Recreational Water Quality Program

Annual Report 2017/18

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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 restore and promote 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 and Hydro Tasmania.

1 EXECUTIVE SUMMARY

This report presents results of the 30th year of the Derwent Estuary Recreational Water Quality Program (RWQ). The RWQ is a joint initiative between six local councils and the State Government of Tasmania. Water samples were collected weekly at 39 sites throughout the estuary between 1 December 2017 and 31 March 2018 and analysed for the faecal indicator bacteria, enterococci.

While the total summer rainfall was higher than the long-term average, over half of the summer rain fell over a three-day period in early December (92 mm as recorded at the Hobart, Ellerslie Road BOM weather station). If not for this single rain event, it would have been a significantly drier than average summer.

The water quality at Swimming Sites during the 2017/18 RWQ season was similar to the previous season. Throughout the season there were 23 occurrences, spread over 12 Swimming Sites, where the enterococci trigger level of 140 MPN 100 mL-1 was exceeded. As a result, twenty re-samples were undertaken. The number of re-tests was similar to the previous season. Of the 18 Swimming Sites, 15 maintained last season's rating, one site improved (Bellerive) and two sites declined (Windemere and Blackmans Bay (south)). Based on water quality results for the past five years, 13 of the 18 Swimming Sites are now classified as having 'good' water quality, three are 'fair' and two are 'poor' (Nutgrove Beach (west) and Blackmans Bay (south)).

Water quality at the Environmental Sites declined significantly compared to the previous season. For the Environmental Sites, where re-tests are not conducted, 73 results were recorded above the trigger level of 140 MPN 100 mL-1, double the number from the previous season. Of the 21 Environmental Sites, 16 maintained their rating, and five sites moved to a poorer rating (Geilston Bay, Hobart Regatta Pavilion, New Town Bay, and MONA Cameron Bay). Based on water quality results for the past five years, nine of the 21 Environmental Sites are now classified as having 'good' water quality, six are 'fair' and six are 'poor'.

This season's results put the spotlight on the need for ongoing sanitary investigations. Rainfall has influenced some of the results and clearly not others. It is recommended that sanitary investigations continue in earnest – particularly at Blackmans Bay (south), Kingston Beach (south), Windermere, and at the Howrah beaches – to identify and correct on-going sources of faecal contamination.

1.1 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).

1.2 Recreational water quality guidelines

The Recreational Water Quality Guidelines for Tasmania (Dept of Health & Human Services, 2007) were developed using 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 quality of a site based on available data. The tiers are:

- *Good*: rolling 5-year 95th Hazen percentile value of < 200 enterococci MPN (Most Probably Number) 100 mL^{-1}.
- *Moderate*: 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 to be a threat to public health in the event of primary contact recreation and the particular local council is required to advise the general public and to erect warning signs to this effect.

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 MPN 100 mL^{-1}, the relevant authority is required to resample, and if two consecutive samples return a result above 280 MPN 100 mL^{-1}, the swimming site must be closed and the public notified. The beach may be re-opened for primary contact recreation only following agreement between the Director of Public Health and Council's Authorised Officer.

2 RECREATIONAL WATER QUALITY PROGRAM.

2.1 Swimming and Environmental sites

Aseptic grab samples are collected each Tuesday by Council and the Environmental Protection Authority (EPA) / Derwent Estuary Program (DEP) from 39 sites 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 show in Figure 1.

- The 18 *Swimming Sites* monitored this season are in locations where a significant number of people swim or conduct other primary contact recreation. These sites are sampled by Council to provide a basis for public health information.

- The 21 *Environmental Sites* monitored this season were selected to provide a broader context for interpretation of Swimming Site results and for other purposes. These sites are sampled by either Council or EPA/DEP were selected based on the following rationale:
  - Bays and coves that are frequently used for secondary contact recreation and/or have foreshore parks;
  - Areas with identified 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.

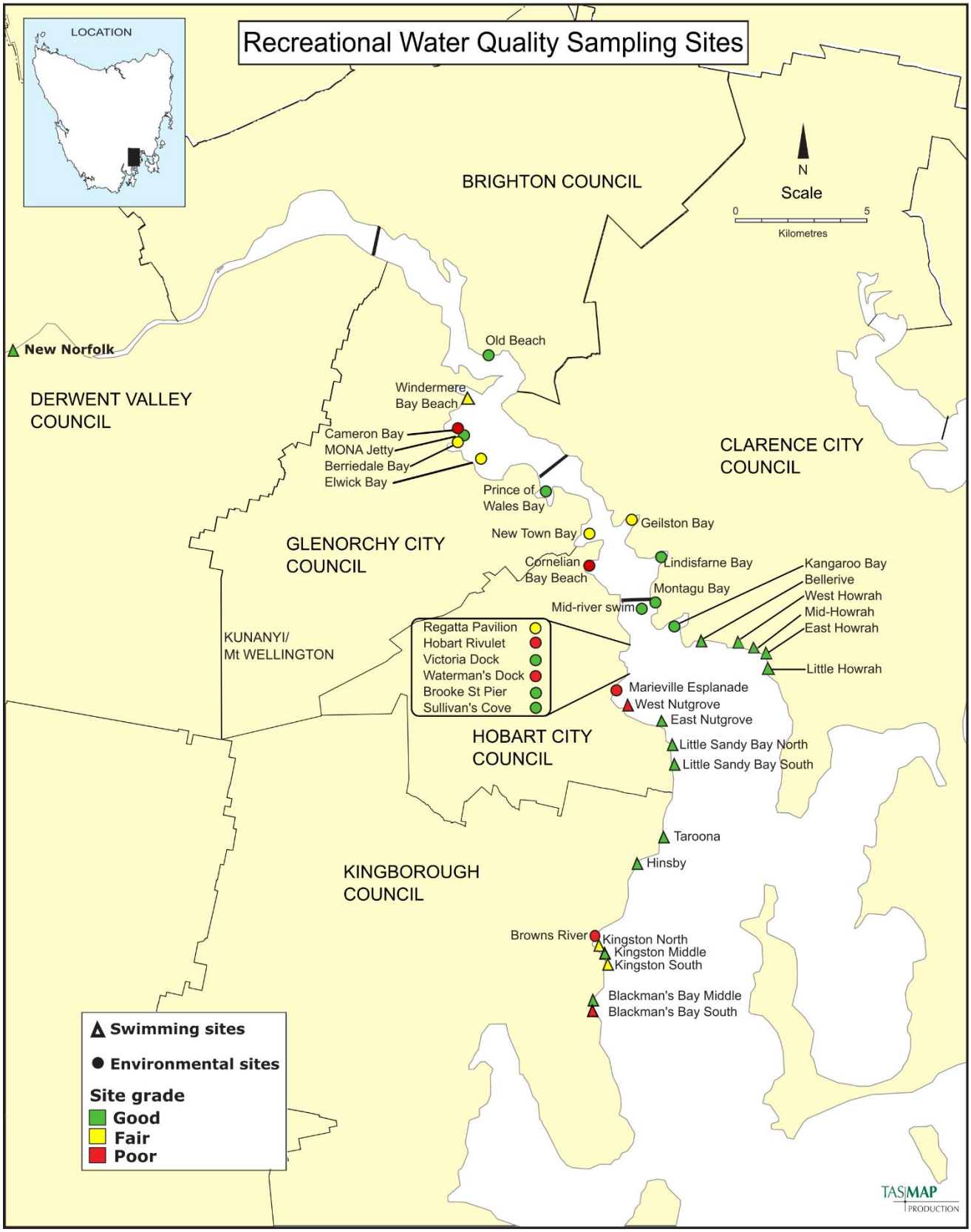

Figure 1: Recreational Water Quality sampling sites (Swimming and Environmental sites) with their current water quality classification based on data collected in the summer months between Dec 2013 and March 2018.

2.2 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.

2.3 Rainfall

The water quality of urban beaches and bays can be strongly influenced by stormwater run-off (NHMRC, 2008), with poorer water quality in wet years compared with dry years. Rainfall data collected and reported by the Bureau of Meteorology (BOM) at a number of weather stations throughout the Derwent estuary catchment are used to compare rainfall throughout 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.

2.4 Sample analysis

All samples are analysed at the Public Health Laboratory (PHL) (St Johns Ave. New Town) using the Enterolert method, which provides confirmed results within 24 hours of analysis. For designated Swimming Sites, if the original sample exceeds the relevant trigger level (NHMRC, 2008), laboratory staff notify the councils so retesting can occur. Results are typically reported between 24 and 48 hours after sample submission to the laboratory.

This season, all Environmental Sites were tested using the large lab testing trays. This provides results up to 20,000, as opposed to giving the result of "> 2,000", which improves result accuracy, and is beneficial for sanitary inspections.

2.4.1 Uncertainty Measurement

As a National Association of Testing Authorities (NATA) accredited facility, the PHL is now required to inform its customers of its ability to provide Measurement Uncertainty (MU) estimations with results.

The PHL explains the MU as follows:

> *All measurements have an inherent uncertainty due to small unavoidable variations in the sample, the media used in testing, the person doing the analysis and all other conditions at the time of analysis. These variations persist despite efforts to standardise measurement conditions, and cannot be eliminated entirely. As a result, repeated tests done on the same sample will give a set of results, each slightly different, grouped around the 'true' value.*
>
> *Measurement Uncertainty is the estimate of the range around a measured value in which the 'true' value occurs for a given level of confidence (the Confidence Interval).*

At the Nov 2017 Monitoring Taskforce Meeting it was decided, in consultation with Paul Grey from the PHL, that in terms of the RWQ program we will only require MU reporting for our swimming beaches, and only when the results fall within the MU range of our enterococci trigger levels of, which is between 99-199 for the trigger level of 140, and between 197-397 for the trigger level of 280. All other results will continue to be reported as a clear Pass/Fail. During the 2017/18 RWQ season, the MU was thus included as a comment in the relevant results.

3 2017/18 RWQ SEASON RESULTS

3.1 Inter-calibration exercise

On the 29 November 2017, environmental health officers from five local council partners together with the DEP simultaneously collected a sample each at two sites on Nutgrove Beach (west). This site was chosen because of recent works by TasWater and City of Hobart to solve long-term poor water quality issues from the Lipscombe Rivulet catchment. The aseptic sampling technique adopted by samplers was assessed as good. Enterococci concentration results were fairly consistent between samplers and sites with medium to high results reported at the first site (close to Lipscombe Rivulet outfall) and low results at the second site (200 m south of the outfall).

Further discussion of the inter-calibration exercise results is available in the *RWQ Inter-calibration report 2017/18* (Visby and Coughanowr, 2017) – see Appendix A. The next inter-calibration exercise will be conducted in November 2018.

3.2 Rainfall

The 2017/18 RWQ season, as measured at the Ellerslie Road, Hobart Bureau of Meteorology (BOM) weather station was wetter than the previous season and slightly wetter than the long-term average, recording 105% of the average summer rainfall for this site. However, just over half of the season's rainfall fell over a three-day period in early December (92 mm), which resulted in the wettest December recorded in 23 years. If not for this single event, it would have been a significantly drier than average season (Table 1).

Table 1: Rainfall recorded (mm) at Ellerslie Road Weather Station (BOM), across the summer months between December 2017 and March 2018, compared with the previous nine summers.

Season	Dec	Jan	Feb	Mar	Total Summer Rainfall	% of long-term average
2008/9	39.2	10	59.2	70	178.4	94.8%
2009/10	58.6	14.4	34.8	30.4	138.2	73.5%
2010/11	31	59.8	54.4	45.4	190.6	101.3%
2011/12	52.4	56	22.6	30.8	161.8	86.0%
2012/13	22	11.4	23.4	48.6	105.4	56.0%
2013/14	28.2	16.2	27.6	23.4	95.4	50.7%
2014/15	78	121.6	21.6	51	272.2	144.7%
2015/16	35	40.2	21.8	17	114	60.6%
2016/17	56.6	60	10.4	37	164	87.2%
2017/18	101	22.2	35.2	38.6	197	104.7%
Long-term average	56.5	47.5	39.5	44.6	188.1	NA

Rainfall varies across the estuary, with long-term averages for the summer months ranging between 164.6 mm at Bushy Park to 204.4 mm at Greenhill Drive in Kingston. There is also a significant rainfall gradient across the estuary with higher rainfall on the western vs eastern shore. During the 2017/18 season, summer rainfall was higher than the long-term average in most locations: Hobart (Ellerslie Road) recorded 8.9 mm more than average, Kingston (Greenhill Drive) 38.4 mm more and Hobart Airport 57 mm more. In the Derwent Catchment (Bushy Park) it rained slightly less than the long-term summer average (Figure 2).

Rainfall on the Eastern Shore has previously been recorded at Rokeby, however, this station was closed down during the 2015/16 season. The Mt Rumney weather station, which was used during the 2016/17, records a 27 mm higher than average long-term summer rainfall than Rokeby. For the 2017/8 season, the station at Hobart Airport, which records 3.5 mm lower long-term summer average than Rokeby was selected as an alternative due to their similarity in long-term summer rainfall averages.

There were six rainfall events in the 2017/18 season where > 10 mm of rain was recorded, and only one event which occurred within a day of a Tuesday sampling event (Monday 4 December), as recorded by the Ellerslie Road BOM weather station:

- Saturday 2 December 22 mm
- Sunday 3 December 37.2 mm
- **Monday 4 December 32.8 mm**
- Sunday 14 January 10.6 mm
- Wednesday 15 February 14.4 mm
- Sunday 25 February 12.4 mm

The rainfall event on Monday 4 December was preceded by two days of heavy rain (92mm over three days as recorded at the Hobart, Ellerslie road BOM weather station). Similar rainfall events were recorded at the Hobart Airport, Bushy Park and Kingston BOM weather stations. This unseasonal rainfall resulted in very high enterococci results at a number of Swimming Sites and the majority of Environmental Sites on Tuesday 5 December (see Appendix B + C for detailed results).

There was only one occasion when sampling took place during a rainfall event (Tuesday 30 January, 9am – Wednesday 31 January, 9am). Less than 5 mm of rain was recorded at each weather station. However, because this event occurred during sampling it resulted in high enterococci results at many sites across the estuary.

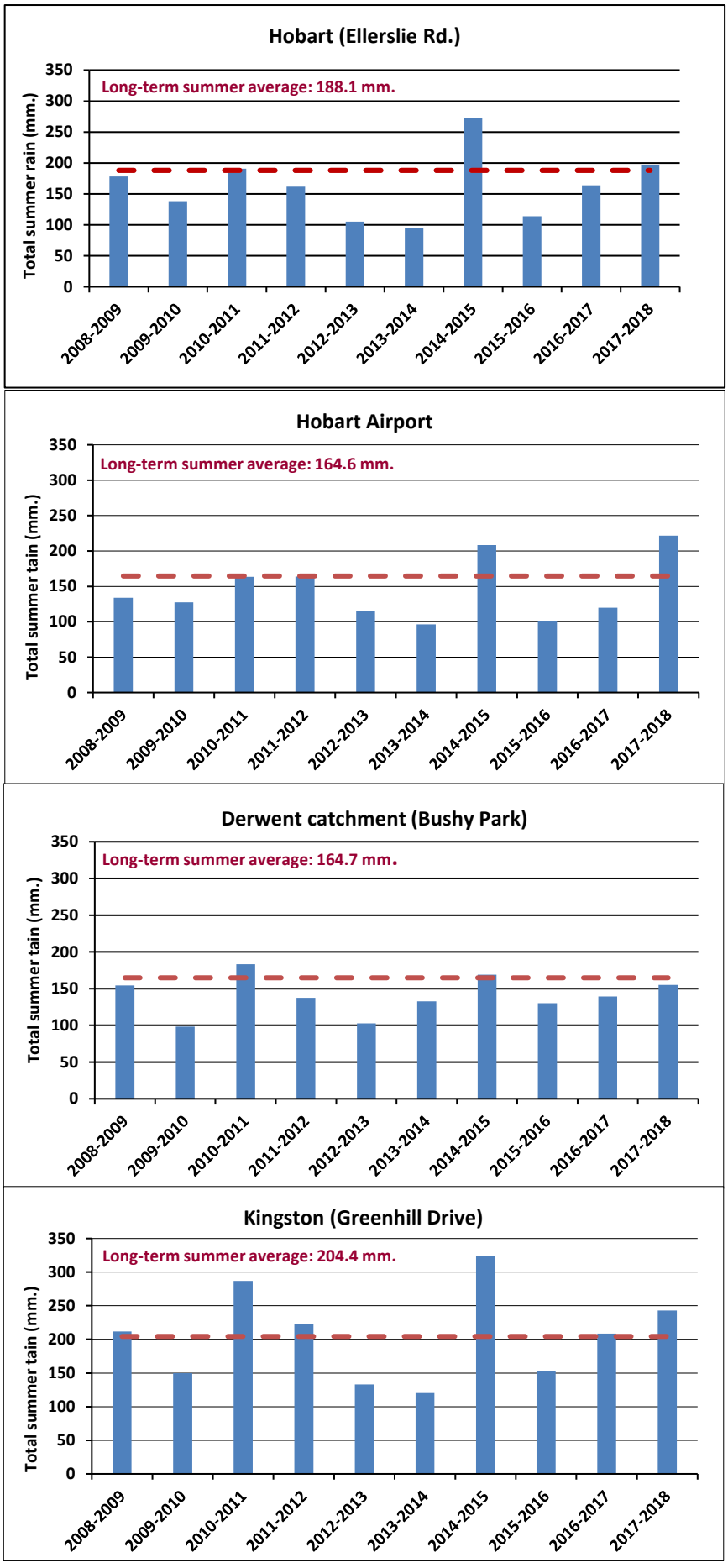

Figure 2: Total rainfall (in mm) at four weather stations in the Derwent estuary catchment during the last 10 RWQ program seasons (between December and March), as recorded by the Bureau of Meteorology. The long-term average rainfall is indicated in red text and by dotted line.

3.3 Site results

Table 2: RWQ program 2017/18 season results, with data collected in the summer months between Dec. 2013 and Mar. 2018. Colour refers to Australian Government's *Recreational Water Quality Guidelines* using rolling 5-year 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}). Number of samples with enterococci readings between 140 and 280 MPN 100 mL^{-1}, > 280 MPN 100 mL^{-1}, and total number of samples, for same 5-year period are also shown.

		5-year Hazen percentile enterococci	Samples between 140 and 280	Number of samples > 280	Total number of samples
Swimming Sites	Bellerive Beach	165	3	2	85
	Blackmans Bay Beach (mid)	95	1	2	85
	Blackmans Bay Beach (south)	505	7	5	85
	*Fitzgerald Park, New Norfolk	125	1	1	62
	Hinsby Beach	23	0	0	85
	Howrah Beach (east)	194	5	2	85
	Howrah Beach (mid)	109	1	3	85
	Howrah Beach (west)	78	0	2	85
	Kingston Beach (mid)	81	1	1	85
	Kingston Beach (north)	286	2	5	85
	Kingston Beach (south)	243	3	4	85
	Little Howrah Beach	102	0	2	85
	Little Sandy Bay Beach (south)	55	1	1	85
	Little Sandy Bay Beach (north)	118	2	0	85
	Nutgrove Beach (east)	132	4	0	85
	Nutgrove Beach (west)	502	3	5	85
	Taroona Beach	45	0	1	85
	Windermere Bay Beach	216	3	3	80
Environmental Sites	* Brooke St Pier	70	0	2	58
	Brown's River	2435	17	30	84
	* Cornelian Bay Beach	3230	5	8	48
	Elwick Bay	342	3	6	77
	Geilston Bay	261	5	2	74
	Hobart Regatta Pavilion	288	3	5	73
	Hobart Rivulet	2006	15	24	74
	Kangaroo Bay	42	1	1	73
	Lindisfarne Bay	96	1	1	74
	Marieville Esplanade	783	13	15	85
	Mid-river Derwent Swim	31	1	1	74
	*MONA Berriedale Bay	400	3	7	59
	*MONA Cameron Bay	532	2	2	32
	* MONA Jetty	218	1	3	62
	Montagu Bay	51	1	0	73
	New Town Bay	281	5	4	74
	Old Beach, Jetty Road	123	2	1	77
	Prince of Wales Bay Marina	140	2	1	74
	Sullivans Cove	51	0	1	73
	Victoria Dock	103	2	1	74
	Waterman's Dock	862	1	8	74

***** Indicates < 5 years of data available. Cornelian Bay is monitored intermittently, when conditions allow.

3.3.1 Swimming Sites

Throughout the season there were 23 occurrences, spread over 12 Swimming Sites, where the enterococci trigger level of 140 MPN 100 mL^{-1} was exceeded, and twenty re-samples were taken. Despite this high number of re-tests, the overall water quality was largely similar to the previous RWQ season.

At the end of the 2017/18 RWQ season, 13 of the 18 Swimming Sites were ranked as having 'good' water quality, three sites 'fair' and two 'poor' based on rolling 5-year Hazen percentile calculations for enterococci. The three sites with the best water quality were Hinsby, Taroona and Little Sandy Bay Beach (south). Hinsby Beach has had no exceedances above 140 MPN 100 mL^{-1} for enterococci during the last five seasons, whilst Taroona and Little Sandy Bay South both had one. The sites with the poorest water quality were Blackmans Bay (south) and Nutgrove Beach (west). These sites also had the greatest number of exceedances > 280 MPN 100 mL^{-1} both recording five over the last five seasons (Table 2).

Despite a slight set-back this season, a gradual overall improvement in long-term water quality, with an increase in 'good' swimming sites has occurred over the past five seasons. The proportion of sites classified as 'good' has steadily increased peaking at 72% (13 sites) during the last two seasons. The proportion of sites classified as 'poor' have remained stable over the past five seasons fluctuating between 5 (1 site) and 11% (2 site) and the proportion of sites classified as 'fair' has steadily declined reaching their lowest numbers (3 sites) during the 2017/18 RWQ season (Figure 3).

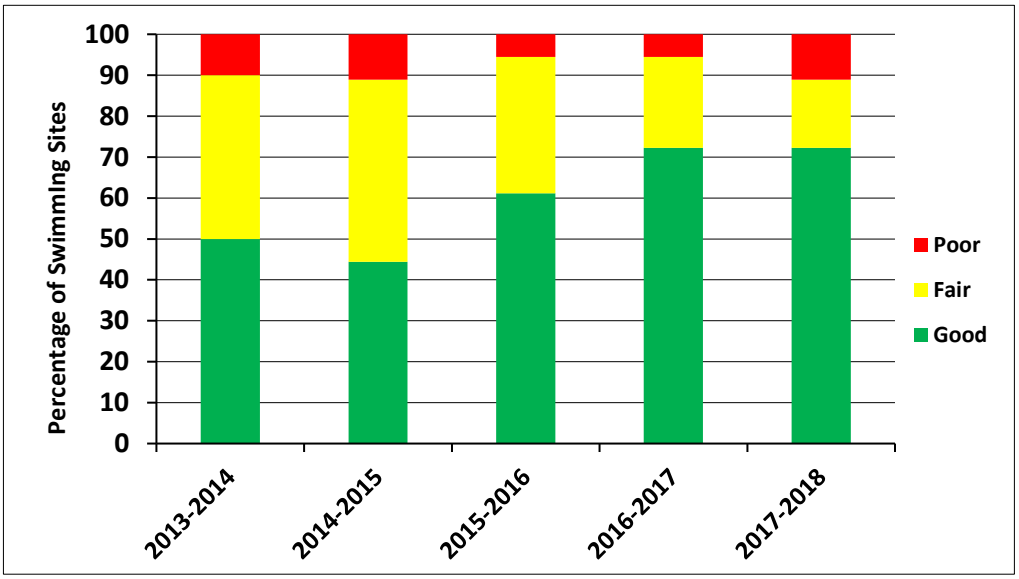

Figure 3. Proportion of Swimming Sites graded as 'Good', 'Fair', and 'Poor' in the last five RWQ seasons.

Changes in classification from the 2016/17 RWQ season to the 2017/18 season occurred at three sites, with one site improving and two sites declining in their water quality rating. At Bellerive Beach the rolling 5-year 95th Hazen percentile rating improved from 'fair to 'good'. At Windemere Bay Beach the rating declined from 'good' to 'fair', and at Blackmans Bay (south) the rating declined from 'fair' to poor'. The water quality improved markedly at Nutgrove Beach (west), however, the rating remains in the 'poor' category (Figure 4).

See the full enterococci results for all Swimming Sites in Appendix B, and read more details about Windermere Bay, Blackmans Bay (south) and Nutgrove Beach (west) in section 4 on Specific Investigations.

The heavy rainfall event that occurred on 2-4 December had a strong influence on water quality on 5 December, with four swimming sites exceeding the guidelines (some by a significant amount). On 30 January, sampling was undertaken during a light rainfall event (< 5 mm from 9 am on Tuesday 30 January – 9am on Wednesday 31 January). Although light, this rainfall was close enough to the time of sampling to probably cause six Swimming Sites to exceed the enterococci trigger level (see Appendix B for detailed results).

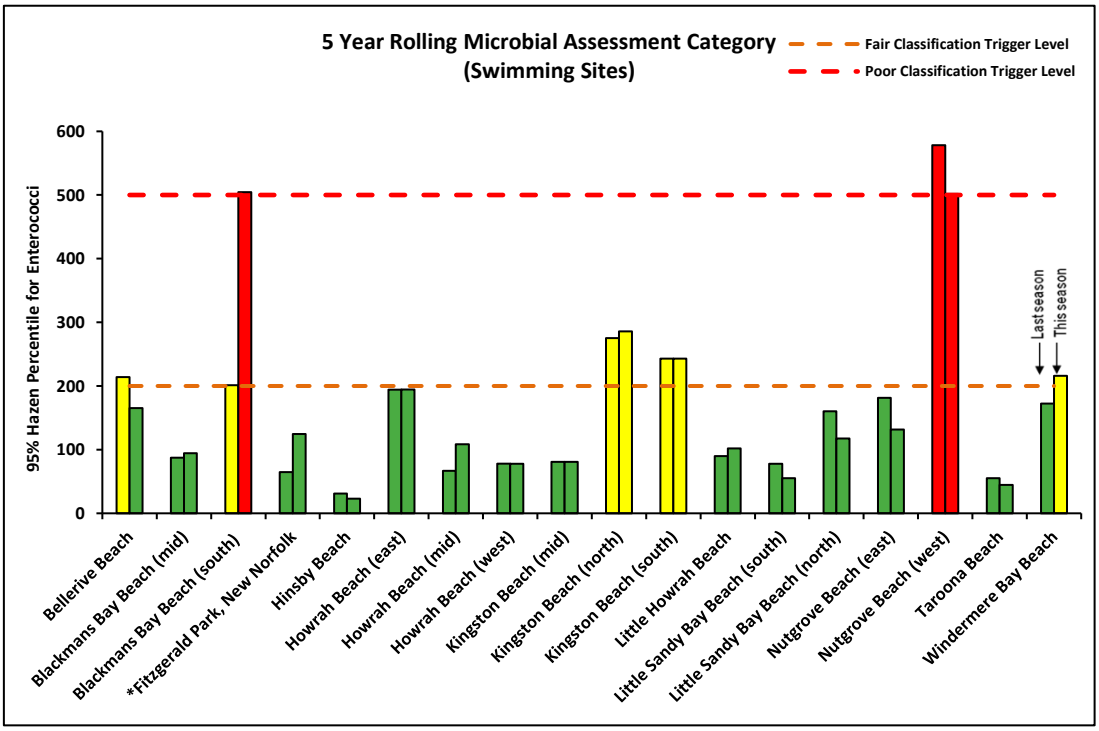

Figure 4: Comparison of rolling 5-year Hazen percentile enterococci result for Swimming Sites. Each site is presented as a pair of results, where the left bar represents 2016/17 RWQ season results, while the right bar represents 2017/18 season result. Green denotes 'good' (< 200 MPN 100 mL^{-1}), yellow 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.

3.3.2 Environmental Sites

The water quality conditions at the Environmental Sites predominantly declined from the previous RWQ season. This can only partly be attributed to the rainfall experienced across the estuary during this season. During the season, there were 73 occurrences where the enterococci trigger level of 140 MPN 100 mL^{-1} was exceeded, double that of last season.

At the end of the 2017/18 RWQ season, nine of the 21 Environmental Sites ranked as 'good', six as 'fair', and six as 'poor' water quality based on rolling 5-year Hazen percentile calculations for enterococci. The three sites with the best water quality were Mid-river Derwent Swim, Kangaroo Bay and Sullivan's Cove. These sites all had only one exceedance > 280 MPN 100 mL^{-1} over the past five seasons. The sites with the poorest water quality were Cornelian Bay Beach, Browns River and the mouth of the Hobart Rivulet. Browns River and Hobart Rivulet has the most exceedances >280 MPN 100 mL^{-1}, recording 30 and 24 respectively (Table 2).

Over the previous three RWQ seasons, there had been a gradual improvement in water quality, with additional 'good' Environmental Sites and a reduction in 'poor' sites. However, during the 2017/18 season, whilst the number of 'poor' sites stayed at a similar proportion in comparison to recent years, the number of 'good' sites declined (Figure 5).

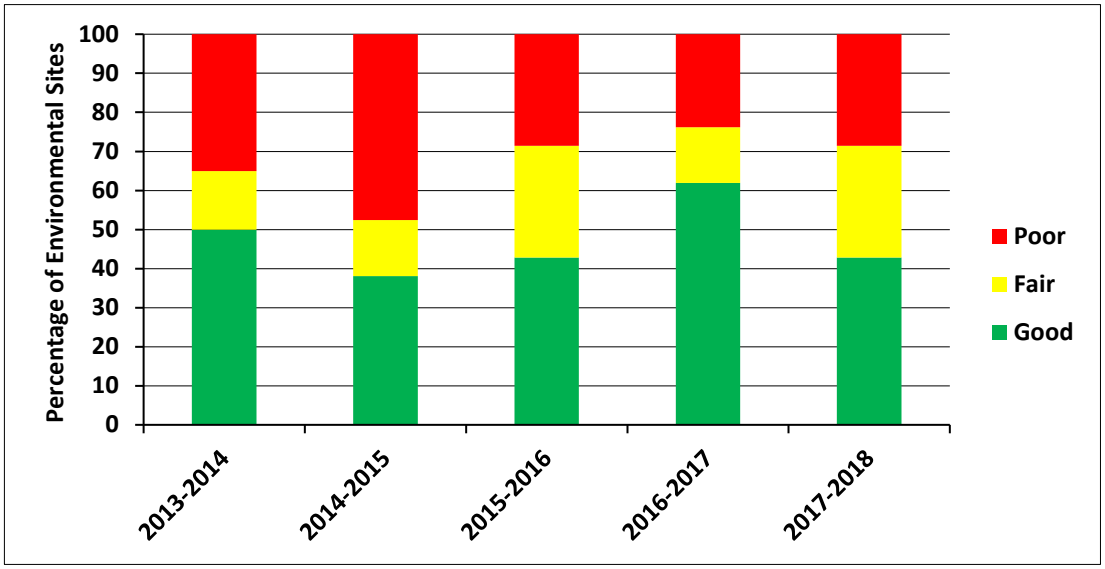

Figure 5. Proportion of Environmental Sites graded as 'good', 'fair', and 'poor' in the last five RWQ seasons.

Changes in the rating classification from the 2016/17 to the 2017/18 RWQ season occurred at five sites, all of which involved a decline. Geilston Bay, Hobart Regatta Pavilion, MONA Jetty and New Town Bay all changed their 5-year rolling 95th Hazen Percentile rating from 'good' to 'fair'. MONA Cameron Bay experienced a decline from 'fair' to 'poor', keeping in mind there has not yet been five years' worth of sampling at this site. Only two Environmental Sites experienced any improvement in water quality. Notably, Hobart Rivulet improved significantly within its poor rating, with a reduction from 3900 to 2006 for its 95th Hazen Percentile rating (Figure 6). See the full enterococci results for all Environmental Sites in Appendix C.

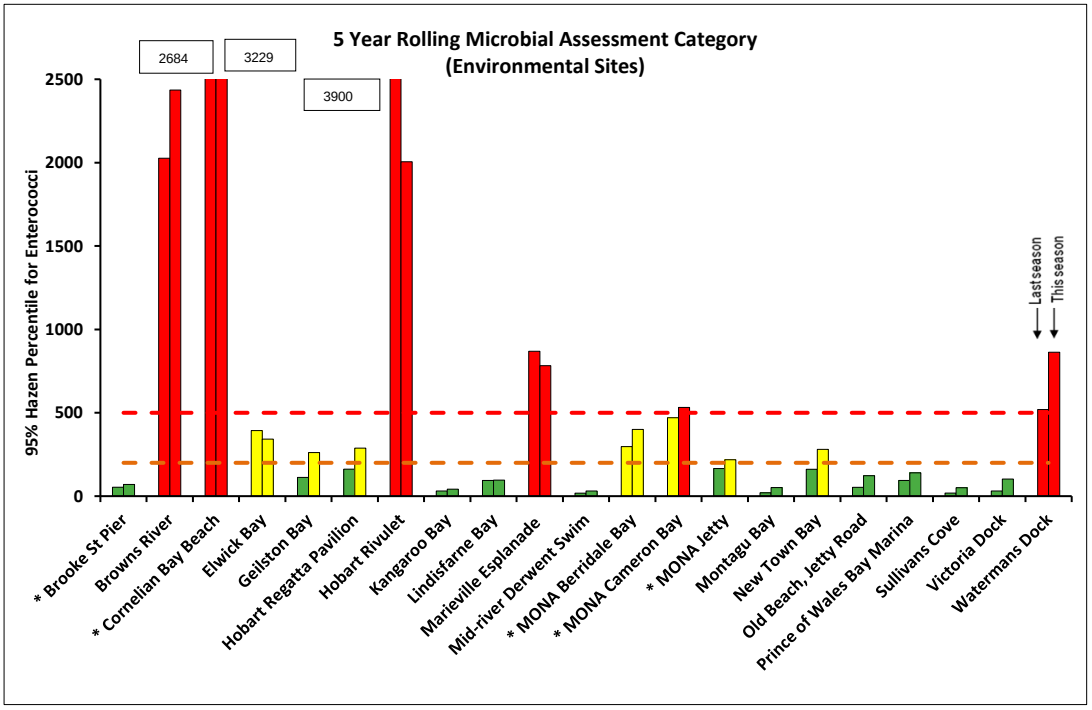

Figure 6: Comparison of rolling 5-year Hazen percentile enterococci result for Environmental Sites. Each site is presented as a pair of results, where the left bar represents 2016/17 RWQ season results, while the right bar represents 2017/18 season result. Green denotes 'good' (< 200 MPN 100 mL^{-1}), 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.

At the Environmental Sites, rainfall could only account for poor water quality in some cases. Heavy rainfall between 2-4 December strongly influenced enterococci results with 14 sites exceeding the trigger level. On the other hand, on 13 March, 10 sites exceeded the trigger level and was preceded by minimal rainfall (see Appendix C for detailed results).

4 SPECIFIC INVESTIGATIONS

While water quality at most beaches is currently classified as good to fair, previous and current monitoring has identified issues at several sites that merit further investigation. Water quality investigations are ongoing at various sites, including the Howrah beaches (Clarence City Council), and at the southern end of Blackmans Bay and Kingston beaches (Kingborough Council) as discussed below. Nutgrove Beach west is looking like finally reaping the benefits from intensive works having been conducted over the last two years.

4.1 Nutgrove Beach (west)

The stormwater outfall of Lipscombe Rivulet has previously been identified as the discharge point for faecal contaminated stormwater that has contributed to a poor recreational water quality rating at the western end of Nutgrove Beach for many years. Over the past two summers, there has been a concerted collaboration between TasWater, City of Hobart (CoH) and the DEP to improve the situation.

During the summer of 2016/17 a highly coordinated investigation took place, including additional end-of-pipe and targeted street sampling; tracking for anthropogenic tracers; hydraulic sewer modelling / pipe pressurisation; dye testing; as well as CCTV investigations. Results from those investigations confirmed a sewerage signal in the stormwater from the rivulet; a crack was discovered in a sewerage pipe causing sewerage to enter gravel surrounding the stormwater pipe at a crossover point; several possible sagging/compromised sewer pipe joints were detected; as were two cross connections at private properties.

During the last spring and summer TasWater undertook significant repairs and pipe re-alignment and the council removed the direct sewage to stormwater cross connection they had located.

CoH are now confident that they have done everything they can to mitigate the long-term water quality issues at Nutgrove Beach (west) and has cautiously ruled out the possibility of other major sources of contamination within the urban catchment. As a part of ongoing monitoring, CoH will continue to sample monthly at the Lipscombe Rivulet stormwater outfall.

This joint effort by CoH and TasWater has resulted in a marked improvement in long-term water quality at Nutgrove Beach west. Although still in the ‘poor’ category (501 MPN/100ml), the rolling 5-year 95th Hazen percentile value for enterococci has improved significantly over the course of the 2017/18 RWQ season. Discussions will now take place as to whether the work conducted and the results obtained warrants a re-set of the classification rating, as the National Guidelines for Managing Risks in Recreational Water (NHMRC, 2008) gives provision for.

4.2 Windermere Bay Beach

Despite showing signs of improvement, Windermere Bay Beach reverted to the ‘fair’ category this season suggesting that there may still be unresolved issues in Faulkner’s Rivulet. Due to dry weather and insufficient flow throughout the rivulet, monthly

sampling of Faulkner's Rivulet was discontinued in April 2017 and has not been recommenced.

4.3 Howrah Beach

Previous investigations have confirmed that recreational water quality at Howrah Beach is highly susceptible to stormwater contamination. Despite all Howrah sampling sites being in the 'good' category, all three sites had enterococci readings exceeding the 140 MPN 100 mL^{-1} trigger level throughout the 2017/18 season, especially at Salacia Avenue.

In 2015 TasWater commenced an investigation into the capacity and potential risk sites in their network to assess whether sewerage is contributing to faecal contamination at the beach. Following on from this work the Clarence City Council (CCC) allocated funding for targeted stormwater sampling and associated investigations, such as opening stormwater lids and taking samples during dry and wet conditions, and two point-sources of contamination were recently identified. These sites were referred to TasWater, who undertook work on the broken and blocked sewerage infrastructure.

Stormwater investigations are continuing in the Howrah beach catchment.

4.4 Blackmans Bay (south)

This season, water quality at Blackmans Bay (south) declined from 'fair' to 'poor', see Appendix B for enterococci results.

Following a decline in water quality from 'good' to 'fair during the 2016/17 season, Kingborough Council conducted an investigation during May - October 2017 to identify if stormwater discharged to Blackmans Bay south is the source of contamination. This investigation included bacterial sampling at seven sites along Illawarra Road and at the stormwater outfall. The investigation concluded that elevated levels of faecal bacteria were present in the lower section of the stormwater system and was being discharged to the beach via the stormwater outfall. The issue was referred to TasWater, who used CCTV and dye testing to investigate the sewer infrastructure in Illawarra Road. A leaking sewage pipe was identified 100 m from the beach and subsequently repaired by TasWater.

Despite fixing the identified leakage, samples with high enterococci results continued at Blackmans Bay south throughout the 2017/18 RWQ season and Kingborough Council has been unable to identify further contamination point sources despite continued investigations. Councils intention is to now invest in end-point treatment of stormwater; a number of potential options are being considered.

4.5 Kingston Beach (south)

For many years there have been issues with contaminated stormwater at Kingston Beach, particularly at the southern end. Extensive efforts have previously been put into finding the source of the contamination, but to no avail, leading to a decision a number of years ago, to install a diversion to discharge a portion of the stormwater in the immediate area to sewer. With recent developments in the same area this diversion was removed and may have contributed to higher enterococci results at the south end of the beach. The diversion is unlikely to be reinstated.

Kingborough Council has conducted additional sampling in the area in the past 12 months, similar to the Blackmans Bay investigation. The only problem found was a laundry connection that was incorrectly connected to stormwater, which has been rectified. The difficulty in detecting sources of contamination are likely due to the

complexity of the Kingston catchment area. However, owing to its high recreational value, Kingston Beach (south) has now been marked for end-point treatment to help alleviate the ongoing problems, while the Council will continue to investigate ongoing problems in the stormwater system.

5 OTHER INVESTIGATIONS

5.1 Upper Estuary

This study followed from two previous investigations into faecal indicator bacteria use in the upper estuary (see RWQ Annual Review 2015/16 and 2016/17). In freshwater systems there is less clarity about which indicator bacteria to use. Recreational water guidelines around the world differ between recommending the use of *E. coli* either exclusively (New Zealand, Canada), use both indicators or have a choice to use one or the other (US EPA, EU), or to only use enterococci (Tasmania, Australia, WHO).

The consistently low enterococci values observed at New Norfolk over many years suggest that either the catchment is not a significant source of faecal bacteria and associated pathogens, or that enterococci is not a sensitive indicator in this freshwater area of the estuary. To further test this, a dual testing trial for both enterococci and *E. coli* was undertaken.

5.1.1 Method

Samples were gathered at the usual New Norfolk sampling site (Fitzgerald Park) during this RWQ season and tested for both *E. coli* and enterococci. Furthermore, data was received from TasWater for the same period, collected from the Bryn Estyn (BE) Water Treatment Plant approx. 4 km. upstream from the New Norfolk RWQ sampling site. Water was sampled at their Downstream Sample Point, approx. 800 m. downstream from BE, and tested for both enterococci and *E. coli*, and Raw Water was collected just upstream from BE as a representative of untreated water and tested for *E. coli* only. Unfortunately, there was only one day over the summer that the RWQ and TasWater monitoring programs overlapped (3 January 2018).

We compared all results with recommended trigger levels from New Zealand (N.Z. Ministry for the Environment, 2002): *The first is alert (or amber) mode, and is triggered when a single sample is greater than 140 enterococci per 100 mL for marine waters* (same as Tasmania) *and 260 E. coli per 100 mL for freshwaters*.

Rainfall data was considered, but given that both *E. coli* and enterococci results were low on 5th December, after three days of very heavy rain (which affected RWQ results at numerous sites in the middle estuary), it suggests that rainfall may possibly not be a significant contributing factor in faecal indicator bacteria results at New Norfolk.

5.1.2 Results

The following figures show a comparison of *E. coli* and enterococci data from the RWQ program (Figure 7), a comparison of data received from TasWater, samples from BE Downstream and the Raw Water intake sites (Figure 8), and a comparison of all *E. coli* and enterococci data, from both programs, with New Zealand and Tasmanian recreational water guideline trigger levels highlighted (Figure 9).

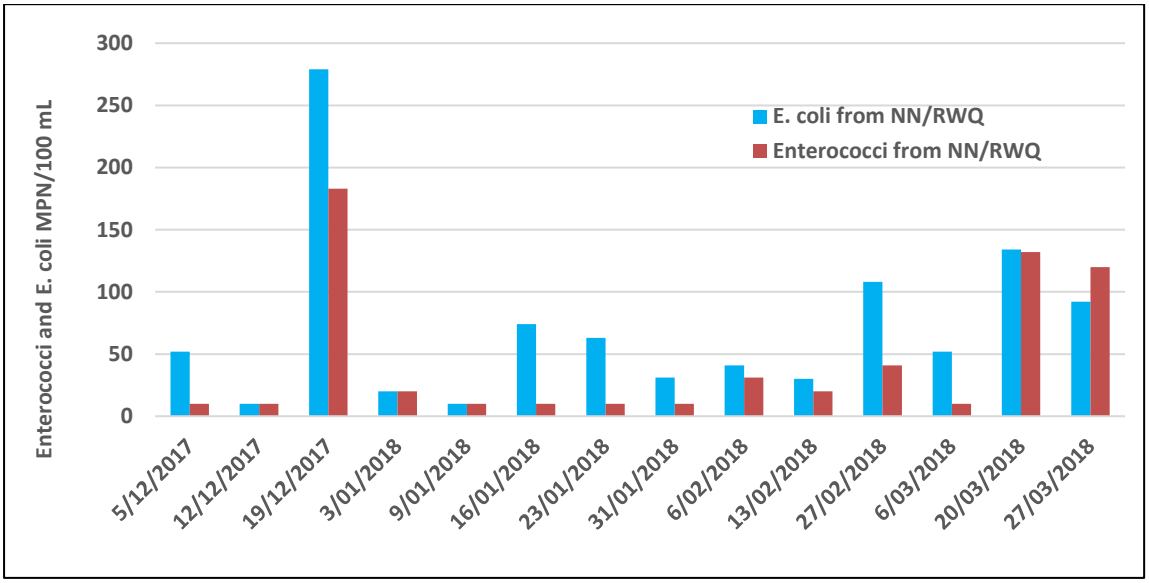

Figure 7. Enterococci and *E. coli* results from the 2017/18 RWQ program, sampled at Fitzgerald Park, N.N.

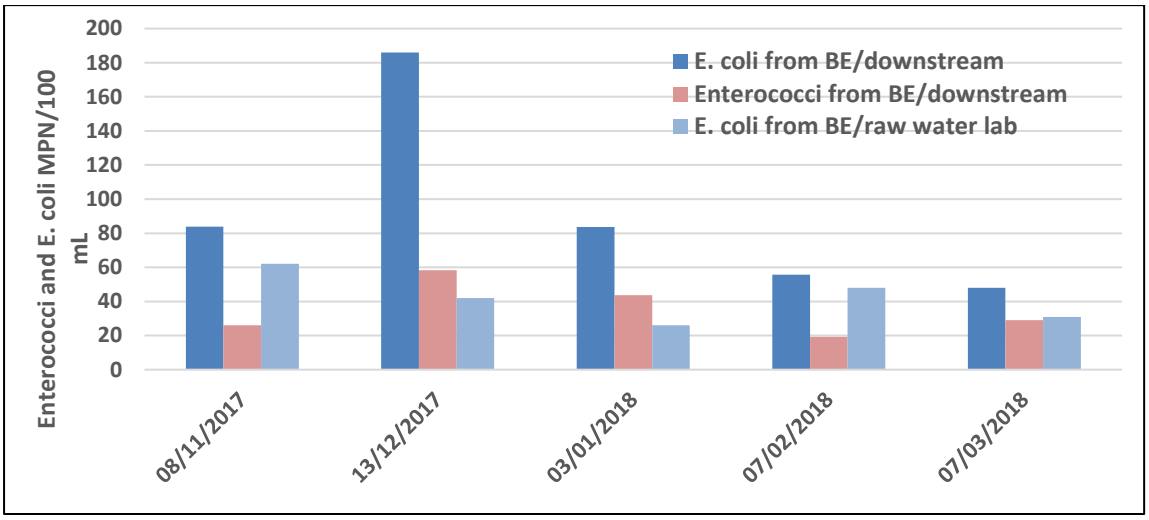

Figure 8. Five Enterococci and *E. coli* results from Bryn Estyn Water Treatment Plant.

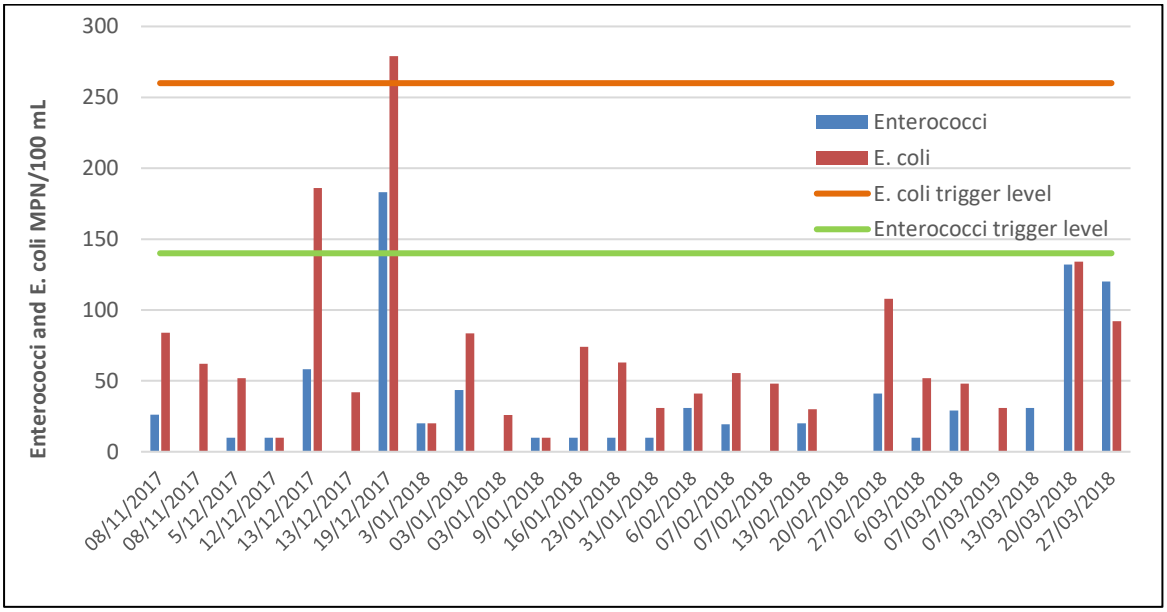

Figure 9. All *E. coli* and enterococci results from the RWQ program and TasWater, with New Zealand and Tasmanian trigger levels.

5.1.3 Discussion

The question for the RWQ program as to which faecal bacteria indicator is most suitable for the mostly freshwater system at New Norfolk, is probably a little closer to being resolved, keeping in mind that we only have very few samples available, so caution is required when interpreting the results.

The *E. coli* and enterococci results collectively suggest that the New Norfolk waters did not pose a health hazard this summer. Only on one occasion were trigger levels exceeded, and these were only the lowest trigger levels.

Results show that *E. coli* levels are almost always proportionately higher than enterococci (as expected from the NZ guidelines)), and possibly show a similarly sensitivity to the New Norfolk conditions. Thus, there do not appear to be a large difference in results, except for the last week of sampling, which may or may not have been affected by rainfall, though overall the results do not appear particularly influenced by rainfall.

The only anomaly in the data was that the *E. coli* results sampled downstream from BE were consistently higher than the raw water entering the treatment plant, and also higher than the *E. coli* results from the RWQ program. Unsure as to the reason for this. A possible explanation may be that the Downstream site is approx. 200 m downstream from where Pump Creek meets the River Derwent. Pump Creek collects water from a large catchment, which may be a high source of *E. coli*. Or the source may be runoff from the Bryn Estyn's sludge lagoons, which are on the downstream side of Bryn Estyn. BE also has a very small Level 1 WWTP onsite, servicing the toilets and kitchen in the Bryn Estyn WTP and the six houses in Bryn Estyn Court. This discharges downstream from BE, somewhere just across the road from the WTP sludge lagoons, but most likely this small amount will have diluted before reaching the Downstream sampling point.

Overall, the limited available data do not appear to suggest that enterococci lack the sensitivity required to be a suitable faecal indicator bacteria for the RWQ program at the New Norfolk sampling site.

For more in-depth details about this study please contact the DEP
ivisby@derwentestuary.org.au

6 RELATED MATTERS

6.1 Predictive modelling

As we only test the water quality of our beaches and bays on Tuesdays, it is not possible to say with certainty what the water quality will be like on the weekends, which is when most people swim. We partly remedy this by providing more generic advice on the classification of beaches based on the long-term monitoring, along with the standing advice to avoid swimming in the Derwent for several days after heavy rain.

Numerous beaches interstate and overseas are now providing the swimming public with a predicted forecast of the water quality for each day. Forecasts are generally produced using a combination of historical water quality data, past and predicted rainfall, and cloud cover conditions, but may also include simulations of the tide and wind-driven currents.

During last winter the DEP commenced investigations of the possibility of conducting a limited forecasting trial at some of our popular swimming beaches. Investigations centered predominantly around rainfall response, i.e. analysing whether rainfall can be

used as the main predictor of water quality. So far this looks unlikely in the Derwent Estuary, which is not a surprise when looking at the rainfall and enterococci results for this year. Many high results cannot be explained by high rainfall events.

Victoria EPA has just generously given the DEP a copy of the model that runs their forecasting system – see http://yarraandbay.vic.gov.au/beach-report/generating-forecasts-for-beach-report-and-yarra-watch for information about the VIC model. DHHS and the DEP will this winter explore options for setting up a student project, or similar, to trial a predictive forecasting system for some of our estuary beaches.

7 COMMUNICATIONS

7.1 Website

Weekly RWQ results were reported via the DEP website (http://www.derwentestuary.org.au/beach-watch/) throughout the summer. The DEP website had a significant upgrade prior to the 2017/18 season, and the new Beach Watch page was viewed by nearly 4500 people over the course of the season, which was an increase of almost 2000 views compared to the previous season. The new page allows the viewer to locate weekly sampling results and long-term rating for a particular beach by clicking on a google map or looking at a table. Swimming and Environmental Sites continue to be reported under the labels *Beach Watch* (Figure 10) and *Bay Watch*.

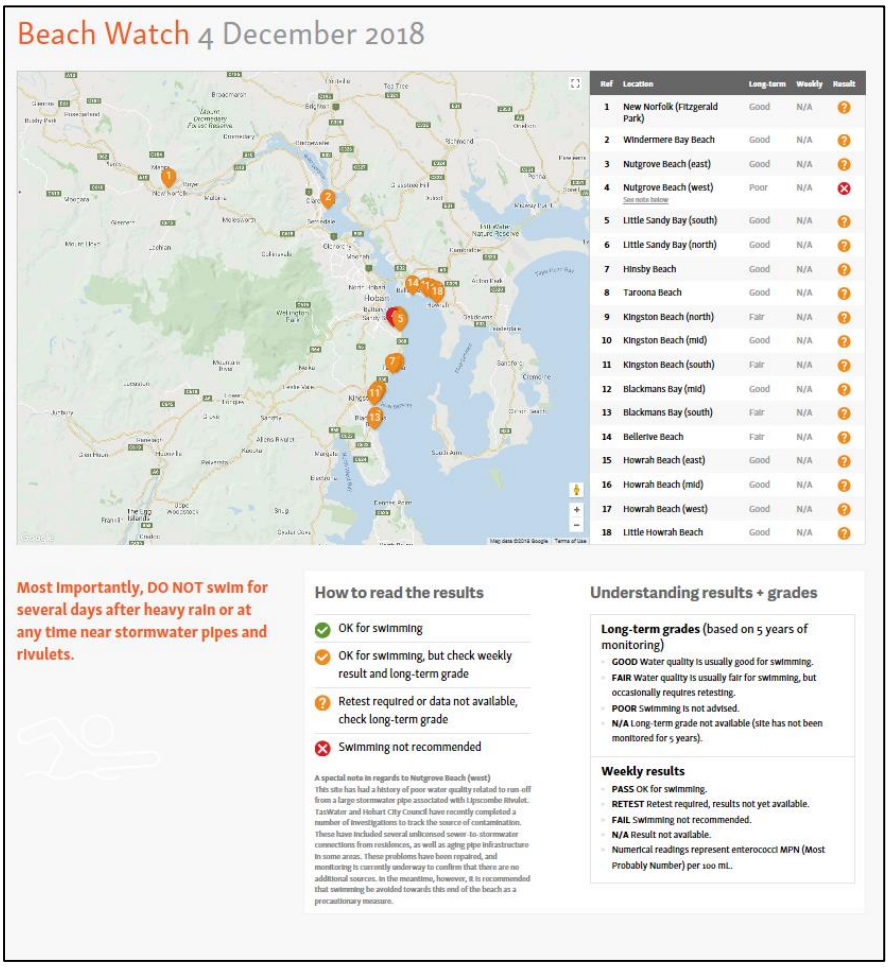

Figure 10. Swimming Sites reported on the new DEP website under the label *Beach Watch* during the 2017/18 season. No data is shown as the image was taken after the season had concluded.

7.2 Facebook

Following on from last season, weekly RWQ results were shared on the DEP Facebook page www.facebook.com/derwentestuary (Figure 11).

The number of Facebook views increased significantly from the previous season. The best result was 1612 views of one post late in the season, which was twice as many views as the most viewed post in the previous season. Typically, RWQ results posts were viewed by an average of 100 people, double the average number of views from the previous season. The number of people reached was maximized when posts were shared by the councils.

Next year we will continue to improve our Facebook postings, aiming for updated weekly photos and focusses on individual beaches or regions. Councils and other stakeholders are encouraged to share DEP posts. All environmental health officers are warmly invited to share photos from their sampling days for this purpose so that we can hopefully reach more people with our results.

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 website and Facebook page when necessary, e.g. when recent or predicted rainfall is greater than 10 mm. This 'protocol' was conducted throughout the season (Figure 11).

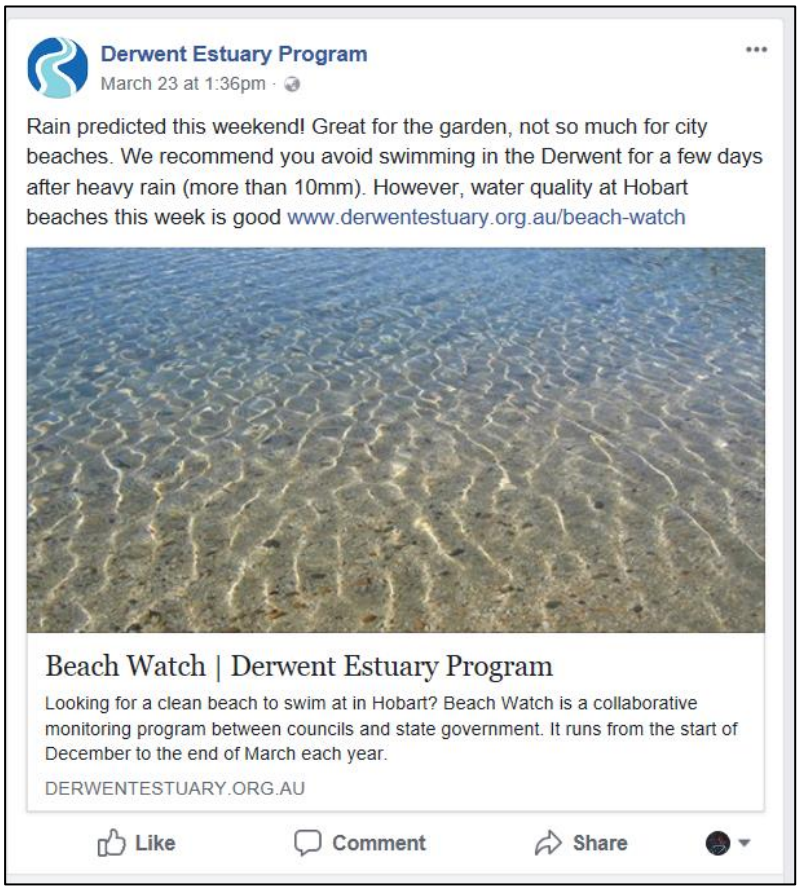

Figure 11. DEP Facebook posting from March 23, referring to the weekly RWQ results on the website.

7.4 Signage

The RWQ signage installed at Derwent swimming beaches is 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 that they are replaced with new signs as required (e.g. when the water quality category changes).

In light of this season's rating changes, it is suggested that the following signage updates take place before next summer:

- Bellerive Beach (from 'fair' to 'good')
- Windermere Bay Beach (from 'good' to 'fair')
- Blackmans Bay south (from 'fair' to 'poor')

8 ACKNOWLEDGEMENTS

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

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10 APPENDIX

10.1 Appendix A – RWQ Intercalibration report 2017-18 by I. Visby, C. Coughanowr.

Executive Summary
Recreational Water Quality (RWQ) monitoring in the Derwent estuary is conducted and reported in accordance with the Recreational Water Quality Guidelines 2007 (*Public Health Act 1997*). In order to ensure consistency of sampling methods and to assess the degree of variability between samples and samplers, the Derwent Estuary Program (DEP) coordinates an annual inter-calibration exercise.

On 29 November 2017, environmental health officers from five council partners together with the DEP simultaneously collected a sample each at two sites on Nutgrove Beach (west). This site was chosen because of recent works by TasWater and City of Hobart to solve long-term poor water quality issues from the Lipscombe Rivulet catchment. Results were fairly consistent between samplers and sites, with medium to high results reported at one site (close to Lipscombe Rivulet outfall) and low results at the second site (200 m south of the outfall).

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 according using a 95th Hazen percentile values for the faecal indicator bacteria enterococci. Long-term water classification codes are based on a 5-year 95th Hazen percentile 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 DEP 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 the season in order to improve consistency of results. A secondary objective is to gain a better understanding of water quality at a particular site.

Methodology
<u>Participants</u>
The DEP (Inger Visby) coordinated the participation of the following council partners:

- Hobart City Council (Natalie Rogers)
- Clarence City Council (Rachel Tenni)
- Glenorchy City Council (Tracy Tavasz)
- Kingborough Council (Alicia Wilson)
- Brighton Council (Brent Basstian)

Location

Site 1 was off the beach near the stormwater outfall at the western end of Nutgrove Beach (west), and Site 2 was approx. 200 m. further east along the beach. An additional sample was also taken by DEP only, directly by the stormwater outfall on the beach to assess this as a potential source of contamination (Figure 1).

Figure 1. Nutgrove Beach (west). Position of the three locations sampled for the RWQ inter-calibration exercise on 29 November 2017. Site 1 is near the outfall, and site 2 is ~200 m east of the outfall, and the outfall itself was also sampled.

Method

Field sheets were completed by entering wind speed, wind direction, preceding rainfall, date and time of sampling. Any general observations were also noted, 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. Bottles were labelled with the site, time, and the sampler's name.

All samplers 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 were delivered to the laboratory immediately upon completion of the inter-calibration event.

In addition to water sampling, Clarence City Council and the DEP used *in-situ* water quality multi-probes, a Horiba Water Quality Checker U-10 and a Hydrolab Quanta respectively. The calibrated multi-probes were deployed to the same depth of water at Site 2 until data readings stabilised. Temperature (^{o}C), pH and salinity (ppt) were compared.

Rain, wind, tide conditions

According to the Hobart weather station at Ellerslie (Bureau of Meteorology 2017) there was a period of fairly heavy rainfall a few days before the sampling:

- 26 Nov - 10.4 mm
- 27 Nov - 17.8 mm

At the time of sampling, the wind was south-easterly, with wind speeds ~ 22 km/hr (Bureau of Meteorology 2017), and the tide was outgoing, at ~ 0.85m (Willy Weather 2017).

Results

The enterococci results from Site 1 varied between 41 and 216 (mean 108.5) MPN/100 mL. At Site 2 all results were < 31 MPN/100 mL. At the stormwater outlet the result was 327 MPN/100 mL (Table 1).

The results from the multi-probes were consistent (pers. com R. Tenni, Clarence City Council) (Table 2, Clarence City Council data not available).

Table 1: Summary of enterococci concentration results (MPN/100 mL) sampled on 29 Nov 2017

Sampler	Site 1: Near outfall	Site 2: 200m south of outfall
Glenorchy	41	30
Brighton	135	31
Hobart	132	20
Clarence	86	20
Kingborough	41	31
DEP	216	<10
Mean	108.5	23.7

Sampler	Directly by outfall
DEP	327

Table 2: Summary from multi-probe comparison exercise from Derwent Estuary Program (DEP), 29 Nov 2017.

Multi-probe	Temperature (°C)	Salinity (ppt)	pH	Conductivity	DO%	DO
Hydrolab Quanta (DEP)	22.91	27.56	8.00	43.00	110.00	7.99

Conclusions

Given that urban stormwater drains are a known source of faecal contamination, together with the high rainfall two days prior, the higher enterococci result from samples collected at Site 1 were expected. However, results were relatively low compared with the sample collected directly by the pipe, indicating significant dilution over a relatively short distance. The variability between 41 and 216 at Site 1 suggests some variability in the flow path and dilution rates.

The low results from Site 2 suggests that at 200 m. distance from the stormwater outfall, the flow from the drain has been largely diluted.

The high result directly by the outfall pipe was expected, due to the recent high rainfall. It is unclear whether recent works by TasWater and City of Hobart towards investigating and resolving decades-long poor water quality issues from the Lipscombe catchment, has fully resolved the problems yet. Our sample at the outlet was not taking in morning

peak-hour usage, but the result was still encouraging low, compared with previous very high results from this pipe. Further sampling from this location will be required to determine whether the water quality has improved consistently.

Overall, the monitoring results demonstrated fairly homogeneous water quality conditions, with results demonstrating the expected variability.

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. Samplers were aware of potential sources of faecal contamination.

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10.2 Appendix B – Swimming Sites results

2017-18 RWQ season Swimming Site results - enterococci MPN per 100 mL.

Date	Swimming Site																	
	Bellerive Beach	Blackmans Bay Beach (mid)	Blackmans Bay Beach (south)	Fitzgerald Park, New Norfolk	Hinsby Beach	Howrah Beach (east)	Howrah Beach (mid)	Howrah Beach (west)	Kingston Beach (mid)	Kingston Beach (north)	Kingston Beach (south)	Little Howrah Beach	Little Sandy Bay Beach (south)	Little Sandy Bay Beach (north)	Nutgrove Beach (east)	Nutgrove Beach (west)	Taroona Beach	Windermere Bay Beach
05-Dec-17	279	86	10	<10	31	97	63	548	62	20	31	121	20	63	121	187	31	1725
12-Dec-17	<10	<10	<10	10	10	<10	<10	20	20	75	20	<10	<10	<10	<10	<10	<10	63
19-Dec-17	41	10	20	183	<10	<10	<10	<10	10	<10	31	10	10	41	<10	63	<10	<10
26-Dec-17	<10	31	20		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	
02-Jan-18	10	120	132	20	<10	10	173	10	63	52	41	10	<10	10	10	10	<10	31
09-Jan-18	<10	63	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10
16-Jan-18	<10	<10	<10	<10	<10	10	<10	20	31	<10	<10	<10	<10	86	<10	10	20	30
23-Jan-18	<10	20	<10	10	<10	<10	<10	63	<10	10	<10	<10	10	10	10	20	<10	41
30-Jan-18	75	10	<10	<10	<10	480	537	41	504	285	<10	52	10	20	10	20	393	959
06-Feb-18	<10	<10	10	31	<10	<10	10	<10	<10	20	30	<10	10	10	<10	<10	<10	<10
13-Feb-18	51	<10	670	20	<10	<10	<10	20	<10	51	41	10	<10	<10	<10	10	<10	<10
20-Feb-18	31	10	41		<10	<10	20	74	<10	<10	41	<10	52	20	<10	<10	<10	20
27-Feb-18	10	<10	199	41	<10	<10	<10	41	<10	75	10	<10	<10	10	<10	96	<10	<10
06-Mar-18	<10	10	146	<10	<10	<10	<10	30	10	<10	75	10	10	10	<10	<10	<10	<10
13-Mar-18	52	183	203	31	<10	41	<10	<10	31	20	<10	52	41	<10	<10	10	<10	20
20-Mar-18	211	683	934	132	<10	231	31	<10	<10	20	20	10	20	52	<10	10	<10	63
27-Mar-18	10	52	63	120	<10	<10	616	31	10	20	10	31	<10	63	41	2613	<10	110

10.3 Appendix C – Environmental Sites results

2017-18 RWQ season Environmental Site results - enterococci MPN per 100 mL.

Date	Environmental Site																				
	Brooke St Pier	Browns River	Cornelian Bay Beach	Elwick Bay	Geilston Bay	Hobart Regatta Pavilion	Hobart Rivulet	Kangaroo Bay	Lindisfarne Bay	Marieville Esplanade	Mid-river Derwent Swim	MONA Berridale Bay	MONA Cameron Bay	MONA Jetty	Montagu Bay	New Town Bay	Old Beach, Jetty Road	Prince of Wales Bay Marina	Sullivans Cove	Victoria Dock	Watermans Dock
05-Dec-17	63	2359	160	884	153	318	332	10	85	448	269	910	1112	631	179	211	120	292	30	73	63
12-Dec-17	20	282	20	10	<10	<10	2187	63	10	63	<10	20	10		<10	41	<10	20	<10	<10	20
19-Dec-17	<10	63	2282	120	<10	288	404	10	52	98	<10	201	31		20	10	<10	<10	<10	<10	<10
26-Dec-17		63	10							31											
02-Jan-18	20	10	529	10	110	<10	359	<10	20	243	<10	75	31		10	110	10	10	<10	<10	<10
09-Jan-18	<10	63	253	<10	<10	121	187	<10	10	216	<10	31	<10	10	<10	420	10	<10	30	20	<10
16-Jan-18	<10	31	31	10	10	52	171	<10	<10	135	<10	51	<10	<10	<10	<10	<10	10	<10	<10	20
23-Jan-18	<10	282	697	<10	<10	<10	20	10	10	10	<10	10	74	10	<10	20	<10	41	<10	<10	<10
30-Jan-18	31	4884	199	86	262	<10	561	226	933	158	10	393	185	109	10	556	148	63	20	110	52
06-Feb-18	<10	63	5475	10	<10	10	10	<10	<10	<10	<10	<10	<10	<10	10	31	41	20	<10	<10	10
13-Feb-18	<10	20	63	31	<10	109	85	<10	20	253	<10	85	10	<10	<10	63	183	10	<10	<10	30
20-Feb-18	<10	121	31	10	<10	<10	20	<10	<10	216	<10	20	10	<10	<10	<10	20	<10	<10	<10	<10
27-Feb-18	<10	341	98	20	146	10	487	20	52	327	31	10	20	<10	63	31	52	20	52	160	52
06-Mar-18	<10	594	63	<10	120	226	121	31	<10	<10	<10	<10	10	<10	<10	10	20	<10	52	<10	<10
13-Mar-18	10	265		<10	683	201	1019	488	209	2142	<10	31	<10	63	<10	298	53	52	<10	1597	3448
20-Mar-18	2602	1723	41	<10	262	2282	259	<10	51	74	148	<10	20	10	10	10	960	10	374	175	41
27-Mar-18		435		63						97		4106	20	20			10				