



# Citizen Science Monitoring for Pathogens on Staten Island

A FINAL REPORT FOR THE NY-NJ HARBOR AND ESTURARY PROGRAM

Prepared by Paul L. Sieswerda, President, Gotham Whale  
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## Introduction:

Gotham Whale, in collaboration with the NY-NJ Harbor and Estuary Program, (HEP), the US Environmental Protection Agency, (EPA) and the Conference House Park, CHP) participated in a Citizen Science Monitoring Project that provided data collection and water quality parameters at sites along the Staten Island shoreline that had human access but were not monitored by any agency and therefore lacking in sufficient water quality data. Gotham Whale worked with John Kilcullen, Director of the Charter House Park to mentor interns and citizen scientists from Staten Island and surrounding communities. An approved QAAP was followed. Data generated from this project therefore has the potential to be used to inform water quality policy and regulatory decisions for the area. Summary data can also inform the public of conditions in the sampled areas.

## Project Summary:

From June 20<sup>th</sup>, 2016 to October 11, 2016 Gotham Whale conducted weekly sampling and monitoring data from seven sites along the north and south shores of Staten Island - Richmond County. Paul Sieswerda, John Kilcullen, and six volunteers participated in all aspect of monitoring GPS and YSI operations, data collection, water sample collection, and laboratory testing. At each site measurements were taken – temperature, salinity, oxygen, and pH, along with observations regarding weather conditions, potential pollution inputs from point and non-point sources and recreational use. i.e. fishing, boating, swimming. Water samples were collected in sterile technique and analyzed at the IEC laboratory to determine the levels of Enterococcus bacteria, an indicator of pathogen contamination. Data were analyzed to determine the levels of Enterococcus, with notes on potential causes due to precipitation, or other causes.

## Sampling Protocol:

Five locations were chosen to be tested along the north shore and two at the southern tip of Staten Island. Each location was targeted to be monitored five times per month for a total of 17 dates for the four-month period. At each site the following parameters were measured with a hand-held YSI probe: water temperature (degrees C), salinity as specific conductance (mS/mg), dissolved oxygen, (mg/l and % saturation), and pH. Observations were made of the environmental conditions that noted cloud cover, precipitation (current,

24, and 48 hours). The tidal stage and water conditions were recorded (color of water, floating debris, and sewage). Pollution sources (point and non-point) and recreational uses such as boating, fishing, swimming were recorded. The location (latitude/longitude) was determined using a hand-held GPS unit. The observations were made by looking in a 360-degree arc around the sample site as well as photographing the site at the sampling time. At each sampling site a water sample was taken using sterile technique for testing for Enterococcus and Turbidity. The sample was placed on ice and transported to the IEC laboratory (at CSI, Staten Island, NY). All samples were conducted within six hours.

At the laboratory, standard protocols were followed to prepare and incubate the sample with Enterokert for 24 hours, after which the specimens were observed by IEC staff under fluorescent lighting to quantify the amount for Enterococcus within the water sample (EPS/QAPP methods, 2016) Data were analyzed using simple statistical measures (mean, geometric means) over the entire season – June 20 – October 11.

Conclusions were drawn between precipitation events and the increase in Enterococcus levels.

Quality control Measures:

In accordance with USEPA – approved Citizen Science QAPP (April 2016) the following measures were taken to ensure that data collection was within all quality control means.

1. Precision: For field sampling measures, a duplicate of the YSI reading was taken (temperature, salinity, pH, oxygen). If the duplicate was not similar, a third reading was taken to determine the proper measurements. The measures were only accepted if within 10%. In the laboratory, a duplicate sample was run by IEC staff, with an alternate method (not Enterokert) to check for agreement between the old and new accepted methods. Laboratory and field duplicates were also run. Any sample duplicates not within 30% of the sample should be rejected.
2. Bias: All sampling sites were along the shoreline and within wading depths or suspended from wharves, which could have led to slight bias, however, the Hudson River, Arthur Kill and the shoreline along Raritan Bay is very dynamic with a lot of flushing. Seasonal variations in temperature, UV radiation and rainfall are known to influence Enterococcus numbers, and therefore result in bias. Variations in rainfall, wind, tides and currents will also influence project parameters. In the laboratory, field samples were calibrated against blank samples. There was a 'blank' with no bacteria (distilled water), and a 'positive control' with a known concentration of Enterococcus placed in to the distilled water. Then, the 'unknown' samples were run and calibrated against the controls.

3. Representativeness: The sample sites were along the North Shore (2), East, along the Hudson River (3), and on the Southern tip of Staten Island (2) adjacent to Raritan Bay. Each area is at least duplicated along the represented shorelines. All sampling locations are in tidally influenced and saline waters. The sites were only sampled over four months out of the year, which does not give data over any season but summer; however, during the summer months there were samples from five time points each month giving a very representative sample of these four months.
4. Comparability: Only one method was used to collect data (YSI, GPS, or Enterolert methods), therefore, data was unable to be compared to other methods for each sampling point. For the laboratory data, standard USEPA QAPP protocols were followed, so the data will be comparable to other studies using this method (Baykeeper's pathogen monitoring project and recipients of EPA's Equipment Loan program).
5. Completeness: Of all the samples collected along the Raritan Bay (n=17 sampling events, n=7 sites, for a total of 105 samples, a 92.2% completion due to some missed sampling sites, 99.04 % were analyzed for Enterococcus levels and 99.04% used in analysis of water conditions and water quality. One out of 105 samples had been accidentally spilled and therefore was not viable. Since NY DEP does not count the sites monitored as bathing beaches, there are no pre-existing data on the sites that were used for this study.
6. Sensitivity: The YSI hand-held probe has a sensitivity of 0.01mg/L for DO. In the laboratory. The Enterolert method has a method detection limit of 10 MPN. All readings are considered accepted as the calibration and quality control checks were within 10% of the accepted values.

**Interpretation of results:**



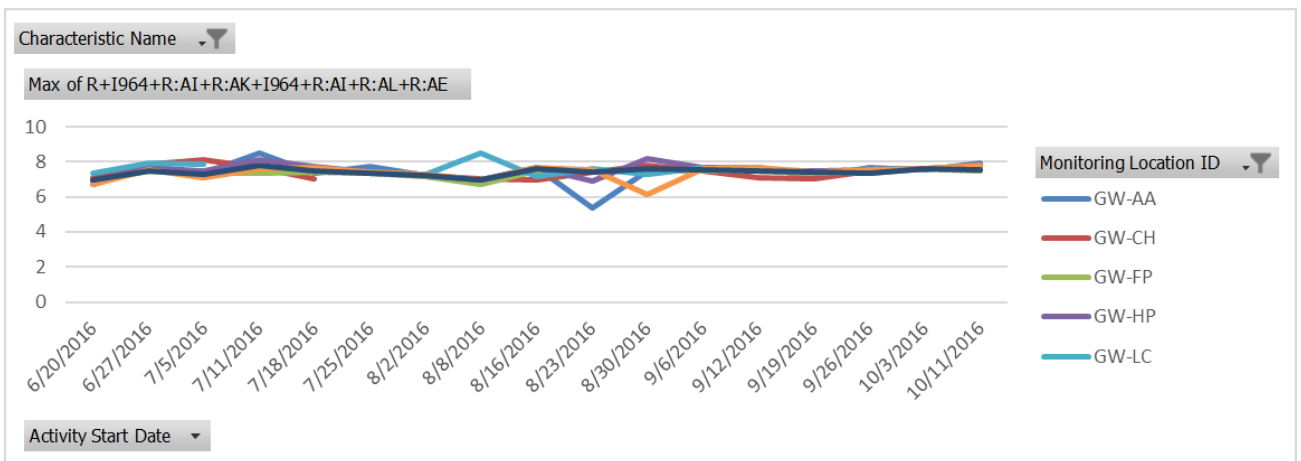
Figure 1. Map of the sampling area. Clockwise – GW-FP, Faber Pool ; GW-SH, Dock at Snug Harbor; GW-NLM, wharf at the National Lighthouse Museum; GW-HP, south of the Home Port; GW-AA, beach at Alice Austen House Park; GW-LC, fishing pier at Lemon Creek; GW-CH, beach at Conference House Park. Green Marker indicates enterococcus levels below 60 when calculated as geometric mean < 60 for 5 sampling days.

Over the course of the project, there were 119 discrete sampling sessions were targeted (n=17 sampling days, n=7 sites sampled each date). On some occasions, the measurements were not taken either due to lack of coverage or access to the

site was not possible. 105 samples were collected. For graphic representations, the geometric mean of each parameter was inserted to smooth the line charts. On each sampling date, at each site, there were measurements collected for (a) temperature, (b) salinity, (c) pH, (d) dissolved oxygen, (e) Enterococcus levels, (f) weather observations, (g) pollution sources, and (h) recreational uses of the site. For the purposes of this report, the authors focused on parameters most commonly used to classify polluted waters -Turbidity, Temperature, and Enterococcus levels.

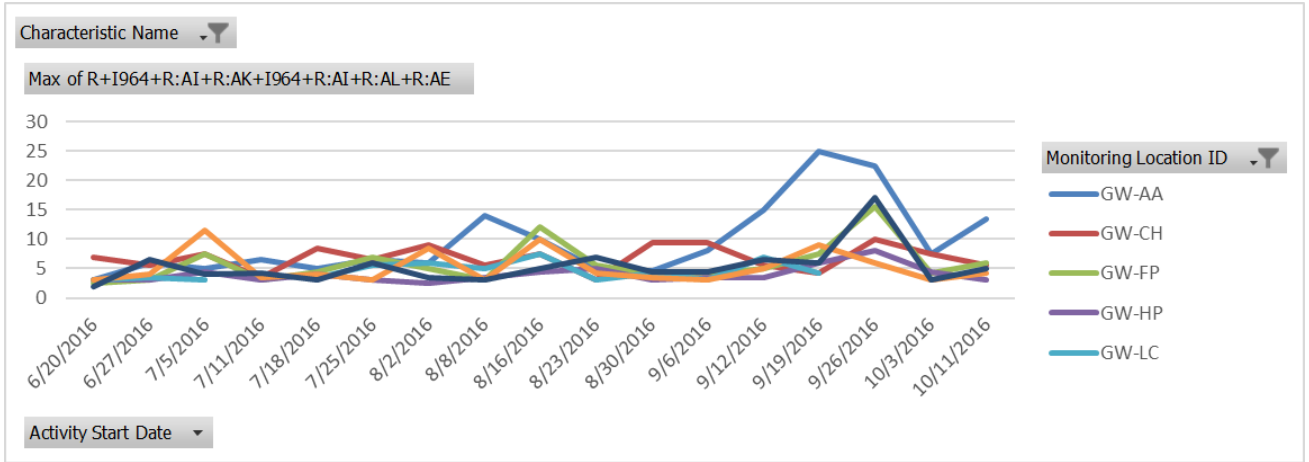
## Representation of Site comparisons:

pH



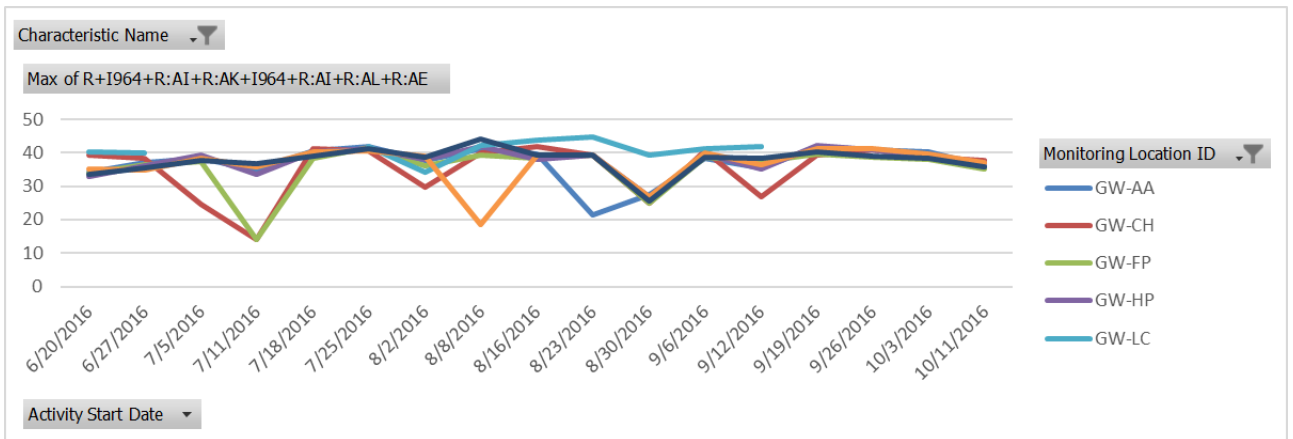
pH was within normal range for an estuary with variations due to tidal changes and after rain events. All sites were consistently in range. Within our study we recorded very few rain events for the summer. One reading was below normal and was rejected as a recording error (GW-CH-2016-08-08) Alice Austin House on 8/23 was exceptionally low with no related reason.

Turbidity:



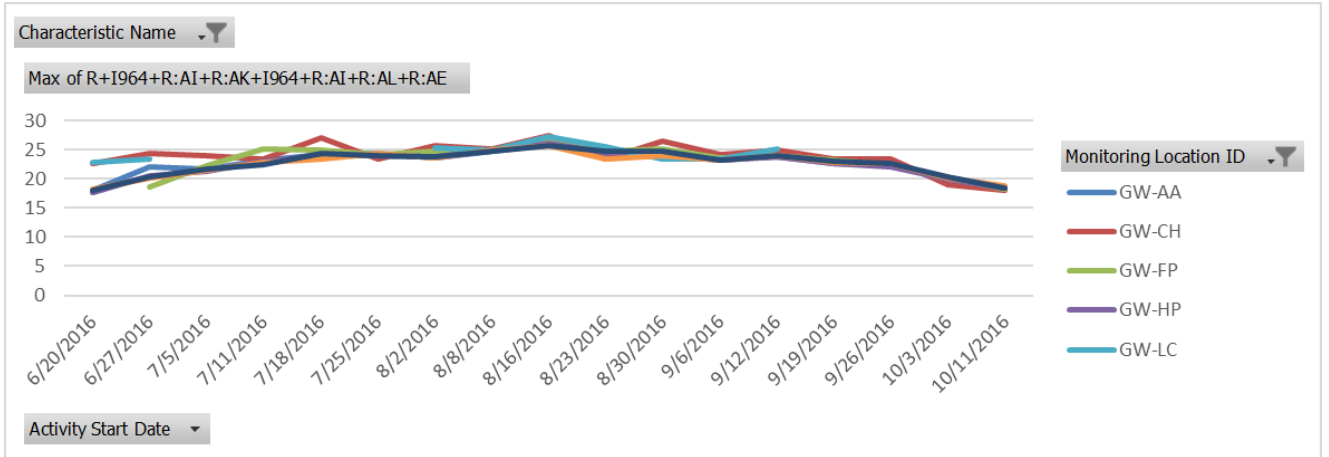
Turbidity was noticeably raised in September for Alice Austen House. This correlated to rain events in early September. (2.51 in. from Sept. 2 -Sept. 9) ref. CNYweather.com

Specific conductance (a measure of Salinity)



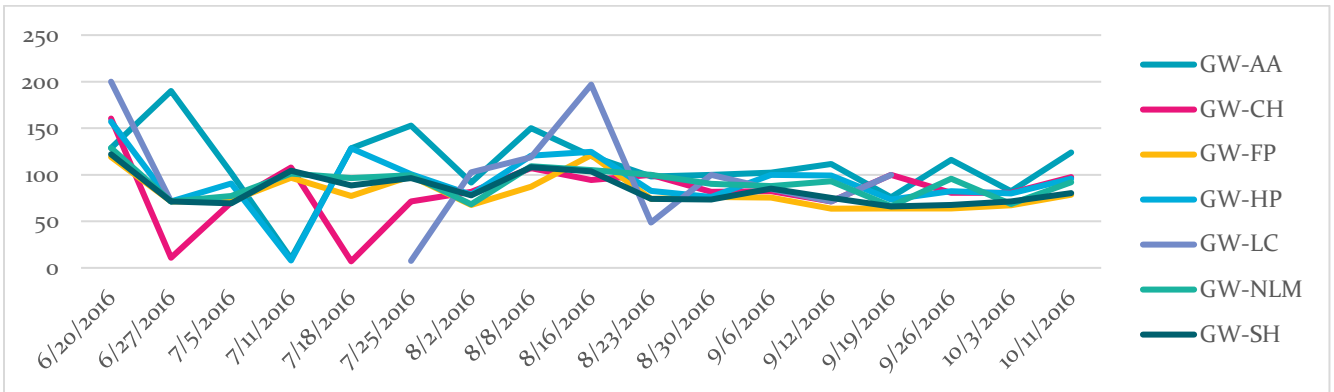
Salinity was highly variable at all sites correlating with tidal influence

Temperature:



Temperature at all sites warmed over the summer and cooled in the fall as expected.

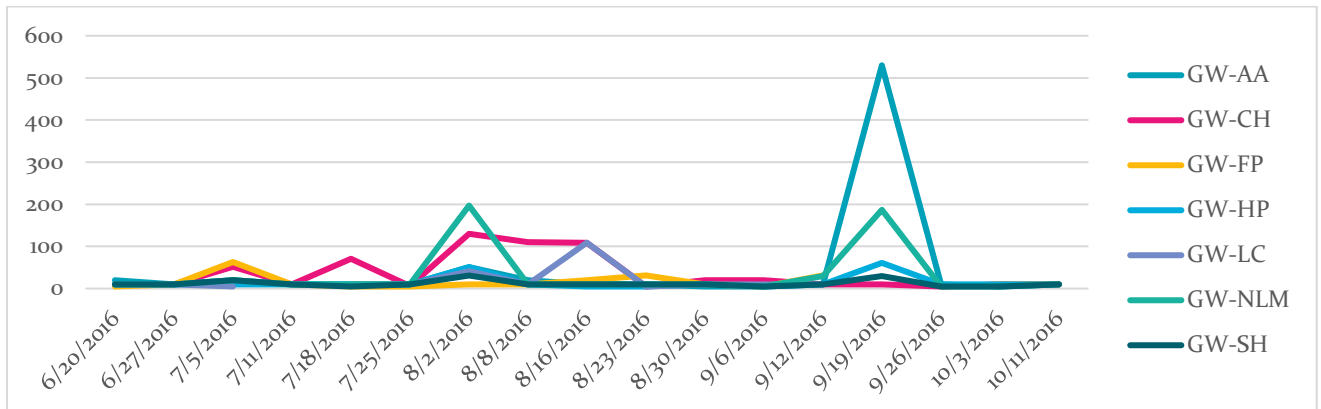
Dissolved Oxygen:



NOTE: DO had inconsistent results and many of the >> 100% and near zero saturation readings should be rejected. We had inconsistent meter reading through the first half of our study. The remainder of the season showed results near or slightly above saturation. Which is consistent with our sampling at highly turbulent locations.



## Enterococcus:



Enterococcus was relatively low throughout the sampling season with the exception of Alice Austen House. This reading reflected an unusual run-off situation from a sewer line from Alice Austen house. It also was after high rainfall in early September.



Run off at Alice Austen House :

Discharge from Alice Austen House was noted and reported to the Park managers. An odor of raw sewage was noted throughout the study period.

Even with this discharge, water sampled from the surf line did not show Enterococcus levels above beach closure levels. The dilution of the run off was great as tidal and river flow flushed the area. One spike was noted which corresponded to a high rain event. (Fig. 1)

## Discussion:

Our findings were somewhat of a surprise since most sites fell below the enterococcus levels used by agencies for beach management decisions and overall levels were low. While this does not mean that the areas sampled should be recommended for swimming, our site readings were better than anticipated by common public perception. Except for the Conference House beach, which incidentally appeared the most attractive bathing site, all locations had good flushing from the Hudson River, tides, and boat traffic. In the Arthur Kill, at Faber Pool and Snug Harbor, tidal flow and the very large ships moved water in and out of a relatively restricted channel. So even with the major industrial use of, and along, the Arthur Kill, the enterococcus levels were low. Our findings were somewhat of a

Our higher readings were at Alice Austen House where an upland sewer leak biased the readings from that site. The results from the Home Port and at the National Lighthouse Museum were lower and reflected the general conditions of the Hudson River. (Fig. 1,2)

At Lemon Creek and especially the Conference House Park, the tidal flow was minimal, buffered by Raritan Bay. The Hudson River has little influence into the Bay and hence any flushing effect is minimal. In fact, Conference House Park had higher relative enterococcus readings which corresponded with the Baykeepers results from the very developed shoreline of Perth Amboy across Arthur Kill in New Jersey.

Alice Austen House

Enterococcus:

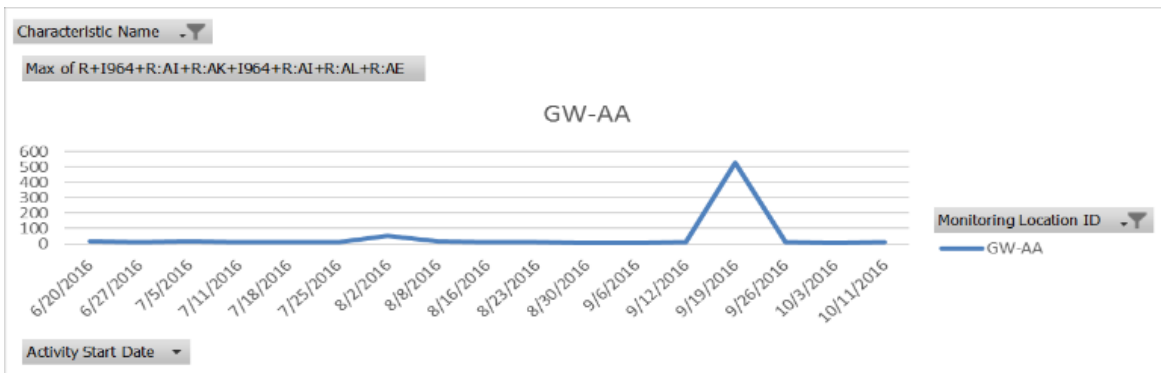


Fig. 1

National Lighthouse Museum

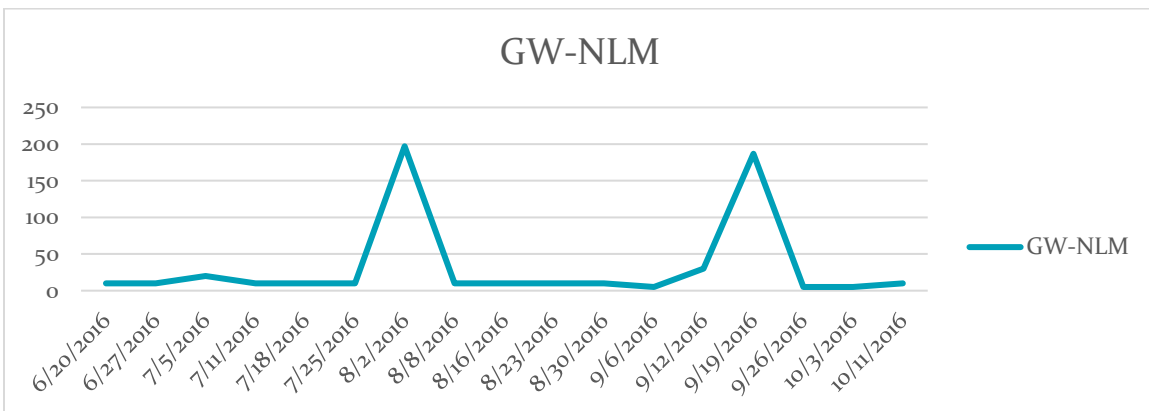


Fig.2

### Citizen Science Volunteers

Over the course of the summer we had the help of 7 volunteers. Gotham Whale acknowledges the contributions of John Kilcullen and three volunteers from the Conference House who collected samples from the southern locations. Linda Cohen and Jason Brenton assisted in the sampling and lab prep of the 5 northern locations. This experience gave an overview of the sampling procedures and lab testing for pathology indicators. Jason is currently working for an environmental testing firm and used our work as reference.



Sampling, testing, and recording at Homeport, Faber Pool, and The National Lighthouse Museum.