Clean Ocean Access 2008-2017 Water Quality Monitoring Summary Report

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EXECUTIVE SUMMARY

Clean Ocean Access collected 4,309 water samples on a weekly basis at several popular swimming locations and likely source areas of *Enterococci* along the Aquidneck Island shoreline and watershed from January 4, 2008 to December 29, 2017. Clean Ocean Access extends sincere appreciation to the volunteers and their tireless effort that allows this program to continue, and equally to City of Newport for funding support from the annual budget, Town of Middletown for funding support from civic appropriations, and Rhode Island Department of Health for supporting the year-round water quality monitoring working towards permanent year-round clean water.

While year to year variation may occur due to a variety of circumstances, overall water quality has improved, however, elevated and persistent bacteria levels are still present at some locations, and new issues have been identified and require resolution. These impairments must be addressed in the years to come by a combination of gray and green infrastructure solutions, and efforts by all island residents to transform our built-landscape into an environment that absorbs stormwater runoff and reduces pollutant loading into our recreational waters.

The Clean Ocean Access year-round weekly water quality monitoring program is a citizen science initiative aimed to directly empower the community to provide monitoring data for use in decision making as part of a sound water quality management plan that includes regular water quality testing, timely identification of point and nonpoint source of pollutants, and effective remediation. The program aims to achieve our long-term goal of permanent year-round clean water as part of the Clean Water Act.

The environmental data collected is integrated with “standard” data collected by state & federal agencies and shared with scientists, residents, stakeholders and policy makers to influence science, decision-making and have an impact at many levels, via effective and open communication. Weekly water samples collected over a nine-year period provides an opportunity for quantitative long-term trend analysis.

During this period, the communities of the City of Newport and Town of Middletown have made significant investments to address the pollution problems facing the Aquidneck Island shoreline and watershed. Island wide coalitions and projects, such as the Green Infrastructure Coalition and Island Waters are poised to advance Aquidneck Island towards permanent year-round clean water to improve the water quality, so our beaches are swimmable and fishable, and our ponds and reservoirs require minimal treatment to provide abundant safe drinking water for our residents and visitors.

It is emphasized that this program focuses on locations that are known for swimming and ocean activities, although not all are necessarily recognized as designated swimming areas. The commitment and endorsement of this activity complements existing efforts and further demonstrates the partnership of the community and city/state/federal agencies.

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1.1 MISSION

Clean Ocean Access (COA) is a grass roots non-profit environmental organization with a primary focus on marine debris, water quality and shoreline access on Aquidneck Island, Rhode Island. The goal of the group is to bring public awareness to local issues with a mission of acting today so that future generations can enjoy ocean activities. Clean Ocean Access believes that environmental sustainability will occur when people spend time outside, together, connecting with nature and understanding the impact that we are having on the environment. We can learn from it and make better decisions in an easier manner when people connect with nature.

The Clean Ocean Access year-round weekly water quality monitoring program is a citizen science initiative aimed to directly empower the community to provide monitoring data for use in decision making as part of a sound water quality management plan that includes regular water quality testing, timely identification of point and nonpoint source of pollutants, and effective remediation. The program aims to achieve our long-term goal of permanent year-round clean water as part of the Clean Water Act.

Our specific goals since 2006 remain the same: (1) to continue to establish a baseline foundation of water quality at several locations that are widely used by ocean enthusiasts although not recognized as designed swimming areas, (2) Official designation of swimming areas, (3) to provide a baseline for possibly re-opening Kings Park Swim Area, (4) to expand the program to test the likely sources of *Enterococci* at Easton's Bay so as to eliminate the sources, (5) to bring public awareness to water quality during "off season" months, a time in which many people use the water for recreation, (6) to bring public awareness to dry-weather water quality issues working in partnership with all agencies, so as to (7) achieve the long term goal of year-round funded water testing in New England and (8) permanent clean water.

1.2 BACKGROUND

In the fall of 2006 COA in a partnership with CoastalVision developed a water testing program with a primary focus on Easton's Beach and the possible sources of bacterial pollution that result in beach closure. The program was funded by the Rhode Island Department of Health (RIDOH) and the Environmental Protection Agency (EPA) Region 1. The result of the program showed that water quality issues persisted even as water temperature decreased in the winter. COA has a large group of year-round ocean enthusiasts and this finding initiated a long-term goal to work towards year-round water testing with the ultimate vision of permanent clean water along the Aquidneck Island shoreline.

In December of 2006, COA received funding from the City of Newport to continue the water testing program into 2007 where COA performed all manpower, logistics, management, data analysis and the City paid the laboratory fees directly to RIDOH. The program results from 2007 showed that water quality issues at Easton's Beach persisted through the winter and spring; some pollution events were strongly correlated with precipitation events while some pollution events were not directly associated with precipitation events.

In December of 2007, COA received funding from the City of Newport to continue and also enhance the water program into 2008 for weekly year-round testing with a similar cost structure as 2007. However, in 2008 the program focus expanded to include several locations that are known for swimming and ocean activities, although not explicitly recognized as swimming beaches by RIDOH. The results of the 2008 program indicated that water quality issues occasionally occurred throughout the year and that a direct correlation of precipitation to high readings does not exist in all cases and that additional and more frequent testing of water quality is required in order to determine the sources and the best short & long-term solutions.

In December of 2008, COA received funding from the City of Newport to continue the program into 2009 and to include two additional locations that are highly recognized as the main contributors of *Enterococci* to Easton's Bay (Newport Moat and the Esplanade outfall). The findings from the 2009 program indicated that both sources continued to be large contributors of *Enterococci* to Easton's Bay and the program also helped to provide further data supporting the opening of Kings Park Swim Area.

The program continued through 2010 into 2014 with a similar structure and results showed that water quality at Kings Park Swim Area warranted consideration of re-opening the swimming location. Water quality at Marine Avenue Beach was poor and an action plan must be developed to find the source of the *Enterococci*. The results from 2010 into 2014 continued to illustrate that a high correlation of precipitation to high readings does not exist in all cases and that additional and more frequent testing of water quality is required to determine the sources and the best short- and long-term solutions.

The program continued through 2015 into 2016 with a similar structure and results. In 2016 additional focus was put towards Bailey Brook and it has been identified that elevated bacteria levels exist in the watershed. In 2017 the program expanded to include Second Beach to establish a year-round baseline, and Third Beach to identify if the elevated summer bacteria levels persist into the winter months.

1.3 PROGRAM STAFF

COA became a non-profit organization in 2014 and the Executive Director performs an advisory role to oversee the program operations, whereas the Program Manager is responsible for the successful program outcome. Weekly planning and execution runs entirely with volunteers from the community. The Executive Director and Program Manager provide oversight for strategic decision making and interaction with local, state and federal officials. The operations and scheduling managers provide weekly operations and logistics management of the entire program making sure the equipment, supplies, chain of custody, survey sheets are completed in compliance with necessary protocol established with RIDOH/EPA in 2006. A team of 25 volunteers provide the manpower for weekly water sampling, survey and logistical tasks for twelve locations along with volunteer courier service to the Rhode Island Department of Health in Providence. A fleet of volunteers exists on-call to provide backup support or surgical strike (at various locations across Aquidneck Island) water testing when required. Over 200 people have volunteered for the COA water quality program since the fall of 2006.

1.4 FUNDING

The City of Newport City Council provides funding for laboratory fees for the COA water quality monitoring program via their annual budget since 2008. Without the support of the City of Newport, this program would not be possible. Rhode Island Department of Health bills the City of Newport on a quarterly basis. The current cost for the program is $25 per sample, with 12 samples taken 52 times per year for a total of $15,600. The City of Newport covers eight samples and Clean Ocean Access pays for the four samples in Middletown via civic appropriations from the Town of Middletown.

1.5 SAMPLING METHODOLOGY

The 2009 through 2017 COA Water Quality monitoring program adopted a new methodology for the date of each weekly test, different from the 2008 method. In 2008, each Saturday a prediction was made as to when it would rain, and the test was scheduled for the following day. This resulted in several tests occurring immediately after and/or during an event, however there were other times that the weather changed, and the event did not occur, and/or the event occurred during a weekend which is not available for non-seasonal laboratory processing. In 2009 a fixed date (Thursday) was selected for the sampling. This approach was chosen to minimize the impact to volunteer personal schedules.

1.6 WATER QUALITY HISTORY

The federal Beaches Environmental Assessment and Coastal Health (BEACH) Act requires that water from designated swimming beaches be tested for *Enterococci*. Extensive EPA studies have shown that *Enterococci* are the most efficient bacterial indicator of water quality. *Enterococcus* is a part of the composition of Fecal Coliform which is a special kind of bacteria that is found primarily in the intestinal tracts of warm blooded animals. These bacteria are released into the environment via human and animal feces and if ingested while swimming or adsorbed via the skin they may cause human disease, infection or rashes.

1.7 WATER QUALITY STANDARDS

Rhode Island bathing water standards are monitored by the Rhode Island Department of Health based on water quality standards set by Rhode Island Department of Environmental Management and the United States Environmental Protection Agency. Saltwater bathing waters must not exceed a single sample standard of 60 *Enterococci* (colony forming units) per 100 milliliters (ML); this is commonly referred to as a single sample maximum (SSM) or action standard. More recently since 2014 this is referred to as the Beach Action Value (BAV).

Analysis of water quality over a long-time period is better understood using the 'geometric mean' a common technique for scientific analysis of large datasets that calculates the typical value of a set of numbers. The geometric mean is a more reliable measure of long term water quality, being less subject to short-term random variation. EPA studies derived the SSM as a percentile indicator of a distribution of concentrations around the 30-day geometric mean. The SSM values in the 1986 EPA *Ambient Water Quality Criteria for Bacteria* were not developed as acute criteria; rather, they were developed as statistical constructs to allow decision makers to make informed decisions to open or close beaches based

on small data sets. For beach locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ML for a geometric mean.

1.8 WATER QUALITY – LABORATORY TESTING METHOD

The current test used by the Rhode Island Department of Health for saltwater bathing water is the IDEXX Enterolert™ method. The technician places a small amount of sampled water (10ML) into a dish with a reacting agent (Defined Substrate Technology nutrient indicator). The mixture is poured into a tray with many cells sealed and allowed to incubate for 24 hours. During the incubation period the nutrient indicator fluoresces when metabolized by *Enterococci*. After the incubation period the technician counts the fluorescent cells (colony forming units, CFU) and refers to the most probable number (MPN) table to determine the reading with a range of values from less than 10 to a maximum value of 24,192 CFU/100ML.

1.9 MONITORING WEBSITE

The COA Water Quality Program is available via the internet at http://www.cleanoceanaccess.org and contains the water testing procedure and guidelines, contact information, schedule of testing and actual water testing results. COA maintains the schedule of testing while the Rhode Island Department of Health directly updates the actual water testing results. COA testing methodology including sampling method, chain of custody and adherence to schedule requirements with partnership from Rhode Island Department of Health and support from EPA Region 1 has resulted in the COA data set being included in the RIDOH data set and can be accessed at http://www.ribeaches.org/ and also within the USEPA Beach Advisory and Closing On-Line Notification (BEACON) program at: http://iaspub.epa.gov/waters10/beacon_national_page.main

2.0 SAMPLING LOCATIONS

The sampling locations are located on the southern part of Aquidneck Island as shown in Figure 1.0.

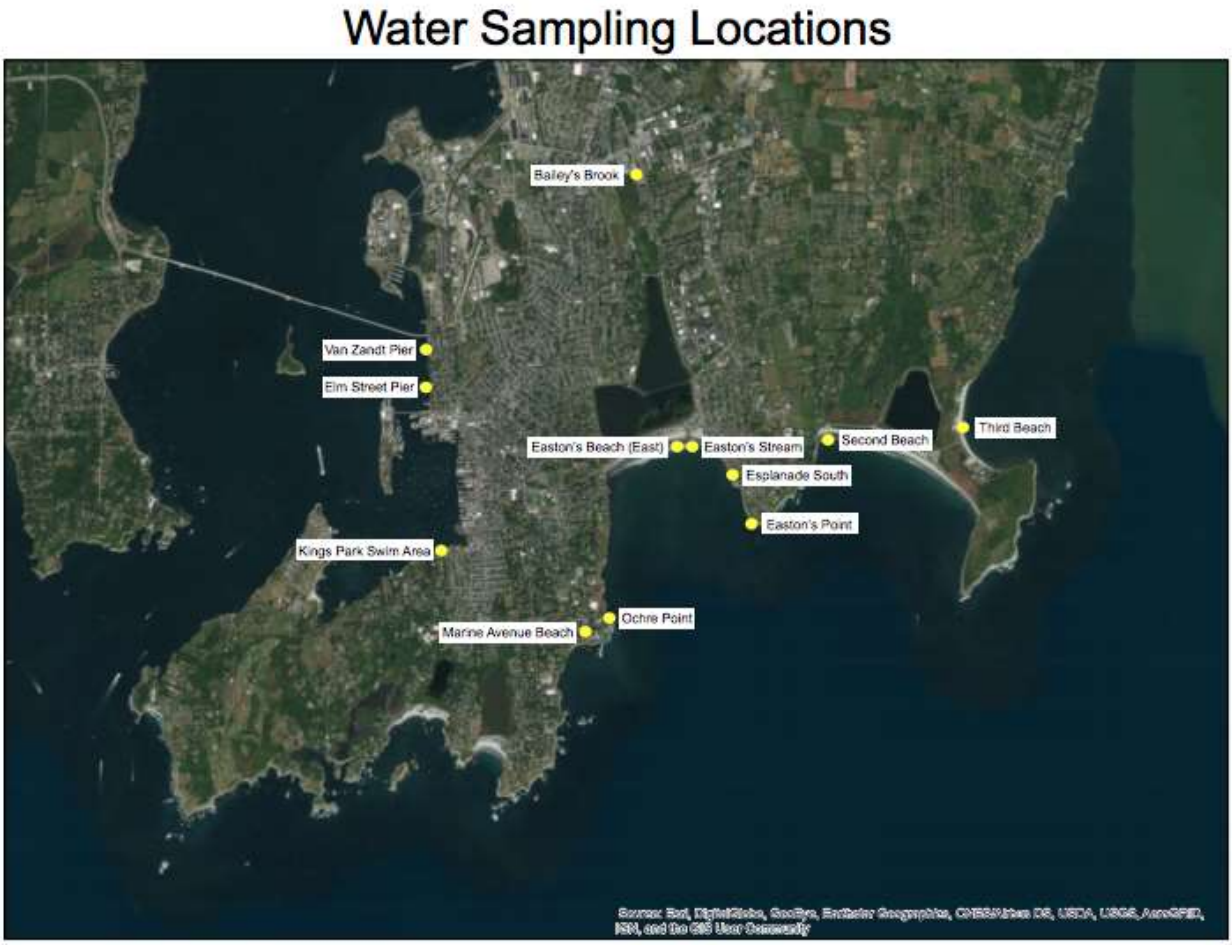

Figure 1.0 | Sampling Locations.

2.1 EASTON'S POINT

This location is a popular area for ocean activities including kayaking, spear-fishing and occasional Paipo boarding. The purpose of testing this location is to establish a baseline and public awareness of coastal water quality. This location is a southeast-facing wave-swept rocky exposure to open ocean at the southern tip of Easton's Point. COA adopted this Coastal Resources Management Council (CRMC) Public Right of Way (Y-1) in the spring of 2008 as a partnership with the Town of Middletown and CRMC.

2.2 EASTON'S BEACH (EAST)

This location is a main attraction for the City of Newport. The exact testing location is halfway between the rotunda and the stream mouth on a south facing beach in an embayment facing the open ocean. The purpose of testing this location is to enrich the dataset of water quality to identify any potential health problems that may exist at the area beaches.

2.3 OCHRE POINT (RUGGLES AVENUE)

This location is a popular area for ocean activities including fishing and body surfing. The purpose of testing this location is for public awareness to the quality of the water. This location is a wave swept exposure on the western point of Easton's Bay facing the open ocean and helps to provide baseline data for the water quality of Easton's Bay. Samples were collected at the base of the seawall at the end of Ruggles Avenue. COA adopted this Coastal Resources Management Council (CRMC) Public Right of Way (Z-4) in the spring of 2008 as a partnership with the City of Newport and CRMC.

2.4 MARINE AVENUE BEACH

This location is a popular swimming spot for citizens of the City of Newport. The city has invested time and effort to establish the Public Right of Way to the shoreline. The purpose of testing this location is for public awareness to the quality of the water. The location is a southeast facing shallow rocky beach open to the ocean. It is on the western side of Ochre Point separated by a rock ledge from the other sampling location.

2.5 KINGS PARK SWIM AREA

This location is a popular swimming spot for previous generations of the City of Newport. The purpose of testing at this location originally was to provide a baseline for re-opening the beach and now it is to provide insight into the current water quality throughout the year. The beach is a northward facing rocky beach in a protected recreational and commercial harbor.

2.6 ELM STREET PIER

This location is a popular swimming spot for a wide range of citizens of the state of Rhode Island including a large percentage of the children of the City of Newport. The pier is located at the southern end of a bulk headed shore in a protected harbor adjacent to Storrer Park and the causeway to Goat Island. The purpose of testing this location is to help establish Elm Street Pier as a designated swimming area and public awareness to the quality of the water.

2.7 VAN ZANDT PIER

This location is a popular swimming spot for a wide range of citizens of the state of Rhode Island including a large percentage of the children of the City of Newport. The pier is located at the northern edge of a bulk headed shore in a protected harbor just south of the eastern terminus of the Pell Bridge. In 2007, COA met with the 6th grade class at Thompson Middle School and recorded that well over half of the students at the assembly had swum at Van Zandt Pier during the summer of 2006. The purpose of testing this location is to help establish Van Zandt Pier as a designated swimming area and public awareness to the quality of the water.

2.8 SECOND BEACH

This location is a popular surfing spot, swimming spot and beautiful beach used by many the citizens of Rhode Island. During the late spring and through the summer and fall, the parking lot is often full at Second Beach indicating its high popularity. You will frequently find surfers here year-round regardless of the weather, making it an important location to test the water quality year-round. The purpose of testing this location is to have continuity with testing of beaches that have high recreational use and enrich the dataset.

2.9 THIRD BEACH

This location offers a boat ramp, summer lifeguard, a picnic area, free parking, and a beautiful sandy beach making it a popular beach location in Rhode Island. In the summer of 2017, high bacteria levels were found at Third Beach bringing up the question of what happens during the winter months. In partnership with the Sachuest Point Wildlife Refuge, Town of Middletown and Rhode Island Department of Health and Department of Environmental management, tested was initiated in the Fall of 2017.

2.10 EASTON'S STREAM

This location is one of the likely primary sources of *Enterococci* affecting Easton's Beach. The moat collects runoff from a large area of the City of Newport (as the western source) and also runoff from Middletown industry surrounding Easton's Pond (as the eastern source). The City of Newport installed a UV disinfection system to treat the water prior to flowing into the ocean to kill the *Enterococci*. The purpose of testing this location at the stream mouth of the moat is to determine the persistence of *Enterococci* from this likely source to aid decision making about water pollution problems in Easton's Bay and to validate the effectiveness of the UV disinfection system.

2.11 ESPLANADE OUTFALLS

The north location is one of the likely primary sources of *Enterococci* affecting Easton's Beach. The outfall contains storm water runoff that is discharged on the far eastern rocky coastline of Easton's Bay adjacent to the Atlantic Beach Club Beach via a 36" diameter steel pipe. The Town of Middletown combined the flow from this pipe and the south location and moved the storm water approximately 1,000 feet offshore via a diffuser system in 2014. The purpose of testing this location is to determine the persistence of *Enterococci* from this likely source to aid decision making about water pollution problems in Easton's Bay.

2.12 BAILEYS BROOK

Because of expanded watershed monitoring for nitrogen and phosphorus in the watershed, efforts were put forth to expand the monitoring of Bailey Brook for bacteria as it is located in our watershed in an urban area with high traffic and could be a source of *Enterococci*. Baileys Brook is long stream that has two stream branches flowing southerly to the North Easton Pond which discharges into the Atlantic Ocean. The North Easton pond which Baileys Brook flows into, is a source of drinking water to the residents of Aquidneck Island, making Baileys Brook an important place to test water quality. Testing at Baileys Brook expands our water quality testing program into Aquidneck Island's watershed and will help us to better understand the sources of *Enterococci*.

3.0 WATER QUALITY RESULTS AT SWIMMING LOCATIONS

3.1.1 OVERALL RESULTS

During the timeframe from January 4, 2008 to December 29, 2017 weekly water samples were collected and there were 3,448 samples collected at nine swimming locations and 861 samples collected at locations near to likely sources of bacteria. The sampling occurred on a weekly basis; whereas in 2008 it occurred on a variable date (Monday through Friday) with partial coordination with precipitation events and in 2009 through 2017 it occurred on a fixed date (Thursday). As shown in figure 2.0 and 2.1 there were 562 samples above the Beach Action Value (60CFU/100ML) in Newport Harbor and Ocean locations, however more of these elevated results occurred in Ocean swimming locations.

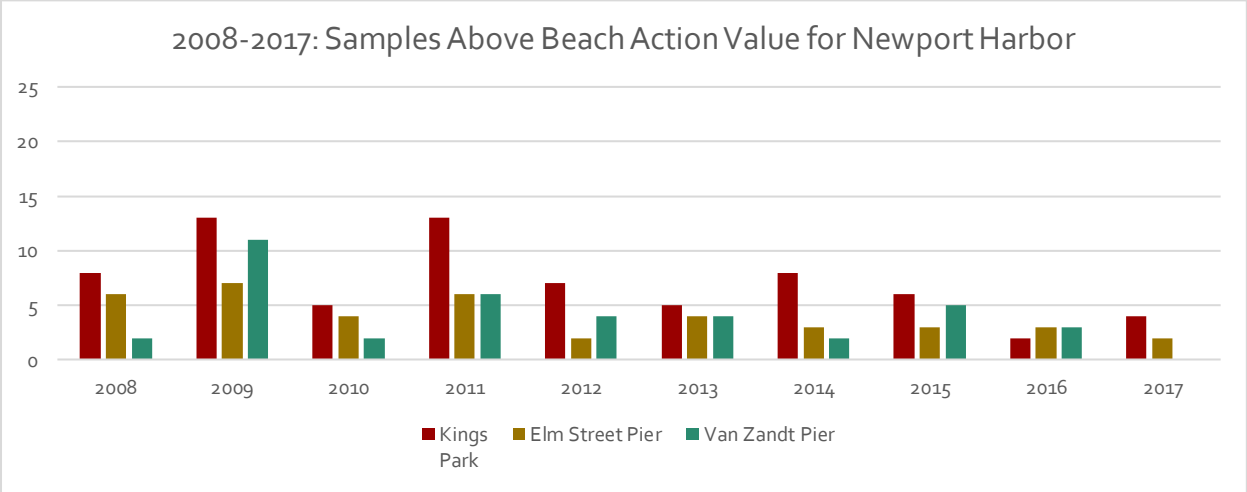

Figure 2.0 | 2008 – 2017: Samples Above Beach Action Value for Newport Harbor.

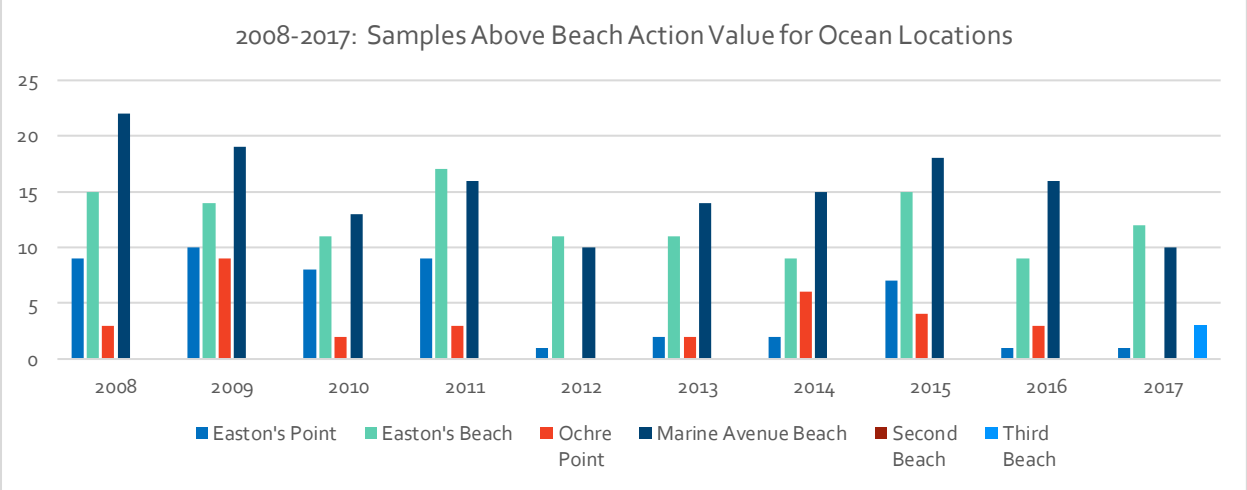

Figure 2.1 | 2008 – 2017: Samples Above Beach Action Value for Ocean Locations.

The general reduction of samples above the Beach Action Value in Newport Harbor can be attributed to the significant efforts made by the City of Newport to reduce combined sewage overflows. Similarly, elevated levels in Ocean Swimming Locations have reduced slightly however persistent elevated levels exist at Marine Avenue Beach and slightly lower levels at Easton's Beach (East).

Analysis of water quality over a long-time period is better understood using a geometric mean. For beach locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. As shown in figure 2.2 the Annual Geometric Mean of Enterococci for Newport Harbor has reduced over the years and all locations are well below the action standard of 32 CFU per 100ml, assuring a high level of confidence of safe swimming water.

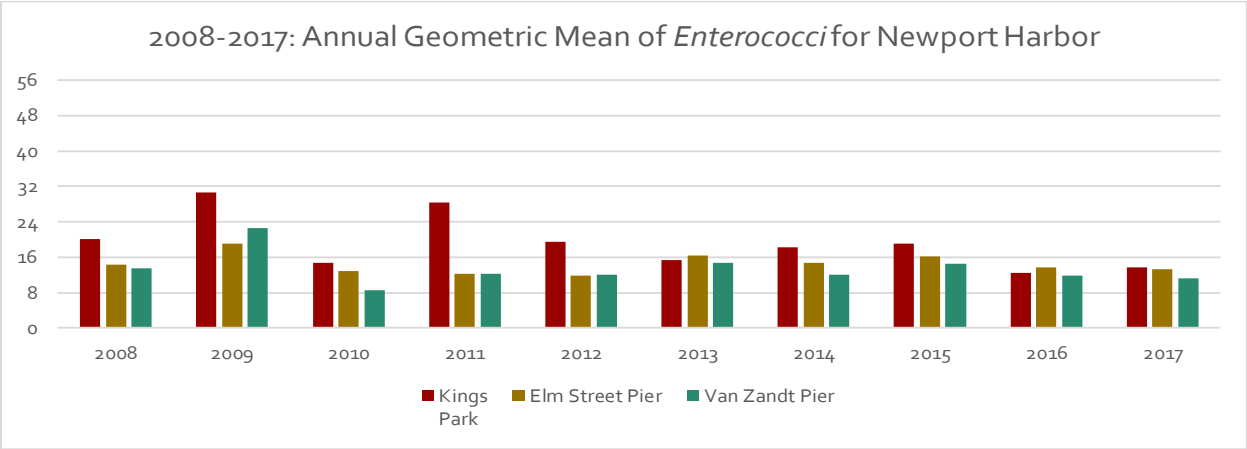

Figure 2.2 | 2008 – 2017: Annual Geometric Mean of Enterococci for Newport Harbor.

As shown in figure 2.3 the Annual Geometric Mean of Enterococci for Ocean locations has reduced and within acceptable ranges for some locations, however water quality at Marine Avenue Beach is impaired and could be improved via efforts underway to improve the water infrastructure on Ruggles Avenue. Water quality has had improvements at Easton's Beach (East) on an annual basis, and a new area of concern is Third Beach in Middletown, however it is premature to speculate if this is a long-term issue.

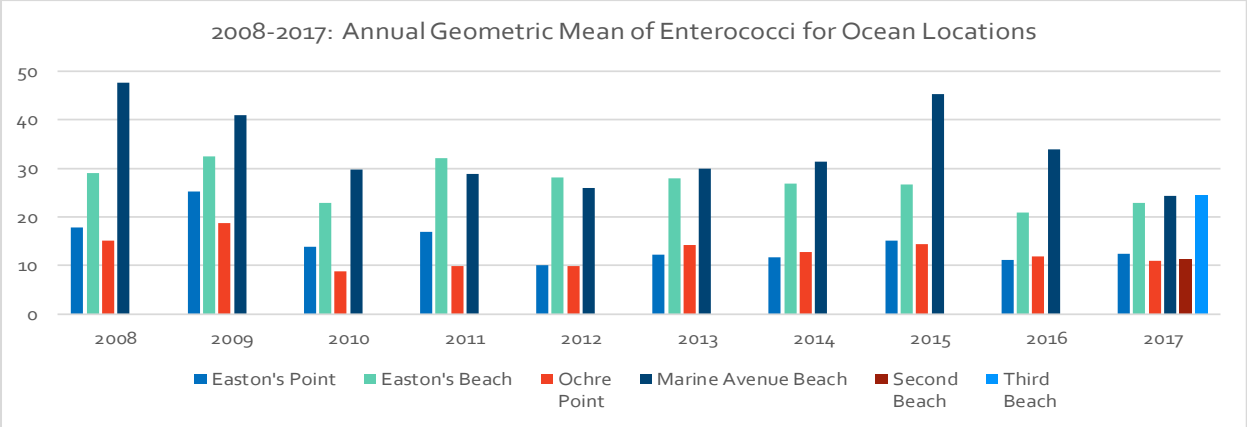

Figure 2.3 | 2008 – 2017: Annual Geometric Mean of Enterococci for Ocean Locations.

Overall, this dataset provides a valuable resource for stakeholders and decisions makers to make informed decisions of how to address water quality issues that face the community of Aquidneck Island. The data set represents a combination of dry-weather and wet-weather patterns and due to the complex set of sources including, but not limited to, potential SSO events, CSO events, animal waste, illicit connections, seasonal boaters, human activity, and other complex situations, it is difficult to quantitatively determine the source of *Enterococci* at these swimming locations.

3.2 2008-2017: WATER QUALITY MONITORING SUMMARY FOR EASTON'S POINT

During the time frame from January 4, 2008 to December 29, 2017 there were 468 water samples collected at Easton's Point, Middletown RI and 50 were above the acceptable limit (60 CFU per 100 ml). These elevated levels occurred mostly during the general time frame from late June through early October with some year to year variation, however the most persistent time frame of elevated readings occurred in the July and August as shown in figure 3.0 in 2008 through 2011:

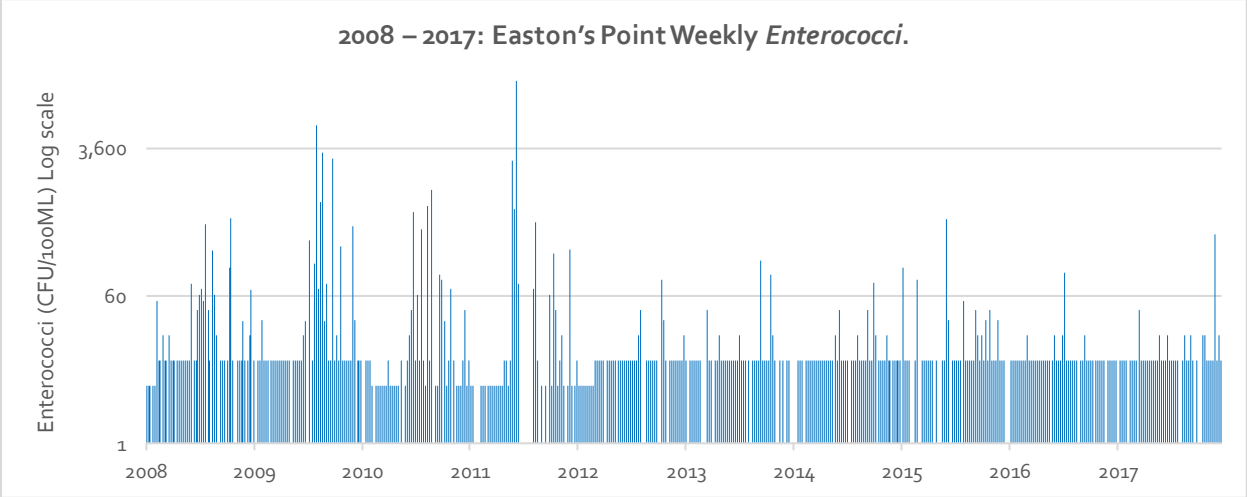

Figure 3.0 | 2008 – 2017: Easton's Point Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For beach locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 3.1:

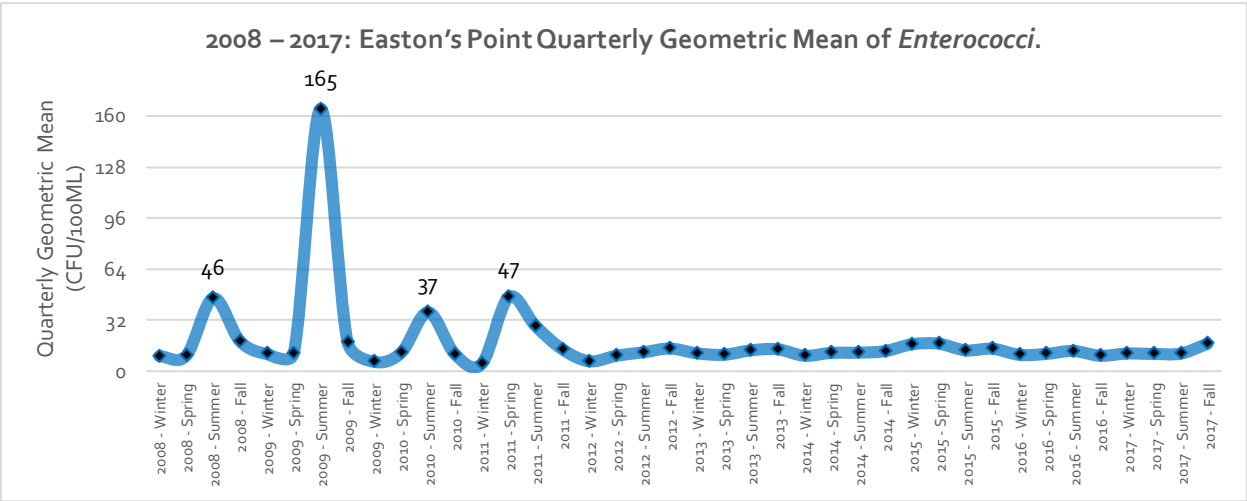

Figure 3.1 | 2008 – 2017: Easton's Point Quarterly Geometric Mean of *Enterococci*.

It is very encouraging that the multi-month elevated levels have not occurred since 2011, and this can be qualitatively attributed to the efforts by the Town of Middletown to identify and resolve all illicit discharges on Easton's Point and surrounding areas that flow into Easton's Bay. Overall, the probable source of *Enterococci* at this location are from illicit discharges such as sanitary wastewater flowing into stormwater outfall, the combined sources of the Newport Moat and Middletown Esplanade which are the primary sources that impact Easton's Bay, recreational boating, pets, and animals. This sampling location is quite remote from Easton's Beach and exposed to open ocean water.

As shown in figure 3.2, only 11% of the 468 samples collected over the 9-year period tested above the acceptable limit and most of these were in the period of 2008-2011. Overall the 9-year geometric mean of 14 CFU per 100 ml is well below the action standard 32 CFU per 100ml.

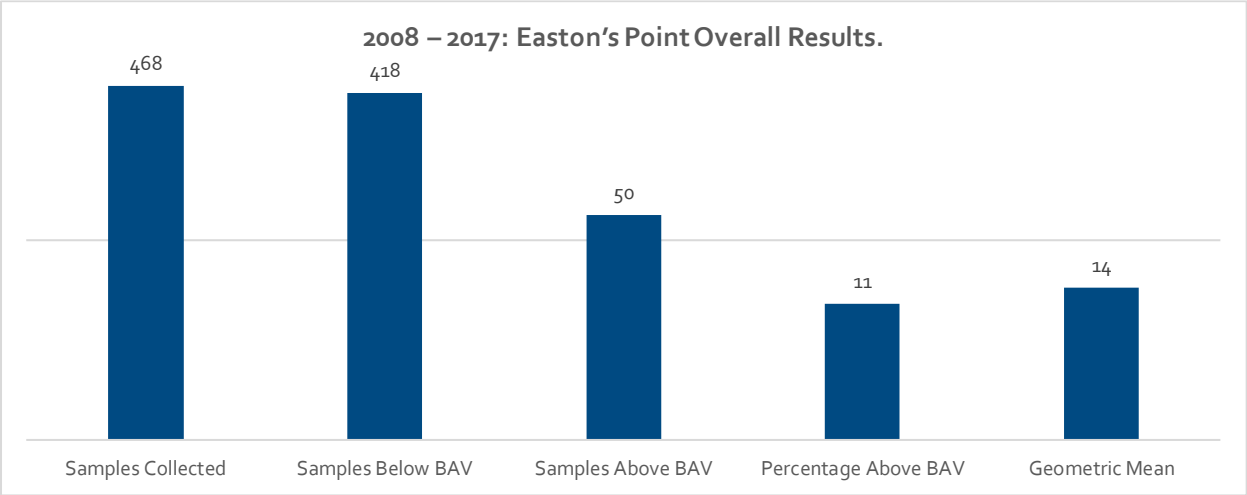

Figure 3.2 | 2008 – 2017: Easton's Point Overall Results.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to address water quality issues at Easton's Beach. With land development continuing around Easton's Point along with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Easton's Point.

3.3 2008-2017: WATER QUALITY MONITORING SUMMARY FOR EASTON'S BEACH (EAST)

During the time frame from January 4, 2008 to December 29, 2017 there were 467 water samples collected at Easton's Beach (East), Newport RI and 124 were above the acceptable limit (60 CFU per 100 ml). These elevated levels occurred more frequently during the warmer months, however elevated bacteria levels continue to occur throughout the year which is an indication of proximity to a source of *Enterococci* as shown in figure 4.0:

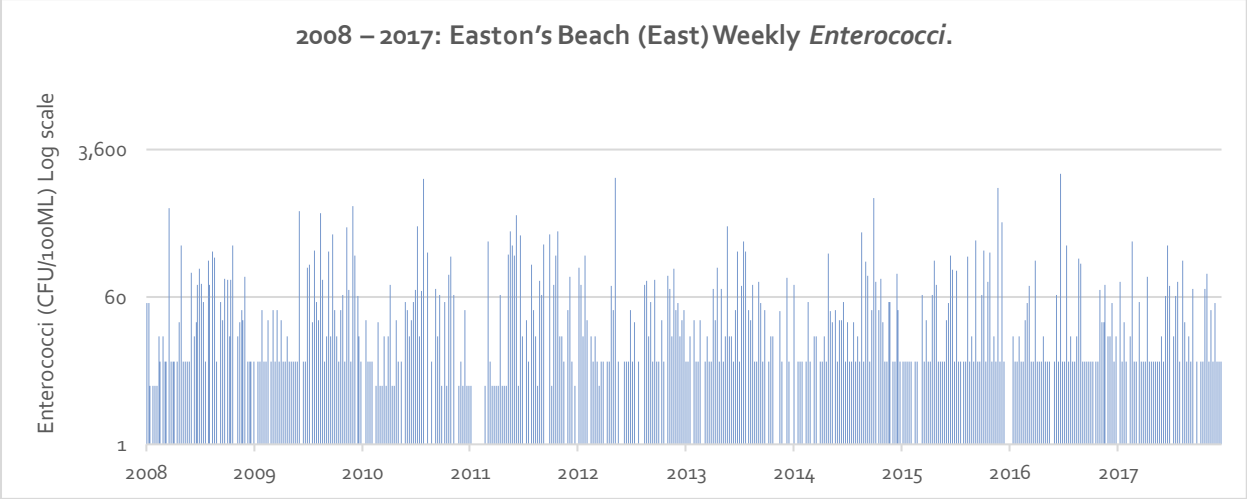

Figure 4.0 | 2008 – 2017: Easton's Beach (East) Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For beach locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 4.1:

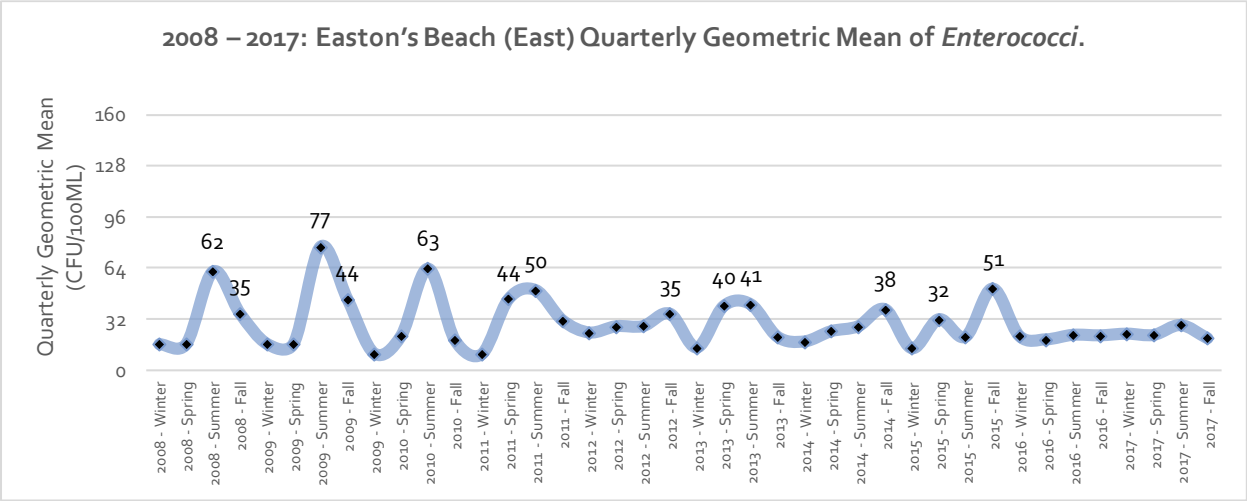

Figure 4.1 | 2008 – 2017: Easton's Beach (East) Quarterly Geometric Mean of *Enterococci*.

The 9-year time series of quarterly geometric mean of Enterococci shows that water quality is slowly improving at Easton's Beach (East), however elevated bacteria levels do occur, and additional measures must be taken to resolve all potential source of bacteria. It is encouraging to see that 2016 and 2017 did not have any quarterly geometric means above the action standard.

COA weekly water testing at Easton's Beach is just one of the data sets that help to document the water quality at Easton's Beach. This data set along with the Rhode Island Department of Health summer monitoring program and water quality monitoring by Easton's Beach management provides a comprehensive data set that will assist stakeholders and decision makers in determining the best solution(s) for achieving permanent year-round clean water at Easton's Beach.

As shown in figure 4.2, only 27% of the 467 samples collected over the 9-year period tested above the acceptable limit. Overall the 9-year geometric mean of 27 CFU per 100 ml is slightly below the action standard 32 CFU per 100ml.

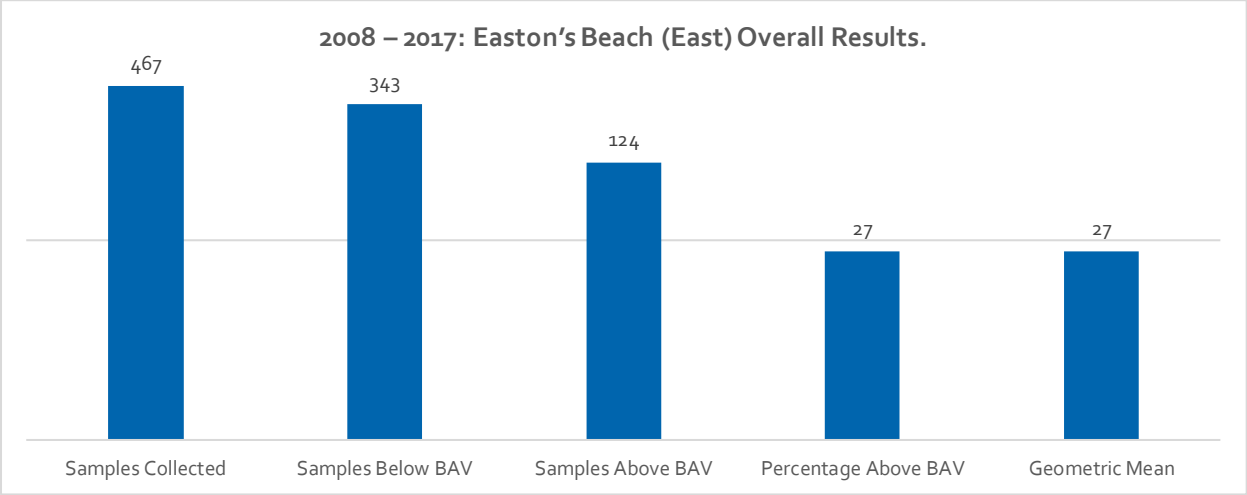

Figure 4.2 | 2008 – 2017: Easton's Beach (East) Overall Results.

The Newport UV disinfection plant (operating in the summer) and Middletown diffuser (year-round operation) are likely having a positive impact on water quality at Easton's Beach. Overall the water quality at Easton's Beach is improving but continued efforts must occur to address the sources of bacteria impairing the local waters, and to continue the establishment of long term trends for improved water quality.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to address water quality issues. With land development continuing around Easton's Beach and surrounding watershed, along with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Easton's Beach.

3.4 2008-2017: WATER QUALITY MONITORING SUMMARY FOR OCHRE POINT

During the time frame from January 4, 2008 to December 29, 2017 there were 433 water samples collected at Ochre Point, Newport RI and 32 were above the acceptable limit (60 CFU per 100 ml). These infrequent elevated levels occurred at various points throughout the year. The overall weekly water quality results are shown in figure 5.0:

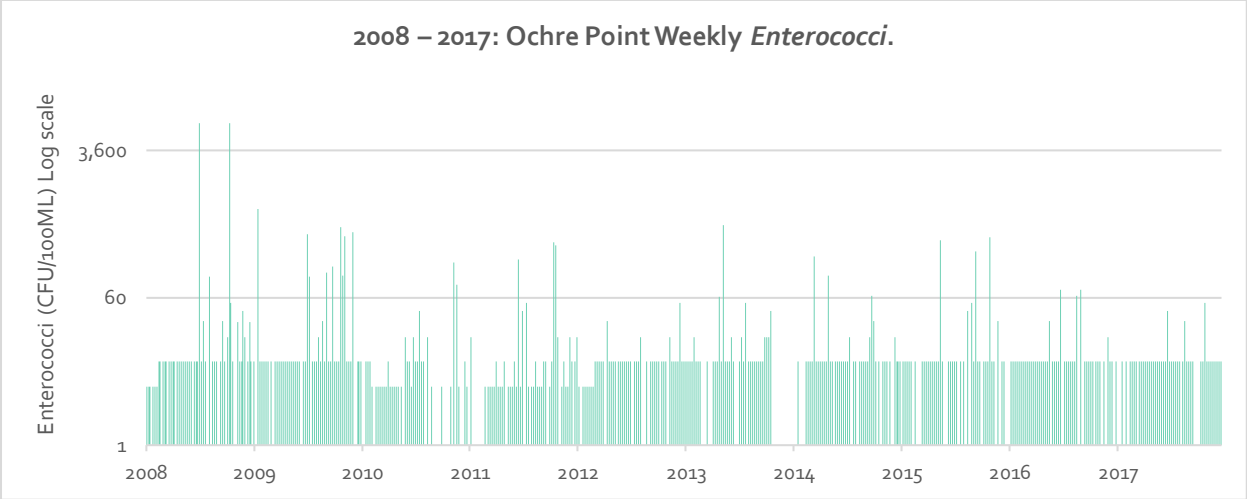

Figure 5.0 | 2008 – 2017: Ochre Point Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For beach locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 5.1:

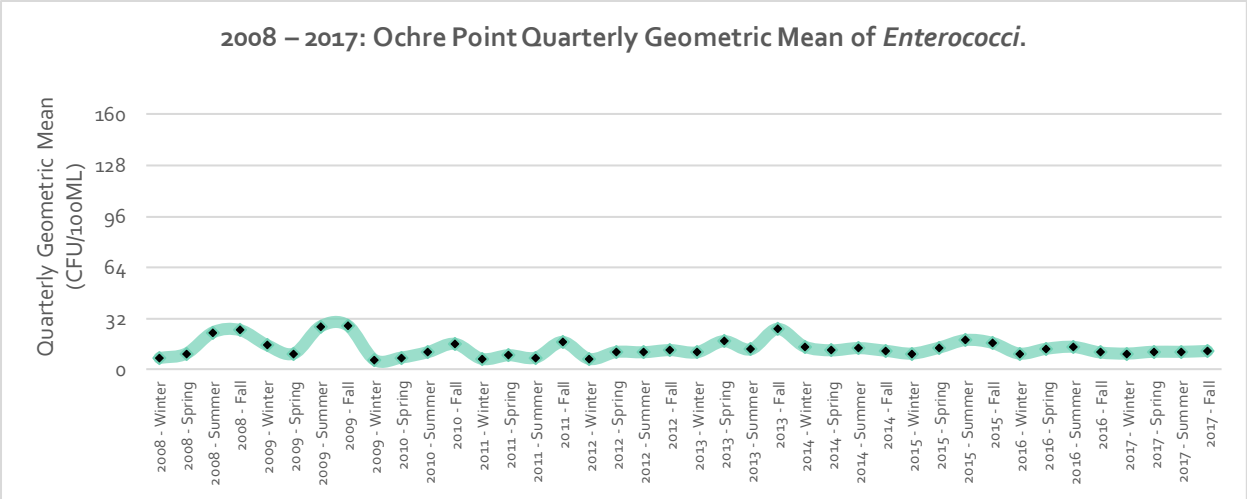

Figure 5.1 | 2008 – 2017: Ochre Point Quarterly Geometric Mean of *Enterococci*.

As shown in previous section for Easton's Point and subsequent section for Marine Avenue Beach, the water quality results at Ochre Point is not always correlated (pattern or persistence); this further illustrates the complex dynamics within Easton's Bay in terms of sources of *Enterococci* and overall circulation and dispersion of *Enterococci*. As suspected in prior years, the abandoned pipes along the cliff walk may be a source of bacteria and this occurred in 2016. Overall, the possible causes of elevated bacterial levels at Ochre Point may be illegal or abandoned sewage pipes, failed drain fields, or return flow from overall storage mechanisms.

As shown in figure 5.2, only 7% of the 433 samples collected over the 9-year period tested above the acceptable limit and the infrequent elevated levels did occur each year. Overall the 9-year geometric mean of 12 CFU per 100 ml is well below the action standard 32 CFU per 100ml.

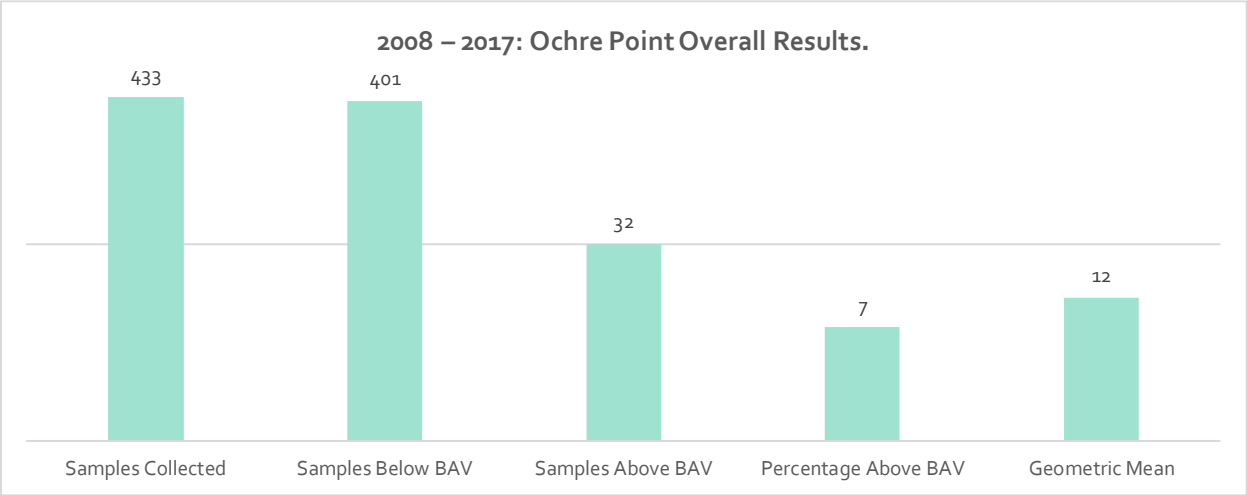

Figure 5.2 | 2008 – 2017: Ochre Point Overall Results.

Although the extensive dataset shows that water quality is very good at Ochre Point, the consistent (although infrequent) elevated levels of bacteria warrant action to identify and eliminate the source of bacteria impairing the local waters. Ochre Point (Ruggles Avenue) is a very popular location for year-round surfing and a popular fishing location.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to address water quality issues at Marine Avenue Beach. With the existence of over 100 outfall pipes along the cliff walk from Memorial Avenue to Sheep Point, and slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Ochre Point.

3.5 2008-2017: WATER QUALITY MONITORING SUMMARY FOR MARINE AVENUE BEACH

During the time frame from January 4, 2008 to December 29, 2017 there were 469 water samples collected at Marine Avenue Beach, Newport RI and 153 were above the acceptable limit (60 CFU per 100 ml). These frequent elevated levels occurred at various points throughout the year and illustrate a health hazard for recreational swimming. The possible sources of bacteria might include storm water containing feces of wild animals, but the area must be studied in greater detail to determine if the cause is from old sewage pipe or drain field from earlier centuries, or faulty infrastructure of nearby storm and waste water systems. The overall weekly water quality results are shown in figure 6.0:

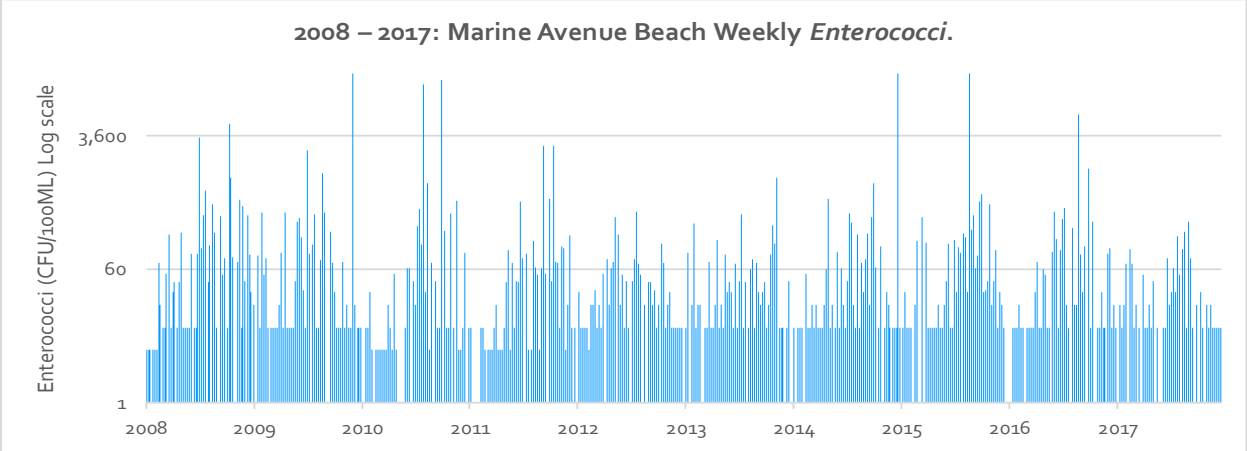

Figure 6.0 | 2008 – 2017: Marine Avenue Beach Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the Enterococci test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 6.1:

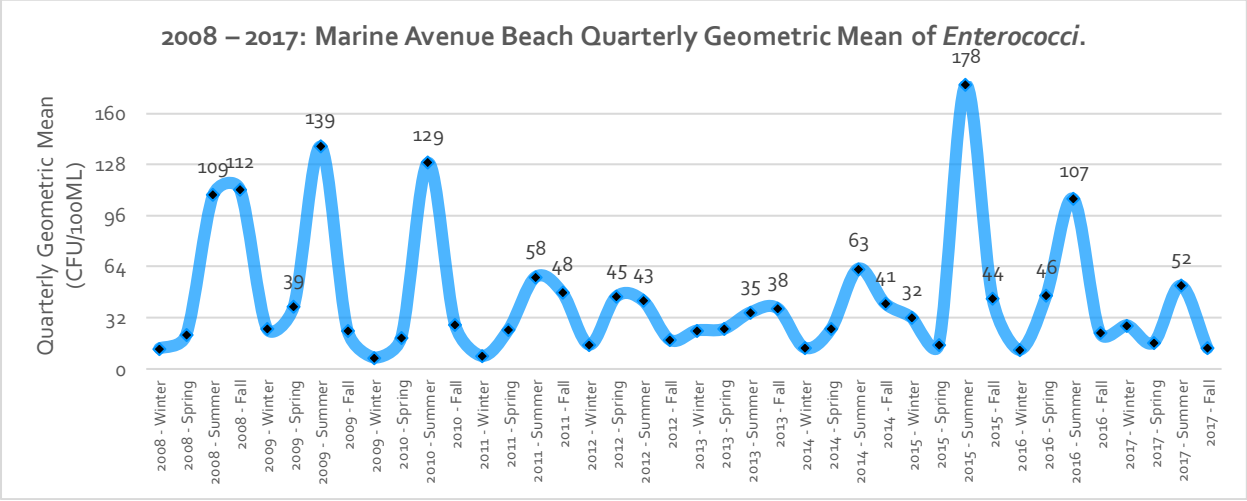

Figure 6.1 | 2008 – 2017: Marine Avenue Beach Quarterly Geometric Mean of *Enterococci*.

As shown in figure 6.1, although the very high levels from 2008-2011 did reduce to lower (levels well above the action standard) during the period of 2011-2014, this trend did not continue and 2015-2016 resumed very high levels with lower but elevated levels in 2017.

As shown below in figure 6.2, over 33% of the 469 samples collected over the 9-year period tested above the acceptable limit and the elevated levels occur though out the entire year, each year. Overall the 9-year geometric mean of 33 CFU per 100 ml is above the action standard 32 CFU per 100ml and supports the request to make sure that all efforts related to storm and waste water improvements include the identification and resolution of bacteria impacting Marine Avenue Beach.

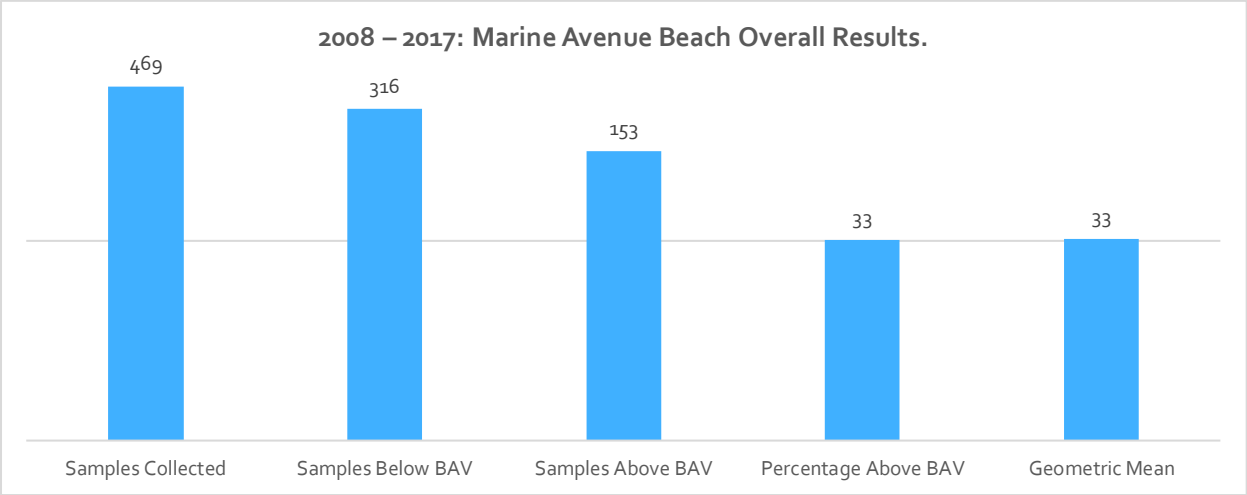

Figure 6.2 | 2008 – 2017: Marine Avenue Beach Overall Results.

Marine Avenue Beach is a very popular swimming location for our residents and this recreational resource must be protected for future use. We are hopeful that the upcoming work efforts for the nearby water infrastructure will result in resolving the bacteria loading occurring at Marine Avenue Beach.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to resolve the current issues. Additionally, the community surrounding this location is a mix of seasonal and year-round residents and development and usage of the storm and waste water system may lead to the subsequent identification of additional issues, such as the nearby sewage pipe that drained from the Breakers Mansion in June 2016.

3.6 2008-2017: WATER QUALITY MONITORING SUMMARY FOR KINGS PARK SWIM AREA

During the time frame from January 4, 2008 to December 29, 2017 there were 469 water samples collected at Kings Park Swim Area, Newport RI and 71 were above the acceptable limit (60 CFU per 100 ml). Elevated levels occurred at various points throughout the year, some occurred during high seasonal harbor usage and/or within the recent time frame of large precipitation events, however a few readings were not associated with either of these types of events. The overall weekly water quality results are shown in figure 7.0:

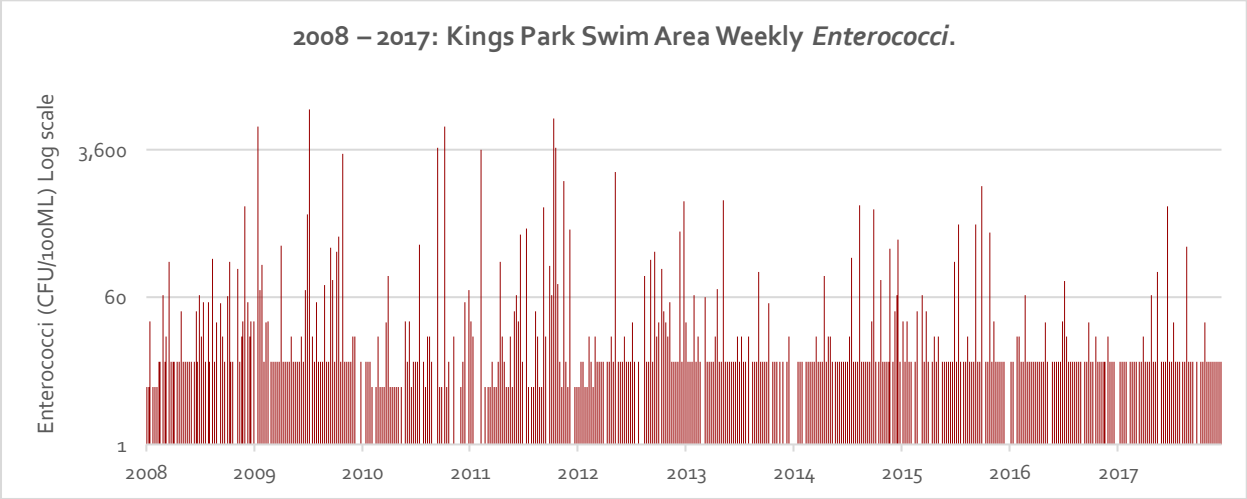

Figure 7.0 | 2008 – 2017: Kings Park Swim Area Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the Enterococci test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 7.1:

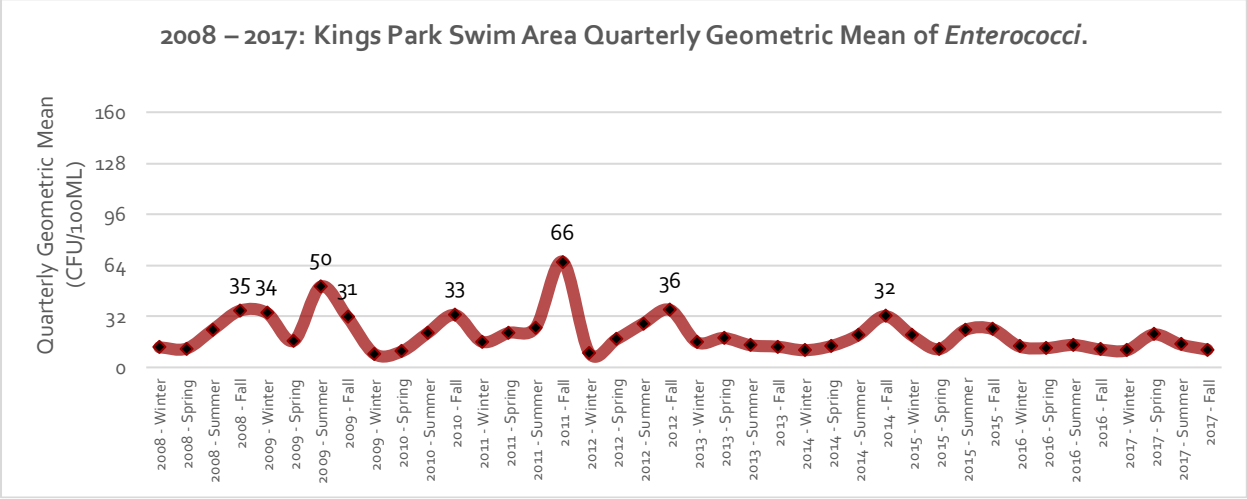

Figure 7.1 | 2008 – 2017: Kings Park Swim Area Quarterly Geometric Mean of *Enterococci*.

The water quality at Kings Park Swim Area is usually acceptable for swimming. However, harbor circulation dynamics are complex and a single sample per week doesn't provide a complete understanding of the total water quality as some of the 67-elevated reading were not always correlated (pattern or persistence) with a probable cause of elevated bacteria levels.

As shown in figure 7.2, 15% of the 469 samples collected over the 9-year period tested above the acceptable limit and the elevated levels occur each year. Overall the 9-year geometric mean of 19 CFU per 100 ml is below the action standard 32 CFU per 100ml and supports the long-term findings that the water quality is acceptable for recreational swimming.

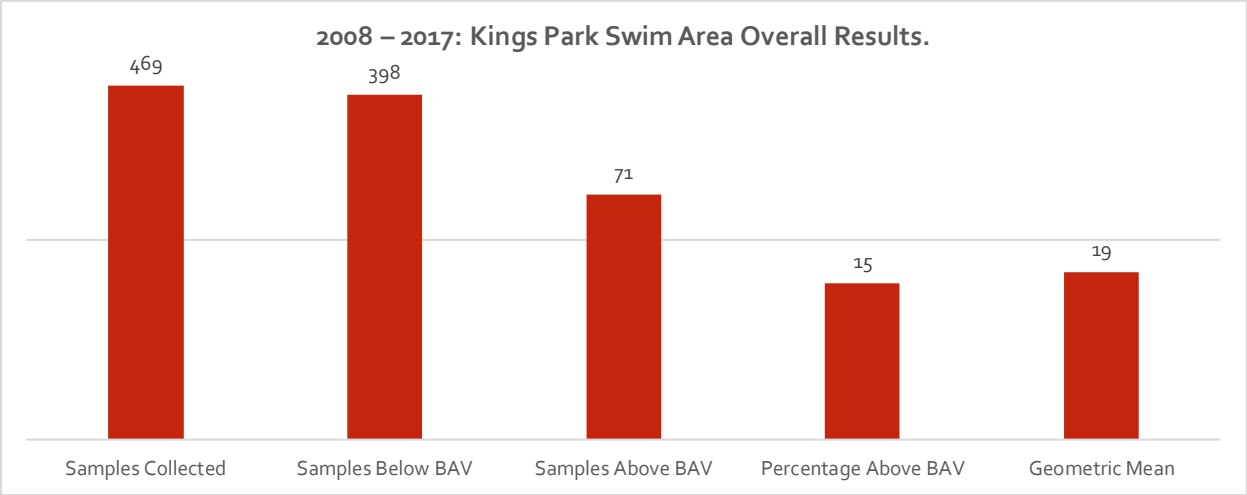

Figure 7.2 | 2008 – 2017: Kings Park Swim Area Overall Results.

Although the extensive dataset shows that water quality is acceptable for swimming, and equally important that it is improving year-over-year at Kings Park Swim Area, the elevated levels of bacteria warrant action to identify and permanently eliminate the source of bacteria impairing the local waters. Kings Park Swim Area is a very popular swimming location for our residents and this recreational resource must be protected for future use.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to reduce combined sewer overflow and increased enforcement of pump-out regulations for boating. Additionally, the nearshore coastline is densely populated and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Kings Park Swim Area.

3.7 2008-2017: WATER QUALITY MONITORING SUMMARY FOR ELM STREET PIER

During the time frame from January 4, 2008 to December 29, 2017 there were 449 water samples collected at Elm Street Pier, Newport RI and 40 were above the acceptable limit (60 CFU per 100 ml). These infrequent elevated levels occurred at various points throughout the year, some occurred during high seasonal harbor usage and/or within the recent time frame of large precipitation events, however a few readings were not associated with either of these types of events. The overall weekly water quality results are shown in figure 5.0:

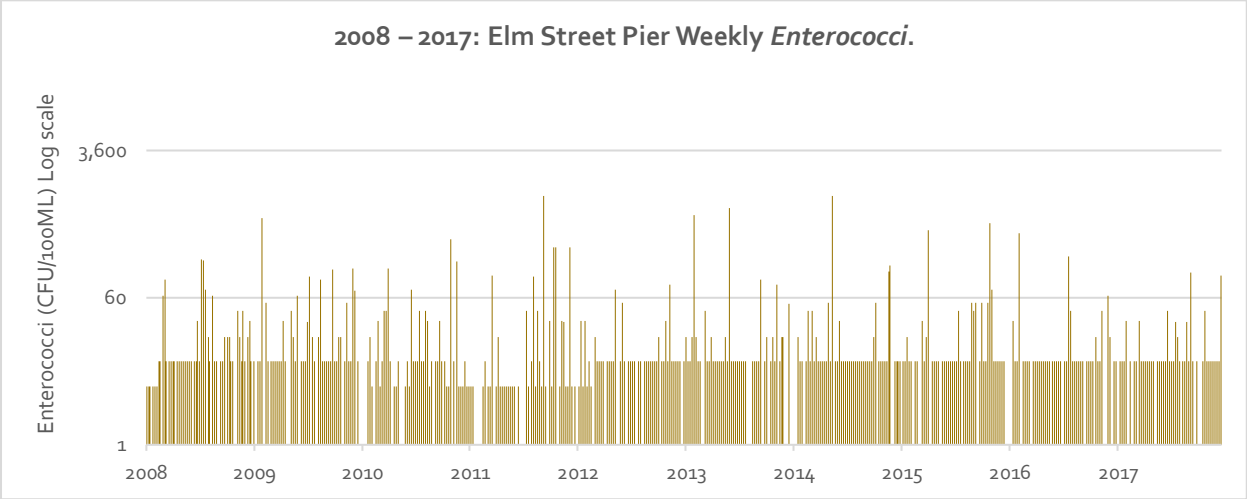

Figure 8.0 | 2008 – 2017: Elm Street Pier Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 8.1:

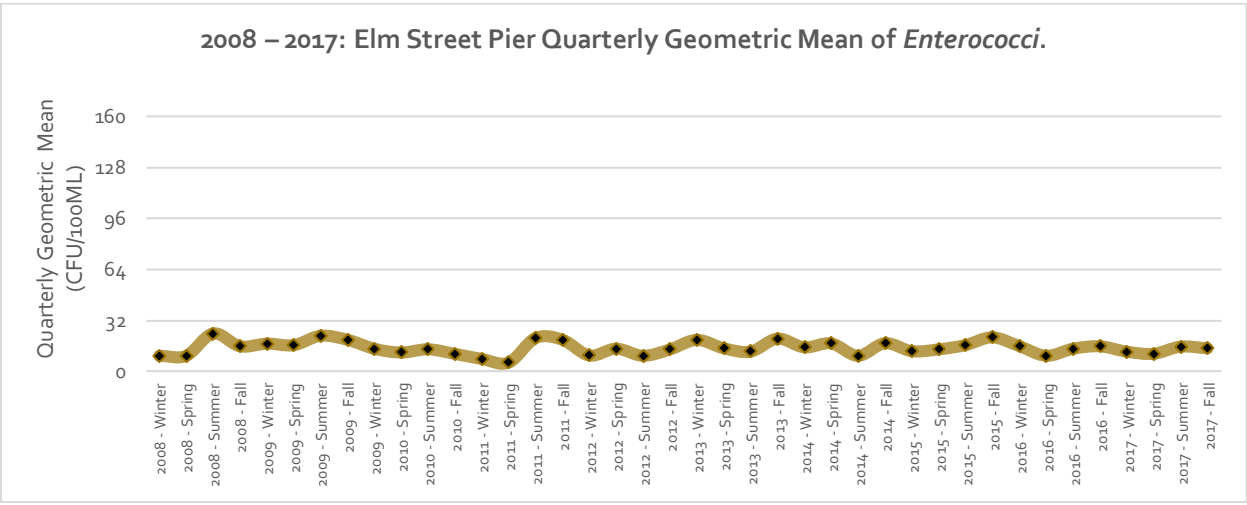

Figure 8.1 | 2008 – 2017: Elm Street Pier Quarterly Geometric Mean of *Enterococci*.

The water quality at Elm Street Pier is consistently acceptable for swimming. However, harbor circulation dynamics are complex and a single sample per week doesn't provide a complete understanding of the total water quality as some of the 38-elevated reading were not always correlated (pattern or persistence) with a probable cause of elevated bacteria levels.

As shown in figure 8.2, only 9% of the 449 samples collected over the 9-year period tested above the acceptable limit and the infrequent elevated levels occur each year. Overall the 9-year geometric mean of 14 CFU per 100 ml is well below the action standard 32 CFU per 100ml and supports the long-term findings that the water quality is acceptable for recreational swimming.

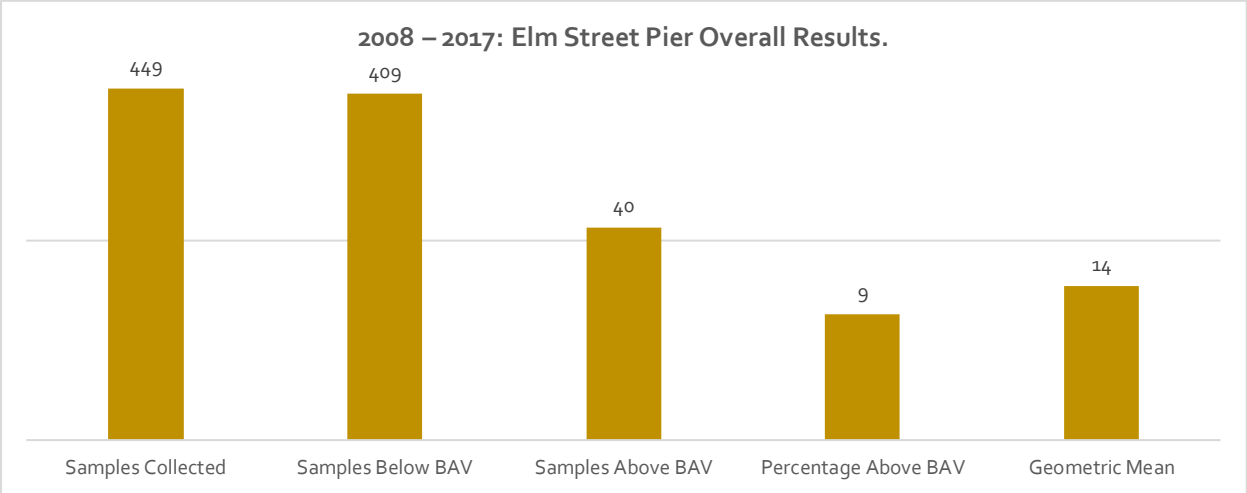

Figure 8.2 | 2008 – 2017: Elm Street Pier Overall Results.

Although the extensive dataset shows that water quality is very good at Elm Street Pier, the consistent (although infrequent) elevated levels of bacteria warrant action to identify and eliminate the source of bacteria impairing the local waters. Elm Street Pier is a very popular swimming location for our residents and this recreational resource must be protected for future use.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to reduce combined sewer overflow and increased enforcement of pump-out regulations for boating. Additionally, the nearshore coastline is densely populated and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Elm Street Pier.

3.8 2008-2017: WATER QUALITY MONITORING SUMMARY FOR VAN ZANDT PIER

During the time frame from January 4, 2008 to December 29, 2017 there were 468 water samples collected at Van Zandt Pier, Newport RI and 39 were above the acceptable limit (60 CFU per 100 ml). These infrequent elevated levels occurred at various points throughout the year, more so during the period of 2008-2013 and to a lesser extent from 2014-2017. However, while some occurred during high seasonal harbor usage and/or within the recent time frame of large precipitation events, a few readings were not associated with either of these types of events. The overall weekly water quality results are shown in figure 9.0:

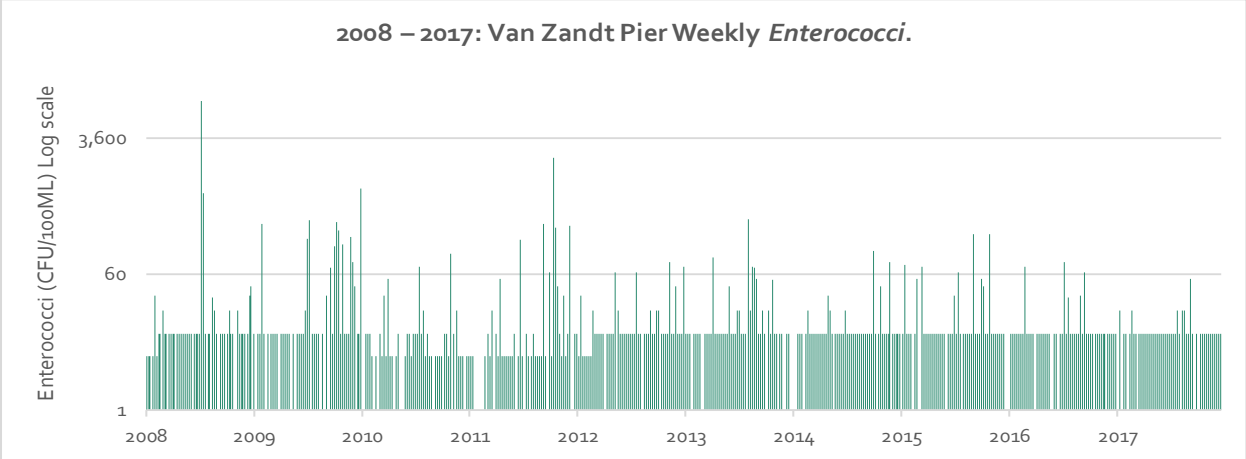

Figure 9.0 | 2008 – 2017: Van Zandt Pier Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 9.1:

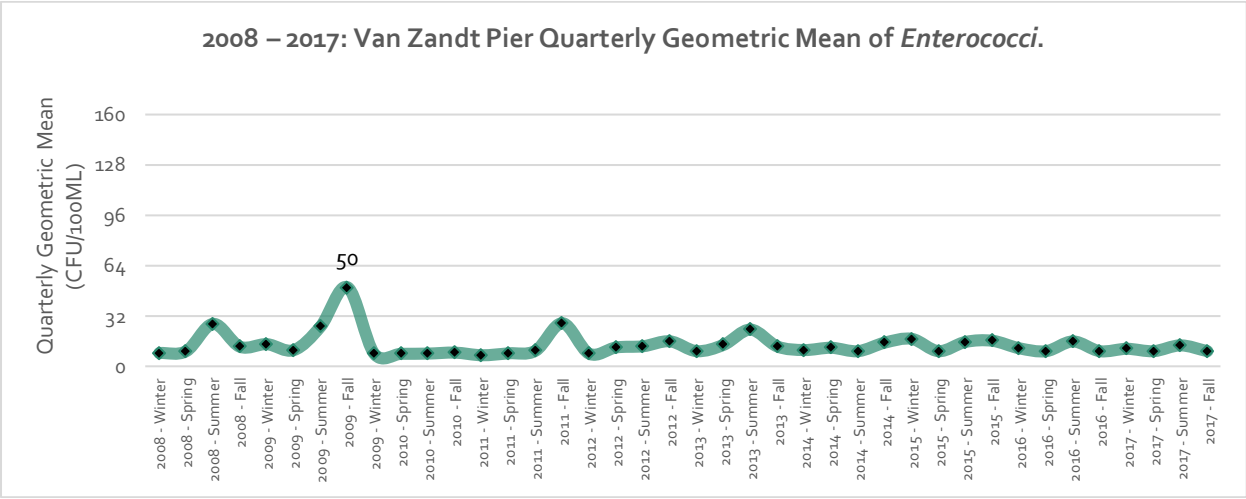

Figure 9.1 | 2008 – 2017: Van Zandt Pier Quarterly Geometric Mean of *Enterococci*.

The water quality at Van Zandt Pier is consistently acceptable for swimming. However, harbor circulation dynamics are complex and a single sample per week doesn't provide a complete understanding of the total water quality as some of the 39-elevated reading were not always correlated (pattern or persistence) with a probable cause of elevated bacteria levels.

As shown in figure 9.2, only 8% of the 468 samples collected over the 9-year period tested above the acceptable limit and the infrequent elevated levels occur each year. Overall the 9-year geometric mean of 13 CFU per 100 ml is well below the action standard 32 CFU per 100ml and supports the long-term findings that the water quality is acceptable for recreational swimming.

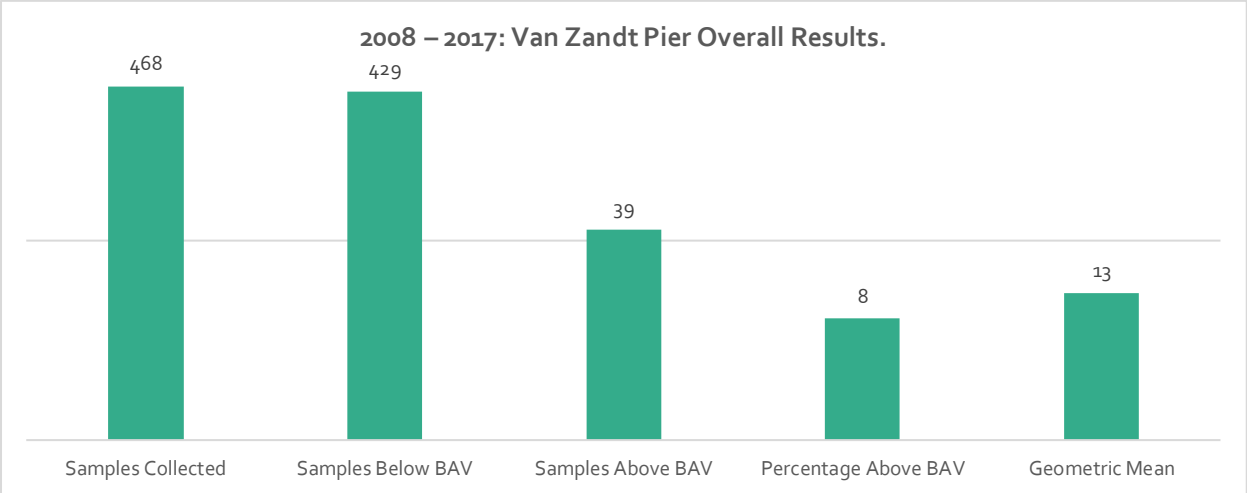

Figure 9.2 | 2008 – 2017: Van Zandt Pier Overall Results.

Although the extensive dataset shows that water quality is very good at Van Zandt Pier, the consistent (although infrequent) elevated levels of bacteria warrant action to identify and eliminate the source of bacteria impairing the local waters. Van Zandt Pier is a very popular swimming location for our residents and this recreational resource must be protected for future use.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to reduce combined sewer overflow and increased enforcement of pump-out regulations for boating. Additionally, the nearshore coastline is densely populated and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Van Zandt Pier.

3.9 2017: WATER QUALITY MONITORING SUMMARY FOR SECOND BEACH

During the time frame from October 12, 2017 to December 21, 2017 there were 11 water samples collected at Second Beach Middletown, RI and zero samples were above the acceptable limit (60 CFU per 100 ml). The overall weekly water quality results are shown in figure 10.0:

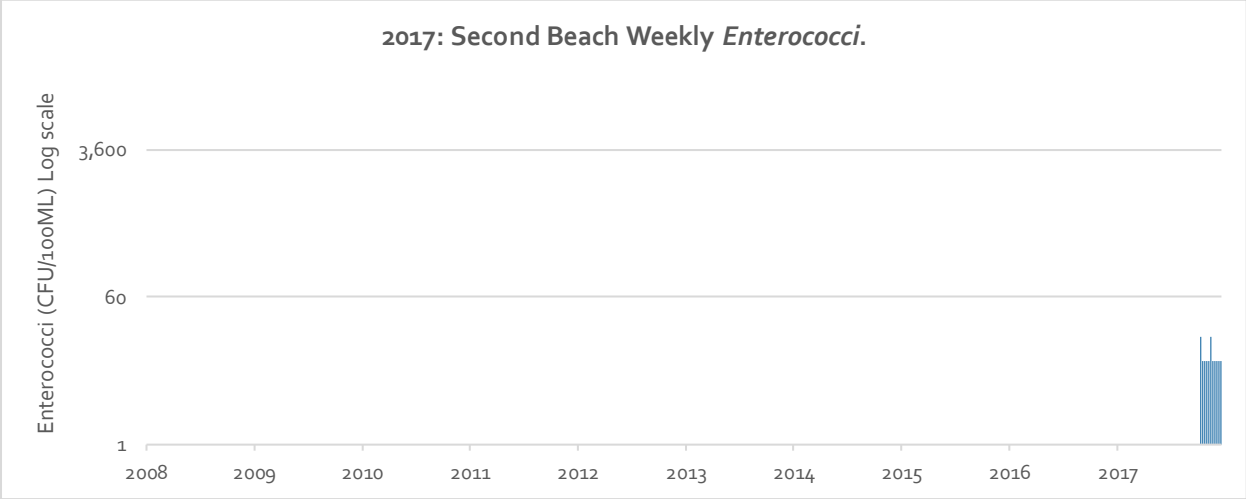

Figure 10.0 | 2017: Second Beach Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 10.1:

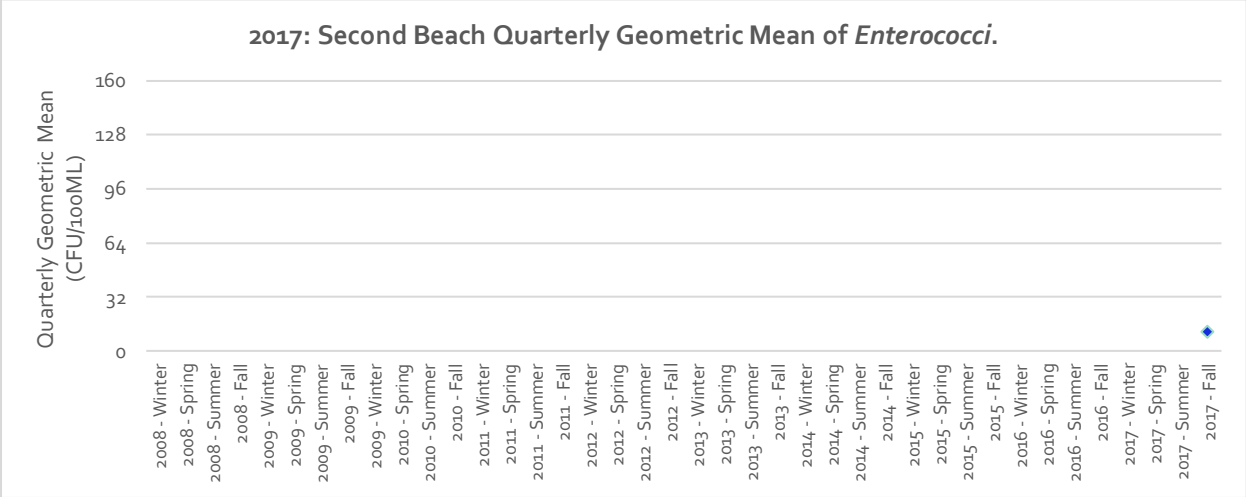

Figure 10.1 | 2017: Second Beach Quarterly Geometric Mean of *Enterococci*.

The short-term water quality at Second Beach is consistently acceptable for swimming. However, the 2-month sampling time frame is not sufficient for predicting year-round water quality patterns.

As shown in figure 10.2, 0% of the 11 samples collected over the 2-month period tested above the acceptable limit. Overall the 2-month geometric mean of 11 CFU per 100 ml is well below the action standard 32 CFU per 100ml and supports the short-term findings that the water quality is acceptable for recreational swimming. Testing will continue at this site in the future.

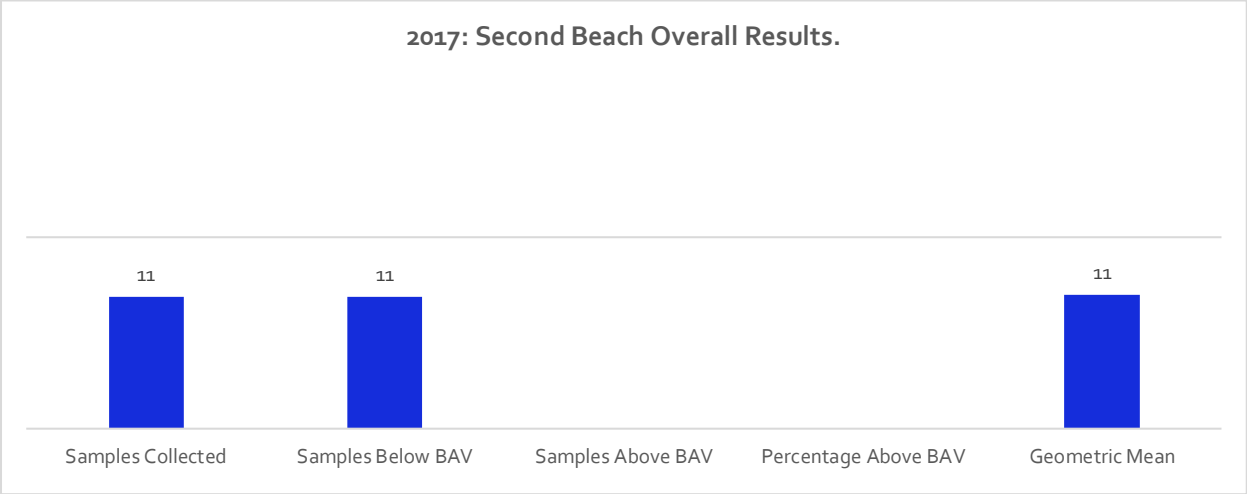

Figure 10.2 | 2017: Second Beach Overall Results.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to reduce combined sewer overflow and increased enforcement of pump-out regulations for boating. Additionally, the nearshore coastline is densely populated and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Second Beach.

3.10 2017: WATER QUALITY MONITORING SUMMARY FOR THIRD BEACH

During the time frame from October 12, 2017 to December 21, 2017 there were 11 water samples collected at Third Beach Middletown, RI and three samples were above the acceptable limit (60 CFU per 100 ml). The overall weekly water quality results are shown in figure 11.0:

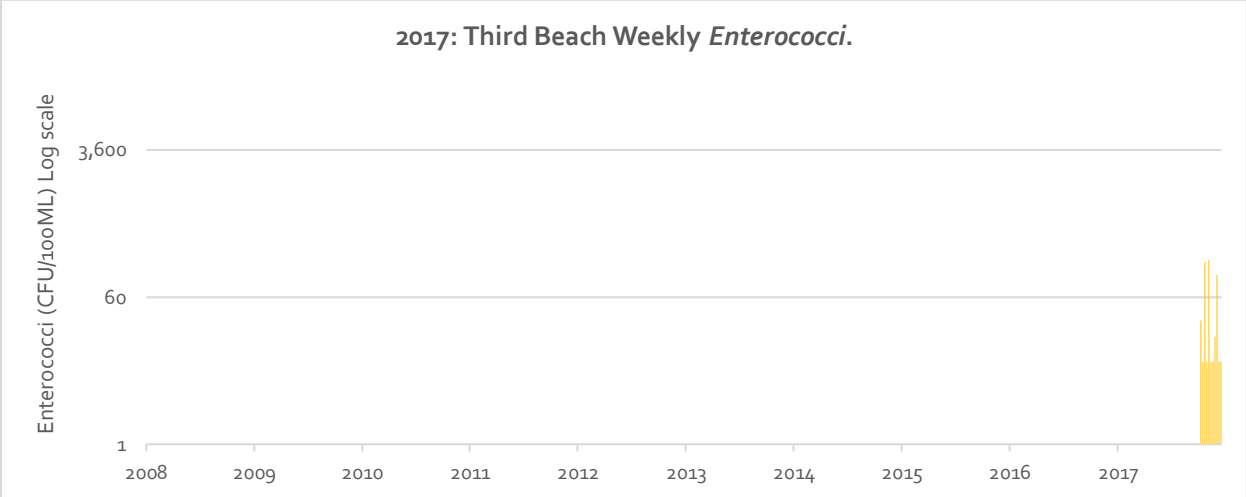

Figure 11.0 | 2017: Third Beach Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner as shown in figure 11.1:

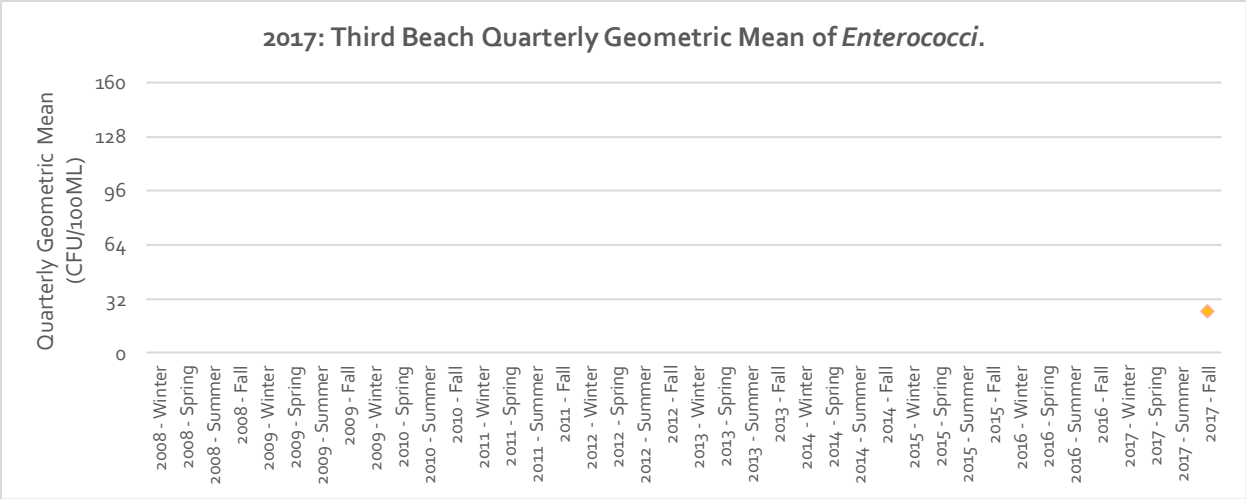

Figure 11.1 | 2017: Third Beach Quarterly Geometric Mean of *Enterococci*.

The short-term water quality at Third Beach showed numerous samples of the accepted beach action value for swimming. However, the 2-month sampling time frame is not sufficient for predicting year-round water quality patterns.

As shown in figure 11.2, 27% of the 11 samples collected over the 2-month period tested, above the acceptable limit. Overall the 2-month geometric mean of 24 CFU per 100 ml is slightly below the action standard 32 CFU per 100ml and supports the short-term findings that the water quality is acceptable for recreational swimming. Testing will continue at this site in the future.

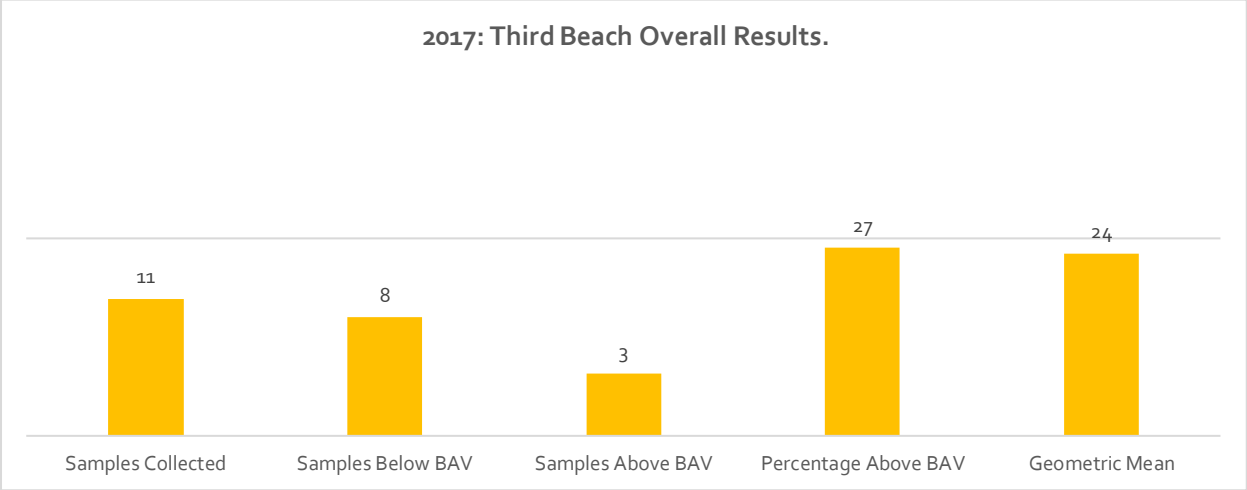

Figure 11.2 | 2017: Third Beach Overall Results.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as additional measures are taken to reduce combined sewer overflow and increased enforcement of pump-out regulations for boating. Additionally, the nearshore coastline is densely populated and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at Third Beach.

4.0 LIKELY SOURCES OF BACTERIA

4.1 2008-2017: WATER QUALITY MONITORING SUMMARY FOR ESPLANADE NORTH & SOUTH

During the time frame from January 15, 2009 to October 18, 2012 there were 155 water samples collected at Esplanade North, Middletown RI and 102 were above the acceptable limit (60 CFU per 100 ml). A project to re-route the flow from Esplanade North to the offshore Middletown diffuser eliminated the testing location for Esplanade North. After completion of the construction project for the Middletown diffuser testing resumed at the shoreline of Esplanade South. From October 17, 2013 to December 29, 2017 there were 197 water samples collected at Esplanade South, and 18 were above the acceptable limit (60 CFU per 100 ml). These results are shown in figure 12.0:

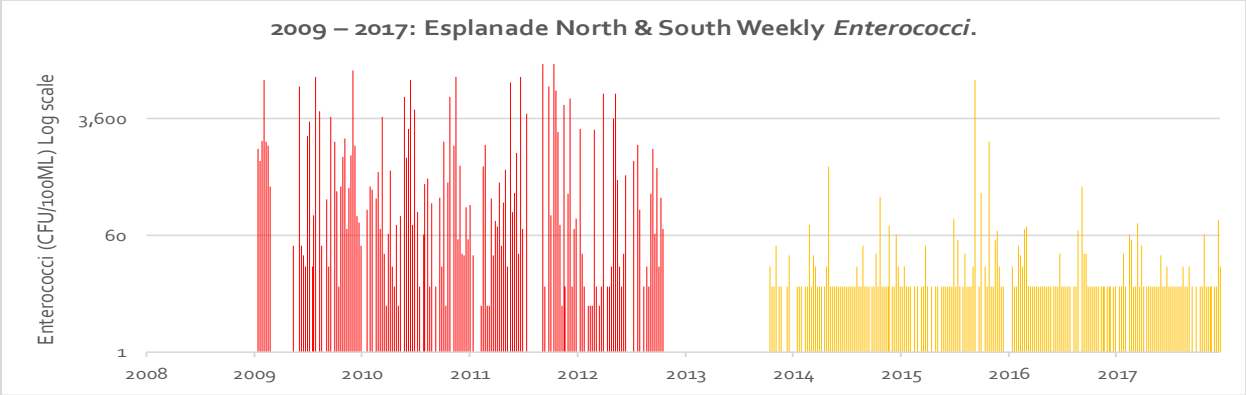

Figure 12.0 | 2009 – 2017: Esplanade North & South Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. Although Esplanade North was not a swimming location, the swimming criteria is applied. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner shown in figure 12.1, with a logscale to accommodate the very elevated bacterial levels from Esplanade North.

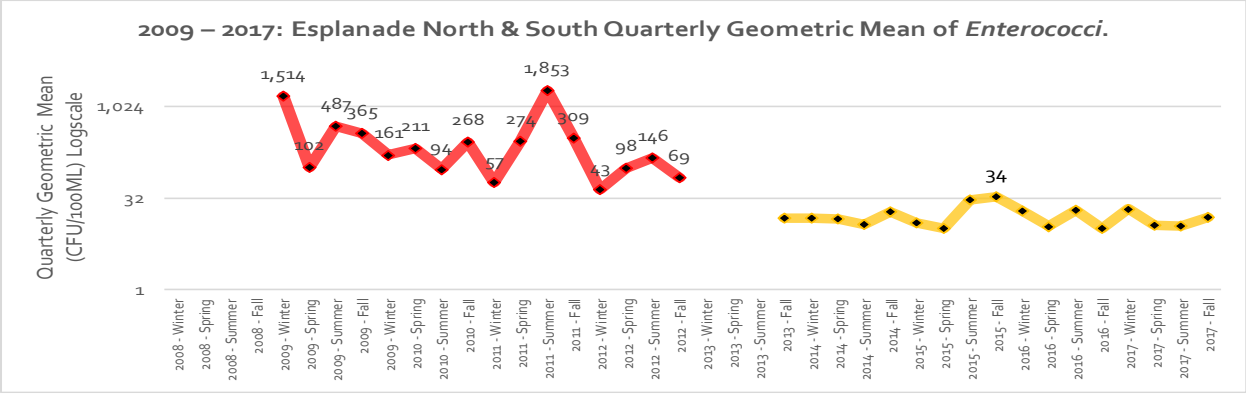

Figure 12.1 | 2009 – 2017: Esplanade North & South Quarterly Geometric Mean of *Enterococci*.

The water quality at the Esplanade has greatly improved since the installation of the Middletown Diffuser. While the Esplanade North storm water was considered a focused source of bacteria, it is now being redirected offshore combined with the storm water from the old pipes near Esplanade South.

It is possible that the infrequent elevated bacteria levels at the shoreline of Esplanade South are from the diffused offshore water, however it could also be from a variety of other sources not limited to the Newport Moat as well as new/not-discovered illegal discharges in Easton's Point.

As shown in figure 12.2, only 9% of the 197 samples collected at Esplanade South over the 4-year period tested above the acceptable limit and the infrequent elevated levels occur each year. Overall the 4-year geometric mean of 15 CFU per 100 ml is well below the action standard 32 CFU per 100ml and supports the long-term findings that the water quality is acceptable for recreational swimming even within proximity to the Middletown diffuser.

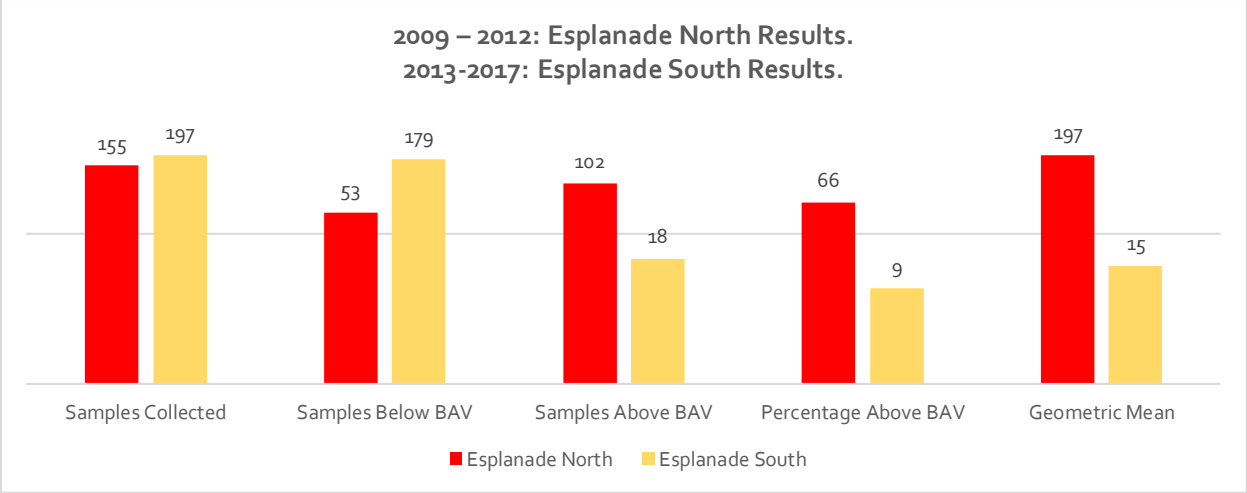

Figure 12.2 | 2009 – 2017: Esplanade North & South Overall Results.

The results in this area are promising, however the occasional elevated levels of bacteria at Esplanade South warrant continued testing to make sure the levels do not increase. Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as land development continues in the Atlantic Beach Area and Easton's point. Additionally, careful monitoring of the Middletown Diffuser requires year-round data acquisition, and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at the Esplanade in Middletown, RI.

4.1 2008-2017: WATER QUALITY MONITORING SUMMARY FOR EASTON'S STREAM

During the time frame from January 15, 2009 to December 29, 2017 there were 423 water samples collected at Easton's Stream, Newport RI, and 124 were above the acceptable limit (60 CFU per 100 ml). It should be noted that Easton's Stream is not a swimming area (although human contact via recreation does occur) and is known to be a source of bacteria that enters the swimming waters of Easton's Bay. These results are shown in figure 13.0:

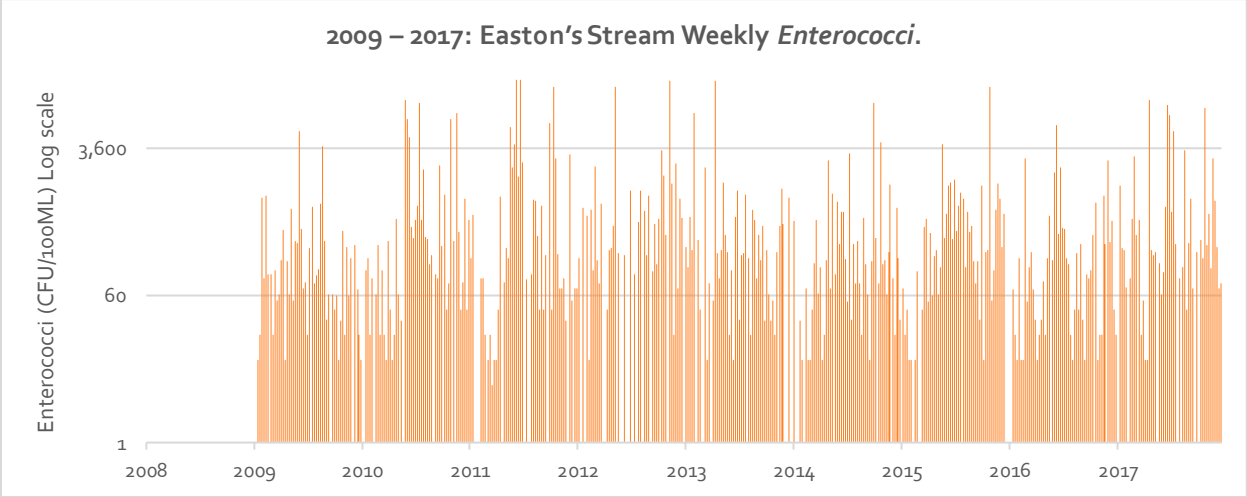

Figure 13.0 | 2009 – 2017: Easton's Stream Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner shown in figure 13.1, with a logscale to accommodate the very elevated bacterial levels from Easton's Stream.

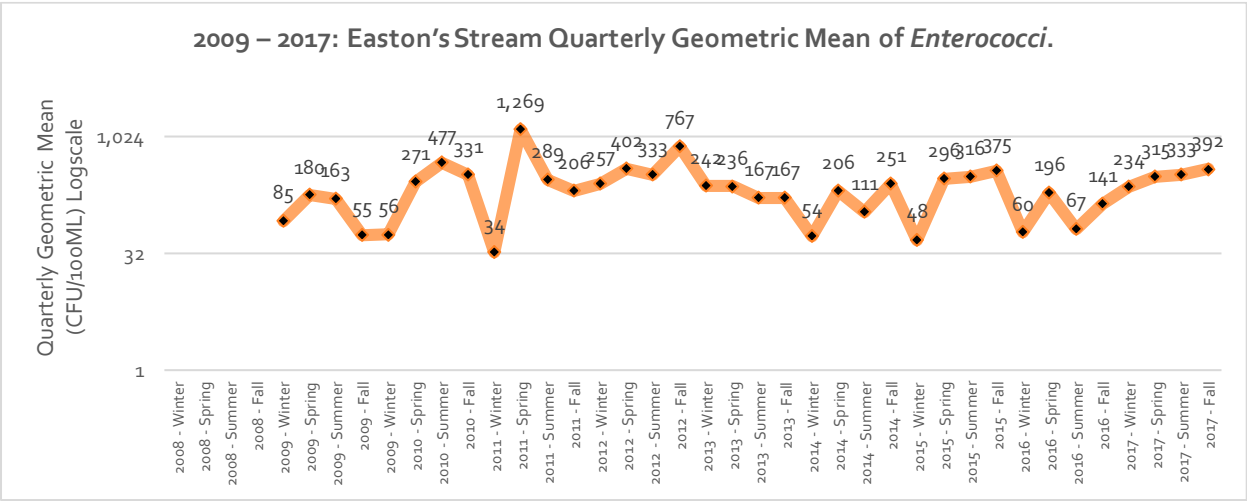

Figure 13.1 | 2009 – 2017: Easton's Stream Quarterly Geometric Mean of *Enterococci*.

The water of Easton's Stream is a complex mixture of storm water from Newport and potential sources including potential overflows from the Middletown pumping station, Department of Transportation stormwater runoff, influences of large tides, runoff from the watershed flanking all sides of Easton's Pond, and bacteria-loaded sediment in the Newport Moat and Easton's Stream. The City of Newport has built a UV plant to treat discharge from the Moat and this was in operation during the summer months for 2013 onwards. The sampling point for Easton's Stream is shoreward of the treatment facility, capturing the summer effluent from the UV plant.

As shown in figure 13.2, 76% of the 423 samples collected at Easton's stream over the 8-year period tested above the acceptable limit with elevated levels occur throughout each year. Overall the 8-year geometric mean of 194 CFU per 100 ml is well above the action standard 32 CFU per 100ml.

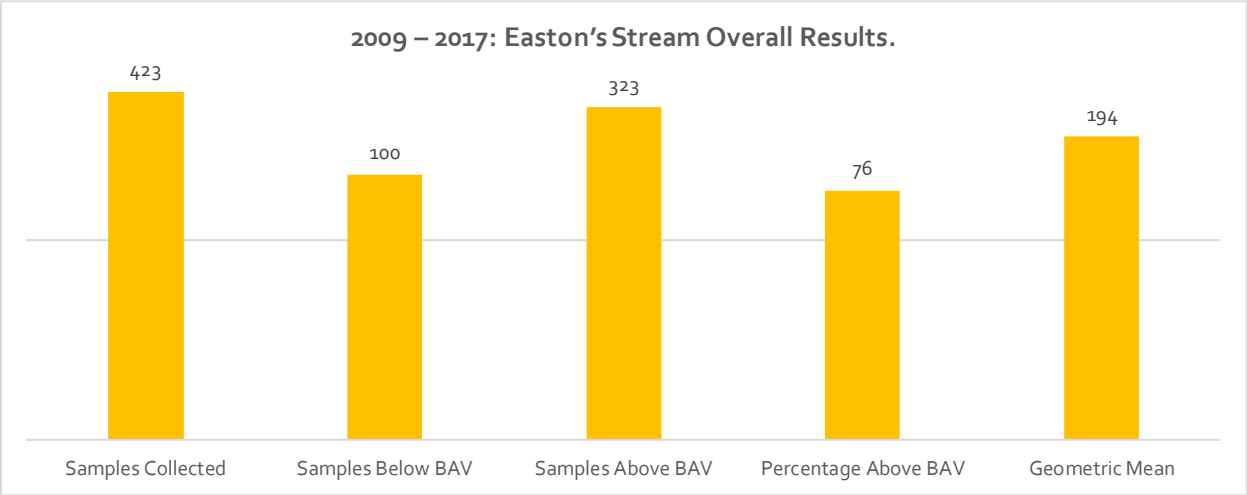

Figure 13.2 | 2009 – 2017: Easton's Stream Overall Results.

The efforts by the City of Newport to reduce beach closures during the summer season have been effective with numerous projects related to storm water and waste water infrastructure, including the effective summer operations of UV disinfection plant. While summer geometric means have decreased, the COA water quality monitoring efforts are focused on year-round water quality and elevated bacteria levels exist at various times throughout the year.

Continued year-round weekly monitoring is vital to protect human health, to maintain the water quality time series for stakeholder and decisions makers, and to monitor for water quality impairments as land development continues around all sides of Easton's Pond. Additionally, the complex interaction of the Newport Moat effluent and the Middletown Diffuser warrant year-round data acquisition, and with slowly rising seas levels that may eventually adversely impact existing storm and waste water infrastructure, it is imperative to continue the weekly year-round monitoring of water quality at the Easton's Stream, Newport RI.

5.0 LIKELY SOURCES OF BACTERIA IN THE WATERSHED

5.1 2017: WATER QUALITY MONITORING SUMMARY FOR BAILEYS BROOK

During the time frame of March 24, 2016 to December 29, 2017 there were 86 samples collected at Baileys Brook, Middletown RI, and 50 were above the acceptable limit (60 CFU per 100 ml). Baileys Brook is in an urban area with high traffic. The exact location is at the bridge crossing Bailey Brook directly behind the Aquidneck shopping plaza on O'Neill Boulevard. The overall weekly water quality results are shown in figure 14.0:

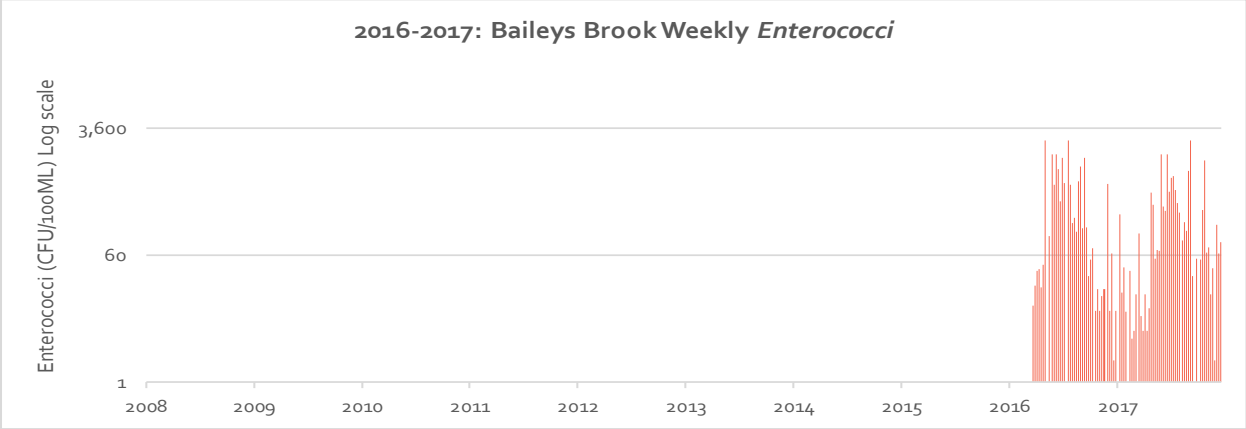

Figure 14.0 | 2017: Baileys Brook Weekly *Enterococci*.

Analysis of water quality over a long-time period is better understood using a geometric mean. For swimming locations, the Rhode Island standard for results of the *Enterococci* test is to compute the geometric mean for at least five samples. The action standard is 32 CFU per 100ml for a geometric mean. The COA weekly sampling did not result in 5 samples per month so the geometric mean is applied in a quarterly monthly manner shown in figure 14.1, with a logscale to accommodate the very elevated bacterial levels from Baileys Brook.

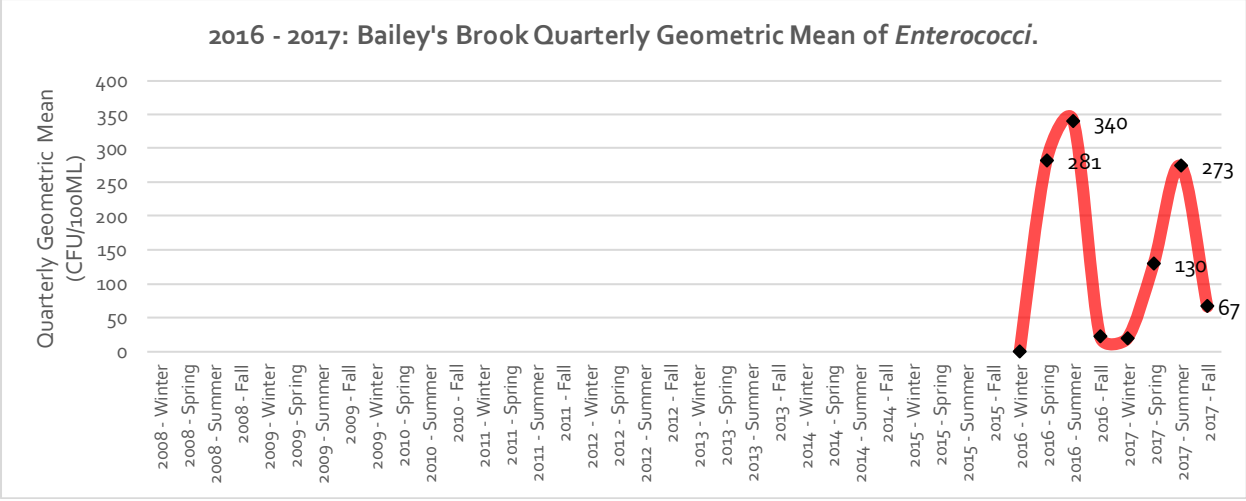

Figure 14.1 | 2017: Baileys Brook Quarterly Geometric Mean of *Enterococci*.

Baileys Brook is a main receptor of storm and urban run-off. Highly effected by watershed, Baileys Brook has numerous potential non-point contaminates.

As shown in figure 14.2, 58% of the 86 samples collected at Baileys Brook over the 2-year period tested above the acceptable limit with elevated levels occur throughout the year. Overall the 2-year geometric mean of 96 CFU per 100 ml is well above the action standard 32 CFU per 100ml.

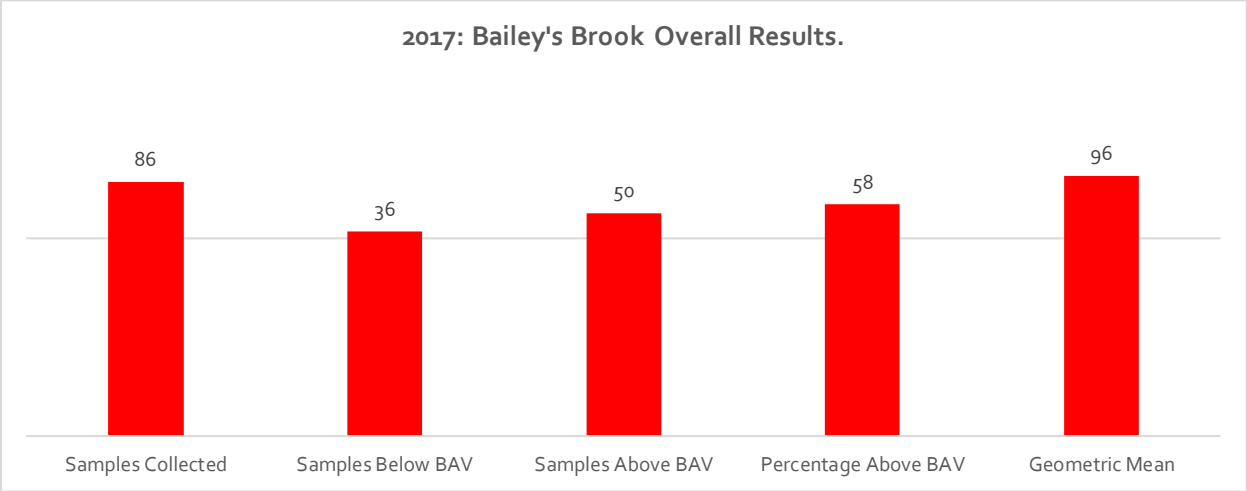

Figure 14.2 | 2017: Baileys Brook Overall Results.

Baileys Brook watershed branches into two south flowing streams, which join and drain directly into North and South Easton's Pond. As Easton's pond provides drinking water for residents of Aquidneck Island, it is imperative to conduct year-round testing to ensure human health. By testing water for bacteria further up the watershed, trends may be seen between distance and time water travels from Baileys Brook to Easton's Pond and ultimately the Atlantic Ocean via Easton's Stream.

6.0 FUTURE ACTIVITIES

The specific goals for the coastal water quality program are a combination of sound water quality management plan that includes regular water quality testing, timely identification of point and nonpoint source of pollutants, and effective remediation. Our specific goals since 2006 remain the same: (1) to continue to establish a baseline foundation of water quality at several locations that are widely used by ocean enthusiasts although not recognized as designed swimming areas, (2) Official designation of swimming areas, (3) to provide a baseline for possibly re-opening Kings Park Swim Area, (4) to expand the program to test the likely sources of *Enterococci* at Easton's Bay so as to eliminate the sources, (5) to bring public awareness to water quality during "off season" months, a time in which many people use the water for recreation, (6) to bring public awareness to dry-weather water quality issues working in partnership with all agencies, so as to (7) achieve the long term goal of year-round funded water testing in New England and (8) permanent year-round clean water.

6.1 SUSTAINING CURRENT PROGRAM

The Clean Ocean access water quality monitoring program must continue with weekly samples at twelve locations and isolated testing at other locations on Aquidneck Island (within budget). The results from 2008 through 2017 show that several locations warrant action for determining the source of *Enterococci* and measures taken to make sure permanent clean water is achieved so that future generations can continue to enjoy ocean activities. Continued year-round testing to inform stakeholders and decision makers about water quality impairment is vital to protecting the water quality at our area beaches, a vital component to our tourism economy.

In 2018, the organization plans to continue weekly water sampling at twelve locations.

6.2 DESIGNATION OF SWIMMING AREAS

Several areas on Aquidneck Island are widely known as recreational swimming areas but are not designated as swimming areas by the local and/or state officials. COA has the goal to work in partnership with the City of Newport, Town of Middletown and Rhode Island Department of Health to take the necessary steps to designate these areas and establish water quality monitoring as part of the state program.

In 2018, the organization will seek funding support to develop a plan to initiate these activities.

6.3 RE-OPENING KINGS PARK SWIM AREA

Fortunately, this goal has been achieved!

In 2018, the organization plans to continue weekly water sampling at this location.

6.4 ELIMINATION OF SOURCES IMPACTING EASTON'S BAY

The likely sources of *Enterococci* in Easton's Bay are the Newport Moat and Middletown Esplanade however elevated readings are also found on surrounding shorelines such as Marine Avenue Beach and the source is not known. COA will work in partnership with the City of Newport, Town of Middletown, and Rhode Island Department of Health to take the necessary steps to address all sources of *Enterococci* impacting Easton's Bay and surrounding shorelines. The solutions are inevitably a combination of education, outreach, water conservation, and gray and green infrastructure solutions.

In 2018, the organization will complete the "Storm water pathogens: Find it & Fix it" project. This project was funded by an agreement (CE00A0004) awarded by the Environmental Protection Agency to the New England Interstate Water Pollution Control Commission on behalf of the Narragansett Bay Estuary Program. The project collected twice monthly 12 water samples and 8 sediment samples from Newport Moat and Easton's Beach from June 2016 to December 2016 to identify bacteria levels during dry & wet weather, identify the likely sources, propose remediation plans, and improvements for conveyance systems. The output from this project will aide stakeholder and decision makers in developing plans to address the bacteria in the Newport Moat. Additionally, plans are underway to expand the water quality monitoring in the Paradise Brook Watershed that drains to Third Beach to determine the source of bacteria.

6.5 ESCALATION OF OFF-SEASON WATER QUALITY ISSUES

After Labor Day the New England beaches are no longer tested for *Enterococci* by the Rhode Island Department of Health. COA will work in partnership with the City of Newport, Town of Middletown and Rhode Island Department of Health to bring awareness to these off-season water quality issues and devise strategies for using this data to make better decisions to improve overall water quality for the shoreline.

In 2018, the organization will seek funding support to develop a plan to initiate these activities.

4.6 RESEARCH OF DRY-WEATHER WATER QUALITY ISSUES

Significant effort has been put towards wet-weather events and beach closure protocols, however the scope of public health concerns needs to include dry-weather water quality issues. We plan to continue the positive energy relationship with all agencies and work to document, discover and address elevated levels of *Enterococci* that occur during long duration dry-weather events.

In 2018, the organization efforts for this goal are listed in section 6.4.

6.7 YEAR-ROUND DESIGNATION AND FUNDING

Currently New England beaches are designated as seasonal use (Memorial Day to Labor Day) and this results in funding from EPA provided to RIDOH to be limited for this period. However, our shorelines are used by recreational swimmers from May through October and a large wave riding population throughout the entire year. COA will work in partnership with local, state and federal officials to change the designation of New England Beaches and establish proper funding for year-round testing.

In 2018, the organization will seek funding support to develop a plan to initiate these activities.

6.8 PERMANENT CLEAN WATER

The current COA water quality monitoring program is based on the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act which requires that water is tested for *Enterococci*. *Enterococcus* is a part of the composition of Fecal Coliform which is a special kind of bacteria that is found primarily in the intestinal tracts of warm blooded animals. These bacteria are released into environment via human and animal feces and if ingested while swimming or adsorbed in the skin they may cause human disease, infection or rashes. However, this is just one of the many factors that impact ocean health. COA will work with local, state and federal officials as the Clean Water Act expands to cover additional factors that impact ocean health such as waste water, storm water and excess nutrients impacting our watershed that drains into the ocean.

In 2018, the organization will work on the goals and activities listed above.

APPENDIX FOR 2008-2017 WATER QUALITY SAMPLING RESULTS:

TABLE 1.0 PRECIPITATION.

Month	Year - 2008	Year - 2009	Year - 2010	Year - 2011	Year - 2012	Year - 2013	Year - 2014	Year - 2015	Year - 2016	Year - 2017
January	1.608	2.749	2.590	0.820	2.180	1.350	2.630	2.730	2.810	4.850
February	4.714	1.013	3.780	3.760	1.320	3.030	2.930	2.140	4.430	1.230
March	4.613	1.648	12.890	2.500	0.510	2.680	2.600	3.570	2.350	3.700
April	2.732	4.906	1.850	3.870	2.150	1.750	5.200	1.550	3.460	4.750
May	2.572	2.330	2.120	2.470	4.510	2.370	0.870	0.890	3.090	5.350
June	2.174	2.470	4.270	2.770	2.930	8.310	1.950	3.880	0.940	1.700
July	3.506	8.090	2.870	1.150	4.250	2.720	4.940	3.630	1.193	2.330
August	2.502	3.340	1.780	4.170	3.390	2.530	2.030	3.470	1.050	2.510
September	6.623	3.670	3.926	5.730	2.020	1.360	1.410	4.310	3.330	2.310
October	1.853	6.130	2.540	6.810	2.030	0.570	2.990	4.080	5.310	5.470
November	3.801	2.920	3.610	4.610	0.310	3.383	4.390	2.840	2.830	3.050
December	5.397	4.340	0.450	2.580	4.060	3.940	5.070	2.320	3.020	2.920
Total	42.095	43.606	42.676	41.240	29.660	33.993	37.010	35.410	33.813	40.170

TABLE 2.0 QUARTERLY GEOMETRIC MEAN.

Quarter	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
2008 - Winter	10			16		7	13	13	10	9			
2008 - Spring	10			16		10	21	12	10	10			
2008 - Summer	46			62		23	109	24	24	27			
2008 - Fall	19			35		25	112	35	16	13			
2009 - Winter	11	1,514		16	85	15	25	34	18	14			
2009 - Spring	12	102		17	180	10	39	17	17	11			
2009 - Summer	165	487		77	163	27	139	50	22	26			
2009 - Fall	19	365		44	55	28	24	31	20	50			
2009 - Winter	6	161		10	56	6	7	8	14	8			
2010 - Spring	12	211		21	271	7	19	10	12	8			
2010 - Summer	37	94		63	477	11	129	22	14	8			
2010 - Fall	11	268		18	331	16	28	33	11	9			
2011 - Winter	5	57		10	34	7	8	16	8	7			
2011 - Spring	47	274		44	1,269	9	25	22	6	9			
2011 - Summer	29	1,853		50	289	7	58	25	21	10			
2011 - Fall	14	309		31	206	17	48	66	20	28			
2012 - Winter	7	43		23	257	7	15	9	10	8			
2012 - Spring	10	98		27	402	11	45	17	14	12			
2012 - Summer	12	146		27	333	11	43	27	10	13			
2012 - Fall	14	69		35	767	12	18	36	14	16			
2013 - Winter	12			14	242	11	24	16	20	10			
2013 - Spring	11			40	236	18	25	18	15	14			
2013 - Summer	13			41	167	13	35	14	13	24			
2013 - Fall	14		15	21	167	25	38	13	21	13			
2014 - Winter	10		15	18	54	14	13	11	15	11			
2014 - Spring	12		15	24	206	12	25	13	18	12			
2014 - Summer	12		12	27	111	13	63	20	10	10			
2014 - Fall	13		19	38	251	12	41	32	18	15			
2015 - Winter	17		12	13	48	10	32	20	13	18			
2015 - Spring	18		10	32	296	14	15	11	14	10			
2015 - Summer	13		30	21	316	18	178	23	17	16			
2015 - Fall	14		34	51	375	17	44	24	21	17			
2016 - Winter	11		19	21	60	10	12	13	16	12			
2016 - Spring	11		11	19	196	13	46	12	10	10	281		
2016 - Summer	13		20	22	67	14	107	14	14	16	340		
2016 - Fall	10		10	22	141	11	23	11	16	10	22		
2017 - Winter	11		21	23	234	10	27	11	13	11	19		
2017 - Spring	11		11	22	315	11	16	21	11	10	130		
2017 - Summer	11		11	28	333	11	52	14	16	14	273		
2017 - Fall	17		16	20	392	12	13	11	15	10	67	11	24

TABLE 3.0 2008-2017: OVERALL STATISTICS.

Statistic	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
Samples Collected	468	155	197	467	423	433	469	469	449	468	86	11	11
Samples Below BAV	418	53	179	343	100	401	316	398	409	429	36	11	8
Samples Above BAV	50	102	18	124	323	32	153	71	40	39	50	0	3
Percentage Above BAV	11	66	9	27	76	7	33	15	9	8	58	0	27
Geometric Mean	14	197	15	27	194	12	33	19	14	13	96	11	24

TABLE 3.1 2008-2017: SAMPLES ABOVE THE BEACH ACTION VALUE PER YEAR.

Samples Above BAV Year	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
2008	9	0	0	15	0	3	22	8	6	2			
2009	10	28	0	14	37	9	19	13	7	11			
2010	8	30	0	11	36	2	13	5	4	2			
2011	9	28	0	17	35	3	16	13	6	6			
2012	1	16	0	11	35	0	10	7	2	4			
2013	2	0	0	11	35	2	14	5	4	4			
2014	2	0	5	9	37	6	15	8	3	2			
2015	7	0	5	15	38	4	18	6	3	5			
2016	1	0	4	9	30	3	16	2	3	3	22		
2017	1	0	4	12	40	0	10	4	2	0	28	0	3

TABLE 3.2 2008-2017: OVERALL STATISTICS FOR GEOMETRIC MEAN.

Annual Geometric Mean Year	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
2008	18	0	0	29	0	15	48	20	14	14			
2009	25	437	0	32	109	19	41	31	19	23			
2010	14	174	0	23	238	9	30	15	13	9			
2011	17	233	0	32	242	10	29	28	12	12			
2012	10	82	0	28	412	10	26	19	12	12			
2013	12	0	15	28	200	14	30	15	16	15			
2014	12	0	15	27	142	13	31	18	15	12			
2015	15	0	19	27	218	14	45	19	16	15			
2016	11	0	14	21	104	12	34	13	14	12	111		
2017	12	0	14	23	313	11	24	14	13	11	86	11	24

TABLE 4.0 SINGLE SAMPLE VALUES FOR 2008.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
4-Jan-08	5			50		5	5	5	5	5			
10-Jan-08	5			51		5	5	5	5	5			
15-Jan-08	5			5		5	5	31	5	5			
23-Jan-08	5			5		5	5	5	5	5			
30-Jan-08	5			5		5	5	5	5	31			
6-Feb-08	52			5		5	5	5	5	5			
13-Feb-08	10			20		10	72	10	10	10			
18-Feb-08	10			10		10	20	10	10	10			
27-Feb-08	20			20		10	10	63	63	20			
6-Mar-08	10			10		10	10	10	98	10			
10-Mar-08	10			10		10	52	20	10	10			
20-Mar-08	20			703		10	173	160	10	10			
27-Mar-08	10			10		10	10	10	10	10			
2-Apr-08	10			10		10	30	10	10	10			
7-Apr-08	10			10		10	40	10	10	10			
17-Apr-08	10			10		10	10	10	10	10			
22-Apr-08	10			30		10	40	10	10	10			
29-Apr-08	10			252		10	183	41	10	10			
5-May-08	10			10		10	10	10	10	10			
13-May-08	10			10		10	10	10	10	10			
19-May-08	10			10		10	10	10	10	10			
28-May-08	10			10		10	10	10	10	10			
4-Jun-08	84			119		10	96	10	10	10			
12-Jun-08	10			20		10	10	10	10	10			
18-Jun-08	10			30		10	10	41	10	10			
23-Jun-08	41			84		10	96	10	31	10			
1-Jul-08	63			131		7,701	3,448	63	10	10			
7-Jul-08	74			86		10	114	20	171	11,199			
14-Jul-08	52			52		31	313	52	168	677			
21-Jul-08	441			10		10	663	10	74	10			
29-Jul-08	41			163			40	52	20	10			
4-Aug-08	10			85		106	124	10	10	10			
12-Aug-08	216			213		10	443	173	63	30			
19-Aug-08	63			181		10	185	10	10	20			
26-Aug-08	20			10		10	10	30	10	10			
8-Sep-08	10			52		10	307	51	10	10			
17-Sep-08	10			31		31	51	20	10	10			
25-Sep-08	10			98		10	84	10	20	10			
2-Oct-08	10			96		20	10	62	20	10			
9-Oct-08	134			20		7,701	5,172	160	20	20			
14-Oct-08	529			97		52	988	10	10	10			
21-Oct-08	10			251		10	86	10	10	10			
6-Nov-08	10			20		30	74	131	41	20			
14-Nov-08	10			30		10	504	10	20	10			
21-Nov-08	10			41		10	10	20	10	10			
25-Nov-08	30			31		41	413	31	41	10			
1-Dec-08	10			105		20	41	754	10	10			
10-Dec-08	10			10		10	313	52	20	10			
17-Dec-08	20			10		30	95	20	31	31			
22-Dec-08	72			10		10	30	31	10	41			
30-Dec-08	10			10		10	20	31	10	10			

TABLE 5.0 SINGLE SAMPLE VALUES FOR 2009.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
15-Jan-09	10	1,259		10	10	703	92	6,867	10	10			
22-Jan-09	10	809		10	20	10	10	74	10	10			
29-Jan-09	31	1,664		41	907	10	336	148	538	269			
5-Feb-09	10	14,136		10	98	10	51	10		10			
12-Feb-09	10	1,624		10	960	10	84	30	52				
19-Feb-09	10	1,396		31	109	10	10	31	10	10			
26-Feb-09	10	336		10	110	10	10	10	10	10			
5-Mar-09	10			41	20		10	10	10	10			
12-Mar-09	10			10	122	10	10	10	10	10			
19-Mar-09	10			41	52	10	10	10	10	10			
26-Mar-09	10			10	63	10	20	10	10				
2-Apr-09	10			31	160	10	100	253	10	10			
9-Apr-09	10			10	379	10	10	10	31	10			
16-Apr-09	10			10	10	10	336	10	10	10			
23-Apr-09	10			20	156	10	10	10		10			
30-Apr-09	10			10	63	10	10	10		10			
7-May-09				10	683	10	10	20	41				
14-May-09	10	41		10	52	10	10	10	20	10			
20-May-09	10			10	275	10	41	10	10				
28-May-09	10			10	262	10	257	10	63	10			
4-Jun-09	10	11,199		657	5,794	10	285	10		10			
11-Jun-09	10	41			389		158	20	10	10			
18-Jun-09	20	30		10	73	10	31	10	10	10			
25-Jun-09	30	20		10	86	10	10	74	10	20			
2-Jul-09		1,935		135	20	350	2,282	598	30	173			
9-Jul-09	285	3,255		146	223	106	97	11,199	107	305			
17-Jul-09	10	20		30	717	10	126	20	20	10			
23-Jul-09	148	122		216	84	10	324	10	10	10			
30-Jul-09	6,867	15,530		52	106	10	10	52		10			
6-Aug-09	74			31	126	20	10	10	20	10			
13-Aug-09	813	4,611		620	768	10	80	10	97				
20-Aug-09	3,255	41		96	3,873	31	1,153	10	10	10			
27-Aug-09	30			10	278	10	341	85	10				
3-Sep-09	84	213		20	31	120		10	10	31			
10-Sep-09	10	20		213	63	10		10	10				
17-Sep-09	10	3,873		20		10	187	240	10	72			
24-Sep-09	2,755			337	62	142	73	97	131	10			
1-Oct-09	10	1,607		41	41	10	30	10	10	138			
8-Oct-09	20	278		20	61	10	10	213	10	288			
15-Oct-09	10	10		10	10	10	10	323	20	226			
22-Oct-09	238	336		41	30	419	10	10	20	10			
29-Oct-09	10	934		63	359	109	74	3,282		148			
5-Nov-09	10	1,785		10	20	327	10	10	10	10			
12-Nov-09	10	74		410	231	10	20	10	51	10			
19-Nov-09	10	318		73	61	10	10	10	10	10			
25-Nov-09	10	990		10	173	10	10	10	10	185			
3-Dec-09	422	19,863		754		364	24,192	20	134	85			
10-Dec-09	31	1,396		187	246		20	20	73	41			
17-Dec-09	10	119		61	72	10	10		10	10			
23-Dec-09	10	95		20	20	10	10			10			
30-Dec-09	10	41		10	10	10	10	10		780			

TABLE 6.0 SINGLE SAMPLE VALUES FOR 2010.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
14-Jan-10	10			31	122	10	10	10		10			
21-Jan-10	10	148		10	171	10	10	10	10	10			
28-Jan-10	10	330		10	20	10	30	10	20	10			
4-Feb-10	5	298		10	98	5	5	5	5	5			
18-Feb-10	5	216		5	63	5	5	5	10	5			
25-Feb-10	5	547		30	243	5	5	20	31				
4-Mar-10	5	74		5	20	5	5	5	5	10			
11-Mar-10	5	3,784		5	121	5	5	5	10	5			
18-Mar-10	5	31		20	20	5	5	5	41	31			
25-Mar-10	5	5		5	10	5	5	30	41	5			
1-Apr-10	10	63		20	275	10	20	110	135	52			
8-Apr-10	5	588		85	41	5	10	5	10	5			
15-Apr-10	5	20		5	10	5	5	5		5			
22-Apr-10	5	10		5	20	5	52	5	5				
29-Apr-10	5	85		31	512	5	5	5	5	5			
6-May-10	5	5		10	63	5		5	10	10			
13-May-10	10	118		10	30	5		5					
27-May-10	5	7,701		52	14,136	20	10	31	5	5			
3-Jun-10	10	909		41	8,297	10	61	10	10	10			
10-Jun-10	20	2,489		20	4,884	10	62	31	5	10			
17-Jun-10	41	14,136		31	408	5		5	74	5			
24-Jun-10	613	86		52	301	20	41	10	10	10			
1-Jul-10	10	4,884		72	497	10	20	10	10	10			
8-Jul-10	63	135		428	725	10	223	10	10	10			
15-Jul-10	10	10		20	12,997	41	386	259	41	74			
22-Jul-10	385			70	496	10	126		10	10			
29-Jul-10	10	61		1,616	2,014	10	17,329	10	10	20			
4-Aug-10	5	359			309		30	5	41	5			
12-Aug-10	727	441		207	292	20	839	20	31	10			
19-Aug-10	10	10			145		5	20	5	5			
26-Aug-10	1,145	183		10	187	5	73	10	10	5			
9-Sep-10	5	10		74	109		41		10	5			
16-Sep-10	5			20	97		10	3,873	10	5			
23-Sep-10	108	223		63	2,282		10	5	31	5			
30-Sep-10	96	20		5	238	5	19,863	5	10	5			
7-Oct-10	30	1,597		52	988		195	6,867	10	10			
14-Oct-10	5	5		5	41		10	5	5	10			
21-Oct-10	10	381		111	85		10	10	5	5			
28-Oct-10	74	7,701		185	8,164	5	327		305	110			
10-Nov-10	10	1,391		63	272	160	10	20	10	10			
17-Nov-10	5	15,531			9,804	86	489		161	20			
24-Nov-10	5	52		5	354	5	5		5	5			
1-Dec-10	5	697		10	41		5	5	5	5			
8-Dec-10	10	31		5	86		10	10	5	5			
15-Dec-10	41	30		41	906	10	98	52	10				
22-Dec-10	5	158		5	41	5			5	5			
29-Dec-10	10	52		5	496		10	74	5	5			

TABLE 7.0 SINGLE SAMPLE VALUES FOR 2011.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
5-Jan-11	5	173		5	171	20	10	31	5	5			
13-Jan-11	5	30			563			20	5	5			
10-Feb-11	5	5			98		10	3,654					
17-Feb-11	5	663			98		10		5				
24-Feb-11	5	1,414		5	20	5	5	5	10	5			
3-Mar-11	5	5		278	10	5	5	5	5	10			
10-Mar-11	5	5		10	20	5	5	5	5	5			
17-Mar-11	5	216		5	5	5	5	10	109	20			
24-Mar-11	5	30		5	10	5	10	5					
31-Mar-11	5	98		5	10	10	20	5	5	10			
7-Apr-11	5	81		5	41	5	5	10	20	5			
14-Apr-11	5	379		63	933	5	5	160	5	52			
21-Apr-11	5	41		5		5	5	20	5	5			
28-Apr-11	10	187		5	86	10	10	10	5	5			
5-May-11	10	605		5	223		40	5	5	5			
11-May-11	5	20		197	173	5	108	5	5	5			
19-May-11	10	12,997		369	6,488	5	5	20	5	5			
26-May-11	2,613	134		254	2,143	5	72	5	5	5			
2-Jun-11	683	262		187	4,106	10	10	41	5	10			
9-Jun-11	24,192	1,076		583	24,192	5	41	63					
16-Jun-11	85	31		5	1,664	171	40	31	5	5			
23-Jun-11		15,531		336	24,192	5	472	341		171			
30-Jun-11		74		20	2,481	41	84	10		5			
14-Jul-11		4,352		31	95	52	96	408	41	10			
21-Jul-11				10		5	5	5	5	5			
28-Jul-11				145	109	5	5	5	10	5			
4-Aug-11	74			41	865	5	141	5	108	10			
11-Aug-11	465			20	855	10	63	41	5	5			
18-Aug-11	10			5	314	5	51	20	41	5			
25-Aug-11				95	41	5	5	5	10	5			
1-Sep-11	5			63	743	5	61	5	5	5			
8-Sep-11		24,192		259	41	10	2,613	738	1,017	272			
15-Sep-11	5	10			187	10	52	20	5	5			
29-Sep-11	63	11,199		341	7,270	5	512	146	31	63			
6-Oct-11	5	120		5	41	10	41	63	5	5			
13-Oct-11	197	24,192		85	19,863	275	2,613	8,664	243	2,014			
20-Oct-11	41	9,804		187	2,723	253	74	3,873	240	240			
27-Oct-11	5	2,247		373	189	20	72	86		41			
4-Nov-11	10	85		20	74		10	10	5	10			
10-Nov-11	20	5		20	74	5	121	5	31	5			
17-Nov-11	5	5,794		10	98	10	115	1,515	30	31			
22-Nov-11		10			30	5	5	10	5	5			
1-Dec-11	5	256		41		5	20	5	5	10			
8-Dec-11	219	7,270		105	3,076	20	169	399	240	259			
15-Dec-11	5	10		10	52	10	10		5				
22-Dec-11	5	74		5	74	10	10	5	5	10			
29-Dec-11	10	108			74	20		5		10			

TABLE 8.0 SINGLE SAMPLE VALUES FOR 2012.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
5-Jan-12	5			134	173	5	30	5	5	5			
12-Jan-12	5	2,481		84			10	10	31	31			
19-Jan-12	5	31		20	697	5	10	10	5	5			
26-Jan-12	5	10		189		5	10	5	31	5			
2-Feb-12	5			31	557	5	10	5	5	5			
9-Feb-12	5	5			10	5	5	20	10	5			
16-Feb-12	5	5		20	663	5	20	10	5	5			
23-Feb-12	5	5		10	122	5	20	5		20			
1-Mar-12	10	2,480		20	2,190	10	31	20	20	10			
8-Mar-12	10	10		10	160	10	10	10	10	10			
15-Mar-12	10	5		5	85	10	20	10	10	10			
22-Mar-12	10	10		10	771	10	10	10	10	10			
29-Mar-12	10	8,660		10		10	52	10	10	10			
5-Apr-12													
12-Apr-12	10	10		10	41	31	81	10	10	10			
19-Apr-12	10	10		10	216	10	20	10	10	10			
26-Apr-12	10	20		82	226	10	61	20	10	10			
3-May-12	10	3,650		41	416	10	74	10	10	10			
9-May-12	10	8,660		1,660	19,900	10	298	1,940	74	63			
17-May-12	10	413		10	199	10	173	10		20			
24-May-12	10	20				10	20	10	10	10			
31-May-12	10	10				10	51	10	52	10			
7-Jun-12	10	31		10	187	10	10	20	10	10			
14-Jun-12	10	487		10		10	41	10		10			
21-Jun-12	10			10		10	10	10	10	10			
28-Jun-12	10			41	1,110	10		10	10	10			
5-Jul-12	10			10			41	30	10	10			
12-Jul-12	10	813		30	110	10	81	10	10	10			
19-Jul-12	10					10	354			63			
26-Jul-12	20	1,420		10	465	10	71	10	10	10			
2-Aug-12	41	148			1,120	20	51		10	10			
9-Aug-12													
16-Aug-12		10		84	645		20	109	10	10			
23-Aug-12	10	20		95	185	10		10	10	10			
30-Aug-12	10	10		20	959		40	10	10	10			
6-Sep-12	10	259		52		10	40	171	10	20			
13-Sep-12	10	1,260		10	119	10	20	10	10	10			
20-Sep-12	10	63		96	443	10	31	213	10	10			
27-Sep-12	10	638		10	146	10	10	20	10	20			
4-Oct-12		20		10	512	10	20	30	20	20			
11-Oct-12	96	223		31	3,450	10	132	134	10	10			
18-Oct-12	31	74		10	1,720	10	73	41	10	10			
25-Oct-12	10				327	10	10	30	31	10			
1-Nov-12				109			20	20	10	10			
8-Nov-12	10			75	24,200	20	30	52	85	86			
15-Nov-12	10			20	1,380	10	10	10	10	10			
21-Nov-12	10			132	20	10	10	10	10	10			
29-Nov-12	10			41	2,380	10	10	10	10	41			
6-Dec-12	10			51	73	10	10	10	10	10			
13-Dec-12	10			20	906	52	10	379	10	10			
20-Dec-12	10			31	521	10	10	10		10			
27-Dec-12	20			41		10		857	10	75			

TABLE 9.0 SINGLE SAMPLE VALUES FOR 2013.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
3-Jan-13	10			10	231	10	10	30	20	10			
10-Jan-13				10	132	10	98	10	10	10			
17-Jan-13	10			20	538	10		10	10	10			
24-Jan-13	10				211	10	20	10	20				
31-Jan-13	10			31	9,800	20	246	63	583	10			
7-Feb-13	10			10		10	10	10	20	10			
14-Feb-13	10			10	279	10	20	20	10	10			
21-Feb-13	10			31	41	10	20	10	10	10			
7-Mar-13				10	2,140		10	61	41	10			
14-Mar-13	41			20	10	10	10	10	10	10			
21-Mar-13	10			10	84		75	10	10	10			
28-Mar-13	10			10			10	10	20	10			
4-Apr-13				74	52	10	10	10	10	98			
11-Apr-13	10			31	24,200	10	20	20	10	10			
18-Apr-13	10			134	195	10	147	75	10	10			
25-Apr-13	20			10	98	61	10	10	10	10			
2-May-13	10			74	216	10	20	10	10	10			
9-May-13	10			10	1,400	450	10	888	10	10			
16-May-13	10			20	327	10	93	10	20	10			
23-May-13	10			426	203	10	30	10	10	10			
30-May-13	10			20	20	10	40	10	719	41			
6-Jun-13	10			20	121	20	30	10	10	10			
13-Jun-13	10			10	10	10	10	10	10	10			
20-Jun-13	10			41	537		71	10	10	10			
27-Jun-13	10			211	1,110		10	20	10	20			
2-Jul-13	20			10	31	10	41	10	10	20			
11-Jul-13	10			81	185	20	319	20	10	10			
18-Jul-13	10			279	197	10	10	10	10	10			
25-Jul-13	10			209	987	52	40	10	10	10			
1-Aug-13	10			41	173	10	10	20		317			
8-Aug-13				31	20	10	60			20			
15-Aug-13	10			84	650	10	81	10	10	74			
22-Aug-13	10			10	496	10	10	10	10	73			
29-Aug-13	10			10	97	10	73	10	10	52			
5-Sep-13	10			92	323	10	30	122	10	10			
12-Sep-13	161			50	160	10	20	10	98	10			
19-Sep-13	10			10	422	10	30	10		20			
26-Sep-13	10			41	30	20	40	10	10	10			
3-Oct-13	10				211	20	10	10	20				
10-Oct-13	10			10	62	20	20	51		20			
17-Oct-13	108		20	20	30	41	95		10	10			
24-Oct-13	20		10	20	52		228	10	20	51			
31-Oct-13	10		10		20		132	10	10	10			
7-Nov-13			41		202		985	10	86	10			
15-Nov-13	10		10	40	420		10	10	10	10			
22-Nov-13			10	10	1,180		10		20	10			
26-Nov-13	10				448		10	10	20				
12-Dec-13	10		10	101			10	10		10			
19-Dec-13	10		30	10	908		41	20	50	10			

TABLE 10.0 SINGLE SAMPLE VALUES FOR 2014.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
2-Jan-14				84	487		10						
16-Jan-14	10		10	10		10	10	10	20	10			
23-Jan-14	10		10	10	30		10	10	10	10			
30-Jan-14	10		10	10	10		10	10	10	10			
13-Feb-14	10		10	10	74	10	52	10	10	10			
21-Feb-14	10		10	52	10	10	10	10	41	20			
27-Feb-14	10		86	10	10	10	10	10	10	10			
6-Mar-14	10		10		41	10	20	10	41	10			
13-Mar-14	10		30	20	148	185	10	10	10	10			
20-Mar-14	10		20	20	496	10	20	20	20	10			
27-Mar-14	10		10		64	10	10	10	10	10			
3-Apr-14	10		10	10	134	10	10	10	10	10			
10-Apr-14	10		10	10	10	10	10	10	10	10			
17-Apr-14	10		10	20	20	10	20	108	10	10			
24-Apr-14	10		20	10	160	10	60	10	10	10			
1-May-14	10		677	199	2,610	110	512	20	52	31			
8-May-14	10		10	40	74	10	10	20	10	20			
15-May-14	10		10	30	1,020	10	20	10	1,010	10			
22-May-14	20		10	41	109	10	10	10	10	10			
29-May-14	10		10	10	830	10	101	10	10	10			
5-Jun-14	41		10	31	253	10	10	10	31	10			
12-Jun-14	10		10	31	616	10	61	10	10	10			
19-Jun-14	10		10	52	613	10	20	10	10	10			
26-Jun-14	10		10	10	168	10	10	10	10	20			
3-Jul-14	10		10	30	51	10	41	10	10	10			
10-Jul-14			10	10	3,130	20	332	20	10	10			
17-Jul-14	10		10	10	31		251	181	10	10			
24-Jul-14	10		10	30	256	10	20	10	10	10			
31-Jul-14	10		10	10	85	10	10	10	10	10			
7-Aug-14	20		20	20	275		176	10	10	10			
14-Aug-14	10		10	10	85	10	10	785	10	10			
21-Aug-14	10		10	364	20	10	73	10	10	10			
28-Aug-14	10		41	10	529	10	30	10	10	10			
4-Sep-14	10		10	160	146	10	81	10	10	10			
11-Sep-14	41		10	108	63	10	181	10	10	10			
18-Sep-14	10		10	10	10	20	20	10	10	10			
25-Sep-14	10		10	41	156	63	298	31	10	10			
2-Oct-14	86		10	933	13,000	31	847	703	20	120			
9-Oct-14	20		31	91	295	10	63	10	52	10			
16-Oct-14	10		10	41	85	10	10	10	10	10			
23-Oct-14	10		231	98	4,350		121	97	10	41			
30-Oct-14	10		10	30	146	10		10	10	10			
6-Nov-14	10		10	10	160	10	10	10	10	10			
13-Nov-14	20		10	10	63	10	30	10	10	10			
20-Nov-14	10		10	52	203		20	10	122	10			
25-Nov-14	10		84	52	1,310	10	10	231	146	86			
4-Dec-14	10		10	10	97		10	10		10			
11-Dec-14	10		10	10	20	20	10	41	10	10			
18-Dec-14	10		61	114	691	10	10	63	10	10			
23-Dec-14	10		20	41	173	10	24,200	299	10	10			
30-Dec-14	10		10	10	31	10	10	10	10	10			

TABLE 11.0 SINGLE SAMPLE VALUES FOR 2015.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
8-Jan-15	134		10	10	74	10	10	31	10	10			
15-Jan-15	10		20	10	20	10	30	10	10	80			
22-Jan-15	10		10	10	41	10	10	31	20	10			
29-Jan-15	10		10	10	10	10	10	10	10	10			
5-Feb-15			10	10	10	10	10	10	10	10			
12-Feb-15													
19-Feb-15	10		10	10	10	10	20	10	10	10			
26-Feb-15	96		10	10	119		142	41	10	52			
5-Mar-15													
12-Mar-15	10		10	63	41	10	300	63	31	75			
19-Mar-15	10		10	10	410	10		10	10	10			
26-Mar-15	10		41	31	504	10	135	41	20	10			
2-Apr-15	10		10	10	51	10	10	10	393	10			
9-Apr-15	10			10	345	10	10			10			
16-Apr-15	10		10	63	61	10	10	10	10	10			
23-Apr-15				164	183	10	10	20	10	10			
30-Apr-15	10		10	84	213	10	10	10	10	10			
7-May-15			10	10	63	10	20	20	10	10			
14-May-15				10	134	292	10			10			
21-May-15	10		10	10	4,106	10	10	10	10	10			
28-May-15	10		10	10	301		20	10	10	10			
4-Jun-15	504		10	31	585		41	10	10				
11-Jun-15	31		10	51	1,290	10	132	10	10	10			
18-Jun-15			10	187	1,390	10	10	10	10	10			
25-Jun-15	10		10	127	288	10	10	10	10	10			
2-Jul-15	10		108	10	1,520	10	146	160	10	31			
9-Jul-15	10		10	125	369	10	30	10	10	10			
16-Jul-15	10		51	10	743		118	450	41	63			
23-Jul-15	10		10	10	1,070	10	100	10	10	10			
31-Jul-15	52		10	10	906	10	177	10	10	10			
6-Aug-15	10		31	10	132		161	10	10	10			
13-Aug-15	10		10	185	613	41	30	20	10	10			
20-Aug-15	10		10	10	355		24,200	10	10	10			
27-Aug-15	10		10	20	422	52	200	10	52	10			
3-Sep-15	10		20	10	158	10	316	10	41	201			
10-Sep-15	41		14,100	285	84	213	61	452	52	10			
18-Sep-15	20			10	158	10	92	10		10			
24-Sep-15	10		10	10	31	10	479	10	10	10			
1-Oct-15	20		266	63	1,270		591	1,310	52	52			
8-Oct-15	10			218	10	10	30		10	41			
15-Oct-15	31		20	10	201	10	31	10	10	10			
22-Oct-15	10		10	91	216	10	41	10	52	10			
29-Oct-15	41		1,610	203	19,900	318	443	364	471	199			
5-Nov-15	10		10	10	52	10	20	10	75	10			
12-Nov-15	10		10	20	121	10	41	31	10	10			
19-Nov-15	10		51	10	663		109	10	10	10			
24-Nov-15	31		71	1,250	1,350	31	10	10	10	10			
3-Dec-15	10		20	10	906		30	10	10	10			
10-Dec-15	10		10	481	233	10	20	10	10	10			
17-Dec-15	10		10	10	586	10	10	10	10	10			

TABLE 12.0 SINGLE SAMPLE VALUES FOR 2016.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
7-Jan-16	10					10		10		10			
14-Jan-16	10		20	20	72	10	10	10	31	10			
21-Jan-16	10		10	10	20	10	10		10	10			
28-Jan-16	10		10	10	10	10	10	20	10	10			
4-Feb-16	10		41	20	171	10	20	20	355	10			
11-Feb-16	10		30	10	10	10	10	10		10			
18-Feb-16	10		20	10	10	10	10	10	10	10			
25-Feb-16	10		75	31	2,720	10		63	10	75			
3-Mar-16	20		81	50	51	10	10	10	10	10			
10-Mar-16	10		10	81	131	10	10	10	10	10			
17-Mar-16	10		10	10	203	10	10	10		10			
24-Mar-16	10		10	10	71	10	10	10	10	10	12		
31-Mar-16	10		10	165	31	10	30	10	10		23		
7-Apr-16	10		10	10	10	10	74	10	10	10	37		
14-Apr-16	10		10	10	20	10	10	10	10	10	39		
21-Apr-16	10		10	10	31	10	10	10	10	10	21		
28-Apr-16	10		10	20	90	10	60	10	10	10	45		
5-May-16	10		10	10	20	10	51	30	10	10	2,420		
12-May-16	10		10	10	173	10	10	10	10	10			
19-May-16	10		10	10	556	31	10		10	10	112		
26-May-16	10		10		163	10	102	10	10		1,550		
2-Jun-16	20		10	10	1,870	10	354	10	10	10	579		
9-Jun-16	10		10	63	6,870	10	152	10	10	10	1,550		
16-Jun-16	10		10	10	337	10	10	10	10		980		
23-Jun-16	10		31	1,850	2,140	75	109	10	10	10	344		
30-Jun-16	20		10	10	397		278	31		10	1,410		
7-Jul-16	114		10	10	384	10	393	94	10	86	613		
14-Jul-16	10		10	253	173	10	20	20	10	10			
21-Jul-16	10		10	10	145	10	10	10	187	30	2,420		
28-Jul-16	10		10	20	20	10		10	41	10	579		
4-Aug-16	10			10	10	10	214	10	10	10	172		
11-Aug-16	10		10	10	41	10	20	10	10	10	204		
18-Aug-16	10		10	20	199	63	20	10	10	10	127		
25-Aug-16			70	174	41		6,910	10	10	10	649		
1-Sep-16	10			151	253	74	94	10	10	31	1,050		
8-Sep-16	10		336	10	31		30		10	10	142		
15-Sep-16	20		31	10	10	10	120	10		63	1,410		
22-Sep-16	10		31	10	109	10		10	10	10	146		
29-Sep-16	10		10	10	98	10	1,300	30	10	10	31		
6-Oct-16	10		10	10	121	10	10	10	10	10	52		
13-Oct-16	10		10	10	323	10	259	10	10	10	75		
20-Oct-16	10		10	10	794	10		20	20	10	10		
27-Oct-16	10		10	10	10	10	10	10	10	10	20		
3-Nov-16	10		10	72	20	10	10	10	10	10	10		
10-Nov-16	10		10	30	20		30	10	41	10	16		
17-Nov-16	10		10	30	983	10	10	10		10	20		
22-Nov-16			10	85	253		10	10		10	20		
1-Dec-16	10		10	20	2,600	20	97	20	63	10	595		
8-Dec-16	10		10	20	266	10	113	10	20	10	10		
14-Dec-16	10		10	50	488	10	10	10		10	63		
22-Dec-16	10		10	10	41		20	10	10	10	2		
29-Dec-16	10		10	20	20	10	10		10	10	10		

TABLE 13.0 SINGLE SAMPLE VALUES FOR 2017.

Date	Easton's Point	Esplanade North	Esplanade South	Easton's Beach	Easton's Stream	Ochre Point	Marine Avenue Beach	Kings Park	Elm Street Pier	Van Zandt Pier	Baileys Brook	Second Beach	Third Beach
12-Jan-17	10		10	91	1,300		20	10	10	20	223		
19-Jan-17	10		10	10	228	10	10	10	10		18		
27-Jan-17	10		31	30	216		20	10	10	10	41		
2-Feb-17	10		10	10	75	10	70	10	31	10	10		
16-Feb-17	10		61	20	97	10	112	10	10	10	36		
23-Feb-17	10		51	280	512	10	70	10		20	4		
2-Mar-17	10		10	10	2,910	10	10	10	10	10	5		
9-Mar-17	10		10	10	327	10	20	10	10	10	17		
16-Mar-17	41		92	52	496	10	10	10	31	10	122		
23-Mar-17	10		10	10	20	10		10	10	10	9		
30-Mar-17	10		41	10	52	10	50	20	10	10	5		
6-Apr-17	10		10	10	10	10	10	10	10	10	17		
13-Apr-17	10		10	104	10	10	10	10	10	10	5		
20-Apr-17	10		10	10	14,100	10	20	10	10	10	11		
27-Apr-17	10		10	10	213	10	10	63	10	10	457		
4-May-17	10		10	10	187	10	41	10	10	10	308		
11-May-17	10		10	10	203	10		10		10	54		
18-May-17	10		10	10		10	10	121	10	10	71		
25-May-17	20		10	10	148	10			10	10	70		
1-Jun-17	10		30	20	63	10		10	10	10	1,550		
8-Jun-17	10		10	10	114	10	10	10	10	10	291		
15-Jun-17	10		10	61	705	10	10	10	10	10	250		
22-Jun-17	20		20	253	12,000	41	84	759	41	10	1,550		
29-Jun-17	10		10	81	9,210	10	20	10	10	10	464		
6-Jul-17	10		10		629	10	30	10	10	10	727		
13-Jul-17	10		10	20	5,790	10	61	30	10	10	770		
20-Jul-17	10		10	61	250	10	30	10	30	10	488		
27-Jul-17	10		10	92		10	162	10	20	20	326		
3-Aug-17			10	10	97	10	50	10	10	10	238		
10-Aug-17	10		10	164	131	10	111	10	10	20	97		
17-Aug-17	20		20	30	3,440	31	189	10	10	20	175		
24-Aug-17	10		10	10	41	10	10	248	30	10	133		
31-Aug-17	10		10	20	262	10	254	10	10	10	906		
7-Sep-17	20		20	10	888	10	84	10	121	52	2,420		
14-Sep-17	10		10	75	73	10	10	10	10	10	31		
28-Sep-17	10		10	10	201		20	10	10	10	55		
12-Oct-17			10	10	285	10	30	10		10	52	20	31
19-Oct-17	20		10	10	173	10	10	10	10	10	261	10	10
26-Oct-17	20		62	74	11,200	52		30	41	10	1,300	10	161
2-Nov-17	10		10	114	246	10	20	10	10	10	65	10	10
9-Nov-17	10		10	10	594	10	10	10	10	10	77	10	168
16-Nov-17	10		10	41	128	10	20	10	10	10	17	20	10
21-Nov-17	10		10	10	2,720	10	10	10	10	10	40	10	10
30-Nov-17	333		10	51	839	10	10	10	10	10	2	10	20
7-Dec-17	10		10	10	231	10	10	10	10	10	162	10	110
14-Dec-17	20		101	10	74	10	10	10	10	10	64	10	10
21-Dec-17	10		20	10	84	10	10	10	110	10	91	10	10