



Beach Report and Yarra Watch Long Term Condition Report

2021-2022

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Water Sciences

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EPA acknowledges Aboriginal people as the first peoples and Traditional custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders past and present and recognise the continuing connection to, and aspirations for Country.



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Glossary

Primary Contact Recreation: recreational activities where the person is in direct contact with the water, can be fully immersed, and can swallow it. For example, swimming, surfing, diving, and water-skiing.

Secondary Contact Recreation: recreational activities where the person has direct contact with the water, but is not fully immersed, and is unlikely to swallow it. For example, boating, canoeing, wading, paddling, and fishing.

Quantitative Microbial Risk Assessment (QMRA): An assessment used to estimate the risk of infection and illness when a population is exposed to environmental microorganisms.

Summary

Environment Protection Authority Victoria (EPA) undertakes weekly microbial monitoring at 36 Port Phillip Bay (PPB) beaches and four Yarra River swimming spots during the swimming season. Each week, the result from each site is assessed against short-term standards and used to inform a daily water quality forecast provided to the community. Each day, this forecast rates the beach or Yarra River site as ‘Good’, ‘Fair’ or ‘Poor’ to help the community make informed decisions about swimming on a short-term basis.

Outside of the summer season, EPA also uses multiple years of this monitoring data to assess how each site is performing against the long-term Environment Reference Standard (ERS) for microbial water quality. This assessment determines if locations generally meet standards for secondary (e.g., boating) and primary contact recreation (e.g., swimming) over a five-year period, and is also used to inform the State of The Environment Report. These results are not meant to inform the short-term swimming decisions of the community during summer.

Two water quality grades are determined for each site monitored by the EPA. The 'All Weather' grade determines water quality based on all samples taken from the past five summers. The 'Dry Weather' grade determines water quality based on a subset of samples collected during dry weather periods only. This is to understand baseline water quality without the influence of stormwater pollution, which decreases water quality in PPB. Overall, the data shows that PPB beaches and the Yarra River have better 'Dry Weather' grades than 'All Weather' grades. For this reason, EPA advises to avoid any recreational contact with water for 24-48 hours following rainfall.

According to long-term standards, all PPB beaches were suitable for secondary contact recreation over the last five summers. Most PPB beaches (64%) were also suitable for primary contact recreation during 'Dry Weather' in the 2017-18 to 2021-22 reporting period. At beaches which did not meet standards during dry weather, detailed investigations and targeted sampling into pollution sources has shown that the risk to human health is low. This is because the standards are overly conservative for protecting human health and assume all faecal pollution in PPB is of high-risk human origin. However, investigations have shown that this is not the case, and that most pollution in PPB is from low-risk animal sources. This means there is likely a lower risk to human health despite what the standards suggest.

The long-term water quality data shows that Yarra River sites were all suitable for secondary contact recreation during the 2017-18 to 2021-22 reporting period. No Yarra sites met long-term water quality standards for primary contact recreation over the most recent five-year period. This is due to a small number of high results over the past five-years and does not mean that all Yarra were are unsuitable for primary contact recreation all the time. Warrandyte has water quality which is suitable for swimming on most days throughout the Summer.

EPA works with Parks Victoria and councils along the Yarra River to provide advice on healthy swimming during summer. To further understand the causes of microbial pollution, EPA is partnering with universities and Melbourne Water to investigate specific sources of microbial pollution and assess microbial risk in the Yarra River. This research will help form actions to improve water quality.

Recreational water quality monitoring

EPA monitors microbial water quality at Port Phillip Bay beaches and along the Yarra River. Yarra River monitoring is undertaken in partnership with Melbourne Water. This monitoring provides water quality information to the community via the Beach Report and Yarra Watch programs. This allows the community to make informed decisions about swimming and other recreational water-based activities. The programs monitor 36 PPB beaches and four Yarra River sites.

Both programs run during the times of year when recreational water use is highest (traditionally December to Labour Day weekend) and consist of:

- twice daily forecasts (to provide short-term health risk messaging to community);
- weekly water sampling (to alert the community to short-term water quality risk and inform long-term water quality management).

Water analyses at PPB beaches measure concentrations of a group of bacteria called enterococci, which are found in the gut of mammals and are a well-established indicator of faecal pollution in marine waters. Analyses of Yarra River water instead measure the bacteria *Escherichia coli*, an established indicator of faecal pollution in freshwater. EPA uses measurements of these bacteria (referred to as microbial water quality) as an indicator of faecal pollution and subsequent risk to public health, based on the Environment Reference Standard (ERS) (a legislative instrument

made under the Environment Protection Act 2017). See more information on [the EPA website](#).

Long-term microbial water quality grades: methods and usage

What are the long-term standards?

The long-term standards (defined in the ERS) outline the standards for long-term condition and trend in microbial water quality. The purpose of long-term standards is for water managers to better understand potential health risks due to water quality, and to inform the long-term management of faecal contamination at EPA's reporting sites.

How were the long-term standards developed?

Long-term standards link the concentration of the indicator bacteria in the water to the risk of illness associated with recreational contact. The standards are based on the best science available and take a precautionary approach for assessing water quality.

EPA uses standards that are aligned with the National Health and Medical Research Council (NHMRC) Guideline for Managing Risks to Recreational Water (2008) (1). These standards reflect the Victorian Government's commitment to better protect public health.

How are long-term standards used to calculate grades?

Assessment of long-term microbial water quality is based on two categories, which are combined in a matrix and used to determine a water quality Grade (see **Table 3** in Appendix A). The two categories used to determine the grade are:

- the Microbial Assessment Category (MAC) – a categorisation of microbial water quality at a site over the past 5 years.

- A Sanitary Inspection Category (SIC) – a determination of the likelihood of faecal pollution occurring

Details of how the MAC and SIC are calculated are as follows.

Determining the MAC

EPA compiles microbial data (i.e., *E. coli* for the Yarra River or enterococci for Port Phillip Bay) from the previous five summer periods and calculates a 95th percentile microbial level for a site. A 95th percentile means the point where 5% of sampling data points will exceed a value. This value is compared to the long-term standards and assigned a Microbial Assessment Category (MAC) between A and E.

Determining the SIC

EPA also conducts a sanitary inspection at each site to assess potential sources of faecal pollution. EPA assigns a Sanitary Inspection Category (SIC) to each site, ranging from 'Very Low' to 'Very High' for the likelihood of a threat to public health.

Determining the Grade

To determine the grade of a site, EPA combines the MAC and SIC for each site to determine a long-term grade using the matrix table in the appendix

- A site graded 'Very Good', 'Good' or 'Fair' has microbial levels meeting long-term standards for primary contact recreation.
- A site graded 'Poor' or 'Very Poor' does not have microbial levels meeting long-term standards for primary contact recreation.

Grades are reported as 'provisional' if minimum data required is not available for MACs (e.g., due to removal of wet weather data for analysis of dry weather conditions), or sanitary surveys needing external review. Provisional grades are still indicative of long-term microbial water quality condition and their reporting is allowed under the NHMRC Guidelines for Managing Risks to

Recreational Waters (2008). Some grades reported here are provisional.

'All Weather' and 'Dry Weather' grades

Two grades are calculated for each site: 'All Weather' and 'Dry Weather'. 'All Weather' grades use microbial data from wet and dry conditions, including samples taken during and after rain. Stormwater pollution can cause high microbial levels in these samples.

'Dry Weather' grades use microbial data from samples taken when there has been less than 1mm of rainfall in the preceding 24h. As stormwater pollution from most rainfall events disperses in 24h, this definition removes the impact of stormwater on microbial water quality from most samples included in the 'Dry Weather' results.

However, after some very large rain events, stormwater pollution can impact microbial water quality for longer than 24h. If these rainfall events were followed by at least a 24h period without rain, then samples after these events will not be removed from the data. This means stormwater pollution can still impact the 'Dry Weather' grades at some sites. EPA is currently reviewing this definition to ensure that 'Dry Weather' grades are a true reflection of beach water quality without the impact of stormwater pollution.

Diffuse sources of pollution can also impact water quality in dry weather. Possible sources of microbial pollution during dry weather are:

- dry weather flows from drains (caused by something other than rainfall, such as a sewage cross-connection, residential discharge or business discharge);
- people swimming (shedding of bacteria into the water);
- damaged toilet facilities, or facilities with septic tanks or on-site systems that could leak sewage;
- sewer spills;
- animal faeces;
- creek and river flows reaching sites, as they can carry their own run-off and microbial pollution;

- water with high microbial levels reaching beaches from boat discharge.

Current Long-term water quality grades for PPB beaches in 2022

'All weather' results for Port Phillip Bay

All 36 beaches met long-term microbial water quality standards for secondary contact recreation. For primary contact recreation, 10 beaches met long-term microbial water quality standards and were graded as either 'Good' or 'Fair'.

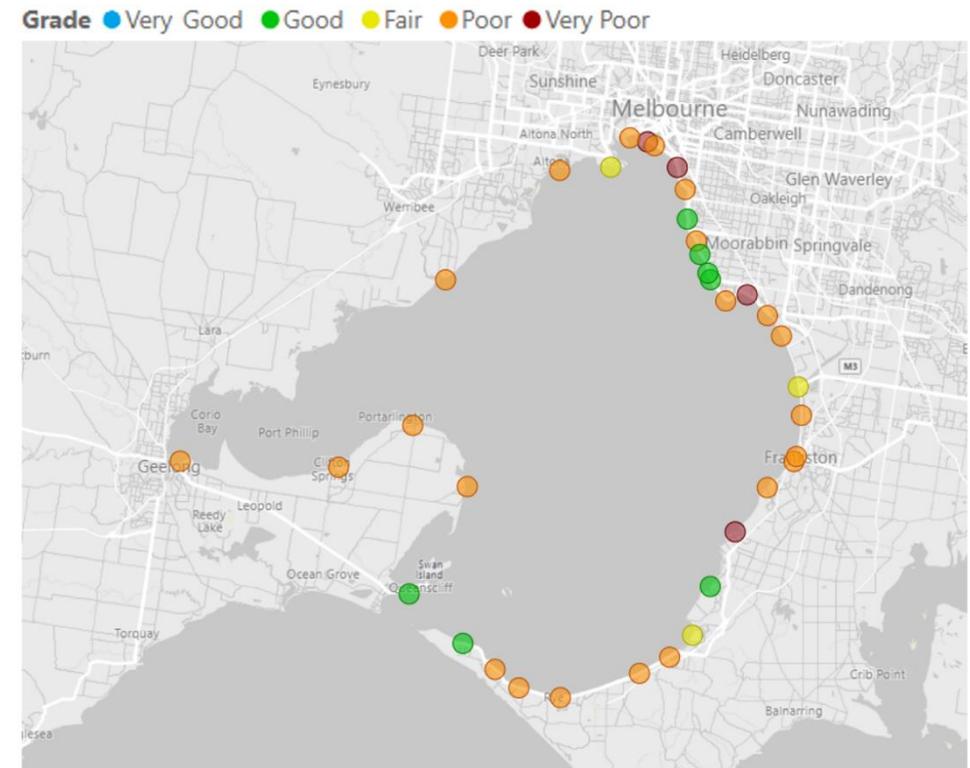


Figure 1: 'All Weather' provisional long-term grades for 36 beaches

for primary contact recreation. Colour indicates grades for each site for 2017-18 to 2021-22.

Stormwater pollution after rain has the biggest influence on long-term microbial water quality. High microbial levels in stormwater pollution can increase the risk of illness because of exposure during swimming. Some sites are more susceptible to stormwater pollution than others. It is difficult to predict which beaches will be impacted during and after isolated rain events. For this reason, as a precaution, EPA advises avoiding any contact with water for 24-48 hours following rainfall.

'Dry weather' results for Port Phillip Bay

'Dry Weather' grades use the same microbial data as 'All Weather' grades, however data from samples collected during or immediately after a rainfall event are removed. Refer to section: 'All Weather' and 'Dry Weather' grades above.

Most beaches (23 out of 36) had microbial water quality meeting long-term standards for primary contact recreation during dry weather over the last 5 summers. 13 beaches did not meet long-term standards, as they had elevated microbial levels during dry weather periods.



Figure 2: 'Dry Weather' provisional long-term grades for 36 beaches for primary contact recreation. Colour indicates grades for each site for 2017-18 to 2021-22.

Beaches not meeting long-term standards still had microbial water quality suitable for swimming on most days during the summers between 2017-18 and 2021-22. During summer, sampling results are assessed against short-term standards and advice is provided to the community on whether water quality is suitable for swimming. For recent short-term results, see EPA publication: [Beach Report and Yarra Watch results 2021-2022 \(2\)](#).

Current long term water quality grades for the Yarra River in 2022

Each Yarra River site is considered representative of a section of river upstream, referred to as a 'reach'. A representative site is based on several locations in the reach having similar historical

microbial data and Sanitary Inspection Categories (SIC). Each reach extends from the sampling site upstream to the next site (e.g. Kew reach extends from Kew sampling site to Warrandyte sampling site; see **Figure 3**).

All four reaches on the Yarra River met long-term microbial water quality standards for secondary contact recreation over the 5-year analysis period for this report (2017-18 to 2021-22).

For primary contact recreation, no reach met standards during wet or dry weather conditions, with 'All Weather' and 'Dry Weather' grades either being 'Poor' or 'Very Poor' along the Yarra River.

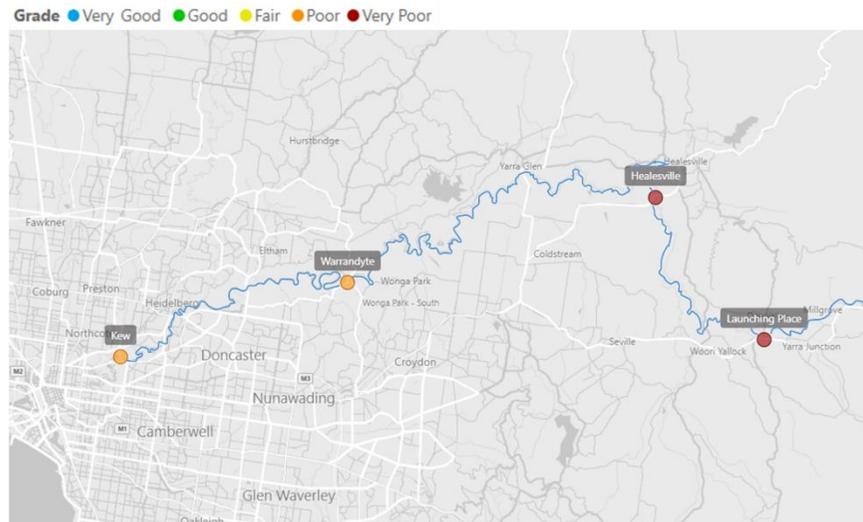


Figure 3: 'Dry Weather' provisional long-term water quality grades for the Yarra River (2017-18 to 2021-22) for primary contact. The blue line indicates the course of the Yarra River to Kew. The stretch below Kew is not included as it is illegal to swim in the Yarra River downstream of Abbotsford.

Stormwater pollution is the most likely driver of poor microbial levels in the Yarra River during and after rain. As a precaution, EPA advises to avoid any contact with water for 24-48 hours following rainfall. Animals such as birds and dogs are the most likely drivers of pollution during dry weather.

Although the Warrandyte reach was graded 'Poor' during 'Dry Weather', microbial levels met short-term standards during weekly sampling over the last five summers. This is due to the short-term ERS standards providing advice on suitability for swimming, rather than long-term water quality management. For recent short-term results, see EPA publication: [Beach Report and Yarra Watch results 2021-2022 \(2\)](#).

The reason for the 'Dry Weather' long term grade of 'Poor' at Warrandyte is due to a small number of samples with high *E. coli* levels elevating the 95th percentile *E. coli* measurement for the site, and subsequently increasing the MAC. The drivers of these high results are difficult to determine and could be the persistent impact of large rain events, or pollution by animals such as birds or dogs. Though these small number of results cause the grade of 'Poor' at Warrandyte, these events are infrequent and do not often impact swimming conditions on a day-to-day basis throughout the summer.

Kew received a grade of 'Poor' during 'Dry Weather' for this reporting period, showing some improvement on past results. The Launching Place and Healesville reaches received grades of 'Very Poor' during 'Dry Weather'. Sanitary inspections for sites in this reach suggests farm animals as possible faecal sources. Creeks upstream that may be contributing to higher microbial levels are also a consideration, as the creeks transport microbial pollution downstream to main river channel.

'Dry Weather' grades of 'Poor' or 'Very Poor' in the Yarra River indicate an increased risk to swimmers. EPA has worked with Parks Victoria; Manningham, and Yarra Ranges Council; and the Department of Health to ensure there are signs at sites in these reaches to minimise this public health risk. The advice for healthy swimming is:

- avoid swimming near stormwater drains;
- avoid swimming for 48 hours after rain;
- try not to swallow water during recreation;
- cover cuts and scratches with waterproof bandages;

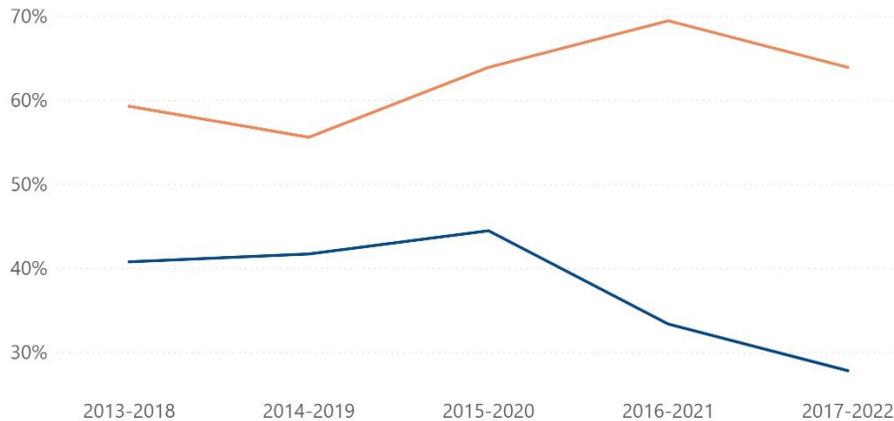
- wash your skin with soap after touching the water and shower after swimming.

Trends in long term water quality for Port Phillip Bay

The long-term trends for beaches are reported as the percentage of all PPB beaches meeting long-term primary contact recreation standards. The total number of beaches has changed over time. In 2014 nine beach sampling sites were added to the program. For this reason, the percentage of PPB beaches meeting standards is out of 27 for the 2013-2018 reporting period. In all other reporting periods, the percentage of PPB meeting standards is out of 36.

Beach Report: Trends in beaches meeting standards

- Percentage of beaches receiving 'Good' or 'Fair' grades for 'Dry Weather'
- Percentage of beaches receiving 'Good' or 'Fair' grades for 'All Weather'



*There were 27 beach report sites in the 2013-2018 rolling data periods, there were 36 sites in the 2014-2019, 2015-2020, 2016-2021 and 2017-2022 rolling data periods

Figure 4: Percentage of beaches meeting long-term primary contact recreation standards in last five reporting periods.

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As expected, a lower percentage of beaches met standards in 'All Weather' compared to 'Dry Weather'. This is due to the reduced influence of stormwater pollution during dry weather periods. The number of beaches meeting standards for both 'All Weather' and 'Dry Weather' has been variable over time, with a decrease in the number of beaches meeting standards during the 2016-2021 and 2017-2022 reporting periods (**Figure 4**).

This decrease may be related to the 2020-2021 and 2021-2022 summers captured during these reporting periods. La Nina events, which are weather patterns that increase rainfall across eastern Australia, occurred during both these periods, and higher than average rainfall was recorded across the greater Melbourne area for both summers. Very heavy or frequent rainfall events can increase stormwater pollution and 95th percentile enterococci levels at a site and may result in a decrease in the number of beaches meeting standards.

Trends in long term water quality for the Yarra River

Yarra River trends are reported for each reach as there are only four reaches. The trends in Yarra River long-term water quality remain mostly unchanged. Each grade here represents a five-year reporting period.

Table 1: Yarra River long-term 'All Weather' grades for primary contact in last five reporting periods.

	Reporting period				
	2013-2018	2014-2019	2015-2020	2016-2021	2017-2022
Launching Place	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
Healesville	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
Warrandyte	Poor	Poor	Very Poor	Poor	Very Poor
Kew	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor

Table 2: Yarra River long-term 'Dry Weather' grades for primary contact in last five reporting periods.

	Reporting period				
	2013-2018	2014-2019	2015-2020	2016-2021	2017-2022
Launching Place	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
Healesville	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor
Warrandyte	Fair	Poor	Fair	Poor	Poor
Kew	Very Poor	Very Poor	Very Poor	Very Poor	Poor

Launching Place, Healesville and Kew reaches consistently do not meet standards for primary contact recreation, with grades of 'Poor' or 'Very Poor' across 'All Weather' and 'Dry Weather' conditions in recent years. The trend in microbial water quality during dry weather at the Warrandyte reach is an exception. Long-term microbial water quality is variable over time at Warrandyte but has met standards during 'Dry Weather' in two out of the last five reporting periods.

Understanding and managing water quality

Challenges associated with metropolitan Melbourne water quality

The standards in the ERS are conservative for protecting public health. To meet these standards, no more than five percent of samples can exceed microbial levels that could cause an outbreak of illness (i.e. exceed MAC B in **Table 3**). As a result, even a small number of high microbial results over a five-year period can result in a site not meeting long-term standards.

Standards are less likely to be met in PPB than other areas around Australia because it has less mixing than ocean beaches (i.e., less wave action, currents at PPB beaches). Many PPB beaches and parts of the Yarra River also have stormwater outlets nearby and can be impacted by faecal contamination from their catchments.

When long-term grades do not meet standards (i.e., 'Very Poor' and 'Poor' grades), this indicates a site that is more susceptible to faecal pollution. The site may pose a higher health risk for recreational users over the five-year period of analysis. However, it does not necessarily mean the site is unsuitable for contact during the summer. EPA's microbial monitoring shows that in summer, water quality generally meets standards for primary contact recreation when there has not been recent rain.

To inform community decision-making about swimming during summer, Beach Report and Yarra Watch programs provide twice daily water quality forecasts. Additionally, if short-term standards are exceeded in weekly sampling, then warnings are issued to the community. Warnings reduce the community's short-term exposure to microbial levels that may result in higher risk of illness.

Current and past work to understand microbial risk

EPA uses the current ERS standards as they are based on well-established NHRMC guidelines about the management of recreational water quality, using the best available science. However, the studies from which the standards were developed are based on overseas environments with conditions not always comparable to PPB and Yarra River. EPA is continuing to work with its partners (including Melbourne Water, local councils, and Monash University) to conduct local studies to better understand water quality and pollution sources in a Victorian context.

Recent collaborative work has included:

- an EPA study in 2017-18 using a quantitative microbial risk assessment (QMRA) at Altona, Elwood, and Frankston beaches to better understand health risks from swimming. QMRA is an evidence-based approach to assess the microbial safety of water. This study involved the monitoring of pathogens in PPB (rather than just indicator bacteria) and a risk assessment into the likelihood of getting sick when ingesting water containing these pathogens. This study showed that risks at Beach Report

sites are lower than what is suggested by the current ERS standards. EPA is using this study to explore other ways of reporting on water quality which are more reflective of risk at beaches.

- an EPA study on microbial source tracking (MST) in 2019-20 at 14 beaches in PPB to understand what types of faeces (e.g., dog, bird) are contributing to microbial detection levels. This is important as faeces from animal sources may contain pathogens less susceptible to causing sickness in people than human faeces.
- A research project including QMRA and source tracking in sections of the Yarra River. This project was led by Monash University and funded by the Australian Research Council, EPA Victoria, and Melbourne Water. Findings of this research are currently in the peer review stage and will be released later in 2022. The QMRA and source tracking at beaches (described in the first 2 points above) showed that most faecal contamination in PPB is from birds and dogs rather than human sources (e.g., sewage). This means that the current long-term microbial water quality standards in the ERS are likely to overestimate health risks as they assume human sources are the main driver of pollution. Results are pending from the Yarra River work.

Findings from these assessments will be used to determine if site-specific standards can be developed. Site-specific standards would better reflect the risk of illness at specific beaches in PPB and Yarra River.

Conclusions and further actions

Recreational water quality remains an important area of investigation for EPA. Most beaches in Port Phillip Bay met long-term standards for primary contact recreation for 'Dry Weather'. For those beaches not meeting standards, targeted sampling as part of the Microbial Source Tracking project found that microbial contamination at these beaches originated mostly from animal sources rather than human sources. Animal sources are considered to pose a lower risk to human health (1, 2).

Though none of the Yarra River reaches met long-term standards during dry weather for the 2016-2021 reporting period, the Warrandyte reach has a history of meeting standards and is currently suitable for primary contact recreation on a short-term basis during summer. EPA is actively working with Melbourne Water on a Quantitative Microbial Risk Assessment and Microbial Source Tracking project to better understand health risk and faecal sources in the Yarra River. This work is near completion.

Assessment against long-term standards for PPB beaches and Yarra River reaches indicates that most are highly susceptible to stormwater pollution during and after rain. EPA advice is to avoid any contact with water for 24-48 hours following rainfall.

QMRA and source tracking results for beach investigations have shown that most faecal contamination in PPB is from birds and dogs. As human sources of faecal pollution pose a higher risk to human health than animal sources, this suggests that current ERS standards likely overestimate health risks for PPB beaches. Similar investigative work on the Yarra River as part of the Yarra River QMRA project conducted by EPA, Monash University and Melbourne Water, will provide information on the appropriateness of current standards for Yarra River reaches.

References

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3. Fewtrell L, Kay D. Recreational Water and Infection: A Review of Recent Findings. *Current Environmental Health Reports*. 2015;2(1):85-94.
4. Smith O, Snyder W, Owen J. Are we overestimating risk of enteric pathogen spillover from wild birds to humans?. *Biological Reviews*. 2020;95(3):652-679.

Appendix A: Classification of long-term recreational water quality

Table 3: Classification matrix for long-term microbial environmental quality indicators and standards for primary and secondary contact recreation. Sanitary Inspection Categories indicate the likelihood of a threat to public health. Microbial Assessment Categories are calculated based microbial data from the previous 5 summers.

		Microbial Assessment Category (MAC) 95 th percentile (Hazen method)				
		A	B	C	D	E
Freshwater		<130 <i>E. coli</i> /100ml	130-260 <i>E. coli</i> /100ml	261-550 <i>E. coli</i> /100ml	551-5500 <i>E. coli</i> /100ml	>5500 <i>E. coli</i> /100ml
Freshwater, Marine, Estuarine		<40 Enterococci/100ml	40-200 Enterococci/100ml	201-500 Enterococci/100ml	501-5000 Enterococci/100ml	>5000 Enterococci/100ml
Sanitary Inspection Category (SIC)	Very Low	Very Good	Very Good	Follow-up	Follow-up	Follow-up
	Low	Very Good	Good	Follow-up	Follow-up	
	Moderate	Good	Good	Poor	Poor	
	High	Good	Fair	Poor	Very Poor	
	Very High	Follow-up	Follow-up	Poor	Very Poor	

EPA combines the MAC and SIC to give each site a grade. "Meeting standards" for secondary contact recreation means a site receiving a MAC of A, B, C, or D. "Meeting standards" for primary contact recreation means a site grade of "Very Good", "Good" or "Fair". For more details, see **How are long-term standards used** to calculate grades?.

Notes

1. A 95th percentile indicates that 95% of the time data points are below that value and 5% of the time they are above that value.
2. A site graded 'Follow-up' may need the SIC investigated; samples reviewed to ensure data related to heavy rainfall is included; and data reviewed for possible analytical errors. There may also be non-sewage sources of faecal indicators (e.g., livestock), which need to be verified.
3. For long term assessment for water-based recreation (primary contact and secondary contact), a rolling water quality dataset with a minimum number of 60 samples must be developed and maintained. The microbial assessment category must be assessed in both general weather (a range of weather conditions) and Dry Weather conditions.
4. For long term assessment for primary contact water-based recreation, data must be collected during periods of high recreational use and a sanitary inspection at a site is required.



Figure 6: 'Dry Weather' long-term microbial grades for beaches in the west of Port Phillip Bay

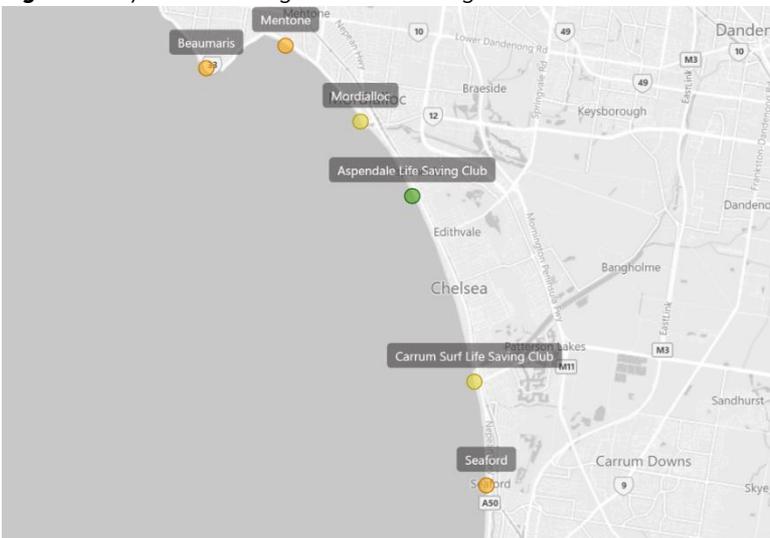


Figure 7: 'Dry Weather' long-term microbial grades for beaches in south-east Melbourne.



Figure 8: 'Dry Weather' long-term microbial grades for beaches in inner Melbourne.



Figure 9: 'Dry Weather' long-term microbial grades for beaches in the lower south-east and the Mornington Peninsula. *Note: Frankston Lifesaving Club is indicated as 'Poor' just south of Frankston Coast Guard.*

Appendix C: Determination of Dry Weather data using the SEPP tool

EPA and Monash University have developed a Hazen method 95th percentile calculator tool (listed as SEPP tool beta 0.4 at <http://www.ephmlab.com.au/code/>) which categorises samples as 'Dry Weather' if there was less than one millilitre of rainfall in the preceding 24 hours. However, as the impact of heavy rainfall events on stormwater pollution may extend for longer than 24 hours, some 'Dry Weather' samples may have been taken during periods where stormwater was still impacting water quality.

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