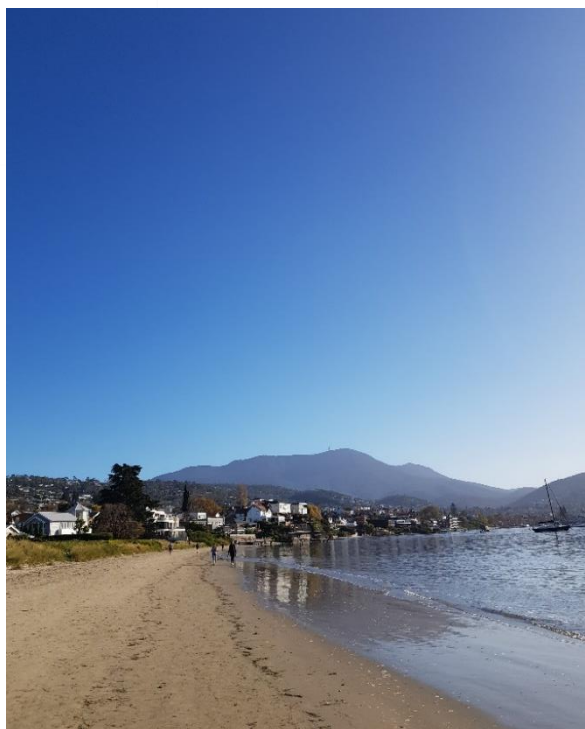
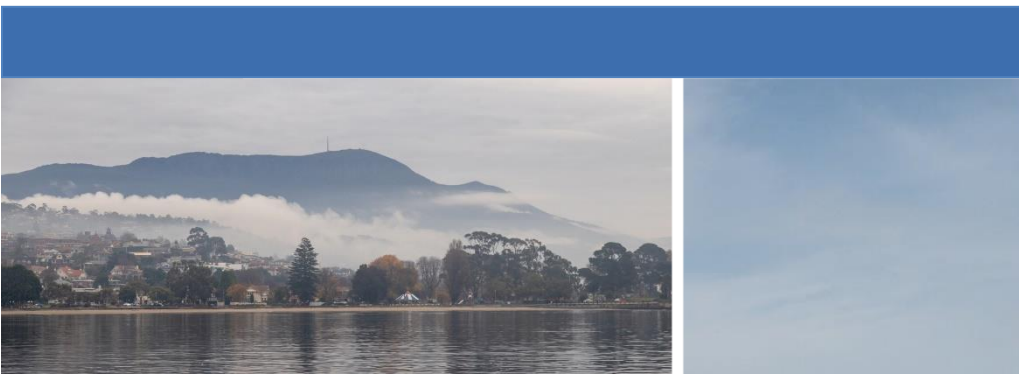


Derwent Estuary Recreational Water Quality Program

Annual Report 2021-22



Derwent Estuary
Program

The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian State Government, businesses, scientists, and community-based groups to share science for the benefit of our estuary. The DEP was established in 1999 and has been nationally recognised for excellence in coordinating initiatives to reduce water pollution, conserve habitats and species, monitor river health and promote greater use and enjoyment of the foreshore.

Our major sponsors include Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough councils, the Tasmanian State Government, TasWater, Tasmanian Ports Corporation, Norske Skog Boyer, Nyrstar Hobart Smelter, Hydro Tasmania, EPA Tasmania, NRM South and the Institute for Marine and Antarctic Studies.



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1 EXECUTIVE SUMMARY

This report presents results of the Derwent Estuary Recreational Water Quality Program (RWQ) 2021-22 season. The RWQ is a joint initiative between six local councils, the State Government of Tasmania, Environmental Protection Authority Tasmania (EPA) and the Derwent Estuary Program (DEP). Water samples were collected weekly at 42 sites throughout the estuary between 1 December 2021 and 31 March 2022 and analysed for the faecal indicator bacteria, enterococci.

Whilst the water quality at most of our swimming beaches was predominantly good throughout the past monitoring season, this summer did see numerous sampling failures, i.e. when the enterococci results exceeds the trigger level of 140 MPN 100 mL⁻¹ set by the Tasmanian Recreational Water Quality Guidelines 2007 (DoH, 2007). This season saw 49 exceedances, compared with 28 last summer. At the end of this season, five swimming sites were graded as Good, nine sites graded as Fair, two as Poor, with four sites yet to be classified. The sites that dropped in their rating were Bellerive Beach (west), Kingston Beach (mid), New Norfolk (Esplanade) – all changing from Good to Fair; and Kingston Beach (north) changing from Fair to Poor. Currently, the two beach sampling sites with the consistently best water quality in the program are both at Little Sandy Bay.

Water quality at the 22 environmental sites was also poorer compared to the previous season. On 51 occasions enterococci results over 140 MPN 100 mL⁻¹ were recorded, compared to 40 times last season. After updating the long-term ratings at the end of the season there are now ten environmental sites graded as Good, one as Fair, and ten as Poor. One site dropped from Good to Fair (Victoria Dock) and five sites changed from Fair to Poor (Geilston Bay, Berridale Bay, New Town Bay, Lindisfarne Bay and Watermans Dock). Two sites did improve their grade, from Fair to Good (Elwick Bay, Cameron Bay). After this season, the Mid-river Derwent sampling location continues to be the environmental site with the consistently best water quality, followed by Montagu Bay and Brooke St Pier.

Overall, it was a dry summer for Tasmania, fourth driest in 122 years, with total summer rainfall below average across the Derwent estuary. The rain that did fall, mostly fell over few days, except for in March. February was particularly dry, with Hobart Airport recording its driest February in 64 years. As always, is it difficult to draw definite conclusions between rainfall and enterococci results. This summer saw several rain events that likely led to very high results, however multiple failed samples were taken on days when there was no rain recorded.

Clarence City Council and Kingborough Council are to be commended for the proactive approach they have adopted to deal with poor water quality issues at local beaches. With both councils now having fully engaged dedicated stormwater investigations officers, many issues have been, and continue to be, identified and are being dealt with, either by councils themselves or by TasWater.

Pollution source-tracking is often intricate work. Frequently the work will be in large and complex catchments, such as the Browns River system that potentially is impacting the recreational water at Kingston Beach. Part of source-tracking is considering all options. This season saw a detailed probe into enterococci concentration in sand on Howrah Beach, which has provided valuable information for all councils who are exploring pollution sources. It is terrific that we are building up local expertise in this field, and to see the generous knowledge-sharing that is taking place across the estuary.

1.1 Season follow-ups

1.1.1 Natural phenomena website

A promised follow-up from the 2020-21 season, was for the DEP to produce some information about sea foam, which councils can share with worried community members who wonder if this is natural or a pollution event. This has led to several new DEP webpages under the heading Natural Phenomena with topics in addition to sea foam, including red tide, bioluminescence and the Bridgewater Jerry:
<https://www.derwentestuary.org.au/natural-phenomena/>.

DEP will add more topics to this page over time - councils are encouraged to come with suggestions.

1.1.2 Sampling in tough conditions

In this season's intercalibration exercise a great question was raised: *If weather conditions don't allow for wading out to the prescribed 0.5-1.0 m water depth to take a sample, should council still sample?*

DoH assisted DEP with the answer:

- *If able to sample, you must sample.*
- *If not able to wade out to 0.5 m, go out as far as is safe and reach out as far as possible with your pole, to get that little more sampling depth.*
- *Always wait a moment for any sediments to settle before sampling, especially in shallow water. Using a pole to reach away from your body also helps avoid sampling resuspended sediments.*
- *Safety is paramount, and if it is not safe to sample on a Tuesday, don't sample, and try for Wednesday as a last resort (inform PHL).*

A follow-up question was raised regarding timing of sampling when conditions are poor/unsafe - whether sampling should occur at all sites on the same day, or if it's ok to split it between days?

Again, DoH assisted with the answer:

It is fine for councils to wait a day and collect all samples the following day. It's more practical. However, considerations should be given to the following:

- *Weather forecast for the following day - is there potential for other sites to be inaccessible if bad weather is forecast for more than a day?*
- *Is there adequate time for a resample should it be required?*

It ultimately comes down to risk assessment and practicality for EHOs. Personal safety is paramount as always.

In the end it comes down to safety and common sense.

2 INTRODUCTION

Water quality monitoring of beaches and bays in the Derwent estuary is coordinated by the DEP in collaboration with Department of Health (DoH), EPA and the six councils that border the estuary (Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough). The primary objectives of the program are to coordinate monitoring, investigations and assist councils and the DoH in managing human health risks associated with poor water quality. The DEP's role in the program is to:

- Coordinate recreational water quality monitoring in the Derwent estuary.
- Compile and analyse data, including classification of beaches and bays, annual reporting and analysis of long-term trends (using methods outlined Tasmanian Recreational Water Quality Guidelines 2007, DoH, 2007).
- Support and facilitate site specific investigations into poor or deteriorating water quality at targeted sites.

The water quality data is made publicly available via the DEP website and Facebook page on a weekly basis throughout the summer (December-March), to allow the community to make informed decisions as to where and when to swim. This data is also used to inform decision-making processes, by identifying stormwater and wastewater assets that require investigating.

2.1 Pathogens and health risks

Water contaminated by sewage and animal faeces may contain pathogenic micro-organisms (bacteria, viruses, protozoa), which pose a health hazard when the water is used for primary contact recreation, such as swimming. Infection may occur by swallowing, inhaling or by direct contact of contaminated water with ears, nasal passages, mucous membranes and cuts in the skin, which allow the pathogens to enter the body (N.Z. Ministry for the Environment, 2002). The most common health conditions associated with primary contact recreation in contaminated water are gastrointestinal disorders, respiratory illnesses, eye, nose and throat infections and skin disorders.

Direct detection of pathogens is not a feasible option for routine assessments since they occur intermittently and are difficult to recover from water. Thus water samples are analysed for the concentration of more easily detected microorganisms, which may indicate the presence of pathogens, referred to as faecal indicator bacteria (refer to Coughanowr et al. 2015 for more information). In the Derwent estuary, enterococci is sampled as the key faecal indicator bacteria, as required by the Tasmanian Recreational Water Quality Guidelines 2007 (DoH, 2007).

2.2 Sources of contamination

Key sources of faecal contamination in coastal waters can include untreated sewage, or faecal contamination from a catchment transported via the stormwater system, animal faeces, or resuspension of contaminated sediments:

- Stormwater systems in urban areas can be contaminated with sewage. The source for this contamination can be caused by a failure in the wastewater (sewage) system, including overflows during high rainfall events, or direct cross-connections, leakages, or animal faeces in low rainfall (or non-rainfall) events.
- Direct contamination can occur from animal faeces. High density animal aggregations, such as birds or dogs, on beaches can contribute to contamination.
- Resuspension of contaminated sediments by wind or wave action is also a possible source of contamination.

Differentiating between contaminant sources can be very difficult, however regular (and case-based) sanitary surveys, possibly combined with specialist laboratory techniques, such as sterol can help advance our understanding. Systematic investigation is critical to locate a pollution source. See the DEP Source Tracking Framework and Toolkit https://www.derwentestuary.org.au/assets/Source_Tracking_Framework_and_Toolkit_Mar2020.pdf.

2.3 Recreational water quality guidelines

Swimming and environmental sites in the Derwent estuary are graded as Good, Fair or Poor. This is in accordance with the Recreational Water Quality Guidelines for Tasmania (DoH, 2007), which are largely based on the national Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Both guidelines are currently under review. The guidelines are based on aseptic grab sample analysis for the faecal indicator microbial group enterococci, and the Tasmanian guidelines adopt a three-tiered approach to classifying the long-term (5 years of data) quality of a site based on available data. The tiers are:

- *Good*: rolling 5-year 95th Hazen percentile value of < 200 enterococci MPN 100 mL⁻¹.
- *Fair*: rolling 5-year 95th Hazen percentile value of 200 - 500 enterococci MPN 100 mL⁻¹.
- *Poor*: rolling 5-year 95th Hazen percentile value of > 500 enterococci MPN 100 mL⁻¹. In this case, water at these sites is considered a threat to public health in the event of primary contact recreation and local councils are required to advise the general public and to erect warning signs.

In addition to long-term site classification, trigger levels have been set to manage public exposure to episodic or emerging water quality issues. If a sample exceeds 140 enterococci MPN 100 mL⁻¹, the council is required to resample as soon as possible, and if two consecutive samples return enterococci results above 280 MPN 100 mL⁻¹, the public must be advised directly via signage on the beach in question. This signage can only be removed by Council's Authorised Officer in consultation with DoH.

3 RECREATIONAL WATER QUALITY PROGRAM

3.1 Swimming and Environmental sites

Aseptic grab samples are collected each Tuesday by Council and the EPA/DEP throughout the Derwent estuary, during summer and early autumn each year (from 1 December to 31 March). Sites are categorised as either swimming sites or environmental sites, as described below, and locations are shown in Figure 3-1. Recreational Water Quality sampling sites (swimming and environmental sites) with their current water quality classification based on data collected in the summer months between December 2017 and March 2022. Sites without five years of data (N/A) are depicted without a rating

- The 20 swimming sites monitored this season are in locations where a significant number of people swim or conduct other primary contact recreation. Primary contact refers to where recreational water is used for whole-body contact, i.e., where there is a risk of swallowing water (NHMRC, 2008). These sites are sampled by councils.
- The 22 environmental sites monitored this season, sampled by either councils or EPA/DEP were selected using the following rationale:
 - Bays and coves that are frequently used for secondary contact recreation and/or have foreshore parks. Secondary contact refers to incidental contact, i.e., activities where only the limbs are regularly wet and in which greater contact (including swallowing water) is unusual, such as boating and fishing (NHMRC, 2008).

- Areas with potential sources of faecal contamination.
 - Sites with relatively low risk of contamination, sampled to contextualise swimming site results.
- Sites associated with major swimming events, such as the Trans-Derwent Swim.

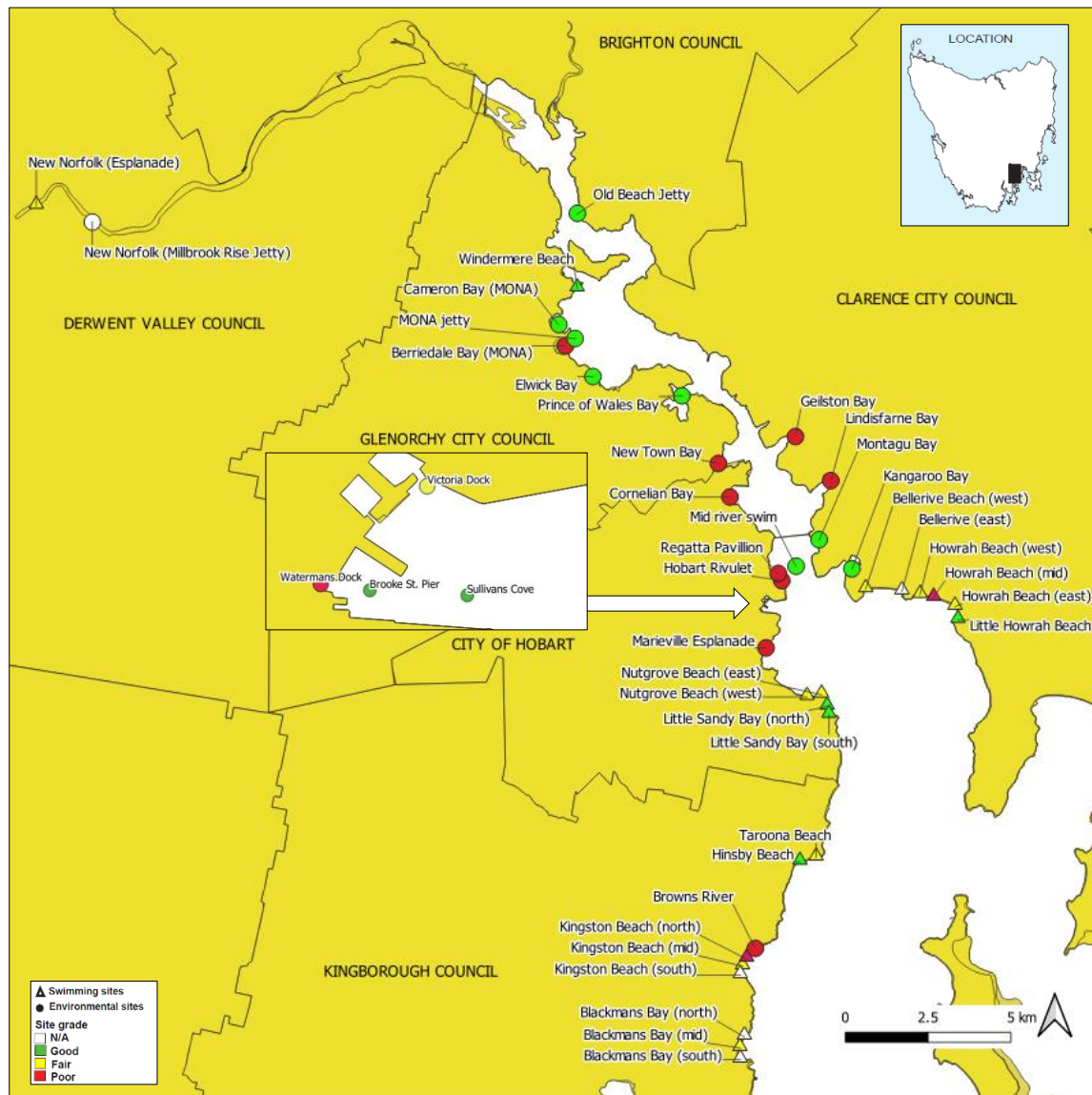


Figure 3-1. Recreational Water Quality sampling sites (swimming and environmental sites) with their current water quality classification based on data collected in the summer months between December 2017 and March 2022. Sites without five years of data (N/A) are depicted without a rating

3.2 Inter-calibration exercise

An inter-calibration exercise is organised by the DEP at the start of each season to ensure that all sampling officers are using the same protocols, thus minimising sampler bias. The sampling method is demonstrated, associated protocols are reviewed, and participants simultaneously sample from a designated location. Results are compared to identify any sampler bias and are also useful to better understand the degree of variability between water samples collected from a given site and/or between sites.

The exercise is also a good opportunity to talk about any concerns and finer details of sampling both by new and more experienced samplers, and good questions are always

brought up for discussion. For a full report on this season's inter-calibration exercise, and for answers to some more in-depth questions raised, see Appendix 9.1. The next inter-calibration exercise will be conducted in November 2022.



Figure 3-2. EHOs sampling together as part of the annual inter-calibration exercise, at Marieville Esplanade on 23 November 2021.

4 2021-22 RWQ SEASON RESULTS

4.1 Long-term site classification

After each RWQ season, a new long-term rating is calculated for all swimming and environmental sites. This calculation is based on the immediate previous five seasons of sampling data for each site. Table 1 below, and also Figure 3-1 above, shows the updated rating after the 2021-22 season. The colours refer to Tasmanian *Recreational Water Quality Guidelines* (DoH, 2007), calculating a rolling 5-year 95th Hazen percentile for enterococci, where green denotes Good (< 200 MPN 100 mL⁻¹), yellow denotes Fair (200 - 500 MPN 100 mL⁻¹), and red denotes Poor (> 500 MPN 100 mL⁻¹). The number of samples with enterococci results between 140 and 280 MPN 100 mL⁻¹, > 280 MPN 100 mL⁻¹, > 140 and total number of samples, for the same 5-year period are also shown.

It is important to note, that for sites where there is not yet five years of data available, there is no long-term rating provided. The 95th Hazen percentile figure listed in Table 2 only provides an indication of a future rating for these sites. It is though very useful for councils to take note of early water quality trends, as they may indicate there are issues that require attention and action now.

Table 1. Long-term ratings for swimming and environmental sites as calculated after the 2021-22 RWQ season. N/A indicates that no long-term rating is available yet.

		Updated long-term rating	5-year 95 th Hazen percentile	Samples between 140 and 280	Samples > 280	Total number of samples
Swimming sites	<i>*Bellerive Beach (east)</i>	N/A	129	1	1	53
	Bellerive Beach (west)	Fair	216	6	1	87
	Blackmans Bay Beach (mid)	Fair	421	4	8	87
	<i>*Blackmans Bay Beach (north)</i>	N/A	167	1	2	53
	<i>*Blackmans Bay Beach (south)</i>	N/A	235	4	1	53
	Hinsby Beach	Good	170	5	2	87
	Howrah Beach (east)	Fair	258	4	4	87
	Howrah Beach (mid)	Poor	538	8	10	87
	Howrah Beach (west)	Fair	392	2	5	87
	Kingston Beach (mid)	Fair	231	4	3	87
	Kingston Beach (north)	Poor	552	5	7	87
	<i>*Kingston Beach (south)</i>	N/A	271	4	2	53
	Little Howrah Beach	Good	172	2	3	87
	Little Sandy Bay Beach (north)	Good	97	0	2	85
	Little Sandy Bay Beach (south)	Good	80	1	0	86
	New Norfolk (Esplanade)	Fair	264	6	3	76
	Nutgrove Beach (east)	Fair	213	4	3	84
	Nutgrove Beach (west)	Fair	268	3	4	86
	Taroona Beach	Fair	417	1	7	87
	Windermere Beach	Good	145	1	3	81
Environmental sites	Brooke Street Pier	Good	70	1	1	68
	Browns River	Poor	2522	8	31	87
	**Cornelian Bay	Poor	1245	7	13	60
	Elwick Bay	Good	133	2	2	80
	Geilston Bay	Poor	711	5	6	68
	Hobart Rivulet	Poor	1829	10	22	68
	Kangaroo Bay	Good	187	4	1	68
	Lindisfarne Bay	Poor	641	2	5	68
	Marievile Esplanade	Poor	1131	9	12	86
	Mid-river swim	Good	39	2	0	67
	Berriedale Bay (MONA)	Poor	671	5	6	68
	Cameron Bay (MONA)	Good	171	4	2	82
	MONA jetty	Good	141	2	2	77
	Montagu Bay	Good	65	1	1	68
	<i>*New Norfolk (Millbrook Rise Jetty)</i>	N/A	222	4	2	45
	New Town Bay	Poor	624	4	8	68
	Old Beach Jetty	Good	197	3	3	73
	Prince of Wales Bay	Good	174	3	1	67
	Regatta Pavilion	Poor	2187	7	8	69
	Sullivans Cove	Good	132	1	1	68
	Victoria Dock	Fair	248	2	3	68
	Watermans Dock	Poor	958	2	5	68

* Indicates < 5 years of data available.

**Cornelian Bay is monitored intermittently when conditions allow, thus result is not robust. Site was not sampled during the 2021-22 RWQ season.

4.2 Site results

4.2.1 Swimming Sites

This season saw no new swimming sites added to the sampling regime. There are still four sites with less than five years of data, thus without an assigned long-term rating. These sites are Bellerive Beach (east), Blackmans Bay Beach (north + south), and Kingston Beach (south). All sites require five years of sampling data to calculate a long-term rating. Updated ratings for all sites are listed in Table 1 above.

The water quality at the swimming sites was not as consistently good this summer as during the last two seasons. This season saw 49 exceedances (enterococci >140 MPN 100 mL⁻¹), compared with 28 last summer and five the previous season (Table 2).

Table 2. Number of swimming sites from the last six RWQ seasons triggering a retest under the Tasmanian Recreational Water Quality Guidelines by exceeding enterococci >140 MPN 100 mL⁻¹ (DoH, 2007).

RWQ season	No. exceedances
2021-22	49
2020-21	28
2019-20	5
2018-19	52
2017-18	23
2016-17	24

At the end of this season, five sites were graded as Good, nine sites graded as Fair, two as Poor, and four sites yet to be classified. The sites that dropped in their rating were Bellerive Beach (west), Kingston Beach (mid), New Norfolk (Esplanade) – all changing from Good to Fair; and Kingston Beach (north) changing from Fair to Poor (Figure 4-1, Figure 4-2). No swimming sites improved their ratings this year. Councils are strongly urged to view Fair sites as an early warning of risk of further decline in local water quality.

As mentioned, The Esplanade site at New Norfolk went to Fair following this season, after seven failed results (Appendix 9.3.1). This is a first for this site, which has a long history of consistently good water quality, and Derwent Valley Council is encouraged to continue their source-tracking investigation.

The two swimming sites with the consistently best water quality in the RWQ program are currently the Little Sandy Bay beaches (south and north). The site with the highest Hazen percentile figure at the moment is Kingston Beach (north). This site has had five exceedances between 140 and 280 MPN 100 mL⁻¹ and seven over 280 during the last five seasons (Table 1 and 5.1). In terms of municipalities, the City of Hobart beaches and Glenorchy's Windermere Beach experienced the consistently best water quality this summer (Appendix 9.3.1).

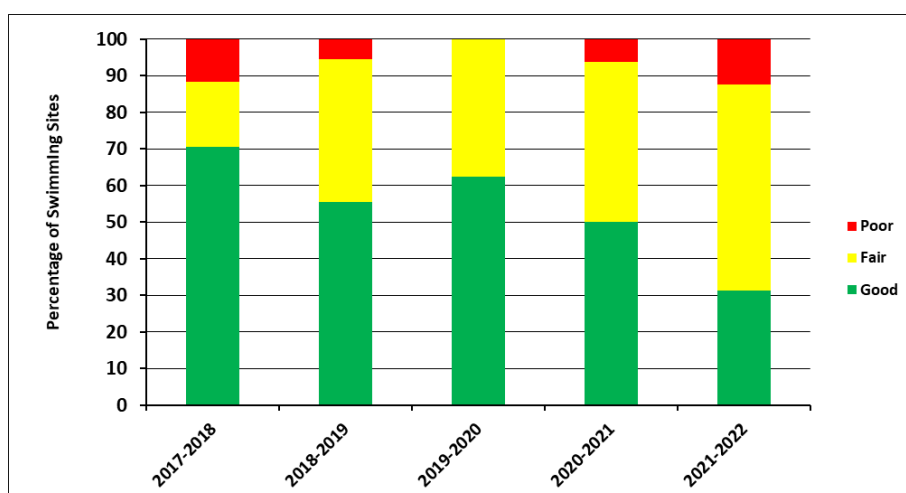


Figure 4-1 Proportion of Swimming Sites graded as Good, Fair, and Poor in the last five RWQ seasons. Note that proportions are only based on those sites with five years of data available.

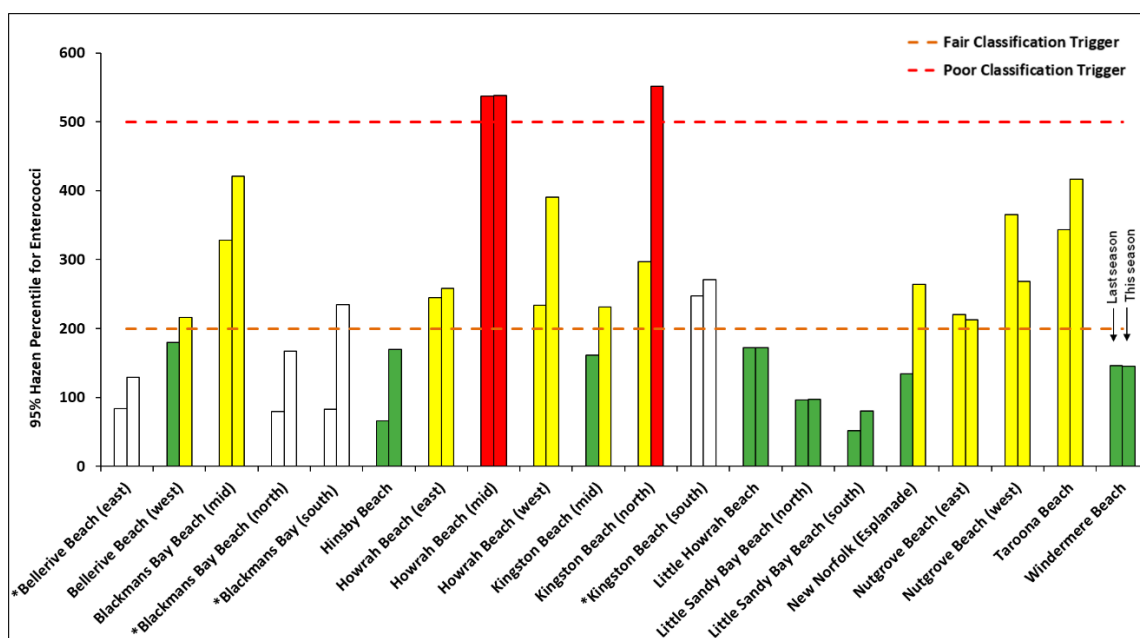


Figure 4-2: Comparison of rolling 5-year Hazen percentile enterococci result for swimming sites. Each site is presented as a pair of results, where the left bar represents 2020-21 RWQ season results, while the right bar represents 2021-22 season result. Green denotes Good (< 200 MPN 100 mL⁻¹), yellow denotes Fair (200 - 500 MPN 100 mL⁻¹), red denotes Poor (> 500 MPN 100 mL⁻¹), and the classification trigger lines are indicated with dotted lines. * indicates that less than five years of data is available, thus those results are less robust.

See the full list of enterococci results for all swimming sites in the 2021-22 season in Appendix 9.3.1, and read more details about specific site investigations in Section 5.

4.2.2 Environmental Sites

There were no new environmental sites added to the sampling program this season; and the only such site without a long-term rating is at New Norfolk, by the Millbrook Rise jetty.

The enterococci results from the 22 environmental sites showed 51 exceedances (enterococci >140 MPN 100 mL⁻¹), compared to 40 during the last summer and 18 the previous season (Appendix 9.3.2, (DEP, 2021).

After updating the long-term ratings at the end of the 2021-22 season there are ten sites graded as Good, one as Fair, and ten as Poor. One site dropped from Good to Fair (Victoria Dock) and five sites changed from Fair to Poor (Geilston Bay, Berridale Bay, New Town Bay, Lindisfarne Bay and Watermans Dock). Two sites improved their grade from Fair to Good (Elwick Bay, Cameron Bay) (Figure 4-3, Figure 4-4).

After this season, the Mid-river Derwent location continues to be the environmental site with the best water quality, followed by Montagu Bay and Brooke St Pier. Mid-river Derwent has only experienced two enterococci sample > 140 MPN 100 mL⁻¹ over the past five seasons (Table 1).

The DEP in cooperation with the EPA, take the water samples at Montagu Bay, Geilston Bay, Mid-Derwent, Sullivans Cove, Brooke St Pier, Watermans Dock, Victoria Dock, Hobart Rivulet, Regatta Pavilion, Lindisfarne Bay, Kangaroo Bay, New Town Bay and Prince of Wales Bay. Unfortunately, four sample days were missed this season due to staff and boat availability.

Sampling at Cornelian Bay has long been intermittent, due to tide and conditions, making the Hazen result from the site less robust. The bay is extremely silty, and problems with getting stuck in the mud when grabbing a water sample is a real issue! No sampling was conducted at this location during the last season.

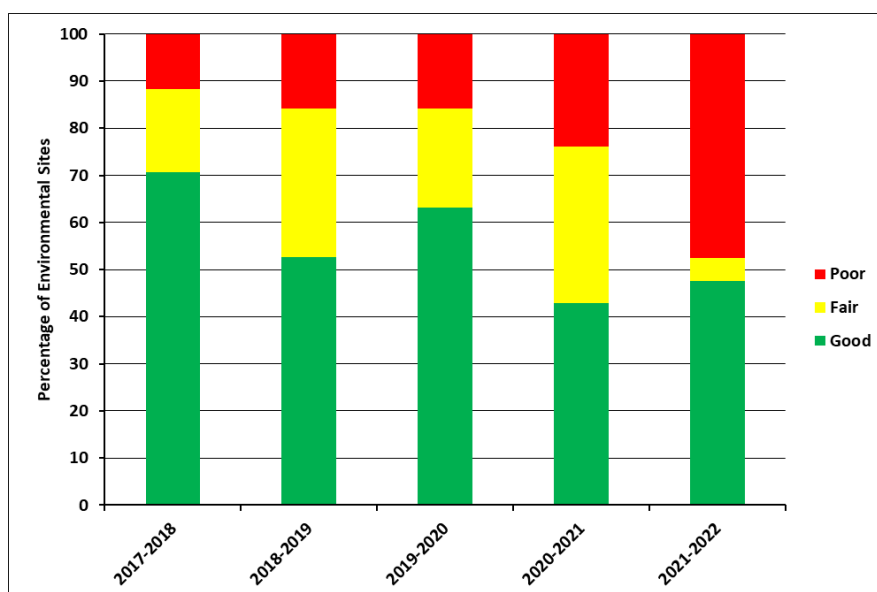


Figure 4-3 Proportion of Environmental Sites graded as Good, Fair, and Poor in the last five RWQ seasons. Note that proportions are only based on those sites with five years of data available.

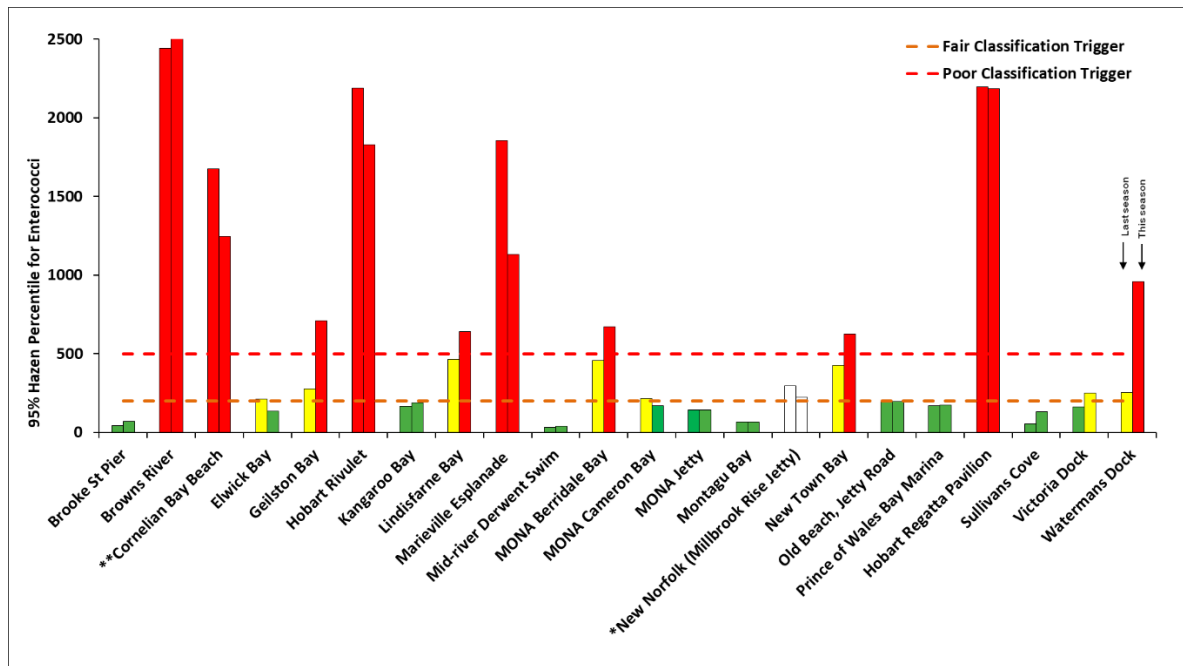


Figure 4-4 Comparison of rolling 5-year Hazen percentile enterococci result for the environmental sites. Each site is presented as a pair of results, where the left bar represents 2020-21 RWQ season results, while the right bar represents 2021-22 season result. Green denotes Good (< 200 MPN 100 mL⁻¹), yellow denotes Fair (200 - 500 MPN 100 mL⁻¹), red denotes Poor (> 500 MPN 100 mL⁻¹), and the classification trigger lines are indicated with dotted lines. * indicates > five years of data available. **Cornelian Bay is monitored intermittently, when conditions allow, thus those results are less robust.

See the full enterococci results for all environmental sites in Appendix 9.3.2.

4.3 Rainfall

Rainfall is a driver of pollution at beaches and other recreational swimming areas as it generates potentially contaminated stormwater runoff and can trigger discharges and overflows from the wastewater (sewerage) system. The water quality of urban beaches and bays can therefore be strongly influenced by rainfall (NHMRC, 2008).

Rainfall varies considerably across the estuary. Rainfall data collected and reported by the Bureau of Meteorology (BoM) at four weather stations throughout the Derwent estuary catchments are used to compare rainfall during each RWQ season (December to March) against the long-term average rainfall for that period. Observations of daily rainfall are nominally made at 9 am and record the total for the previous 24 hours. Hobart (Ellerslie Road), Kingston (Greenhill Drive), Hobart Airport and New Norfolk (west) have been selected as representative of RWQ sampling sites in the Derwent estuary. Long-term averages for the summer months are currently ranging between 141.80 mm at New Norfolk and 202.40 mm at Kingston, the latter generally experiencing more rain than the other sites. During the 2021-22 RWQ season, total rainfall was below average for all four stations (Figure 4-5).

The complete 2021-22 summer rainfall data for the four BoM weather stations that cover the Derwent estuary are listed in Appendix B 9.2.

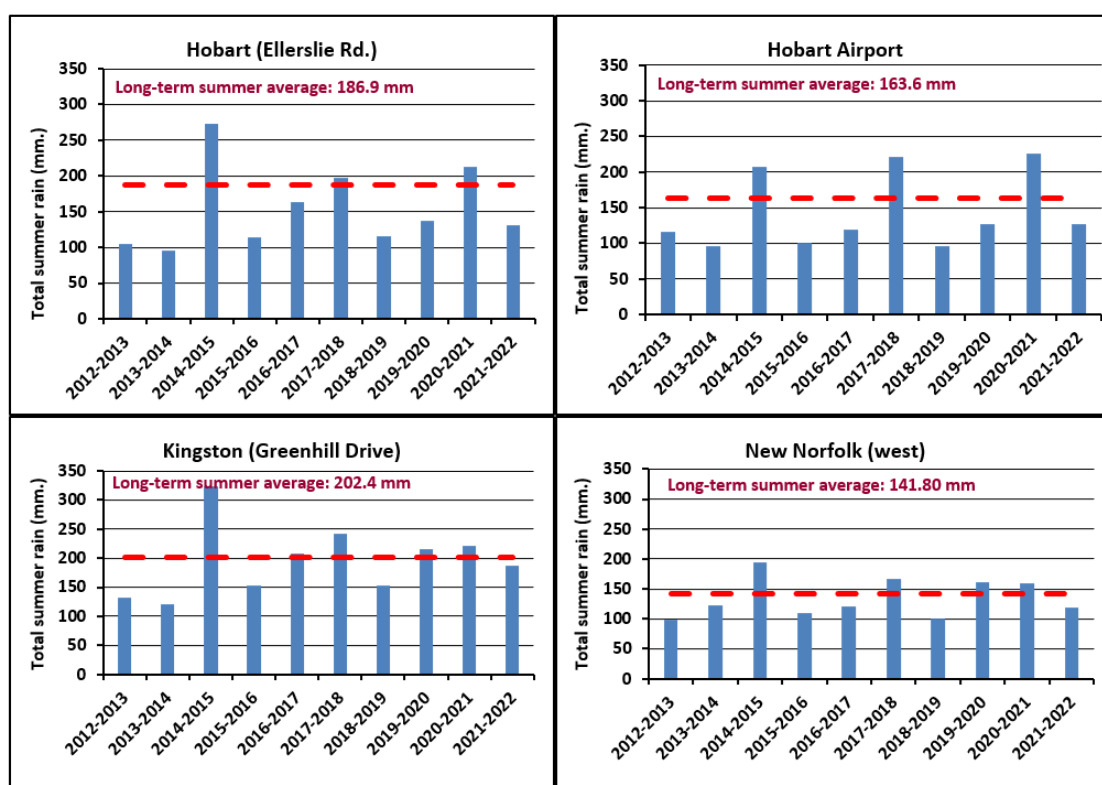


Figure 4-5 Total rainfall (in mm) at four weather stations in the Derwent estuary catchments during the last ten RWQ program seasons (between December and March), as recorded by the Bureau of Meteorology (2022). The long-term average rainfall is indicated in red text and by dotted line.

Overall, it was a dry summer for Tasmania, fourth driest in 122 years. In the estuary the summer rain mostly fell over few days, except for in March. In December most rain fell on the 3rd and 7th. January was also mostly dry, but rainfall still exceeded the monthly average for all four BoM sites, due to heavy rain falling on 7th and 8th. February was very dry across Tasmania, especially in the south-east. Hobart Airport had its driest February in 64 years of record, and Hobart (Ellerslie Road) had its driest February since 2001. In March, Tasmania's rainfall was 26 % below average, but across the estuary the total monthly rainfall was either just below or above the average. Rain fell throughout the month, with six days experiencing rainfall > 5 mm, and heavy fall on 1st of March (Table 3; BoM, 2022b).

Table 3. Comparing monthly average and total rainfall data from Dec 2021 to March 2022 for four estuary BoM sites (BoM, 2022a). February is highlighted in red, with its considerable difference between total and average rainfall.

		Hobart (Ellerslie Rd)	Hobart Airport	Kingston (Greenhill Dr)	New Norfolk (west)
Dec. 2021	Total monthly rainfall	40.8	42.8	52.4	31.7
	Long-term monthly average	56.3	52.1	53.4	43
Jan. 2022	Total monthly rainfall	54.4	61.2	47.4	47.6
	Long-term monthly average	46.9	40.3	49.7	34.6
Feb. 2022	Total monthly rainfall	5.4	2.6	14.4	4.8
	Long-term monthly average	39.1	34.9	42.5	28.3
Mar. 2022	Total monthly rainfall	30.6	20.4	73.6	34.6
	Long-term monthly average	44.6	36.3	56.8	35.9

4.3.1 Enterococci response to rainfall at swimming sites

The DEP this year again conducted a preliminary assessment of a possible relationship between enterococci concentration and rainfall. The assessment includes all enterococci samples collected across the swimming sites this season, a total of 335 samples. Results were separated into two groups:

- **Group 1.** Enterococci results < 140 MPN 100 ml⁻¹: 286 samples.
- **Group 2.** Enterococci results > 140 MPN 100 ml⁻¹: 49 samples.

These two groups were separately assessed for a possible response to rainfall (Figure 4-6). Rainfall data was used from the four local BoM stations, outlined in the previous section, with records for the 24 hours prior to 9 am on the day of sampling. Rainfall after 9 am on the day of sampling was not included. This decision was made based on other reports that take the same approach (DEP, 2013; DPIE, 2019).

Group 1 (enterococci < 140 MPN):

- 286 samples.
- 69 % of the enterococci results (< 140 MPN 100 ml⁻¹) occurred when no rain fell in the preceding 24 hours.
- 26 % of results occurred on days when the total rainfall in the preceding 24 hours was < 5 mm.
- 3 % of results occurred on days when the total rainfall in the preceding 24 hours was between 5.1 and 10 mm.
- 2 % of results occurred on days when the total rainfall in the preceding 24 hours was between 10.1 and 20 mm.

Group 2 (enterococci > 140 MPN):

- 49 samples.
- 63 % of high enterococci values (> 140 MPN 100 ml⁻¹) occurred when no rain fell in the preceding 24 hours.
- 16% of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was < 5 mm.
- 4 % of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was between 5-10 mm.
- 16 % of results occurred on days when the total rainfall in the preceding 24 hours was between 10.1 and 20 mm.

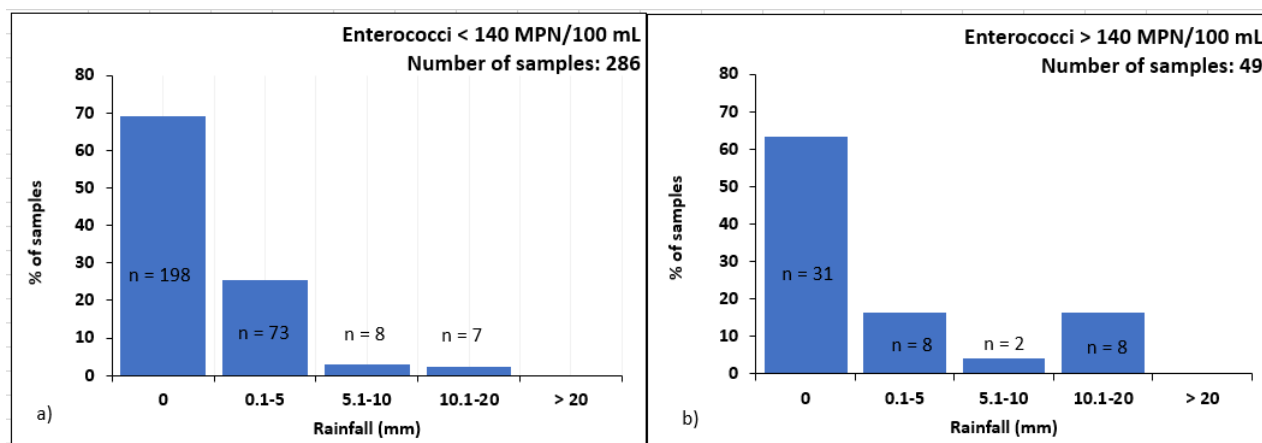


Figure 4-6. (a) Proportion of enterococci sample results < 140 MPN 100 ml⁻¹ and (b) > 140 MPN 100 ml⁻¹ matched with rainfall data from four BoM stations across the estuary. Graphs include all samples collected at swimming sites during the 2021-22 RWQ season. n = number of samples.

As Figure 4-6 shows, of the 335 swimming site samples collected this summer, 85 % of enterococci results (286 samples) were < 140 MPN 100 ml⁻¹. Rainfall did not appear to negatively influence most enterococci results, with 88 of all 106 rainfall events (> 1 mm rain) resulting in enterococci < 140 MPN 100 ml⁻¹; including 15 samples taken when rainfall of between 5 and 20 mm was recorded.

Summing up, on ten sampling days there was *some* rain recorded *somewhere* in the estuary (Appendix B, 9.2). A number of these rain events appear to have directly led to high results, such as 1st of March, when considerable rain fell across the estuary followed by ten beach failures. These fails may have been caused by contaminated stormwater runoff, which as mentioned earlier also can trigger discharges and overflows from the wastewater system. The season also saw 31 samples exceeding the trigger level on days where there was no rain recorded, such as multiple fails on 1st of February, which recorded no rain for the four previous days. There are numerous reasons for dry weather fails, including sewage cross-connection, sewage spill, sewer leak, residential or business discharge, as well as swell and high winds resuspending sediments. See section 6.1 for Clarence City Council's sediment investigation.

Ideally this rainfall assessment is replicated for individual beaches, which would give greater confidence in the analysis. Beaches may respond differently to rainfall depending on the proximity of sampling sites to stormwater outlets, activities in, and topography of, the catchment. Such analysis may assist decision-making and allocation of resources.

5 SPECIFIC INVESTIGATIONS

The DEP recommends that councils view a Fair site classification as a forewarning that problems with poor water quality may escalate, and therefore warrants investigation. It is very encouraging that several councils now have stormwater investigation officers dedicated to such work. Water quality investigations are ongoing at various estuary sites as discussed below.

DEP continues to encourage councils with Fair or Poor water quality ratings sites to take advantage of the 2020 Source Tracking Framework and Toolkit, which outlines a standard process for identifying sources of faecal pollution in the Derwent estuary (at the beach) and in its sub-catchments (in the stormwater network). The information includes a flow chart to help investigators find the pollution source by taking them through easy-to-follow screening, tracing and remediation phases, and then provides detailed information about subsurface infrastructure investigation tools, water quality indicators, and microbial source tracking methods:

https://www.derwentestuary.org.au/assets/Source_Tracking_Framework_and_Toolkit_Mar2020.pdf

The following site-specific information has been provided by individual councils.

5.1 Howrah Beach

In response to the decline in water quality along Howrah Beach reported in last year's DEP recreational water quality report, Clarence City Council (CCC) launched a thorough investigation into water quality in the area. CCC employed a dedicated Stormwater Officer to help accelerate the investigation at Howrah Beach, working to identify the sources of contamination impacting water quality along this popular stretch of beach.

As the first step in the investigation, water quality specialist Dr Christine Coughanowr produced a report in July 2021 in which eight recommendations were provided to inform the direction of the investigation:

Recommendations/actions	Status
Describe the four catchments to Howrah Beach, including number of businesses, schools, residences, and previous work done.	<i>Completed</i>
Request a report from TasWater on sewage infrastructure issues in Howrah area, including investigations and repairs over the last 5-10 years and frequency of sewage spills/pump station overflows.	<i>Completed</i>
Map information from the stormwater investigations.	<i>Completed</i>
Collect and compile information on the old tip beneath Wentworth Park and conduct groundwater monitoring to assess whether the tip is a source of faecal contamination.	<i>Completed</i>
Contact the Derwent Estuary Program for any stormwater results from the council network.	<i>Completed</i>
Plan and complete a sediment sampling program of Howrah Beach.	<i>Completed</i>
Commence weekly sampling of the stormwater outfalls with intensive ammonia testing of the stormwater catchments and set up a sampling results sheet that includes a variety of observations inclu. weather, flow levels, tide, ammonia reading.	<i>Ongoing</i>
Ask council engineering department for information on sewage spills/pump station overflows/known problem areas in the stormwater network.	<i>Completed</i>

Between August 2021 and 1 June 2022, council's investigation revealed 63 issues related to stormwater contamination. The breakdown of issues identified was as follows:

- One sewer to stormwater direct connection issue
- 11 defective sewer pipe connections between house and mainline
- 13 defective stormwater infrastructure issues
- 29 defective sewer infrastructure issues
- Five sewer blockages
- Four minor, intermittent issues which are under further investigation by council.

In October 2021, following groundwater sampling at Wentworth Park, no evidence of faecal contamination was discovered, and no further testing is recommended. In November 2021, Clarence City Council hosted a pop-up community information and feedback session near Howrah Beach, which was well received by the community.

Public education on stormwater pollution and appropriate remediation, and intervention measures upstream of the beach will commence in the 2022-23 financial year. These intervention measures may include the creation of bioretention basins and installation of strategically placed Gross Pollutant Traps (GTPs) upstream in the stormwater network, to reduce larger polluting material from reaching the beach.

Council also conducted a comprehensive sediment sampling program in March 2022 to identify if other sources of contaminants and/or environmental conditions may be affecting the recreational water quality. Results indicated that stormwater outfalls were still the likely cause of contamination along Howrah Beach, thus investigations into stormwater and sewer infrastructure will continue within the catchment.

Bellerive Beach (west) and two environmental sites (Lindisfarne Bay & Geilston Bay) have all seen water quality rating declines following the 2021-22 season. Council is planning to utilise the approach that has been developed during the Howrah Beach investigation to commence monitoring and investigations into these areas in the 2022-23 financial year.

5.2 Marieville Esplanade

The environmental site Marieville Esplanade in Sandy Bay has been in the Poor section for many years. The sample site is by the rowing club house within the Short Beach Reserve, about 150m from the mouth of Sandy Bay Rivulet. The reserve is a very popular place for locals to meet up and walk their dogs (off lead area).

City of Hobart (CoH) has designed a sampling plan to investigate point sources of pollution that may be impacting upon the water quality at Marieville Esplanade. This sampling operation has been developed to understand and address the impact of the Sandy Bay Rivulet on the Marieville Esplanade area at Short Beach. Current investigations are focused on the New Town Rivulet, however, the Sandy Bay rivulet has been identified as a high priority once the current investigation has been completed.

5.3 Cornelian Bay

COH is looking to undertake an audit of Water Sensitive Urban Design infrastructure across all catchments, including a targeted examination of the Bell Street bioretention basin, which treats one of two stormwater lines entering Cornelian Bay. This may include water quality sampling to assess efficacy in reducing pollutant loads, including faecal contamination, and a review of the infrastructure design and condition to inform future management practices of the site. Funding is likely to be requested as part of the 2023/2024 financial year to renew the Bell St bioretention basins functional capacity.

5.4 Hobart Rivulet/Regatta grounds

A combination of aging infrastructure, a collection of discrete leaks and piping issues (both private and public), and the significant catchment size of Hobart Rivulet have led to the long-term poor water quality of grade the Hobart rivulet outfall and, more recently, the sample site near the Hobart Regatta grounds.

In response to this, the City of Hobart is currently working directly with TasWater to locate, source track and repair several leaks in the underground section of Hobart Rivulet.

5.5 Kingston Beach

Council has a full time Stormwater Investigations Officer to track sources of contamination back up the catchment to their source, using a combination of methods, including visual inspection as well as ammonia and bacterial testing.

Further out of season sampling and investigations into the Browns River catchment area are currently in progress to identify potential sources of contamination entering Browns River, and subsequently Kingston Beach.

6 SPECIAL STUDIES

As part of each RWQ season, the DEP, supported by DoH, usually conducts an additional special-interest project that supplements a particular current focus. This season, DEP took the opportunity to provide support to a recent sediment sampling program by Clarence City Council at Howrah Beach, which allowed for additional samples to be taken. Thank you for the ongoing support from DoH to cover sample testing cost at the Public Health Lab.

Enterococci can concentrate in beach sand, thus potentially impacting the local recreational water quality. The following section contains excerpts from the report *Howrah Beach, Sediment Sampling Program (March 2022)*, which provides valuable information for other councils who are investigating pollution sources.

6.1 Sediment sampling at Howrah

The sediment sampling program was prompted by declining RWQ results along Howrah Beach ... sampling was taken during a period where high tide was at its lowest, allowing bacteria to accumulate without tidal interruption. The aim of this study was to clarify whether the beach sand and sand around stormwater outfalls could contribute to current beach gradings through resuspension and release of enterococci. Of particular interest was finding out whether concentrations are highest in dry sand, at the back of the beach, which would suggest a land-based source, as opposed to from the marine environment. Additionally, qualitative analysis was undertaken to observe the general beach environment each day of the study with the aim of trying to link external beach conditions to enterococci concentrations.

45 sand samples were taken over the 3 days across the beach, along with 12 sand samples from beneath the stormwater outfalls, and another 18 samples from the stormwater itself.

It has been found that bacteria levels are far higher in the sand at the stormwater outfalls and within the stormwater flows than across the wider beach area. The results allow us to conclude that the source of poor recreational water quality at Howrah Beach is unlikely to be beach sand. Focus must remain on the Howrah stormwater catchment as the primary source of contamination (CCC, 2022).

6.2 Forecasting

As we conduct our weekly water quality sampling on Tuesdays, it is not possible to say with absolute certainty what the water quality is like on the weekends, which is of course when most people swim. We remedy this by providing the public with long-term ratings for each beach in addition to the Tuesday result, along with the DoH standing advice to avoid swimming in the estuary for several days after heavy rain and never near stormwater outfalls.

Numerous beach authorities, interstate and overseas, provide their swimming public with a *prediction* of the water quality each day. Such forecasts are generally produced using a combination of long-term water quality data, recorded and predicted rainfall, and maybe tide and wind-driven currents. Such a program provides the public with additional up-to-date information to help decide whether to go swimming on a given day.

The June post-RWQ season meeting agreed to put together a small taskforce to explore trialling such a system in the Derwent estuary, possibly based on NSW's "Daily pollution forecasts", which predict the *likelihood* of bacterial contamination on individual beaches: <https://www.environment.nsw.gov.au/topics/water/beaches>.

7 COMMUNICATIONS

There was little TV and newspaper media about the RWQ program throughout the season. More and more people obtain general information and news via social media rather than traditional sources, including websites, which is also apparent for the RWQ program. As can be seen below, the DEP Facebook posts have more reach than the Beach Watch website. Both website and Facebook views are possibly higher than reported, as some people hide or clear their browsing history.

7.1 Website

Weekly RWQ results were reported via the DEP website on the *Beach Watch* page (for swimming sites) <https://www.derwentestuary.org.au/beach-watch/> and the associated *Bay Watch* page (for environmental sites). These pages allow the public to locate a weekly sampling result and long-term rating for a particular beach or bay by clicking on an interactive map or looking at a table.

The Beach Watch page had over 3780 page views over the course of the 2021-22 RWQ season, which is up about 1000 views from last season. Balmy Sunday 23 Jan saw the most page views (122).

7.2 Facebook

Weekly RWQ results are shared on the DEP Facebook page www.facebook.com/derwentestuary and Instagram <https://www.instagram.com/derwentestuaryprogram/>. This season saw an increase in Facebook reach from previous summers, with an average post reach of around 340 (up from around 150). The greatest reach was from a post in mid-January with 2085 views. The more our partners share the posts, the greater our reach (thanks 😊).

7.3 Weekend advisory

The most important message that we need to convey to the swimming public, is to not swim after heavy rains, due to the water quality of urban beaches and bays being often strongly influenced by stormwater run-off (NHMRC, 2008). We keep an eye on the weekend forecasts and can put out an advisory on the DEP Facebook page when necessary, e.g. when recent or predicted rainfall is greater than 10 mm. This 'protocol' was conducted throughout the season (Figure 7-1).



Figure 7-1 DEP Facebook posting from 7 January 2022 referring to the weekly RWQ results during a week with poor weather forecast for the weekend.

7.4 Signage

The signs installed at Derwent estuary swimming sites are a useful source of information for beach users. The DEP recommends that local councils conduct an annual review of signage in their municipality to ensure that all signs are located in the most appropriate locations (i.e. visible to most visitors), are in good condition (e.g. free of graffiti and not obstructed by vegetation), and that they are replaced with new signs as required (i.e. when the water quality category changes). For new swimming sites, it is recommended that signs are only erected once a long-term rating has been established, which is after five seasons.

After updating the long-term ratings following the 2021-22 season, the following beach sign changes are recommended:

- Bellerive (west) – from Good to Fair
- Kingston Beach (mid) – from Good to Fair
- Kingston Beach (north) – from Fair to Poor
- New Norfolk (Esplanade) – from Good to Fair

Councils are not required to put up signs to indicate the water quality for environmental sites but may choose to do so in well-visited locations.

8 ACKNOWLEDGEMENTS

The DEP would like to again sincerely thank all council environmental health officers and other council staff who have contributed to the annual RWQ season, as well as EPA staff who have assisted with boating requirements. Many thanks also go to the staff at the Public Health Laboratory and the Department of Health for their ongoing participation and friendly support, and our industry partners, including TasWater.

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9.1 Appendix A - Intercalibration report, RWQ season 2021-22

9.1.1 Executive Summary

Recreational Water Quality (RWQ) monitoring in the Derwent estuary is conducted and reported in accordance with the Recreational Water Quality Guidelines 2007 (DoH, 2007). The latest annual program report can be viewed [here](#). To guarantee correct and consistent water sampling technique, to assess the degree of variability between samples, samplers and various nearby locations, and importantly, to ensure trust in the data gathered, the Derwent Estuary Program (DEP) coordinates an annual inter-calibration exercise prior to the start of the RWQ season.

On a mild, sunny morning on 23 November 2021, environmental health officers from four councils, together with the DEP, collected water samples at two sites at Marieville Esplanade, Sandy Bay. Results were consistent between samplers and sites. Low results were reported at Site 1 (regular RWQ sampling site), as well as at Site 2 (out from the Sandy Bay Rivulet) despite a slightly higher reading from the mouth of the rivulet itself.

The sampling results demonstrated little variability between samplers and highlighted how quickly the marine environment can dilute localised pollution. Samplers adopted good sampling technique, and showed satisfactory knowledge about field sheets, sample storage, wader safety, and potential sources of faecal contamination.

9.1.2 Introduction

The RWQ monitoring is conducted and reported in accordance with the Recreational Water Quality Guidelines 2007 (*Public Health Act 1997*). The guidelines recommend classifying primary contact recreation beaches using 5-year 95th Hazen percentile values for the faecal indicator bacteria enterococci:

- Good (surveillance mode) = < 200 MPN/100 mL.
- Fair (alert mode) = 200 - 500 MPN/100 mL.
- Poor (action mode) = > 500 MPN/100 mL.

The long-term beach classification guidelines do not take into account the possible influence of variability in the data due to differences in sampling techniques between samplers, or possible heterogeneity of the sampled water body. The RWQ program uses data provided by a number of different council environmental health officers, which increases the risk of variability due to sampling technique. Thus, the primary objective of the annual inter-calibration exercise is to review and practice sampling methods at the start of each season, in order to improve consistency of results. A secondary objective is to gain a better understanding of water quality at a particular site.

9.1.3 Methodology

9.1.3.1 Participants

The DEP (Inger Visby) coordinated the participation of the following:

- Kingborough Council (Lauren Johnson)
- Clarence City Council (Jerri Clavant, Dan Rhodes)
- City of Hobart (Kara Tyrell, Madelaine Flemming)

- Derwent Valley Council (Tracy, Sandra McMillan)

Additional staff from Dept of Health contributed to the group discussion. There were apologies from Brighton Council and Glenorchy City Council.

9.1.3.2 Location

Sample 1 was taken at the regular RWQ sampling site at Marieville Esplanade, Sandy Bay. Sample 2 was obtained from Sandy Bay Rivulet. An additional sample was taken directly by the mouth of Sandy Bay Rivulet, to assess this as a potential source of contamination (Figure 9-1).

Marieville Esplanade is one of the RWQ program's environmental sites, and is not a dedicated swimming site (see details about difference between swimming and environmental sites in the [annual report](#)). The site has been in the Poor category for many years. It is a popular place for locals to meet up and walk their dogs (off-lead area). City of Hobart is embarking on an investigation into remediating the water quality in this location.



Figure 9-1. Location of the three sites sampled for the RWQ inter-calibration exercise on 23 November 2021 at Marieville Esplanade, Sandy Bay.

9.1.3.3 Safety

Wader safety was discussed, including how valuable wader safety courses are. Wearing waders can be highly hazardous if water gets inside them, e.g., from boat wake or when bending to take a water sample. The DEP recommends that everybody complete a Wader Safety course. In the meantime, watch this very useful short video on wader safety <https://www.mast.tas.gov.au/guides/wader-safety/>. Furthermore, as part of wader safety, it is important to wear a tight belt, and ideally also wear a personal flotation device (PFD).

For added security, it is also recommended that no one samples on their own. Always be aware of the surroundings and only conduct sampling if it is safe to do so.

9.1.3.4 Method

Filling in the laboratory submission form was discussed, including entering wind speed, rain, wind direction, date and time of sampling. This becomes important if results are high and we need to look back at conditions at sampling time. Participants were also encouraged to note other observations, such as discolouration, odour, construction activity, boat presence, density of wildlife, evidence of faeces, proximity to stormwater outfalls, or any other matters which might influence results. Participants were also reminded to take a photo or make a copy of the lab submission form to file for their own records.

All bottles should be pre-sterilised and provided by PHL. They are dated by the lab, so ensure that you are not using old bottles. Just before sampling, bottles were labelled with the site, time, and the samplers' names. Always worth having a spare bottle, should one become compromised (e.g., by touching the inside of the lid by mistake when sampling).

Samplers waded out to about 1 m depth (two stayed in at about 0.5 m depth) and concurrently collected a single sample at each site from an approximate water depth of 0.3 m. Bottles were only opened immediately prior to collecting the sample. Once the bottle cap had been removed, care was taken to ensure that this was not contaminated by fingers or by contact with surfaces. The bottle was quickly plunged to the required sampling depth, then it was tilted upward with the mouth pointed upward. The sample was brought to the surface and a portion of the sample tipped out so that the level in the sample container was at the bottle collar. The sample lid was screwed tightly shut before removing it from the sample pole, and the sample was placed upright in a chilled esky ready for transport to the laboratory. Samples should be delivered to the laboratory ASAP after sampling (24 hr max.), and on this day they were delivered approx. 1 hour after sampling.

Following the group session, an additional calibration exercise took place: comparing results from multi-probes by Clarence City Council and the DEP. Clarence is currently the only council who uses a multiprobe to collect physico-chem data at time of water sampling.

9.1.4 Results

The enterococci results from Site 1 varied between < 10 and 20 MPN/100 mL, and at Site 2 they were between < 10 and 73 MPN/100 mL or less. At the river mouth the enterococci result was 175 MPN/100 mL (Table 4).

Table 4. Summary of enterococci concentration results (MPN/100 mL) sampled on 23 November 2021

Sampler	Site 1: Marieville Esplanade (RWQ site)	Site 2: Marieville Esplanade (by Sandy Bay Rivulet)	Sandy Bay Rivulet (mouth)
Jerri (CCC)	<10	<10	
Sandra (DVC)	20	10	
Tanya (DVC)	10	73	
Kara (CoH)	10	20	
Lauren (KC)	20	<10	
Dan (CCC)			175

The results from the multi-probe comparison are listed in Table 5.

Table 5. Summary from multi-probe comparison exercise on 23 Nov 2021.

Multi-probe	Temperature (°C)	pH	Turbidity (NTU)
YSI (DEP)	16.4	8.1	3.2
Horiba (CCC)	16.5	8.4	6.0

9.1.4.1 Rain, wind, tide conditions

According to the Hobart weather station at Ellerslie Road (BoM, 2022a), there was less than 1 mm of rain in the three days preceding the exercise.

At 10.30 am on the day of sampling, the wind was north, north westerly, with wind speeds ~ 22 km/hr, and the tide at its highest at 1.4 m (WillyWeather, 2021).

9.1.5 Conclusions

The water quality was mostly excellent at the two beach sampling sites. The results demonstrated homogeneous water quality conditions, with only minor variability between samplers. The one slightly higher enterococci result at site 2 (73 MPN/100mL), may have been caused by minor sediment resuspension or pathogens flowing from the river; with the result still well below the trigger level for retesting.

Given that urban rivulets and stormwater drains are a known source of faecal contamination, the higher enterococci result from the river mouth was expected. The generally low results out from the river mouth (site 2) indicate significant dilution over a short distance. The difference between the enterococci results suggests there was little variability in the flow path and dilution rates. The results from the two sondes were also comparable.

Samplers adopted good aseptic grab sampling technique, removing bottle lids at the last moment before collecting a sample, protecting the bottle and lid from contamination, labelling bottles correctly and storing samples in a chilled esky for subsequent transport to the laboratory.

9.1.6 Additional issues

The inter-calibration exercise always raises interesting questions, as was the case this year. Thanks Paul Grey (PHL) and Scott Burton (DoH) for helping answer the questions.

Why do samples have to be kept cold?

- Samples must be kept cold (but not frozen) and delivered for testing within 24 hours to reduce the likelihood of unpredictable changes in bacterial numbers between sampling and testing. If samples are warm, bacteria will be more active metabolically and may die-off in clean waters or increase in numbers in nutrient-rich waters.
- The PHL may reject samples that have not been kept cold.

If weather conditions don't allow for wading out to the prescribed 0.5-1.0 m water depth to take a sample, should council still sample?

- If able to sample, you must sample.

- If not able to wade out to 0.5 m, go out as far as is safe and reach out as far as possible with your pole, to get that little more sampling depth.
- Always wait a moment for any sediments to settle before sampling, especially in shallow water. Using a pole to reach away from your body also helps avoid sampling resuspended sediments.
- Safety is paramount, and if it is not safe to sample on a Tuesday, don't sample, and try for Wednesday as a last resort (inform PHL).

9.1.7 Acknowledgements

Thank you very much to all the new EHOs who participated in this session with great enthusiasm and willingness to learn, share and contribute to group discussion, and to the local councils for valuing and prioritising the RWQ program. It was also encouraging to see Dept of Health staff participate and support the session.

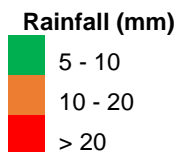
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9.2 Appendix B – Rainfall data across the Derwent estuary

Table 6. Daily rainfall (up to 9 am on sample days) between December and March at four BOM weather stations across the Derwent estuary: Hobart's Ellerslie Rd (HE); Hobart Airport (HA); Kingston's Greenhill Drive (KG); and New Norfolk West (NN). RWQ sampling days are highlighted in yellow.

December 2021					January 2022					February 2022					March 2022				
Date	HE	HA	KG	NN	Date	HE	HA	KG	NN	Date	HE	HA	KG	NN	Date	HE	HA	KG	NN
1st	0	0	0	0	1st	0	0	0	0	1st	0	0	0	0	1st	8.8	4.6	17	13
2nd	0	2.4	0	0	2nd	0	0	0.2	0.2	2nd	0	0	0	0	2nd	2.4	0.4	2.2	1.8
3rd	31	23.2	35	26	3rd	1.6	1	2.4	0.4	3rd	0.4	0	0	0	3rd	0.2	0.2	0	0
4th	0.8	0.2	1.2	1	4th	0.2	0	0	0	4th	3.8	0	2.8	0.2	4th	0	0	0	0
5th	1.4	0.2	0.6	0.6	5th	1.6	0.2	2.2	0	5th	0	0.4	0	0	5th	0	0	0	0
6th	0	0	0	0	6th	0.4	0	0	0	6th	0	0	1	0	6th	3.8	2.6	6	7
7th	2	10.8	2.6	1.2	7th	19	11	18	11	7th	0.2	0	0	0	7th	0.2	0	0	0
8th	0.4	1.6	5.6	0	8th	26	49	22	34	8th	0	0	0	0	8th	0.2	0	0	0
9th	0	0	0	0	9th	0.2	0.2	0	0	9th	0	0	0	0	9th	0	0	0	0
10th	0	0	0	0	10th	0	0	0	0	10th	0	0	0.4	2.2	10th	0	0	0	0
11th	2	0.6	1.8	0	11th	0	0	0	0	11th	0	0	0	0	11th	0	0	0	0
12th	0	0.2	0	0	12th	0	0	0	0	12th	0	0	0	0	12th	0	0	0	0
13th	0	0	0	0	13th	0	0	0	0	13th	0	0	0	0	13th	0	0	0	0
14th	0	0	0	0	14th	0	0	0	0	14th	0	0	0	0	14th	0	0	0.4	0
15th	0	0	0	0	15th	0	0	1	0	15th	0	1.6	0.4	0	15th	5.2	1.8	22	0.2
16th	0	0	0.6	0	16th	4.2	0	0	0	16th	0	0.2	0	0	16th	2.4	1.2	3.2	2
17th	0	0	0	0	17th	0	0	0.2	0	17th	0.2	0	0.6	1	17th	0	0	0.4	0
18th	0	0	0	0	18th	0	0	0	0	18th	0	0	0.2	0	18th	0.4	0.4	1.6	0
19th	0	0	0	0	19th	0	0	0	0	19th	0	0	0.2	0	19th	0	0	0	1.6
20th	1	1.2	1.8	2.9	20th	0	0	0	0	20th	0	0	0	0	20th	0	0	0	0
21st	0	0	0	0	21st	0	0	0	0	21st	0	0	1.2	0.6	21st	1.8	1.2	5	0
22nd	0	0	0	0	22nd	0	0	0	0	22nd	0	0	0	0.8	22nd	0.2	0	0	0
23rd	0	0	0	0	23rd	0	0	0	0	23rd	0	0.2	0	0	23rd	4.4	4.8	9	8.2
24th	0	0	0	0	24th	0	0	0	0	24th	0	0	0	0	24th	0.2	0	0	0
25th	0	0	0	0	25th	0	0	0.4	0	25th	0	0	1.6	0	25th	0	0	0	0
26th	0.2	0	0	0.2	26th	0	0	0	0	26th	0	0	0	0	26th	0	0	0	0
27th	1.8	2.2	3.4	0.2	27th	0	0	0	0	27th	0	0	0	0	27th	0	0	0	0
28th	0	0.2	0	0	28th	0.8	0	0.6	2	28th	0.8	0.2	6	0	28th	0	0	0	0
29th	0	0	0	0	29th	0	0	0	0						29th	0	0	1	0.8
30th	0	0	0	0	30th	0	0	0	0						30th	0.2	2.6	0	0
31st	0	0	0	0	31st	0	0	0	0						31st	0.2	0.6	5.8	0.2



9.3 Appendix C – 2021-22 enterococci results

9.3.1 Swimming sites

Date	CoH				CCC							KC							GCC	DVC	
	Little Sandy Bay Beach (south)	Little Sandy Bay Beach (north)	Nutgrove Beach (east)	Nutgrove Beach (west)	*Bellerive Beach (east)	Bellerive Beach (west)	Howrah Beach (east)	Howrah Beach (mid)	Howrah Beach (west)	Little Howrah Beach	*Blackmans Bay Beach (north)	Blackmans Bay Beach (mid)	*Blackmans Bay Beach (south)	Hinsby Beach	Taroona Beach	Kingston Beach (north)	Kingston Beach (mid)	*Kingston Beach (south)	Windermere Bay Beach	New Norfolk (Esplanade)	No.exceedences over 140 MPN
07-Dec-21	20	<10	n/a	31	<10	41	246	161	146	20	10	<10	63	218	171	20	52	<10	52	158	6
14-Dec-21	<10	<10	n/a	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	52	20	0
21-Dec-21	10	135	41	187	<10	41	670	146	85	295	181	85	249	63	41	<10	10	203	<10	31	7
29-Dec-21	<10	20	<10	<10	216	20	<10	<10	31	<10	<10	10	10	<10	<10	10	20	10	n/a	n/a	1
04-Jan-22	<10	<10	<10	10	31	10	<10	63	109	30	<10	<10	<10	<10	10	<10	<10	41	110	288	1
11-Jan-22	<10	<10	20	<10	10	<10	20	<10	20	<10	<10	<10	20	<10	<10	98	<10	<10	<10	97	0
18-Jan-22	75	20	<10	<10	41	41	218	464	31	31	10	395	1354	249	52	<10	226	10	<10	41	6
25-Jan-22	<10	10	<10	10	<10	10	<10	<10	31	<10	20	75	121	<10	30	20	<10	31	<10	279	1
01-Feb-22	10	n/a	10	63	86	241	10	546	1112	<10	20	1354	241	1789	697	733	20	262	97	223	10
08-Feb-22	10	20	<10	10	10	<10	<10	<10	<10	<10	<10	<10	20	<10	<10	20	10	10	10	12033	1
15-Feb-22	98	10	<10	<10	20	41	<10	110	<10	20	<10	10	<10	10	<10	<10	10	<10	74	98	0
22-Feb-22	20	<10	<10	10	<10	10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	10	20	20	187	1
01-Mar-22	98	410	41	31	135	374	<10	1160	613	10	<10	<10	201	<10	<10	3076	2143	1722	359	556	10
08-Mar-22	10	<10	<10	<10	<10	<10	10	202	20	<10	<10	10	31	<10	<10	30	<10	<10	<10	62	1
**15/03/2022	20	31	110	85	10	30	20	52	52	<10	52	31	110	<10	<10	213	121	120	10	41	1
22-Mar-22	10	20	10	10	20	<10	63	31	<10	98	471	404	<10	20	20	265	110	86	10	108	3
29-Mar-22	<10	10	<10	31	<10	10	<10	<10	<10	<10	<10	30	122	<10	<10	52	<10	20	52	63	0
																					49

Figure 9-2 2021-22 RWQ season swimming site results listed under each local council. Results are enterococci MPN per 100 mL. Last column lists the number of enterococci result exceedances above 140 MPN per 100 mL., which are also highlighted in red.

* Indicates sites with less than five years of data available.

** All Kingborough (KC) sites were sampled on 16 March instead due to weather conditions.

9.3.2 Environmental sites

The dates listed below are the regular Tuesdays when sampling should take place. Due to weather, boat and skipper availability the sites sampled by EPA/DEP were changed or cancelled on several occasions throughout this season. These sites are: Broke St. Pier, Geilston Bay, Hobart Rivulet, Kangaroo Bay, Lindisfarne Bay, Mid-river, Montagu Bay, New Town Bay, Prince of Wales Bay, Regatta Pavilion, Sullivans Cove, Victoria Dock and Watermans Dock.

	Brooke St Pier	Browns River	Cornelian Bay Beach	Elwick Bay	Geilston Bay	Hobart Rivulet	Kangaroo Bay	Lindisfarne Bay	Marieville Esplanade	Mid-river Derwent Swim	MONA Berridale Bay	MONA Cameron Bay	MONA Jetty	Montagu Bay	* New Norfolk (Millbrook Rise Jetty)	New Town Bay	Old Beach, Jetty Road	Prince of Wales Bay Marina	Regatta Pavilion	Sullivans Cove	Victoria Dock	Watermans Dock	No. exceedances over 140 MPN
07-Dec-22	10	663	n/a	10	960	272	134	121	156	86	2035	52	<10	31	75	512	86	52	62	146	20	73	7
14-Dec-22	<10	156	n/a	10	20	74	<10	10	<10	<10	<10	20	<10	<10	20	86	10	<10	75	<10	<10	<10	1
21-Dec-22	<10	75	n/a	<10	110	132	<10	10	31	<10	31	20	<10	41	98	<10	20	<10	<10	<10	<10	10	0
29-Dec-22	n/a	30	n/a	n/a	n/a	n/a	n/a	n/a	97	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
04-Jan-22	63	457	n/a	<10	288	10	31	41	10	<10	20	52	<10	<10	41	75	10	10	109	10	<10	631	3
11-Jan-22	10	459	n/a	n/a	<10	41	10	10	10	<10	10	10	20	<10	52	20	<10	10	10	<10	10	98	1
18-Jan-22	<10	420	n/a	31	20	52	10	10	<10	<10	52	41	20	<10	31	20	<10	<10	<10	<10	<10	10	1
25-Jan-22	<10	657	n/a	<10	41	41	<10	131	<10	<10	10	<10	<10	<10	52	20	n/a	<10	<10	<10	<10	52	1
01-Feb-22	<10	1334	n/a	10	<10	341	10	97	670	10	262	241	10	41	20	<10	20	10	31	<10	<10	86	5
08-Feb-22	n/a	75	n/a	<10	n/a	n/a	n/a	n/a	31	n/a	<10	<10	<10	n/a	146	n/a	n/a	n/a	10	n/a	n/a	n/a	1
15-Feb-22	n/a	<10	n/a	10	n/a	n/a	n/a	n/a	122	n/a	145	160	<10	n/a	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2
22-Feb-22	n/a	350	n/a	<10	n/a	n/a	n/a	n/a	63	n/a	<10	10	<10	n/a	120	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
01-Mar-22	146	6488	n/a	384	1918	583	183	1860	708	<10	594	161	315	10	199	84	n/a	<10	134	134	905	1430	14
08-Mar-22	<10	359	n/a	<10	<10	228	<10	10	<10	10	20	61	<10	10	41	<10	<10	<10	10	<10	<10	<10	2
15-Mar-22	134	1017	n/a	20	246	481	74	96	422	<10	85	10	<10	20	31	1467	41	<10	305	109	<10	160	7
22-Mar-22	20	309	n/a	20	148	318	75	63	41	<10	63	<10	20	10	41	323	<10	134	97	<10	20	10	4
29-Mar-22	20	213	n/a	20	10	31	52	10	<10	<10	<10	20	20	<10	131	63	<10	<10	<10	<10	<10	<10	1
																							51

Figure 9-3 2021-22 RWQ season environmental site results. Results are enterococci MPN per 100 mL. Last column lists the number of enterococci result exceedances above 140 MPN per 100 mL, which are also highlighted in red.

* indicates site with less than five years of data available.