater runoff from the nearby roads and urban area may affect water quality in heavy rain. Bouddi National Park and nature reserve form the beach foreshore.

Timeseries plots

Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.
Pearl Beach Rockpool

Description
The rockpool is located at the foot of cliffs at the southern end of Pearl Beach in Broken Bay and is a popular swimming site for families with young children. The pool is situated close to the surf club, and the beach is a busy holiday venue in summer.

Pollution Sources
The baths are backed by Brisbane Water National Park. Runoff from roads and pavements in the township of Pearl Beach and outflow from the lagoon may affect the water quality during heavy rain, although the catchment is very small.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.
Pearl Beach Lagoon

Description  The lagoon is shallow and very small, and intermittently opens to the ocean at Pearl Beach. The sampling site is located near the opening of the lagoon to the beach, where the water is used as a play area by children.

Pollution Sources  Although the majority of its upper catchment is within Brisbane Water National Park, the lagoon itself is surrounded by the township of Pearl Beach, with residences and roads very close to the waterway.

Timeseries plots  Slightly elevated levels of faecal coliforms were recorded over the monitoring period, with values exceeding the median guideline limit in dry weather conditions and in response to low levels of rainfall.

See page 100 for key to map

See page 4 for key to graph
Pretty Beach Baths

Description
These tidal baths are netted and are located in Brisbane Water near the entrance to Broken Bay. There is a narrow sandy beach, a foreshore park, boat ramp and picnic area. The area is popular with families with small children during summer.

Pollution Sources
The foreshore is predominantly urban and the waterway is a popular boating area. During heavy rain, water quality at this location could be affected by stormwater pollution from both upstream and downstream of the baths, depending on the tidal flow.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.

See page 100 for key to map

See page 4 for key to graph
Umina Beach

Description
Umina Beach is a very popular beach located near the entrance to Brisbane Waters. The beach is patrolled during the summer swimming season. As the beach faces the open ocean, conditions at the beach can vary and depend on the size and direction of ocean swell. When calm, it is a popular area for families with small children. The area is also known for sailboarding and surfriding in some conditions. A surf club, carpark, amenities and a caravan park are located nearby.

Pollution Sources
The catchment contains part of Brisbane Water National Park but is substantially urbanised. Ettalong Creek and a number of stormwater drains discharge into Broken Bay in the vicinity of the site, and these may affect water quality during heavy rain.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.

See page 4 for key to graph
Umina Lagoon

**Description**

The sampling site is a protected, shallow sandy area located near the opening of Ettalong Creek at the southern end of Umina Beach in Broken Bay. The lagoon is particularly popular with children when conditions at nearby Umina Beach are rough. The lagoon is intermittently open to the bay. It is adjacent to a caravan park and recreation reserve popular with families.

**Pollution Sources**

Although much of the foreshore in the area is recreation reserve, the catchment contains urban development. Ettalong Creek drains into the lagoon and may carry pollution from urban runoff during rainfall.

**Timeseries plots**

Levels of faecal coliforms exceeded the median guideline limit on most sampling occasions, in both dry and wet weather conditions.

See page 4 for key to graph
**Wamberal Beach**

**Description**

Wamberal Beach is the northern end of a 2.8-kilometre-long beach that extends between Wamberal Lagoon in the north and Terrigal Lagoon in the south. The northern end of the beach is backed by the Wamberal Lagoon Nature Reserve. The beach is patrolled during the summer swimming season and is popular with the local community and surfers. The sampling site is adjacent to the flagged area for the surf club, which is a focus for swimmers in summer.

**Pollution Sources**

The foreshore of the beach is composed of Wamberal Lagoon Nature Reserve to the north and is largely urbanised to the south. Outflow from Wamberal lagoon may affect water quality at the beach following heavy rain. The catchment for the lagoon is partly urbanised.

**Timeseries plots**

Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.

See page 100 for key to map.

See page 4 for key to graph.
**Woy Woy Baths**

**Description**
These estuarine tidal baths consist of a netted enclosure and surrounding boardwalk and are located in Woy Woy channel, a branch of Brisbane Water. The baths are situated close to the commercial district of Woy Woy and are adjacent to a foreshore park and picnic area.

**Pollution Sources**
The foreshore in the vicinity is predominantly parks and reserves although much of the catchment is urbanised. There are several wharves and waterfront residences nearby, and the waterway is a popular boating area. During heavy rain, water quality at this location could be affected by stormwater pollution from both upstream and downstream of the baths depending on the tidal flow, as well as by local sources.

**Timeseries plots**
Levels of faecal coliforms were generally low throughout the monitoring period, providing little or no evidence of sewage contamination.

See page 100 for key to map

See page 4 for key to graph
Yattalunga Baths

Description
These estuarine tidal baths consist of a netted enclosure and boardwalk in the upper reaches of Brisbane Water. There is a sandy beach nearby, and the baths are adjacent to a foreshore park.

Pollution Sources
The foreshore in the vicinity is predominantly parks and reserves although much of the catchment is urbanised. There are several wharves and waterfront residences nearby, and the waterway is a popular boating area. During heavy rain, water quality at this location could be affected by stormwater pollution from nearby creeks as well as by local sources.

Timeseries plots
Levels of faecal coliforms were generally low over the monitoring period, providing little or no evidence of sewage contamination.

See page 4 for key to graph