

Chapter 5

Quality assurance program

Introduction

To ensure that the data collected and reported under the Beachwatch, Harbourwatch and Beachwatch Partnership programs are accurate and reliable, a number of quality assurance (QA) processes are included in the programs, covering:

- field sampling (equipment preparation, sample collection and sample storage and transport)
- laboratory analysis
- data management
- community reporting.

The results of these assessments are discussed in this section.

Field sampling

Background

Water quality sampling for the Beachwatch programs is undertaken by a number of different organisations (Table 27).

Methods

The collection of water samples by Sutherland Shire Council, Hunter Water Corporation and Sydney Water Corporation is audited by Beachwatch Programs field officers on a quarterly basis throughout the year.

Audits on Beachwatch Programs field officers are conducted throughout the year by the Beachwatch Senior Project Officer.

Field audits are conducted on partnership councils at the commencement of the summer season by Beachwatch Programs field officers.

Audits include an assessment of the field officer's performance according to established Beachwatch Programs sampling protocols, including aseptic sampling techniques, sample collection, and sample storage and documentation of field observations. These protocols are based on internationally recognised methods for the collection of water samples in recreational bathing areas (APHA 1998).

Percentage compliance is calculated for each of the three components of the audit: sampling technique, sample collection, and storage and field observations. A total compliance is then calculated as the average compliance from each of these three components.

Table 27: Organisations undertaking sampling as part of the Beachwatch programs

Agency	Regions	Sampling period
Beachwatch (OEH)	Northern Sydney Beaches, Central Sydney Beaches, Pittwater, Sydney Harbour, Botany Bay, lower Georges River and Port Hacking	Year-round
Sutherland Shire Council	Southern Sydney Beaches	Year-round
Hunter Water	Ocean beaches in Port Stephens, Newcastle and Lake Macquarie shires	Year-round
Sydney Water	Ocean beaches in Wollongong, Shellharbour and Kiama shires	Year-round
Partnership Program councils	Byron, Ballina, Richmond Valley, Clarence Valley, Kempsey, Port Stephens, Port Macquarie-Hastings, Newcastle, Wyong, Gosford, Wollongong, Shoalhaven, Eurobodalla and Bega Valley council regions	Varied (between October and April)

Following the audits, a detailed report describing the findings and highlighting issues of concern is prepared. A copy of the report is provided to the audited organisation for its information and for action, if necessary.

Results and discussion

The results of the field sampling audits conducted between May 2010 and April 2011 are summarised in this report.

Overall compliance was calculated as the average total compliance achieved from the audits.

Sydney

Beachwatch field officers achieved 100 per cent compliance with the established sampling protocols for the beach sampling run. Sutherland Shire Council lifeguards achieved an overall compliance of 98 per cent with the established sampling protocols. Non-compliance by Sutherland Shire Council lifeguards included not placing samples on ice immediately after collection.

Hunter

Sample collection in the Hunter region complied well with established Beachwatch sampling protocols. Hunter Water achieved an overall compliance of 98 per cent from the quarterly audits. Non-compliance by Hunter Water included storage and transport of samples at above the recommended temperature.

Illawarra

Sample collection by Sydney Water in the Illawarra region complied well with established Beachwatch sampling protocols, with a compliance of 100 per cent.

Partnership Program councils

All councils in the program recorded excellent compliance with established Beachwatch sampling protocols. Some councils were reminded of the importance of compiling a field manual to ensure consistency among officers undertaking the sample collection.

Conclusion

Auditing in the Sydney, Hunter, Illawarra and partnership council regions has shown an excellent level of compliance with established Beachwatch sampling protocols. The sampling officers demonstrated good understanding of aseptic water sampling and storage techniques, and a sound local knowledge of potential beach pollution sources and water quality issues.

These results indicate that water quality samples collected by, and provided to Beachwatch, are of an acceptable and high standard.

Laboratory analysis

Background

Since February 1993, Beachwatch has regularly sent sets of water samples to a number of National Association of Testing Authorities (NATA) accredited microbiological laboratories in order to determine the reliability of routine data provided by the contracted laboratory relative to those from other laboratories. The quality assurance program in 2010–2011 involved six independent laboratories and was undertaken on a monthly basis.

The Interlaboratory Comparison Program was extended to the Beachwatch Partnership Program when it commenced in 2002 (as the Beachwatch Partnership Pilot Program). In 2010–2011, testing was carried out at the beginning of the swimming season. Only results from council laboratories without NATA accreditation are reported. Council laboratories with NATA accreditation are not included in this report as they already comply with strict assessments and regular proficiency testing.

Methods

For the Beachwatch Program, laboratory QA involves the collection of three duplicate environmental samples at the start of each month. Samples are sent to five laboratories in the Sydney region and one laboratory in the Hunter region.

The environmental samples were collected from a location in the lower Parramatta River known to have a wide range of enterococci levels. To ensure that the set of samples sent to each laboratory is near-identical, a large sample is collected, shaken to ensure homogeneity, and then sub-sampled to six replicates. This process is completed three times, from slightly varied sampling locations.

Water samples for the Beachwatch Partnership Program laboratory QA were collected in a similar manner. Four samples covering a range of microbial densities were sent to thirteen laboratories extending from the far north to the far south coast of New South Wales.

Data analysis

Results for the Beachwatch interlaboratory program were calculated in two sections.

First, the geometric mean of each of the samples was calculated from the results of all the

laboratories; this is termed the consensus mean. This consensus mean was used to represent the best estimate of the true density of enterococci bacteria. The individual results for each laboratory were then compared with the consensus mean to calculate the relative deviation.

Analysis of variance (single factor ANOVA) was undertaken to determine whether there were any significant differences among the laboratories.

Data collected in the interlaboratory comparison study were analysed similarly. The deviation of the sample results from the consensus mean was determined, and a statistical analysis of variance was carried out to ascertain, if any, differences between the results of Beachwatch Partnership Program laboratories.

Results and discussion

Beachwatch and Harbourwatch programs

The relative accuracy of the contracted laboratory for the Beachwatch interlaboratory program was determined over two time periods, because of a change in the contracted laboratory during the 2010–2011 reporting year. Results that are within 0.3 log-units of the known value (equivalent to a halving or doubling of density on a linear scale) are considered to be acceptable.

From May 2010 to October 2010 the contracted laboratory performed well, with 83 per cent of their enterococci results within 0.3 log-units of the consensus mean. Enterococci results outside this range were only just outside the acceptable limit and at low bacterial densities (Figure 38).

Statistical analysis of the data showed that there was no significant difference among the results reported by the laboratories in the Beachwatch interlaboratory program. The contracted laboratory is Laboratory B in Figure 39.

From November 2010 to April 2011 the new contracted laboratory performed very well with 89 per cent of enterococci results within 0.3 log-units of the consensus mean. As shown in Figure 40, on only one occasion were the results just above or below the acceptable range.

Statistical analysis of the data showed that there was no significant difference among the results reported by the laboratories in the Beachwatch interlaboratory program. The contracted laboratory is Laboratory A in Figure 41.

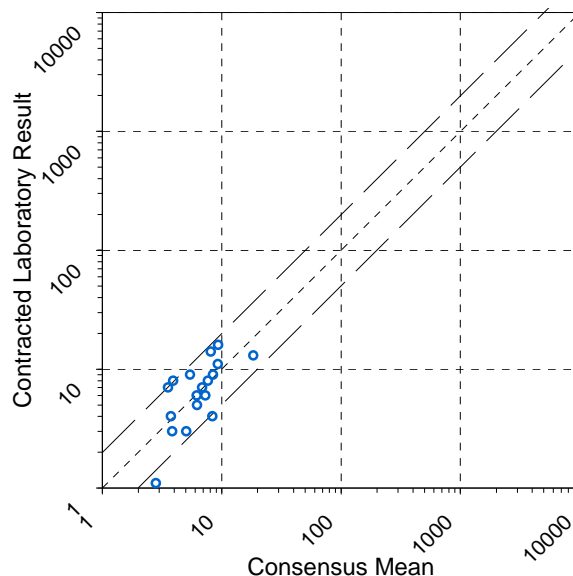


Figure 38: Distribution of enterococci results for the contracted laboratory, May 2010 to October 2010

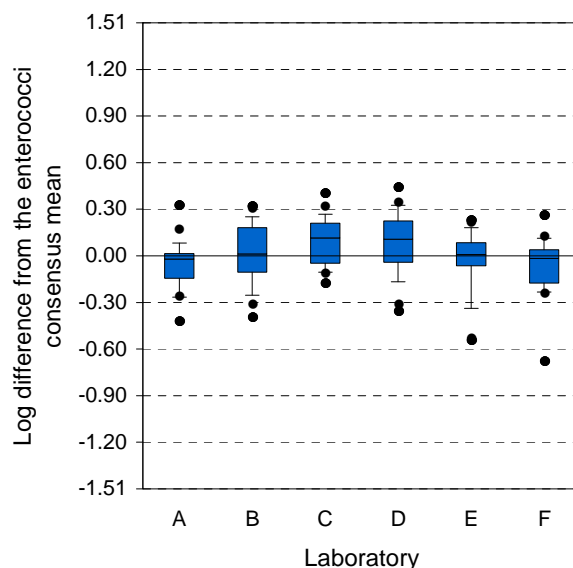


Figure 39: Deviation from the consensus mean for each laboratory in the Beachwatch Interlaboratory Comparison Program, May 2010 to October 2010

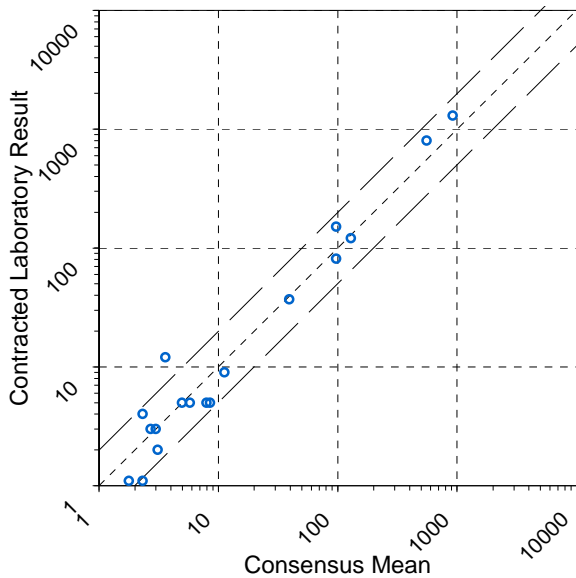


Figure 40: Distribution of enterococci results for the contracted laboratory, November 2010 to April 2011

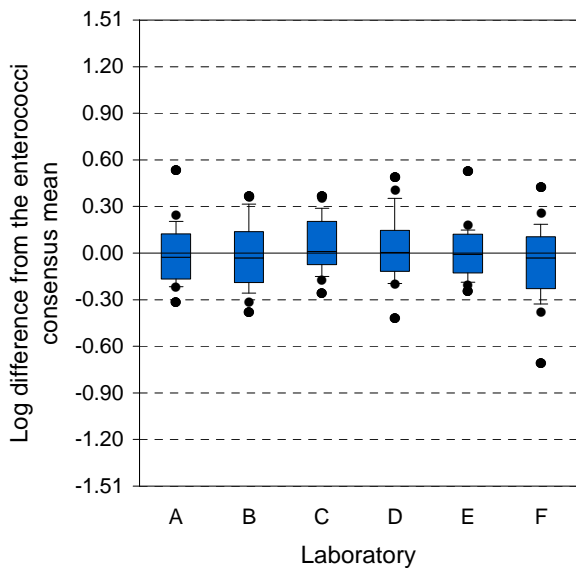


Figure 41: Deviation from the consensus mean for each laboratory in the Beachwatch Interlaboratory Comparison Program, November 2010 to April 2011

Beachwatch Partnership Program

The interlaboratory comparison study for the Beachwatch Partnership Program was conducted in November 2010, and the results are presented in Figure 42. The results from the four laboratories without NATA accreditation are presented for each sample in light blue, and the consensus mean of each sample is in dark blue.

There is a high level of certainty for the enterococci results from three laboratories, with data clustered around the consensus mean. However, one laboratory consistently underestimated all results, with three results outside the acceptable range of within 0.3 log-units of the consensus mean.

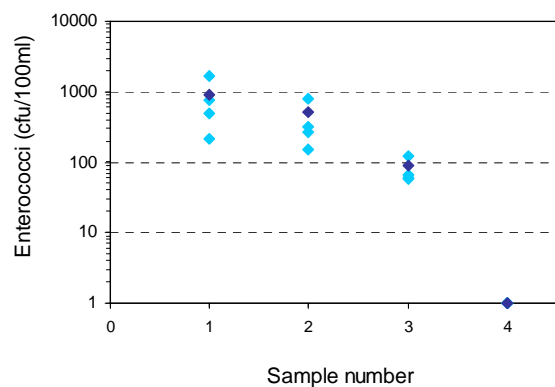


Figure 42: Results for the Beachwatch Partnership Program Interlaboratory Comparison Program

Additional quality assurance testing was conducted on the laboratory that underestimated all results to determine whether this was due to delay in receiving the samples, or to problems with enterococci analysis. To do this a duplicate sample was sent by council to a nearby NATA accredited laboratory to investigate if the estimation of enterococci densities differed significantly from their own.

The results from additional testing indicated that the laboratory performed well for enterococci analysis, suggesting that the initial anomalous results were due to degradation of the samples themselves, rather than to laboratory error. Further testing will be undertaken in 2011–2012.

Laboratory performance during 2010–2011 was similar to that recorded over the previous six summers, with most laboratories reporting results within 0.3 log-units of the consensus mean for all samples.

The results generated by each laboratory were statistically analysed to determine whether there were significant differences among the results from different laboratories. This analysis found that there

were no significant differences among laboratories for enterococci analysis (P value > 0.05).

Conclusion

The results from the two contracted laboratories used by the Beachwatch Program during 2010–2011 did not differ significantly from those of other NATA accredited laboratories in their estimation of enterococci densities. This indicates that the results reported are in the acceptable range, and confidence can be placed in the accuracy of water quality results reported in the Sydney region.

For the Beachwatch Partnership Program, the results from the 2010–2011 laboratory quality assurance were very good, and confidence can be placed in the accuracy of all data in this report. Although one laboratory underestimated all enterococci samples, and reported three results outside the acceptable limits, results from additional testing were within the acceptable range.

The laboratory QA program for the Beachwatch Partnership Program is more challenging owing to the distance between the laboratories involved in the program. The bacterial level in a sample can change significantly through time because of growth or die-off, and therefore delays in sample analysis can be a significant source of variation in data.

The laboratory quality assurance programs highlight the observation that a single result from any one laboratory can be substantially different from those reported by other laboratories. Therefore, when monitoring and reporting microbial water quality, it is preferable and more reliable to report results as trend analyses to minimise the effect of the occasional aberrant result.

Data management

Water quality results for swimming sites in the Sydney, Hunter and Illawarra regions are regularly electronically forwarded to Beachwatch Programs from the contracted laboratory, and by Hunter Water and Sydney Water laboratories. The water quality data are uploaded to the Beachwatch water quality database (BACTO) for storage and data evaluation.

All partnership councils transferred water quality data to OEH on a regular basis, for centralised storage on the BACTO database. In some cases, data were emailed directly from the analysing laboratory.

Quality assurance procedures for the storage of data on the centralized database followed a rigorous protocol that was developed as part of the

Beachwatch Program. This included data validation procedures to identify anomalous results.

Validated data were uploaded to the Beachwatch website by Beachwatch staff. This website (www.environment.nsw.gov.au/beach) provides online access to water quality monitoring data and assists councils to prepare their State of the Environment reports.

Community reporting

Providing the community with current beach water quality information is a core function of the Beachwatch programs, so reporting has been incorporated into the QA program.

This part of the QA program enables Beachwatch to measure the accuracy, consistency of content and punctuality of all reports released, and evaluates the reporting undertaken by partnership councils. When necessary, this information is used to improve the reporting process.

This section is divided according to the four main forms of reporting beach water quality in New South Wales. These are:

- Sydney daily bulletins
- weekly star ratings
- monthly reports
- regional council reporting.

Sydney daily bulletins

Beachwatch and Harbourwatch bulletins are generated daily to report on the likelihood of bacterial contamination at Sydney ocean and harbour swimming areas. This information can be accessed by the public through the Beachwatch website (www.environment.nsw.gov.au/beach) and the Beachwatch and Harbourwatch information line (1800 036 677). The information is also sent by email to a range of stakeholders and media. Bulletin emails replaced the faxed bulletin in 2009.

Beachwatch and Harbourwatch bulletins are based on telemetered rainfall data and any reported pollution incidents that could affect beach water quality. The bulletins include a prediction of the likelihood of pollution at ocean beaches and harbour swimming areas, as well as daily weather, tides and coastal conditions, based on the Australian Bureau of Meteorology's Metropolitan Forecast and Coastal Waters Forecast.

Daily bulletins are audited weekly to determine the accuracy of the pollution scenarios on the basis of rainfall, and the punctuality of emailed distribution. The accuracy and the punctuality of the daily bulletin updates, and the reported rainfall and tidal weather information, are also measured.

The results from the quality assurance audits are stored in an electronic database, with a weekly summary of any detected errors distributed to the field officers for their attention and action, if necessary.

Figure 43 shows a high accuracy in the reported pollution scenarios during both the winter and the summer season, with a minimum of 99 per cent accuracy. The Beachwatch bulletins were distributed in a timely manner 97 per cent of the time during winter, and 95 per cent of the time during summer. The timeliness of the Harbourwatch bulletins was very good, with compliance of 97 per cent and 100 per cent during the winter and summer seasons, respectively. Lateness of bulletins was usually only by a few minutes and the result of technical problems.

There were 212 daily bulletin updates through the 2010–2011 reporting year, of which only 15 were Harbourwatch updates. The accuracy of the updates was extremely good, with 100 per cent compliance for the winter and 98 per cent

compliance for the summer season. The timeliness of the updates was very good, complying 100 per cent of the time during winter, and 91 per cent of the time during summer.

The rainfall and tide information was accurate to a high level, with the rainfall information complying 99 per cent of the time during winter and 98 per cent of the time during summer. Tide information was accurate 100 per cent of the time and 94 per cent of the time during winter and summer, respectively.

Weekly star ratings

Each week during the summer season, star ratings for the Sydney, Hunter, Illawarra and partnership council regions are published on the Beachwatch website under 'Reporting'. The star ratings are based on NHMRC (2008) guidelines, with one star indicating poor water quality, through to a four-star rating indicating excellent water quality. The star ratings are calculated using a spreadsheet, and are approved by the Beachwatch manager before publishing on the Beachwatch website.

Star ratings are published in the *Newcastle Herald* and the *Port Stephens Examiner* newspapers in the Hunter region and in the *Illawarra Mercury* in the Illawarra. These advertisements run from November to March.

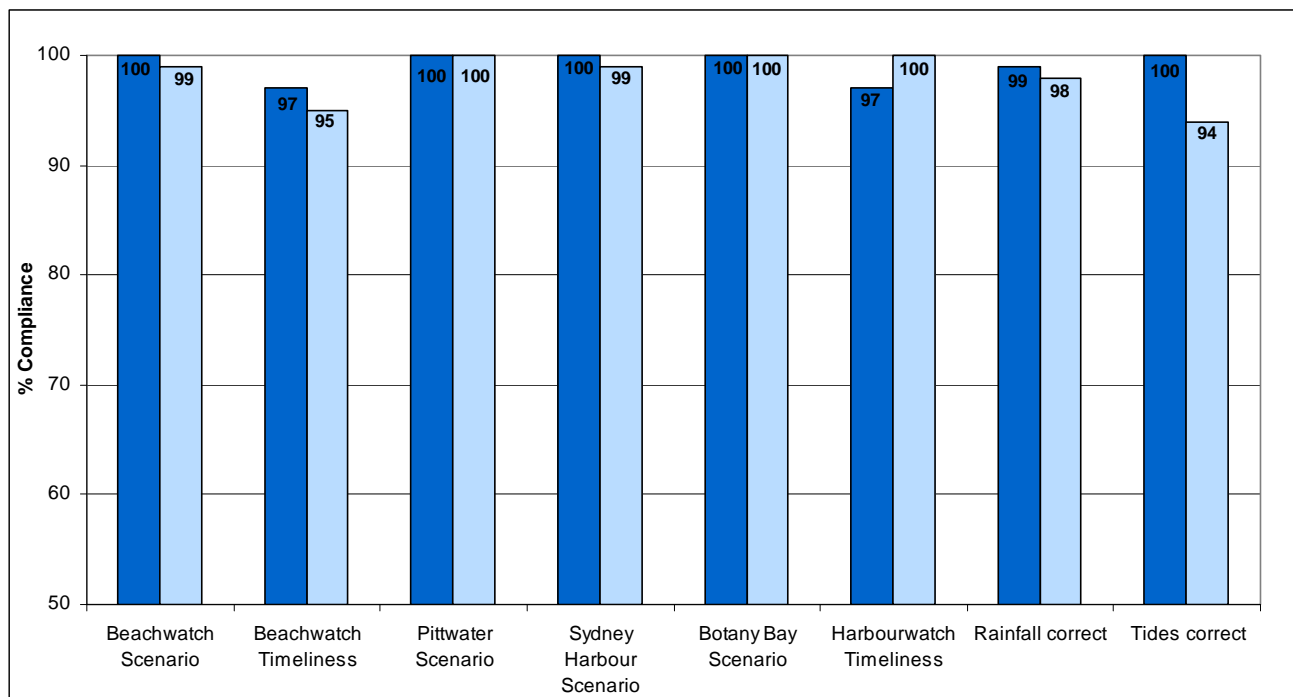


Figure 43: Quality assurance results for the Beachwatch and Harbourwatch daily bulletins during winter 2010 (■) and summer 2011 (□)

The star ratings published in the Hunter region are calculated by Beachwatch, confirmed by Hunter Water and then submitted to the newspaper for preparation of the graphic. A copy of the graphic is then supplied to Beachwatch for checking and approval prior to publication.

The same procedure is followed in the Illawarra region, with Beachwatch calculating the star ratings and Sydney Water confirming them before submission to the newspaper. The graphic produced by the newspaper is checked and approved by Beachwatch prior to publication.

As the star ratings for the Sydney, Hunter, Illawarra and partnership council beaches are quality assured by different people and/or agencies, any potential errors in calculations or in the presentation of data were detected prior to publication. No erroneous reports were published in 2010–2011.

Monthly reports

The Beachwatch and Harbourwatch monthly reports give details of the performance of Sydney ocean and harbour beaches for the previous month. These reports are available on the Beachwatch website under 'Reporting'. Before distribution, all computer-generated calculations are checked manually to ensure accuracy. As a result, all errors are detected before distribution of the reports.

Regional council reporting

An assessment of the reporting capabilities was made for partnership councils during the field audit visit and periodically throughout the summer season. Most partnership councils provide their water quality data regularly for the publication of star ratings on the Beachwatch website, as mentioned earlier.

Visits to partnership councils by Beachwatch field officers identified opportunities to improve community reporting of water quality results. The visits revealed that most councils have information about their Beachwatch programs on the council website, but the information in most cases was not kept current.

Some regional councils undertook media releases throughout the 2010–2011 summer season with the assistance of Beachwatch field officers. The media releases were drafted, edited and approved by Beachwatch Programs and councils to ensure the information released was accurate.

