IMPROVING BATHING WATER QUALITY: AUCKLAND CASE STUDIES

Timothy Hopley, Healthy Waters, Auckland Council

Kirsten Gerrard, Healthy Waters, Auckland Council

ABSTRACT

Many of Auckland's beaches are subject to intermittent microbiological contamination, which poses a risk to human health through recreational contact. Auckland's Safeswim website and beach signage communicates near real-time bathing risk at beaches over the summer months. Long-term health warning signage is erected at beaches with poor long-term water quality and Auckland Council has a programme that investigates these catchments to identify the faecal sources. Intervention solutions are then implemented to improve water quality.

The presence of microbiological contamination within the marine environment is often presumed to be the result of human related sources, such as wet weather-induced combined sewer and designed wastewater overflows into streams or directly from coastal stormwater outfalls. In addition, aging infrastructure, private septic systems or cross connections may contribute microbiological contaminants to the stormwater network and associated open waterways. However, non-human sources of contamination from domestic, wild and farmed animals and birds also enter the aquatic environment directly or via overland flow.

Effective management of microbiological contamination requires knowledge of the source animal so that appropriate intervention solutions can be applied. Recent advancements in molecular techniques have permitted the use of genetic markers to distinguish between sources of faecal pollution. Auckland Council's Healthy Waters department investigates these sources of faecal contamination and uses intervention solutions such as education, enforcement, stock exclusion, planting or a combination of solutions to reduce and eliminate sources of faecal pollution.

This paper will present a range of Auckland case studies that have been carried out by Auckland Council to investigate the sources of faecal contamination. These case studies will describe the investigation process and the sources of faecal contamination identified in each beach catchment. The case studies will also highlight the lessons learned from identifying and resolving the catchment faecal contamination issues.

KEYWORDS

Microbial source tracking; *Escherichia coli*; *E. coli*; marine; water quality; faecal pollution; Safeswim, bathing.

PRESENTER PROFILE

Timothy Hopley is a Healthy Water Specialists within the Wai Ora Team of Auckland Council. Timothy brings to the project freshwater sampling and field experience and also project management skills. Timothy graduated from Lincoln University with a Bachelor's degree in Ecology and Conservation and is currently completing a Master's thesis at University of Auckland.

1 INTRODUCTION

Long-term health warning signage is erected at beaches with poor long-term water quality according to the Microbial Assessment Category grades for marine sites (MAC grades). Once a beach is issued with long-term signage it is then incorporated into an investigation programme designed to identify the faecal sources so intervention solutions can be implemented to improve water quality.

The programme has two stages. The first stage is to test water discharging from stormwater outfalls onto a beach for *Escherichia coli* (*E.coli*) during rain events and dry periods. At the same time samples are also filtered for Microbial Source Tracking (MST) analysis. The *E.coli* samples are categorized into the surveillance (<260 *E.coli*/100ml), alert (>260 - <550 *E.coli*/100ml) and action levels (>550 *E.coli*) categories for freshwater according to the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE & MoH, 2003). The results are then prioritised with MST analysis being performed on the samples that returned the highest *E.coli* levels for both wet and dry days. With the intention on analysing all or at least a large majority of the alert and action categorised samples.

The second stage looks at the stormwater outfalls identified from the first stage with high *E.coli* levels and identified selected MST markers, either human, avian, dogs or ruminant. The sampling process is repeated up the stormwater network from the outfall or stream utilising manhole sampling and stream walks. All major or suspicious outfalls are tested for *E.coli* with samples filtered for MST analysis during rain events and dry periods. The results are then used to target mitigation methods or further investigate the source of the high *E.coli* with the aim of eliminating or reducing the levels. As will be shown with the case studies, these vary according to the identified faecal source and environment types.

2 CASE STUDIES

2.1 NORTHERN MANUKAU BEACHES

The Northern Manukau Beaches is a collective group of small beaches in the Manukau Harbour. Properties in these catchments are either on on-site wastewater treatment systems or reticulated systems and most have small streams that drain from small catchments onto the beach. Other outfalls also discharge onto the beach such as stormwater drains from roads and private property. In most instances the sampling targets these outfalls and the streams. Investigations to date have focused on French Bay, Titirangi Beach, Wood Bay, Huia Bay, Fosters Beach, Laingholm Beach and Green Bay with the stage 1 method described above and some stage 2 investigations begun.

2.1.1 FRENCH BAY

Five sites were identified for sampling within the French Bay catchment. In 2015 all of these were targeted using the stage 1 method. During the investigation it became apparent that some sites were continuously dry and subsequently dropped from future sampling. The investigation found that freshwater inputs usually exceeded the MfE

guidelines in both dry and wet weather. From 15 samples analysed for MST, eight were positive for dogs, six positive for human and two were positive for avian (Each sample can contain multiple positive results).

2.1.2 TITIRANGI BEACH

Five sites were identified for sampling within the Titirangi Beach catchment. The results showed that rainfall events greater than 3mm produced elevated *E.coli* levels. However some samples were also high during dry weather and only elevated during rainfall events. Like many of the Northern Manukau Harbour beaches the small stream that runs thru the catchment and flows onto the beach can be influenced by beach sandbank movement restricting flow. This flow restriction may account for higher concentrations of *E.coli* due to bacterial proliferation as a result of favourable conditions in these environments. From 26 samples analysed for MST, 11 were positive for dogs, 13 were positive for avian and eight were positive for human sources of faecal contaminaiton.

2.1.3 WOOD BAY

Seven sites were identified for sampling within the Wood Bay catchment for 2015. These were then reduced to five sites for the following year. All sites entering the beach had elevated levels of *E.coli* for both dry days and wet days sampled, exceeding the MfE guidelines. Rainfall exacerbated the levels. From 38 samples analysed for MST analysis dogs were positive in 10 samples, avian were positive in six samples and human were positive in six samples. The overall results for Wood Bay were inconclusive. Some sites had high levels of *E.coli* but had no positive results when analysed for MST, making it extremely difficult to identify the sources. Additional sampling is planned to help with decision making.

2.1.4 HUIA BAY

Hui Bay is a small community that is solely on on-site wastewater treatment systems. Six outfalls were sampled along the beach front at Hui Bay. This included two streams that flow along opposite sides of the valley. From 35 samples analysed for MST, 24 were positive for human. Four samples were positive for avian, two were positive for dog, and ruminant markers were present in two of the samples. Human faecal contamination was positively identified in five of the six sites with the remaining site having a "probable weak human source" indicating that human faecal contamination is a significant contribution to the beach.

2.1.5 FOSTERS BEACH

Fosters Beach is another small community with on-site wastewater. From the seven sites sampled, 6 had evidence of human faecal contamination and four had evidence of dog faecal contamination. Outfalls differed to what was shown on GIS layers indicating potentially illegal non-consented discharges onto the beach. This also highlights the importance of regular stock-takes of stormwater outfalls and updating of GIS layers.

2.1.6 GREEN BAY

Green Bay has a small beach front with a limited drainage catchment. The results from this bay are very cryptic, with no positive source results, despite having *E.coli* results in the thousands. All three sites had probable human sources or potentially cat, rabbit,

possum or weak human sources (BacH marker). The small catchment size will help to identify potential sources of the high *E.coli* levels with a more targeted investigation.

2.1.7 LAINGHOLM BEACH

During the stage 1 investigation eight sites were sampled. Three freshwater sites, a stormwater discharge point and four marine sites. From 16 samples analysed for MST nine were positive for human, seven were positive for dogs and four were positive for avian sources. All positive avian samples were from the same site located on the stream where it enters onto the beach and is a common spot for moderate numbers of birds to gather.

Laingholm Beach is one of the few beaches where stage 2 investigations are underway. To date, the stage 2 investigation has been completed on a small stream which flows along one side of the valley. Another stage 2 investigation is being completed on the opposite side of the valley to the stream to investigate the stormwater network that flows to one of the biggest outfalls on the beach that had positive human results during the stage 1 investigation.

Given the information found during the stage 1 investigation it was deemed that two separate stage 2 investigations would be utlised. One focusing on the stream and one focusing on the stormwater infrastructure on the opposite side of the valley. The stream walk undertaken as part of the stage 2 investigation for the creek found 37 pipes of varying sizes and varying material entering the stream. *E.coli* samples and notes were taken along the stream at 15 sites. Similar to the stage 1 investigations, sampling was completed on both dry and wet days along the stream. The results found that from 15 sites during dry weather five exceeded the MfE guidelines (>260 E.coli/100mL). Compared to all 15 sites exceeding the guidelines during wet weather. MST analysis completed for the dry sampling found positive human marker in one sample, avian in three samples and dogs in one. MST analysis done on the wet weather samples found human markers in seven out of 15 samples and dog marker in 12 out of 15 samples. This confirms the increase of faecal contamination that arises from rain events.

The second stage 2 investigation looks at the stormwater netowrk. This is currently underway. Sites have been identified with focus on areas of wastewater infrastructure and particular focus on locations where the two infrastructure types cross over one another. The results will be analysed and areas between sampling points that have shown to be of concern will undergo further scrutiny utilising die testing and CCTV to pinpoint the problem.

3 CHRISTMAS BEACH

Christmas Beach is a small beach on a small island at the top of the Waitematā Harbour. The catchment that drains onto the beach is small and houses are on a reticulated system. Six outfalls were identified that discharge onto the beach for a stage 1 investigation. All outfalls, at some point, had elevated *E.coli* levels well above the MfE guidelines. Twenty three samples were sent away for MST analysis and the results came back with six sites being positive for the dog marker and three positive for the human marker. A number of sample with high *E.coli* levels had with "faecal source not identified". This can happen for a number of reasons and highlights the need for replication at each site.

As a mitigation method Auckland Council's animal control were notified and asked to undertake education and compliance within the catchment to reduce dog faecal contamination.

4 WEYMOUTH

Weymouth is located on the East side of the Manukau Harbour. It has had long term warning signage for bathing in place since 2000. During 2014/2015 an investigation similar to the stage 1 and 2 methods was instigated using *E.coli*, enterococci and MST analysis. The investigation found that one main outfall was of major concern with positive human markers and to a lesser degree positive markers for avian and dogs. Further investigation found 44 wastewater and stormwater infrastructure issues within the catchment, all of which were remedied by mid-2016.

Re-sampling was undertaken in late 2015/2016 to measure the effectiveness of the remedied work. The results found that human sources were still present but greatly reduced with avian and dog sources most prevalent. Another series of re-sampling was undertaken in 2016/2017 with the results showing that 13 of the 15 samples were positive for avian. Human sources were found only once during a higher than average rainfall event.

Mitigation methods for the avian faecal contamination are currently being planned to control the ducks at the reserve near the beach. These include signage to discourage people from feeding the ducks and strategic planting for filtering runoff and minimizing the area available for ducks to congregate.

5 CONCLUSIONS

- Microbial Source Tracking remains a highly efficient tool for highlighting areas of faecal contamination when used in conjunction with *E.coli* or enterococci sampling.
- Replication of MST analysis at each site is imperative to ensure positive marker identification.
- Sampling on both dry periods and during rain events have shown to be important method in understanding what is happening further up in the catchment.
- Stream walks have been beneficial for investigating potential sources of contamination.
- Up to date GIS layers with all known stormwater outfalls identified make identifying illegal and suspicious outfalls easier.

ACKNOWLEDGEMENTS

This work has relied on many people from within Auckland Council and external consultants. We would like to acknowledge the effort done by Justine Quinn (Tonkin & Taylor), Martin Neale (Puhoi Stour).

REFERENCES

Quinn, J.L., Neale,M.,W. (2016). Selected Northern Manukau Beaches (French Bay, Titirangi Beach, Wood Bay) Water Quality Investigation. Prepared by Golder Associates (NZ) Limited for Auckland Council. (In review).

[2]Quinn, J., L., Neale, M.,W. (2016). Laingholm Beach water quality investigation. Prepared by Golder Associates (NZ) Limited for Auckland Council. Auckland Council technical report, TR2016/030.

Faecal Source Tracking, Laingholm Stream Catchment (November, 2017). Prepared by Golder Associates for Auckland Council. (In review).