

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2016 Lake Erie Beach Monitoring



Prepared by
Water Quality and Industrial Surveillance Division

Introduction

Since 1992, the Northeast Ohio Regional Sewer District (NEORSD) has conducted bacteriological sampling on Lake Erie at Edgewater Beach, Villa Angela Beach, and Euclid Beach, in an effort to monitor bacteriological densities at the beaches. In 2005, sampling at Euclid Creek was added to determine the impact the creek may have on the water quality at Villa Angela and Euclid Beaches.

In 2016, the NEORSD continued these sampling efforts by monitoring the *Escherichia coli* (*E. coli*) densities at Edgewater, Villa Angela, and Euclid Beaches and Euclid Creek. The purpose of this sampling was to communicate beach conditions to the public and evaluate water quality standards attainment. In this report, an evaluation of water quality standards attainment will be made from the results from each sample site.

The sampling was completed by interns trained by NEORSD Level 3 Qualified Data Collectors (QDCs) certified by Ohio Environmental Protection Agency (Ohio EPA) in Chemical Water Quality Assessment, or by NEORSD Level 3 QDCs, as explained in the NEORSD study plan *2016 Lake Erie Beach Monitoring*, which was approved by Ohio EPA on April 20, 2016. Sample analyses were conducted by NEORSD's Analytical Services division, which is accredited by the National Environmental Laboratory Accreditation Program.

Table 1 indicates the sampling sites with respect to location, site or river mile (RM), latitude/longitude and description. Figure 1 is a map of the sampling locations at Edgewater, Euclid and Villa Angela Beaches and Euclid Creek.

In addition to monitoring for *E. coli*, the NEORSD has also performed limited harmful algal bloom (HAB) monitoring in the past several years, in response to recent increases in HABs in Lake Erie. No visible signs of HABs were observed during the 2016 field season. Therefore, no samples for algal identification or microcystin analysis were collected in 2016.

Table 1. List of Lake Erie and Euclid Creek Sampling Sites						
Location	Site	Latitude	Longitude	Description	Quadrangle	Purpose
Edgewater Beach	East	41.4893°	-81.7392°	Eastern half of the beach. In line with the brick stack on the other side of the freeway	Cleveland South	<ul style="list-style-type: none"> • Public notification of water quality conditions at bathing beaches • Determination of water quality standards attainment • Evaluation of the impact of point and non-point sources
Villa Angela Beach	East	41.5851°	-81.5677°	Eastern half of beach, mid-distance between the 3 rd and 4 th break walls	East Cleveland	
Euclid Beach	East	41.5843°	-81.5686°	Eastern half of beach in line with the East side of the pile of stones on the beach	East Cleveland	
Euclid Creek	RM 0.55	41.5831°	-81.5594°	Downstream of Lakeshore Boulevard	East Cleveland	

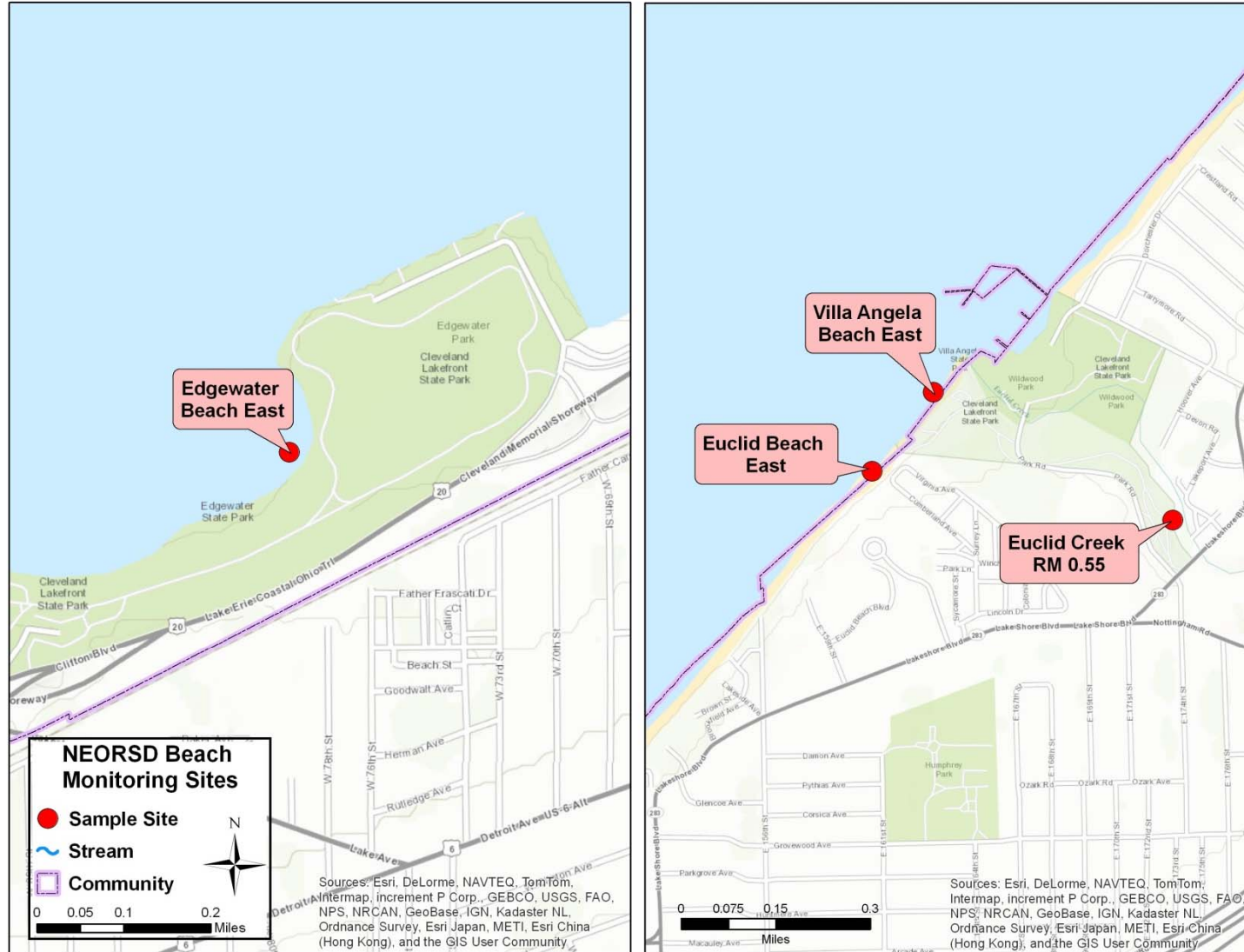


Figure 1. Map of Sampling Sites

Sampling Schedule and Methods

Bacteriological sampling was conducted from May 2, 2016, to September 29, 2016. From May 2 through May 19, water samples were collected from each beach and Euclid Creek RM 0.55 (further referred to simply as Euclid Creek) four days a week (Monday through Thursday). Beginning May 23 and lasting through September 4, samples were collected at each beach and Euclid Creek seven days a week. From September 5 through September 29, sampling at all sites returned to four days a week (Monday through Thursday). Although the official beach recreational season lasts until October 31, NEORSD ceased sampling at all sites on September 29 due to the low temperatures in October preventing swimming activities at the beaches.. A total of 133 samples were collected at each site for a total of 562 samples including 30 duplicates.

Field analysis included the use of a Hanna HI 98129 meter to measure pH, water temperature, and conductivity. Additionally, the Hach 2100Q Portable Turbidimeter was used to obtain field turbidity measurements. All water samples, field parameters and analyses were collected as specified in the most current NEORSD Beach Sampling Standard Operating Procedure (*SOP-EA016-18*) and Ohio EPA's *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2015).

Bacteriological grab samples were collected in a 1-liter sterilized polypropylene container. Samples at each location were collected approximately 6-12 inches below the surface, in water that was approximately three feet deep. At the time of sample collection, field parameters were measured and field observations and water conditions were documented at each beach site. All data that was collected was recorded on an NEORSD Beach Sampling Field Data Form. All samples were placed in a cooler with ice and stored in a locked NEORSD vehicle until the samples were transferred to NEORSD's Analytical Services sample receiving with a Chain of Custody. All Beach Sampling Field Data Forms, Chains of Custody and Certificates of Analysis are available upon request from the Water Quality and Industrial Surveillance Division, and the Analytical Services Division.

The quality assurance and quality control of bacteriological water sample collections included field duplicates that were collected at a frequency not less than 5% of the total samples collected. A total of 30 duplicate samples were collected for a final duplicate frequency of 5.3%. Since field blanks are not required by method SM 9223 or by the National Environmental Laboratory Accreditation Conference (NELAC) for bacteria analysis, no bacteriological field blanks were collected during the study. Analytical Services has procedures in place which are required by NELAC to demonstrate that the sample containers are clean and sterile.

Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

$$\text{Formula 1:} \quad \text{RPD} = \left(\frac{|X-Y|}{((X+Y)/2)} \right) * 100$$

X= is the concentration of the parameter in the primary sample
Y= is the concentration of the parameter in the duplicate sample

For bacteriological samples, the acceptable RPD is 133.3%. Those RPDs that are higher than acceptable may indicate potential problems with sample collection and, as a result, the data would not be used for comparison to the water quality standards. All duplicate samples collected were within the acceptable RPD of 133.3%. Therefore, no data collected as a part of this study was rejected.

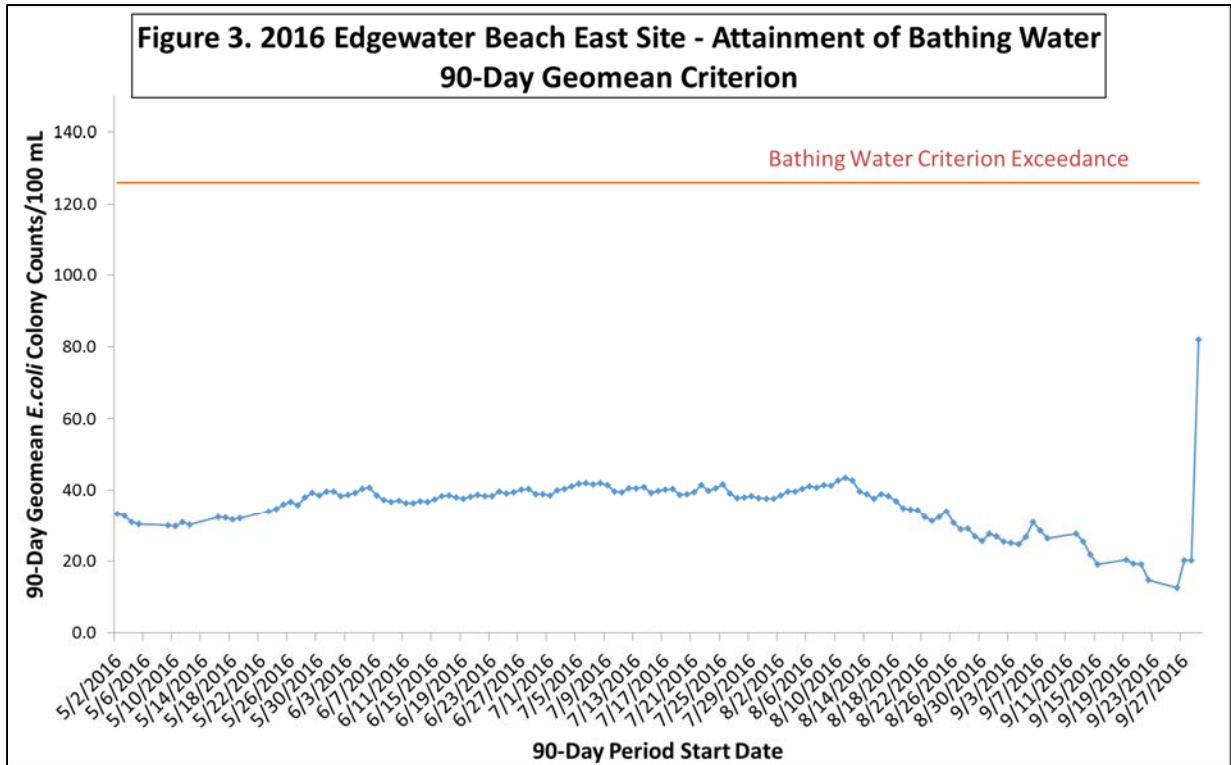
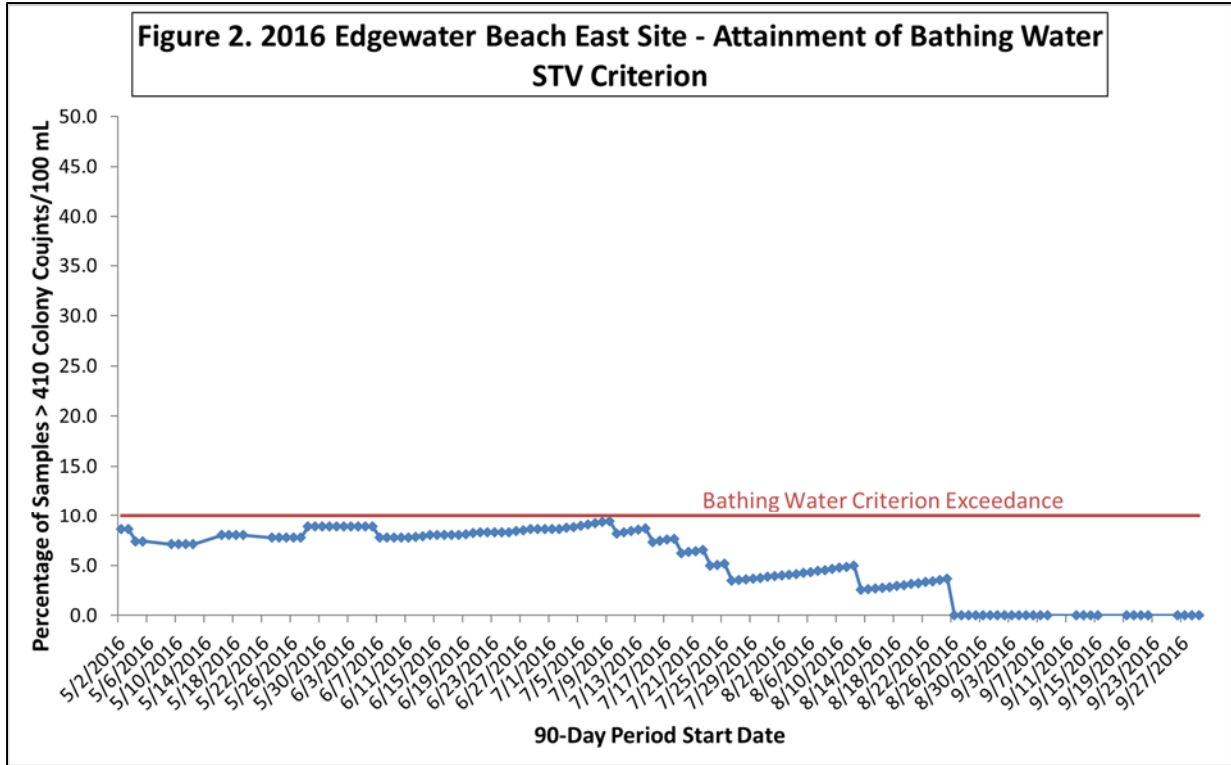
Results and Discussion

The *E. coli* results from each beach site were compared to the Ohio Water Quality Standards in order to determine recreational use attainment. From May 1st to October 31st, the three beaches are designated as Bathing Waters for the Protection of Recreational Use, while Euclid Creek is designated as a Primary Contact Recreation Stream (Ohio EPA, 2016). Both the Bathing Waters and Primary Contact Recreation criteria for *E. coli* include a statistical threshold value (STV) criterion not to exceed 410 colony counts units per 100 milliliters (colony counts/100mL) in more than ten percent of the samples collected during any 90-day period and a 90-day geometric mean criterion of 126 colony counts/100mL. The Bathing Waters criteria also maintain the use of the previous single sample maximum limit of 235 colony counts/100mL as the beach action value for the purpose of posting daily water quality advisories.

Recreational Use Attainment Status

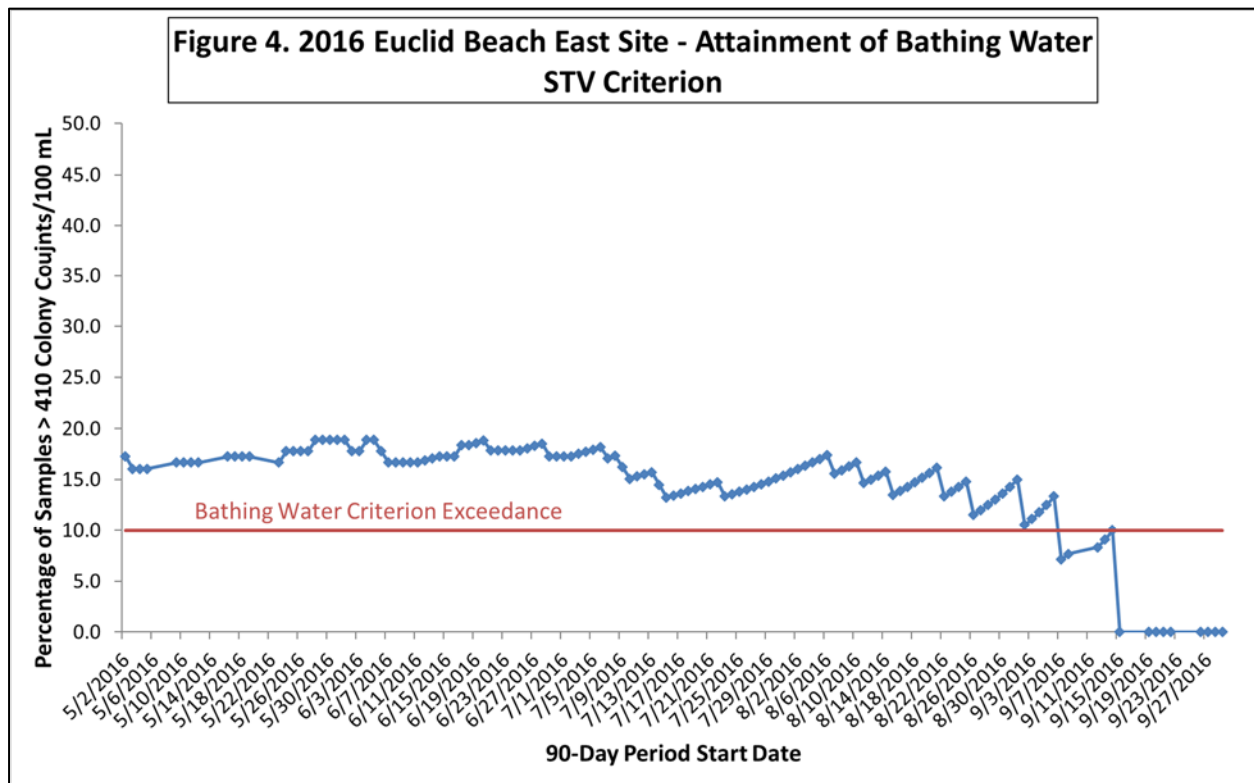
Edgewater Beach

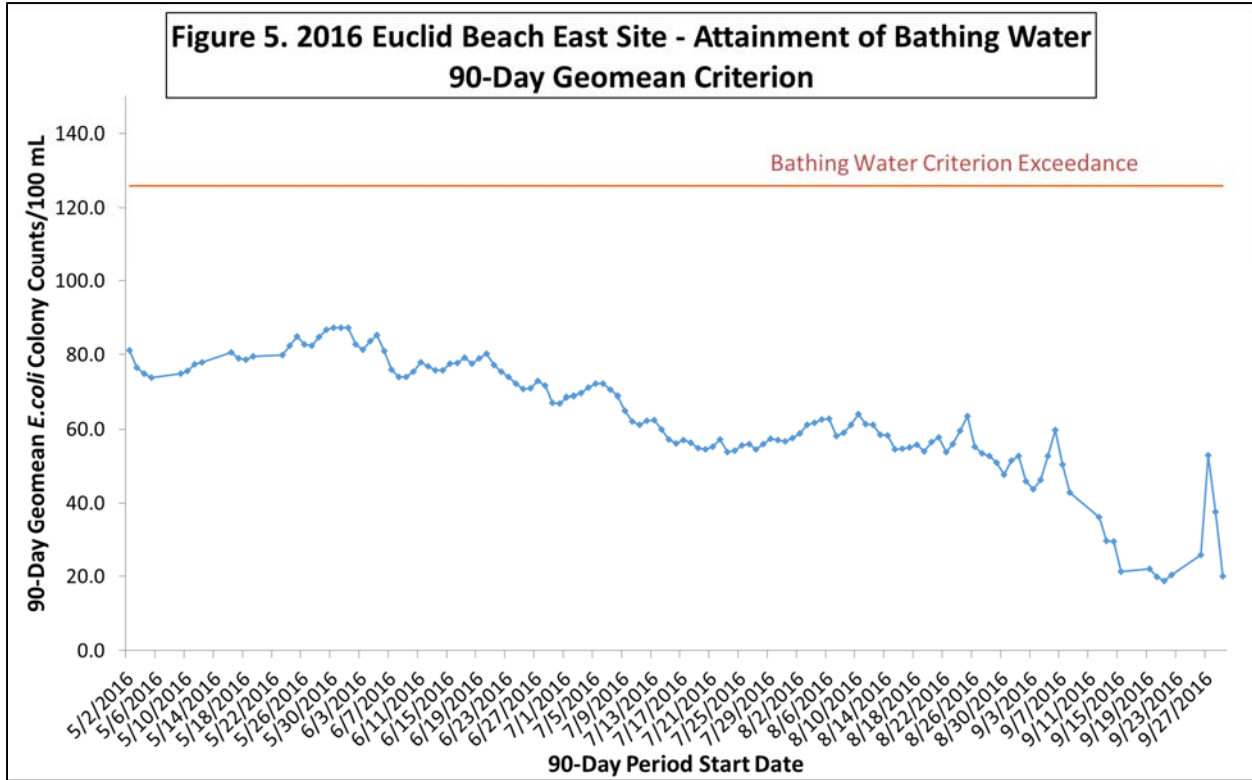
The water quality at Edgewater Beach was found to be in full attainment of the Bathing Water recreational use STV and geometric mean criteria (Figures 2 and 3) for all 90-day periods in the 2016 recreational season. Single samples exceeded the beach action value of 235 colony counts/100mL for only 11 of the 133 sampling events, a frequency of 8.3%. Seven of the 11 exceedances of the beach action value (63.6%) occurred within 48 hours of a rain event with a total rainfall greater than 0.10 inches.



Euclid Beach

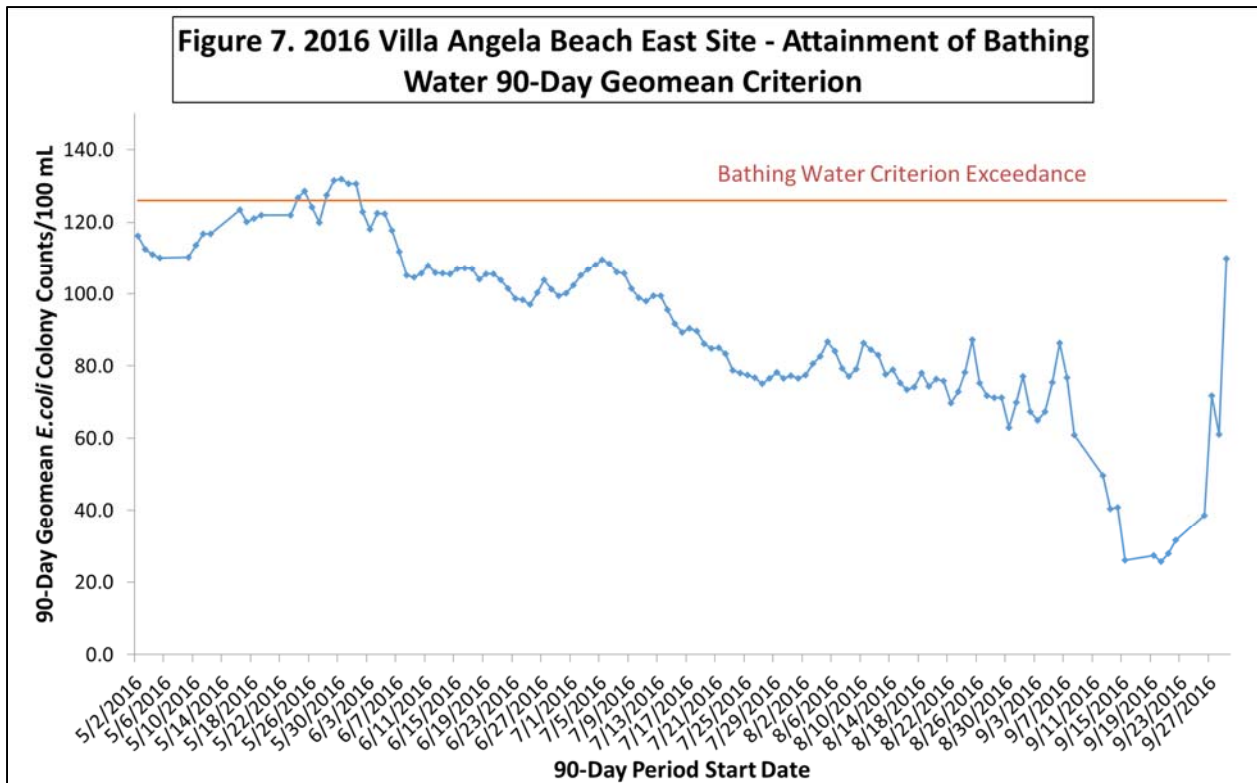
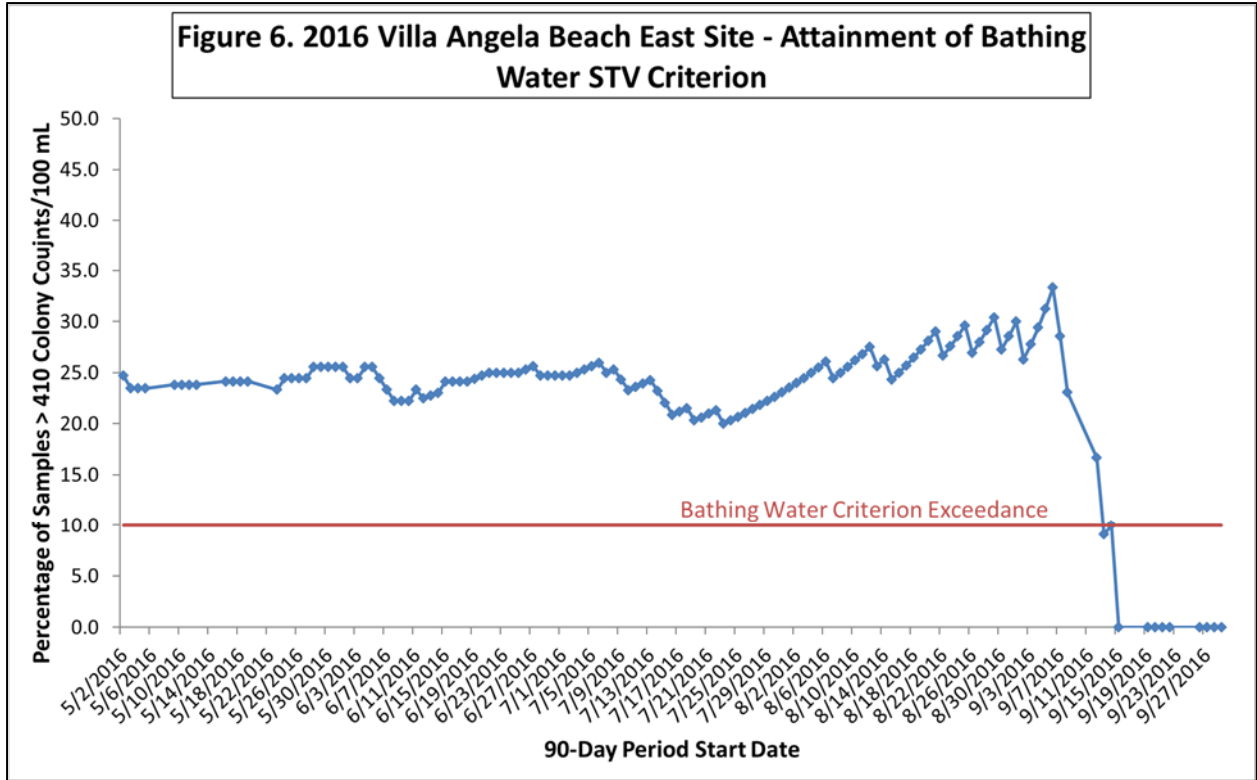
Euclid Beach was in partial attainment of the Bathing Water recreational use criteria in 2016. Euclid Beach was in non-attainment of the STV criterion for 89.5% of the 90-day periods (Figure 4). However, Euclid Beach was in attainment of the geometric mean criterion for 100% of the 90-day periods (Figure 5), placing Euclid Beach in partial attainment of the Bathing Water recreational use criteria. Single samples exceeded the beach action value of 235 colony counts/100mL for 33 of the 133 sampling events, a frequency of 24.8%. Nineteen of these 33 exceedances (57.6%) occurred within 48 hours of a rain event with a total rainfall greater than 0.10 inches.





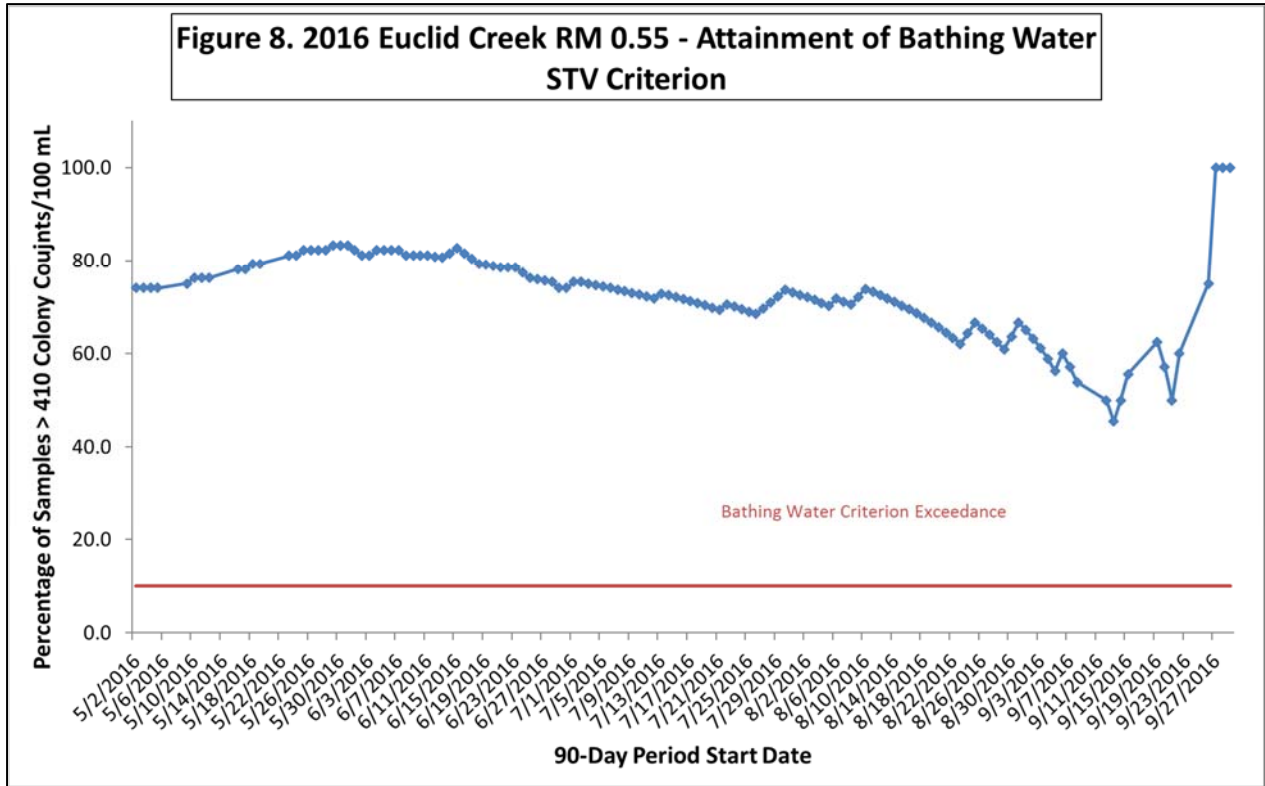
Villa Angela Beach

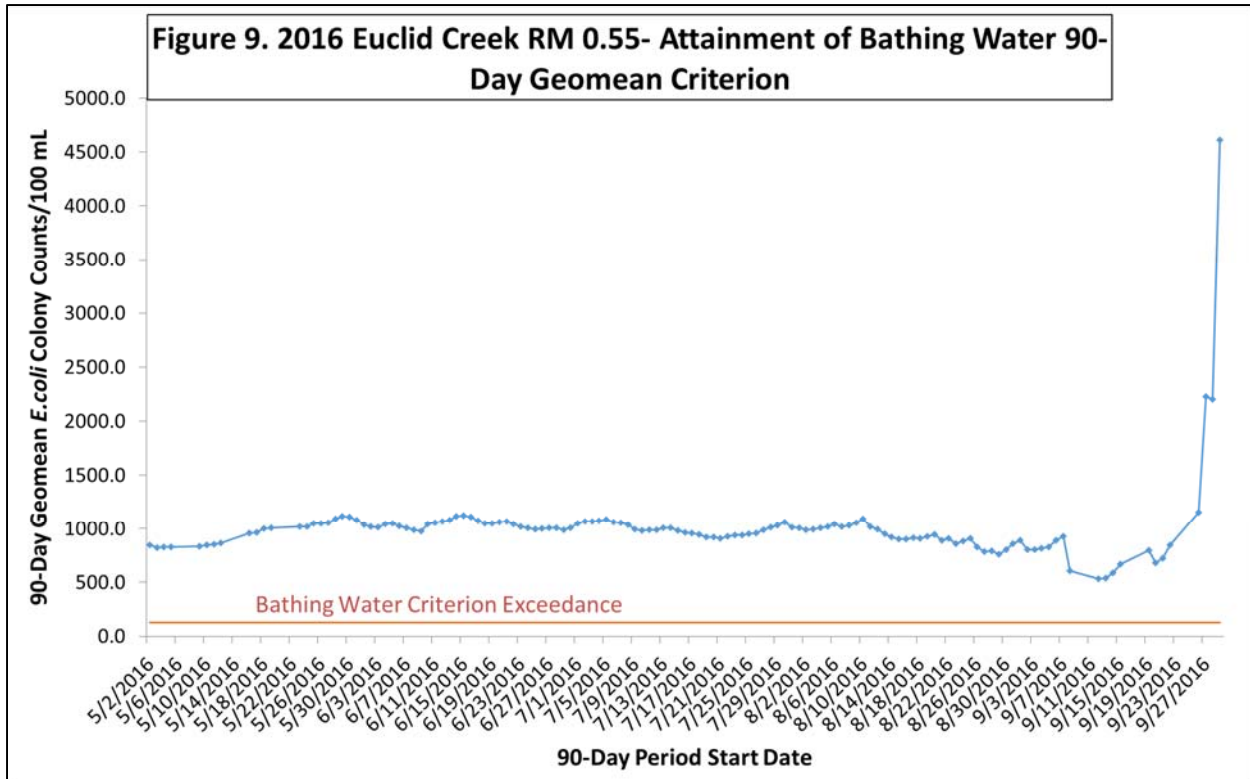
Villa Angela Beach was in non-attainment of both Bathing Water recreational use criteria in 2016. Villa Angela exceeded the STV criterion for 91.7% of the 90-day periods (Figure 6), and the geometric mean criterion for 5.3% of the 90-day periods (Figure 7). Single samples exceeded the beach action value of 235 colony counts/100mL for 44 of the 133 sampling events, a frequency of 33.1%. Twenty-five of these 44 exceedances (56.8%) occurred within 48 hours of a rain event with a total rainfall greater than 0.10 inches.



Euclid Creek RM 0.55

Euclid Creek was in non-attainment of both Bathing Water recreational criteria in 2016 (Figures 8 & 9). Euclid Creek exceeded both the STV and geometric mean criteria for 100% of the 90-day periods. As further discussed below, Euclid Creek RM 0.55 has displayed this degree of exceedance for as long as monitoring has been performed by the NEORSD on Euclid Creek.





Comparison with Historical Data, Rainfall, and CSO Occurrence

Table 2 presents historical data on the recreational use criteria exceedances for all of the sites included in this study. The NEORSD began submitting beach monitoring data to the Ohio EPA credible data program in 2009. Therefore, prior data is not included in this comparison. It should be noted that the recreational use criteria have been modified within the presented timeline. From 2009 to 2014, the applicable Bathing Waters recreational use criteria included an *E. coli* criterion not to exceed a single sample maximum (SSM) of 235 colony counts/100mL in more than ten percent of the samples collected during any 30-day period, and a seasonal geometric mean (SGM) criterion of 126 colony counts/100mL (Ohio EPA, 2010). The current 90-day STV and geometric mean criteria took effect in 2015. The data presented in Table 2 represents exceedances of the criteria that were applicable at the time of sample collection. For comparative purposes only, the SGM *E. coli* density was also calculated from data collected in 2015 and 2016 even though it does not apply to data collected from these years.

Table 2. Historical Recreational Use Criteria Exceedances.				
Site	Year	SSM/STV % Exceedance	Geometric Mean % Exceedance	SGM
EDGE	2016	0.0	0.0	35*
	2015	34.8	0.0	77*
	2014	93.0	N/A	60
	2013	66.0	N/A	53
	2012	58.6	N/A	41
	2011	92.2	N/A	98
	2010	73.0	N/A	56
	2009	90.6	N/A	107
EUBE	2016	89.5	0.0	71*
	2015	97.8	33.8	136*
	2014	98.0	N/A	126
	2013	97.0	N/A	144
	2012	99.3	N/A	118
	2011	100	N/A	149
	2010	90.0	N/A	110
	2009	100	N/A	112
VABE	2016	91.7	5.3	99*
	2015	97.8	51.8	181*
	2014	96.0	N/A	147
	2013	91.0	N/A	141
	2012	100	N/A	110
	2011	100	N/A	174
	2010	100	N/A	128
	2009	100	N/A	172
EC RM 0.55	2016	100	100	907*
	2015	100	100	1246*
	2014	100	N/A	1617
	2013	100	N/A	1092
	2012	100	N/A	973
	2011	100	N/A	1351
	2010	100	N/A	1047
	2009	99.3	N/A	852
Exceedances of historical SGM criterion in Bold (>126 colony counts per 100mL)				
*SGM does not apply. Calculated for comparative purposes only.				

E. coli densities were found to be historically low at all three beaches in 2016 resulting in a decrease in exceedances of the SSM/STV criterion and geometric mean criterion compared to previous years. Edgewater Beach was found to be in complete attainment of the Bathing Water recreational use criteria for the first time since beach

monitoring efforts were performed by the NEORSD. Exceedances of the geometric mean criterion were also historically low at Villa Angela and Euclid Beaches in 2016.

The decreases in recreation use criteria exceedances are most likely due to the historically dry recreational season that occurred in 2016. Table 3 presents total rainfall in inches during the past five years of recreational seasons (May 1st to October 31st) as measured at the Division Avenue (located near Edgewater Beach) and Easterly WWTP rain gauges (located near Euclid and Villa Angela Beaches and Euclid Creek). Total rainfall during the 2016 recreational season was the lowest observed in the past 5 years by greater than 7.0 inches of total rainfall. Wet-weather¹ events have been known to contribute to elevated bacteria levels by causing discharges from CSOs, storm sewer runoff, urban runoff, and runoff from contaminated beach sand to enter Lake Erie. Therefore, the dry season observed in 2016 most likely was the primary factor responsible for the lower number of exceedances of the recreational water quality criteria this season.

Table 3. Total Rainfall (Inches) from May 1st to October 31st.		
Year	Division Ave Rain Gauge	Easterly Rain Gauge
2016	13.87	16.23
2015	23.40	23.41
2014	24.50	25.12
2013	21.35	28.31
2012	26.46	24.80

Combined sewer overflow discharge may have contributed to the elevated *E. coli* densities observed at Villa Angela and Euclid beaches. Proximity of nearby CSO outfalls to Edgewater, Euclid, and Villa Angela Beaches are shown in Figures 10 and 11. The number of overflow events and total volume of discharge from each of the listed CSOs from May 1 to October 31, 2015 and 2016, is presented in Table 4. In the proximity of Edgewater Beach, only 9 overflow events occurred during the 2016 recreational season from CSO-002, the Westerly Wastewater Treatment Center Overflow. This was decreased from 16 overflow events from 2015, further emphasizing the impact that the dry season in 2016 had on factors influencing beach water quality. Despite the relatively dry year, over 87 overflow events still occurred in the proximity of Euclid and Villa Angela Beaches in 2016. These events most likely contributed to the elevated *E. coli* densities observed at these beaches. Future long-term CSO storage tunnels currently under construction are

¹ Wet-weather sampling events: greater than 0.10 inches of rain but less than 0.25 inches, samples collected that day and the following day are considered wet-weather samples; greater than 0.25 inches, the samples collected that day and the following two days are considered wet-weather samples.

expected to reduce the frequency and total volumes of these discharges. It is expected that reduction of CSO events will have a positive influence on water quality at these beaches with respect to recreational criteria.

Elevated *E. coli* densities at Euclid and Villa Angela Beaches are additionally influenced by the proximity of these beaches to Euclid Creek. Euclid Creek has been in 100% exceedance of the recreational water quality criteria for seven continuous years. Local water current studies have demonstrated that the discharge of Euclid Creek flows to Euclid and Villa Angela beaches and therefore directly impacts beach water quality. The elevated *E. coli* densities present at Euclid Creek are most likely due to a combination of sanitary sewage contamination from illicit discharges and combined sewer overflows, as well as contamination from fecal matter from companion animals, urban wildlife, and park wildlife from the surrounding urban community. Future NEORS D projects including illicit discharge remediation efforts, microbial source tracking efforts, and the completion of the Euclid Creek Storage Tunnel, a CSO control structure, are expected to lead to improvement of the water quality of Euclid Creek in the coming years. It is therefore expected that these programs will also have a positive impact on the water quality of Euclid and Villa Angela Beaches.



Figure 10. Proximity of CSO Outfalls to Edgewater Beach



Figure 11. Proximity of CSO Outfalls to Euclid and Villa Angela Beaches

Table 4. CSO Events from May 1st to October 31, 2016.					
Outfall ID	Nearest Beach	Number of Overflow Events		Total Overflow Volume (Million Gallons)	
		2016	2015	2016	2015
CSO-002	Edgewater	9	16	125.3	235.2
CSO-069	Edgewater	0	3	0.0	6.48
CSO-071	Edgewater	0		0.0	
CSO-001	Euclid/Villa Angela	28	31	1346.7	2301.9
CSO-206	Euclid/Villa Angela	13	13	18.3	50.7
CSO-239	Euclid/Villa Angela	39	46	26.7	60.0
CSO-242	Euclid/Villa Angela	7	17	9.0	20.7

Conclusions

Edgewater Beach was found to be in full attainment of the recreational water quality criteria for the 2016 recreational season. Euclid Creek failed to meet attainment of both recreational water quality criteria in 2016 for the seventh consecutive year. Euclid Beach was found to be in partial attainment of the recreational criteria, having met the 90-day geometric mean criterion, while failing to meet the 90-day STV criterion. Villa Angela Beach failed to meet attainment of both the 90-day STV and 90-day geometric mean criteria for *E. coli*. Geometric mean *E. coli* densities for the entire sampling season were historically low at all beaches in 2016. This is most likely due to the limited rainfall that occurred during the 2016 sampling season, which resulted in decreased CSO events, and decreased stormwater runoff from possibly contaminated surfaces including pavement and beach sand. Additionally, no harmful algal blooms were observed at the monitored beaches in 2016.

Acknowledgements

Field activities and report review completed by the following, except where otherwise noted:

Kelsey Amidon
Nya Aron
Donna Friedman
Seth Hothem

Mark Matteson
Mario Meany
Denise Phillips
John Rhoades

Eric Soehnlén, Author
Nicole Velez

WQIS Paraprofessional Interns: Lindsay Baker, Bryanna Boggan, James Ferritto, Joseph Schiel

Analytical Services Division – Completed analysis for all bacteriological sampling.

References

- Ohio Environmental Protection Agency. (2010). State of Ohio Water Quality Standards *Ohio Administrative Code* Chapters 3745-1-31, 3745-1-26, 3745-1-07. Revision: Adopted December 15, 2009; Effective March 15, 2010. Division of Surface Water, Standards and Technical Support Section. Columbus, Ohio.
- Ohio Environmental Protection Agency. (2015). *Surface Water Field Sampling Manual for water quality parameters and flows*. Columbus, OH: Division of Surface Water.
- Ohio Environmental Protection Agency. (2016). State of Ohio Water Quality Standards *Ohio Administrative Code* Chapter 3745-1 (Revision: October 2, 2015; Effective:

2016 Lake Erie Beach Monitoring
April 20, 2017

January 4, 2016). Columbus, OH: Division of Surface Water; Standards and
Technical Support Section.