NORTHEAST OHIO REGIONAL SEWER DISTRICT

2014 Lake Erie Bacteriological Sampling Results at Edgewater, Euclid and Villa Angela Beaches

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 2014, 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 *E. coli* results from each sample site.

The sampling was completed by NEORSD Level 3 Qualified Data Collectors certified by Ohio Environmental Protection Agency (Ohio EPA) in Chemical Water Quality Assessment, as well as trained personnel, as explained in the NEORSD study plan *2014 Lake Erie Bacteriological Sampling of Edgewater, Euclid and Villa Angela Beaches*, which was approved by Ohio EPA on April 3, 2014. Sample analyses were conducted by NEORSD's Analytical Services division, which is accredited by the National Environmental Laboratory Accreditation Program.

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

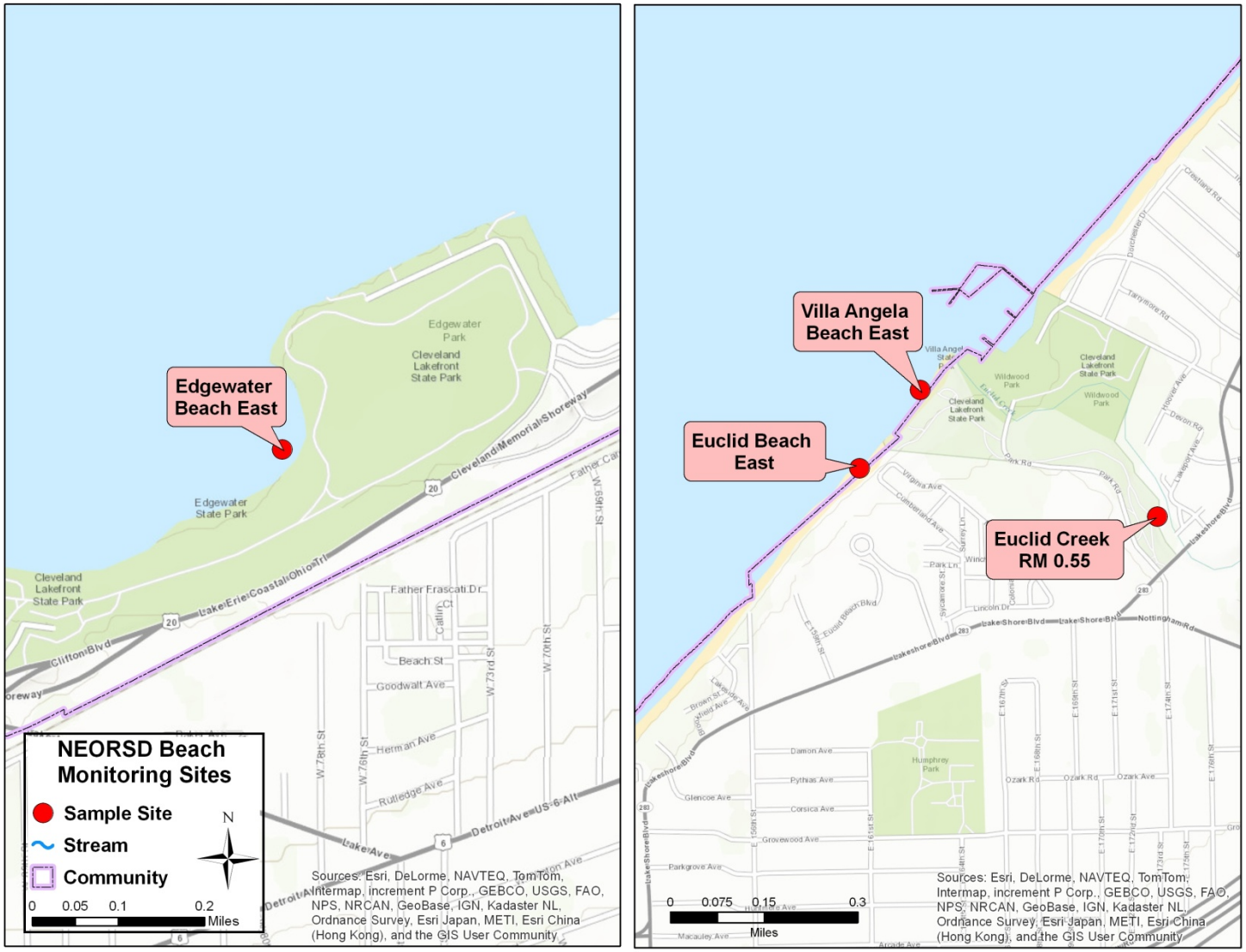


Figure 1. Map of Sampling Sites

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	• 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 3rd and 4th 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	

Sampling Methods

Bacteriological sampling was conducted from May 1, 2014 to September 25, 2014. From May 1 through May 15, water samples were collected from each beach and Euclid Creek RM 0.55 four days a week (Monday through Thursday). Beginning May 19 and lasting through September 5, samples were collected at each beach seven days a week. Samples were collected from Euclid Creek RM 0.55 from May 19 through September 5 five days a week (Monday through Friday) and were only collected on the weekends and holidays if there was rainfall greater than 0.25 inches up to two days before or during sampling. Rainfall data for Euclid Creek RM 0.55 was obtained from the NEORSD Easterly Wastewater Treatment Plant rain gauge. From September 8 through September 25, sampling at all sites returned to four days a week (Monday through Thursday). Although the typical beach recreational season lasts until October 31, NEORSD ceased sampling at all sites on September 25 due to staffing limitations. A total of 416 samples were collected from all three of the beaches and a total of 114 samples were collected from Euclid Creek RM 0.55 during 2014.

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 chemistry, bacteria, and flows* (2013).

Bacteriological grab samples were collected in a 2-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 (Figure 2). 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. Since field blanks are not required by method 1603 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.

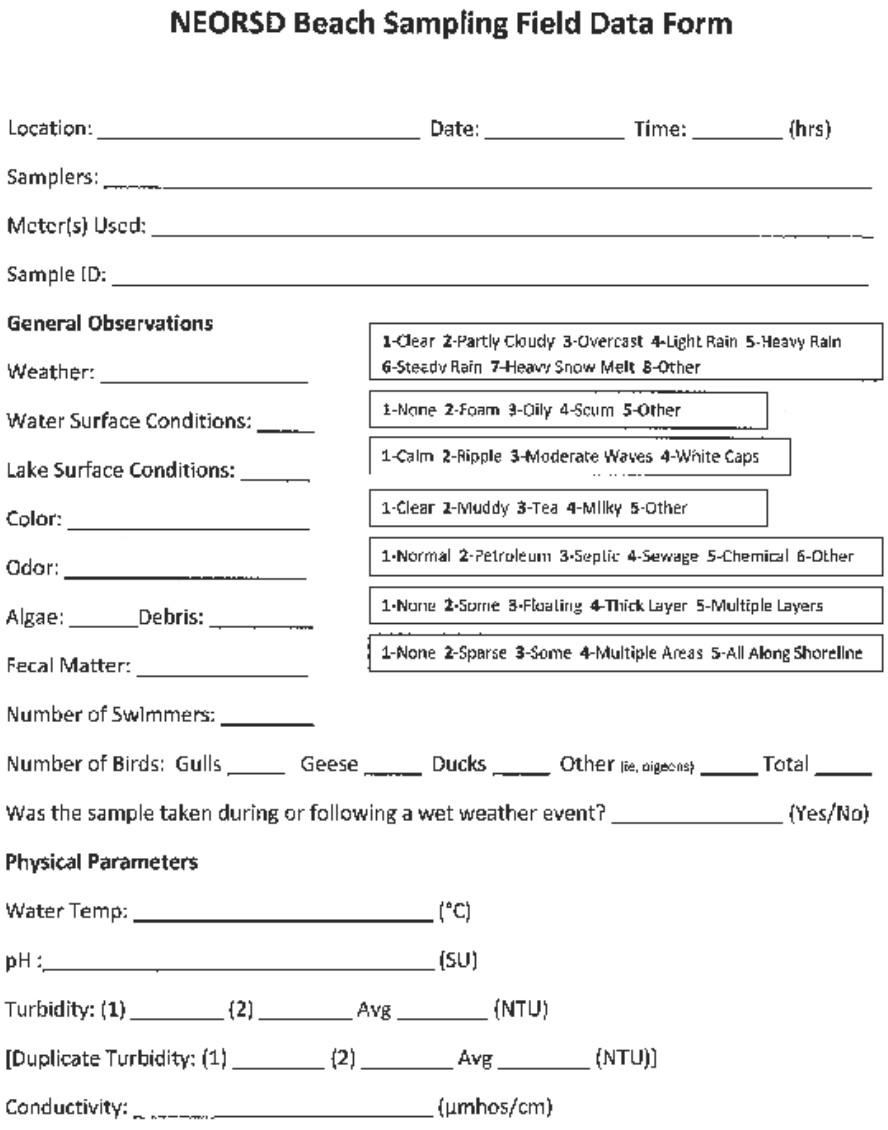
Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

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 was not used for comparison to the water quality standards. In 2014, no unacceptable discrepancies were found during beach water chemistry sampling.

Figure 2. Example of the NEORSD Beach Sampling Field Data Form



NEORSD Beach Sampling Field Data Form

Location: _____ Date: _____ Time: _____ (hrs)

Samplers: _____

Meter(s) Used: _____

Sample ID: _____

General Observations

Weather: _____ 1-Clear 2-Partly Cloudy 3-Overcast 4-Light Rain 5-Heavy Rain 6-Steady Rain 7-Heavy Snow Melt 8-Other

Water Surface Conditions: _____ 1-None 2-Foam 3-Oily 4-Scum 5-Other

Lake Surface Conditions: _____ 1-Calm 2-Ripple 3-Moderate Waves 4-White Caps

Color: _____ 1-Clear 2-Muddy 3-Tea 4-Milky 5-Other

Odor: _____ 1-Normal 2-Petroleum 3-Septic 4-Sewage 5-Chemical 6-Other

Algae: _____ Debris: _____ 1-None 2-Some 3-Floating 4-Thick Layer 5-Multiple Layers

Fecal Matter: _____ 1-None 2-Sparse 3-Some 4-Multiple Areas 5-All Along Shoreline

Number of Swimmers: _____

Number of Birds: Gulls _____ Geese _____ Ducks _____ Other (ie, pigeons) _____ Total _____

Was the sample taken during or following a wet weather event? _____ (Yes/No)

Physical Parameters

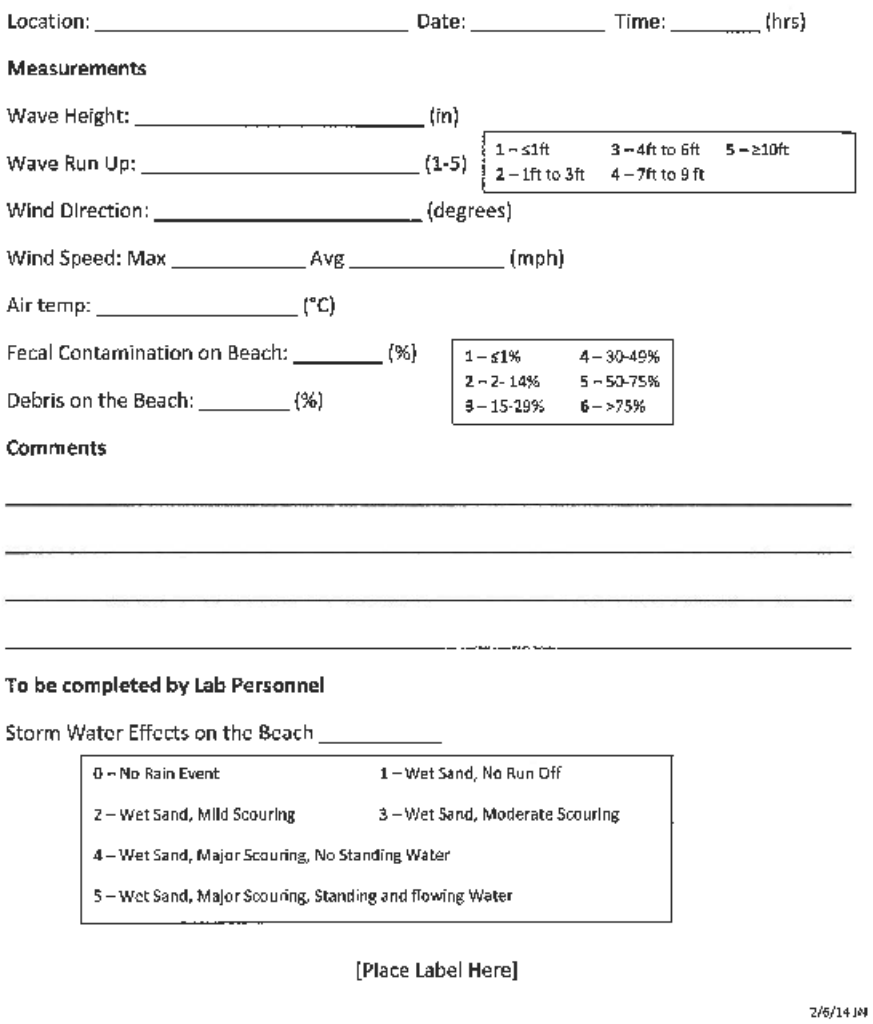
Water Temp: _____ (°C)

pH : _____ (SU)

Turbidity: (1) _____ (2) _____ Avg _____ (NTU)

[Duplicate Turbidity: (1) _____ (2) _____ Avg _____ (NTU)]

Conductivity: _____ (µmhos/cm)



Location: _____ Date: _____ Time: _____ (hrs)

Measurements

Wave Height: _____ (in)

Wave Run Up: _____ (1-5)

1 – ≤1ft	3 – 4ft to 6ft	5 – ≥10ft
2 – 1ft to 3ft	4 – 7ft to 9 ft	

Wind Direction: _____ (degrees)

Wind Speed: Max _____ Avg _____ (mph)

Air temp: _____ (°C)

Fecal Contamination on Beach: _____ (%)

Debris on the Beach: _____ (%)

1 – ≤1%	4 – 30-49%
2 – 2- 14%	5 – 50-75%
3 – 15-29%	6 – >75%

Comments

_____

_____

_____

_____

To be completed by Lab Personnel

Storm Water Effects on the Beach _____

0 – No Rain Event	1 – Wet Sand, No Run Off
2 – Wet Sand, Mild Scouring	3 – Wet Sand, Moderate Scouring
4 – Wet Sand, Major Scouring, No Standing Water	
5 – Wet Sand, Major Scouring, Standing and flowing Water	

[Place Label Here]

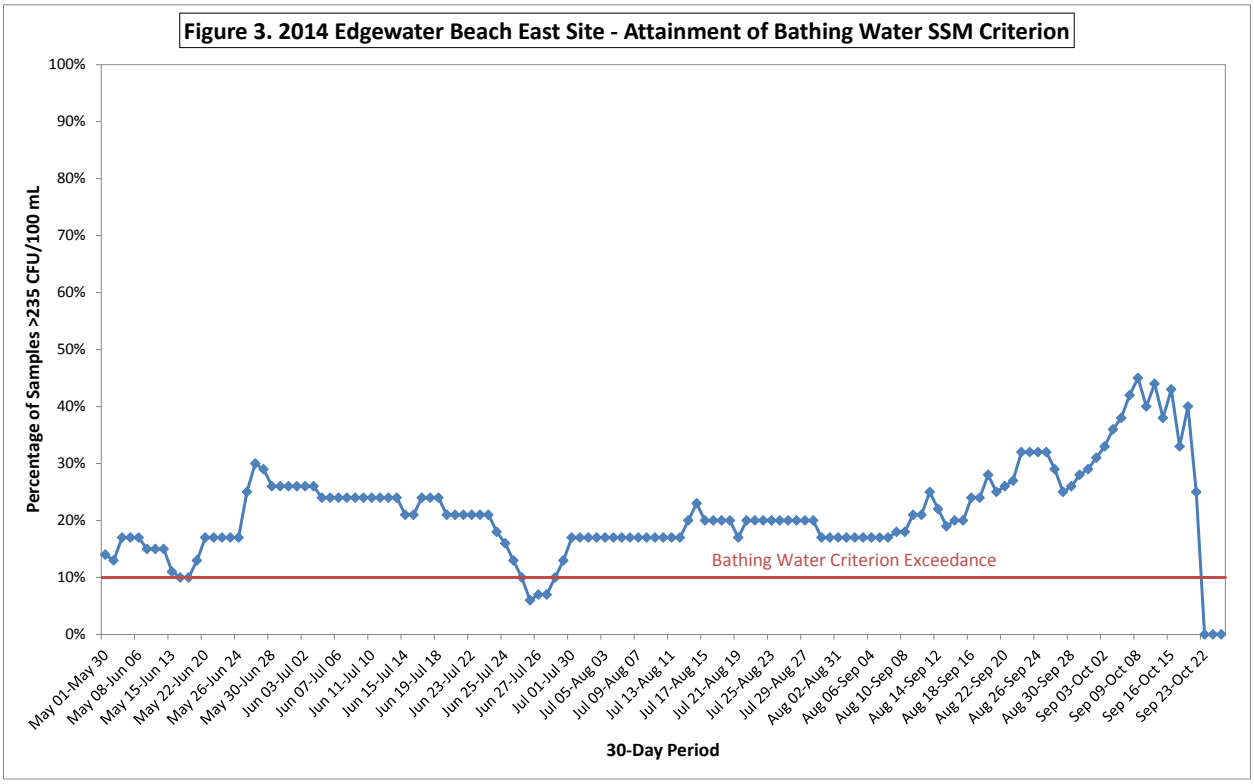
2/6/14 JN

Beach Results and Discussion

The *E. coli* results from each beach site were compared to the Ohio water quality standards to determine recreation use attainment. From May 1st to October 31st, the three beaches are designated as Bathing Waters for the Protection of Recreation Use (Ohio EPA, 2010). The Bathing Waters criteria include an *E. coli* criterion not to exceed a single sample maximum of 235 colony-forming units per 100 milliliters (cfu/100mL) in more than ten percent of the samples taken during any thirty-day period and a seasonal geometric mean criterion of 126 cfu/100mL.

Edgewater Beach

At Edgewater Beach East, 7% of thirty-day periods were in attainment of the single sample maximum (SSM) criterion, while 93% exceeded the criterion (Figure 3). Although there were multiple exceedances of the SSM criterion, this site was in attainment of the seasonal geometric mean (SGM) criterion (Figure 6).



A possible explanation for the exceedances of the SSM criterion is wet weather. According to NEORSD, a wet weather day is dependent on the amount of rainfall within the three previous days. A day is considered dry weather at least 48 hours after a total rainfall of 0.1 inches to 0.25 inches and at least 72 hours after a total rainfall exceeding 0.25 inches. Forty-six percent of the recreation season at Edgewater Beach was considered wet weather[1]. Wet weather events may contribute to elevated bacteria levels by causing discharges from CSOs, storm sewer runoff and urban runoff to enter Lake Erie.

Three NEORSD CSOs in the vicinity of Edgewater Beach are monitored daily by NEORSD's Sewer System Maintenance and Operation (SSMO) department. These CSOs discharged to Lake Erie a total of 32 times during the recreation season and may have had an effect on *E. coli* densities at the sampling site (Table 2). Although all of these CSOs are in close proximity to the beach, it is unknown if these overflow events had a direct effect on the water quality at Edgewater Beach.

[1] Rainfall data obtained from NEORSD's Division Avenue Pump Station Rain Gauge.

Table 2. Number of Monitored NEORSD CSO Overflows During 2013 Recreation Season

CSO	Location	Number of Overflows	Beach/Creek Potentially Affected
069	Upper Edgewater Beach	1	Edgewater
071	Harborview Drive and West 117th Street	13	Edgewater
002	NEORSD Westerly Water Pollution Control Center from the Combined Sewer Overflow Treatment Facility	18	Edgewater
001	Storm overflow at Easterly Wastewater Treatment Plant	26	Euclid Beach, Villa Angela
206	North end of East 156th Street at Lake Erie	2*	Euclid Beach, Villa Angela
242	East 142nd Street and Lakeshore Boulevard	8*	Euclid Beach, Villa Angela
239	Lakeshore Boulevard at Euclid Creek	29	Euclid Beach, Villa Angela, Euclid Creek

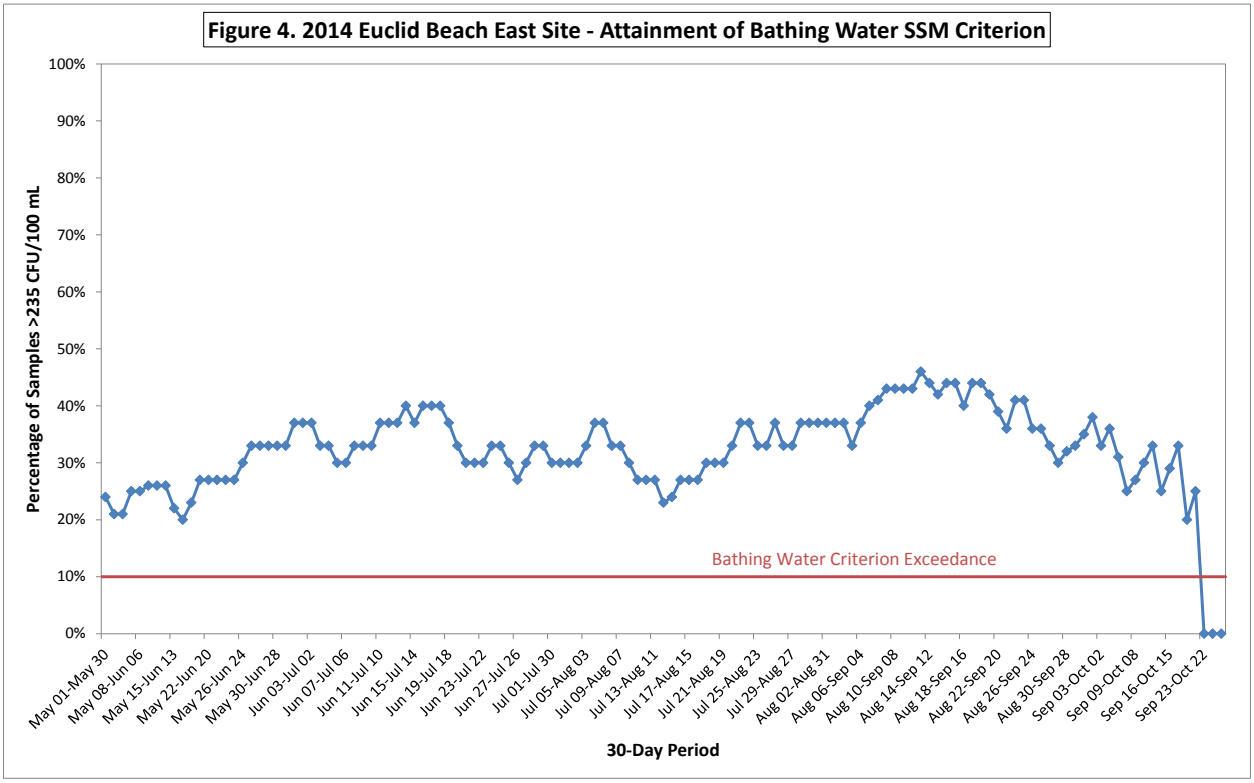
*Equipment reporting issues since 5/20/14 for CSO 206 and 8/1/14 for CSO 242. Actual number of overflows unknown.

Growing evidence suggests that beach sand can often times be contaminated with bacteria, sometimes at concentrations higher than in the water. Beach sand may serve as a reservoir for pathogens that may be released into surrounding waters through wave action or runoff. Additionally, nutrients in the sand may promote survival and growth of bacteria (Sabino et al, 2014). In 2013, NEORSD in cooperation with the Cleveland Metroparks began improvements at the lakefront beaches, including extensive clean-up efforts, namely at Edgewater Beach. Part of the clean-up effort included a sand groomer (mechanical rake towed by a tractor) which raked the beach sand on a daily basis. The groomer was able to rake the sand at a maximum depth of eight inches (Picciano, 2013).

According to Kinzelman and Skalbeck (2006), deep grooming without leveling of the sand, such as what was performed at Edgewater Beach, was found to decrease *E. coli* densities in the sand, which may translate to decreased *E. coli* densities in the nearshore water. However, it was frequently noted that through the process of raking the beach sand at Edgewater Beach, the tractor often pushed sand into the shoreline water, which included the tractor itself sometimes driving into the water. This process may be inadvertently introducing potentially contaminated beach sand and potentially contaminated equipment into the nearshore waters, which may be negatively effecting the *E. coli* density at the shoreline and possibly at the sampling site. Grooming alone is unlikely to significantly reduce the number of thirty-day period water quality exceedances at Edgewater Beach (Kinzelman & Skalbeck, 2006). Other factors to consider include beach slope, avian waste, wind conditions, wave action and contaminated runoff.

Euclid Beach

At Euclid Beach East, all but three thirty-day period exceeded the SSM (98%)(Figure 4); however, this site just met attainment of the SGM criterion (Figure 6).



A possible explanation for the exceedances of the SSM criterion is wet weather. Wet weather may cause CSOs, storm sewer runoff, and urban runoff that might contain elevated *E. coli* densities to enter the lake. Fifty-three percent of the recreation season at Euclid and Villa Angela Beaches was considered wet weather[2]. Four NEORSD CSOs in the vicinity of Euclid and Villa Angela Beach are monitored daily by NEORSD's SSMO department. These CSOs discharged at least 65 times during the recreation season and may have had an effect on *E. coli* densities at the sampling sites (Table 2). (During the sampling season, the exact number of overflows from CSOs 206 and 242 were unknown due to equipment reporting issues.) Also, CSO 207, at East 156th Street and Lakeshore Boulevard, and CSO 208, north of Neff Road and East Park Drive, which are not monitored by the SSMO department, may have overflowed during the recreation season. Although these CSOs are in close proximity to the beaches, it is unknown if these overflow events had an impact on the water quality at Euclid Beach. Aside from CSOs, other sources and factors affecting contamination of the beach water may include wave height and direction, wind conditions, avian waste, runoff and contaminated beach sand.

[2] Rainfall data obtained from NEORSD's Easterly Wastewater Treatment Plant Rain Gauge.

Similar to Edgewater Beach, sand may or may not be having an impact on *E. coli* densities in the water at Euclid Beach. In the study, "Foreshore Sand as a Source of *Escherichia coli* in Nearshore Water of a Lake Michigan Beach" by Whitman and Nevers (2003), researchers discovered that *E. coli* densities in sand and water were significantly correlated, with the highest density being found in foreshore sand[3], followed by those in submerged sediment and water of increasing depth. The study also stated that foreshore beach sand is an important non-point source of *E. coli* to lake water because it is capable of supporting high density bacteria for sustained periods, independent of lake, human, or animal input.

In 2014, Euclid Beach was not groomed to the extent that Edgewater Beach was. Therefore, potentially contaminated sand that may be increasing *E. coli* densities at Euclid Beach through wave action may be a bigger problem than at Edgewater Beach. Wave action must be taken into account at Euclid Beach as it may influence the early colonization and distribution of *E. coli* in beach sand and the subsequent release of sand or sediment-borne *E. coli* in lake water (Ischii, Hansen, Hicks & Sadowsky, 2007). It should be noted that Euclid Beach was groomed more frequently in 2014 than 2013, which may have helped reduce the densities of *E. coli* in the sand and subsequently in the nearshore water, thereby meeting attainment of the SGM criterion.

Villa Angela Beach

At the Villa Angela Beach East site, 96% of thirty-day periods exceeded the SSM criterion (Figure 5) and the site was in nonattainment of the SGM criterion (Figure 6). A possible explanation for the exceedances of the SSM criterion could be wet weather. Wet weather may cause CSOs, storm sewer runoff, and urban runoff to enter the lake that may contain elevated *E. coli* densities. As previously mentioned, there are four monitored NEORSD CSOs in the vicinity of Villa Angela and Euclid Beach that discharged at least 65 times during the recreation season. Although these CSOs are in close proximity to the beach, it is unknown if the overflow events had an impact on the water quality at Villa Angela Beach. Similar to Euclid Beach, contaminated beach sand in conjunction with wave action, avian feces, wind direction and runoff, may also be having a negative effect on the water quality at Villa Angela Beach, since this beach was not extensively groomed during 2014.

[3] The area of shoreline that lies between the average high tide mark and the average low tide mark.

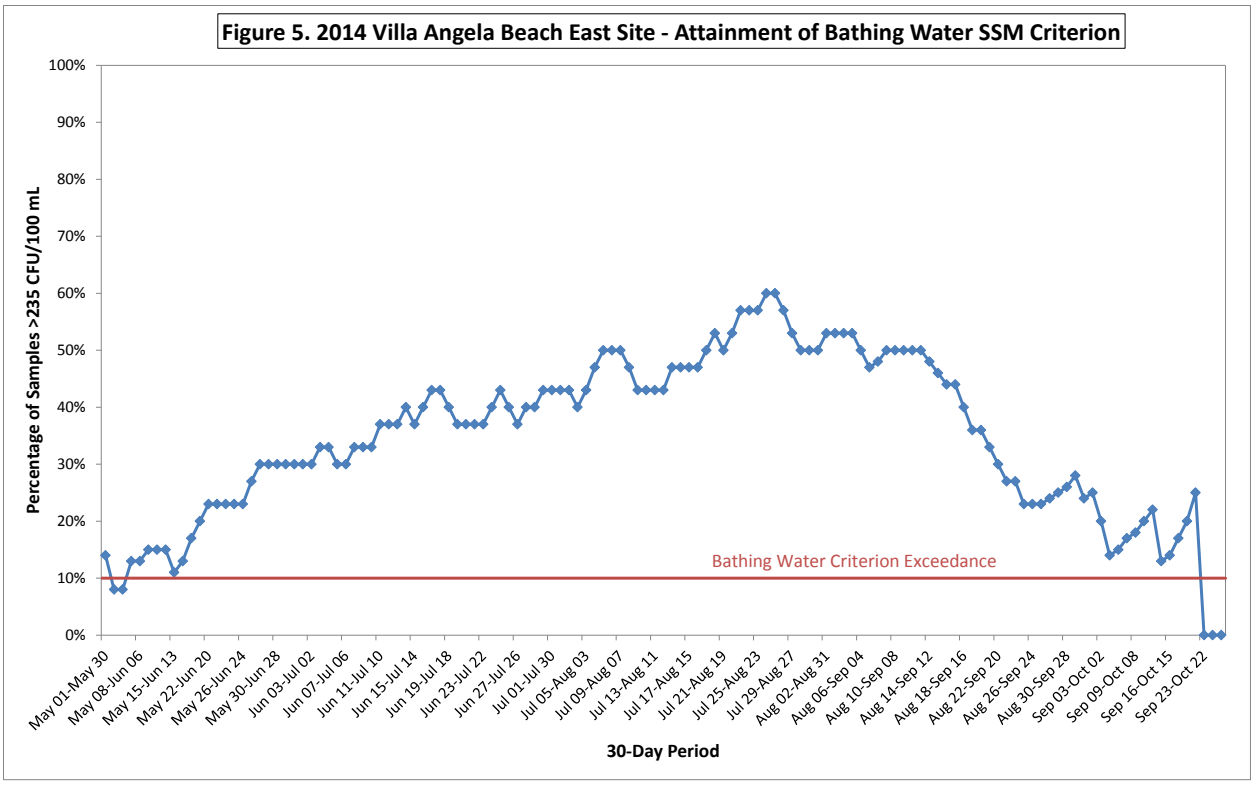


Figure 5. 2014 Villa Angela Beach East Site - Attainment of Bathing Water SSM Criterion
Percentage of Samples >235 CFU/100 mL
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Bathing Water Criterion Exceedance
May 01-May 30
May 08-Jun 06
May 15-Jun 13
May 22-Jun 20
May 26-Jun 24
May 30-Jun 28
Jun 03-Jul 02
Jun 07-Jul 06
Jun 11-Jul 10
Jun 15-Jul 14
Jun 19-Jul 18
Jun 23-Jul 22
Jun 27-Jul 26
Jul 01-Jul 30
Jul 05-Aug 03
Jul 09-Aug 07
Jul 13-Aug 11
Jul 17-Aug 15
Jul 21-Aug 19
Jul 25-Aug 23
Jul 29-Aug 27
Aug 02-Aug 31
Aug 06-Sep 04
Aug 10-Sep 08
Aug 14-Sep 12
Aug 18-Sep 16
Aug 22-Sep 20
Aug 26-Sep 24
Aug 30-Sep 28
Sep 03-Oct 02
Sep 09-Oct 08
Sep 16-Oct 15
Sep 23-Oct 22
30-Day Period

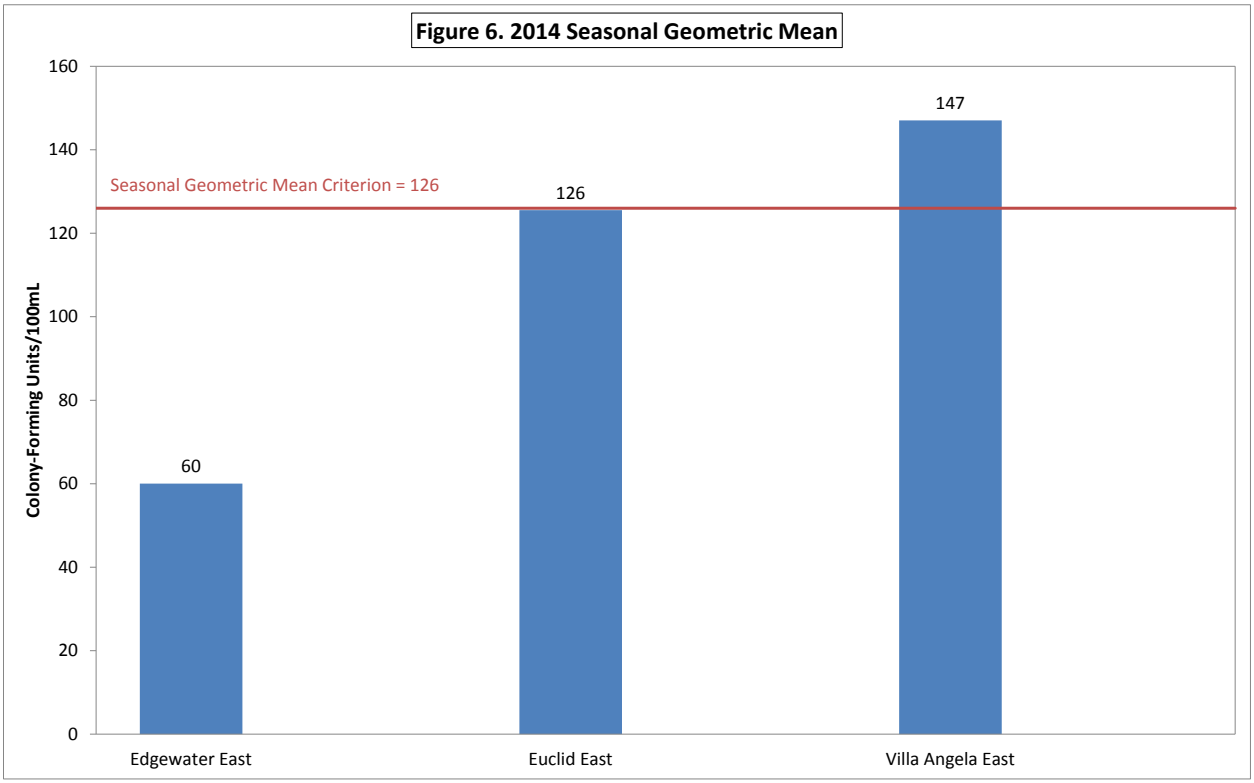
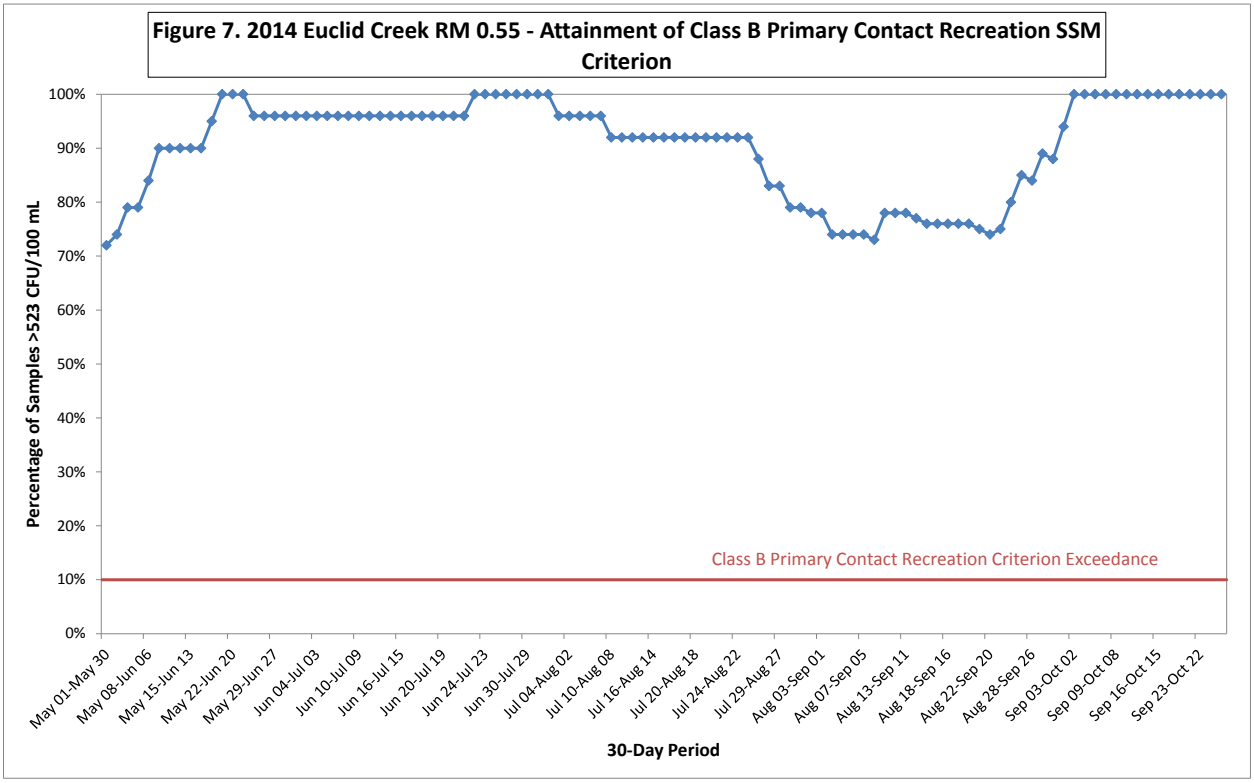


Figure 6. 2014 Seasonal Geometric Mean
Colony-Forming Units/100mL
160
140
120
100
80
60
40
20
0
Seasonal Geometric Mean Criterion = 126
60
126
147
Edgewater East
Euclid East
Villa Angela East

Euclid Creek Results and Discussion

The *E. coli* results from the Euclid Creek site were compared to the Ohio water quality standards to determine recreation use attainment. Euclid Creek is designated as Class B Primary Contact Recreation for the Protection of Recreation Use (Ohio EPA, 2010). The Class B Primary Contact Recreation criteria include an *E. coli* criterion not to exceed a single sample maximum of 523 cfu/100mL in more than ten percent of the samples taken during any thirty-day period and a seasonal geometric mean criterion of 161 cfu/100mL. The criteria are only in effect during the recreation season (Ohio EPA, 2010).

During the 2014 sampling season at Euclid Creek RM 0.55, all thirty-day periods (100%) exceeded the SSM criterion (Figure 7). Additionally, this site had an SGM of 1617 cfu/100mL and therefore failed to meet attainment of the SGM criterion.



A possible explanation for the exceedances of the SSM and SGM criterion could be wet weather. Looking at wet weather occurrences in 2014, 53% of the recreation season at Euclid Creek was considered wet weather[4]. Wet weather may cause CSO overflows, storm sewer runoff, and urban runoff to enter the creek that may contain elevated *E. coli* densities. CSO 239, which is located approximately 400 feet upstream of the Euclid Creek RM 0.55 sampling site, overflowed 29 times to Euclid Creek during sampling. Also, CSO 210, located under the Saint Clair Avenue Bridge, and CSO 209,

[4] Rainfall data obtained from NEORSD's Easterly Wastewater Treatment Plant Rain Gauge.

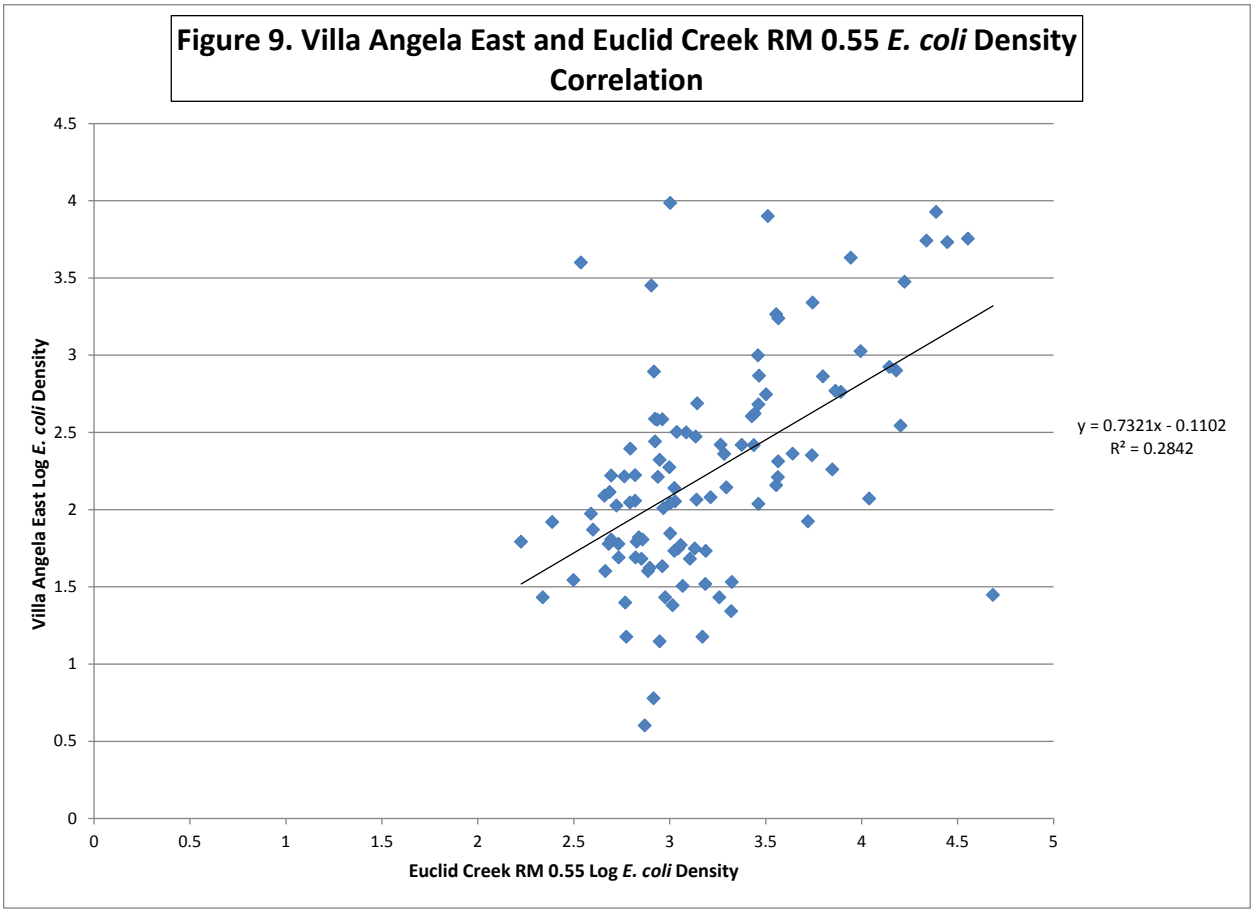
located just north of Lakeshore Boulevard, which are not monitored by the SSMO department, may have also overflowed during the recreation season. Although these CSOs discharge to Euclid Creek, it is unknown if the overflow events had an impact on the water quality in Euclid Creek or Villa Angela Beach.

Additionally, bacteriological contamination of the storm sewers in the cities of Cleveland and Euclid could have an impact on the *E. coli* densities. Contamination of the storm sewers has been thoroughly investigated since 2012 by WQIS personnel as part of NEORSD's Illicit Discharge Detection and Elimination program, and when applicable, has been communicated to the appropriate community for eventual remediation. Although the investigation is still ongoing, the issue of storm sewer bacteriological contamination remains a concern for the health of Euclid Creek. Finally, failing septic systems or urban runoff in the Euclid Creek watershed may also be impacting the water quality at RM 0.55.

Impact of Euclid Creek on Villa Angela Beach

Due to its close proximity, *E. coli* densities measured in Euclid Creek may be impacting the sampling sites on Villa Angela Beach (Figure 8). In the report titled "Interaction and Influence of Two Creeks on *Escherichia coli* Concentrations of Nearby Beaches: Exploration of Predictability and Mechanisms" (Nevers, Whitman & Frick, 2007), it was discovered that *E. coli* contamination in creeks had the greatest effect on *E. coli* densities at surrounding beaches. The transportation of *E. coli* from the creeks to the beaches was significantly influenced by wind speed and direction, currents, wave height and shoreline orientation. Thus, it was hypothesized that bacteria that enter Euclid Creek may flow downstream and prevailing winds and currents may direct the bacteria toward Villa Angela Beach. However, the correlation between bacteriological densities at Euclid Creek RM 0.55 and bacteriological densities at Villa Angela Beach East prove to be weak (Figure 9), with an R^2 value of 0.2842. Conditions in the creek and at Villa Angela Beach, such as wind direction and current, may not have been conducive to show a strong direct effect. Additionally, bacteria from Euclid Creek may become diluted before reaching Villa Angela Beach. Although weak, this relationship should continue to be monitored to determine seasonal variability.

Figure 8. Orientation of Euclid Creek and Villa Angela Beach



Conclusions

Edgewater, Villa Angela and Euclid Beaches

In 2014, beach sampling sites exceeded the SSM criterion 93%, 98% and 96% of the time at Edgewater Beach, Euclid Beach and Villa Angela Beach, respectively. Edgewater Beach and Euclid Beach were the only beaches in attainment of the SGM criterion.

In 2014, at all beaches, a lower percentage of thirty-day periods were in attainment of the SSM criterion compared to the 2013 data (Table 3). This reduction in SSM criterion attainment in 2014 may be the result of the daily beach groomer, which could have been increasing *E. coli* concentrations by taking contaminated sand, equipment and/or rubbish into the nearshore water where sampling occurs. Additionally, due to the 2014 season ending nearly a month early, the colder weather and water temperatures in October could have helped decrease *E. coli* densities. According to Tiefenthaler et al. (2008), *E. coli* densities tend to peak in July and then begin to sharply decline starting in August due to cooler water temperatures which is not favorable for *E. coli* survival. If sampling would have continued through the end of October, the possibility of lower *E.*

coli densities may have helped increase the percentage of thirty-day periods in attainment, and/or decrease the overall SGMs at each site.

The SGMs at Edgewater and Villa Angela Beaches in 2014 were higher than in 2013 (Table 4). The Euclid Beach SGM decreased by 18 most probable number/100 milliliters (MPN/100mL) from 2013. Although both 2013 and 2014 had a similar amount of total rainfall (even with the 2014 season ending early), 2014 had a higher percentage of wet weather days for all beach sites. At Edgewater Beach, over 46% of the days were considered wet weather compared to 43% in 2013. At Euclid and Villa Angela Beaches, 53% of the days were considered wet weather compared to 46% in 2013. More intense, heavy rainfall may cause more frequent CSO discharge events, stormwater runoff, urban runoff and other pollutant loads. These potential sources that could enter Lake Erie may contain elevated bacteriological densities. Additionally, differences may be attributed to seasonal variability (i.e., wind speed, wind direction, wave height, and number of CSO discharge events, etc.) from year to year.

Table 3. 2013-2014 Beach SSM Criterion Attainment

Beach	Year	% Attainment	% Exceedance
Edgewater	2014	7%	93%
	2013	34%	66%
Euclid	2014	2%	98%
	2013	3%	97%
Villa Angela	2014	4%	96%
	2013	9%	91%

Table 4. 2013-2014 Edgewater Beach SGM Criterion Attainment

Beach	Year	SGM (MPN/100mL)	Attainment of Criterion
Edgewater	2014	60	YES
	2013	53	YES
Euclid	2014	126	YES
	2013	144	NO
Villa Angela	2014	147	NO
	2013	141	NO

Euclid Creek

The sampling site at Euclid Creek RM 0.55 exceeded the SSM criterion 100% of the time and exceeded the SGM criterion, corresponding to no attainment in 2014. The 2014 Euclid Creek data was identical to the 2013 data, as both years exceeded the SSM criterion 100% of the time and both years exceeded the SGM criterion (Tables 5 and 6). However, this site had a higher SGM in 2014 than 2013, which may be attributed to a

variety of causes, such as more wet weather days and a shorter sampling season in 2014. Additionally, the investigations on Euclid Creek have identified numerous improper connections within the Euclid Creek watershed that may be continually affecting the health of the creek.

Table 5. 2013-2014 Euclid Creek SSM Criterion Attainment

Year	% Attainment	% Exceedance
2014	0%	100%
2013	0%	100%

Table 6. 2012-2013 Euclid Creek SGM Criterion Attainment

Year	SGM (MPN/100mL)	Attainment of Criterion
2014	1617	NO
2013	1092	NO

All Sites

Elevated *E. coli* densities continue to be observed at the Edgewater, Villa Angela, and Euclid Beaches, as well as Euclid Creek. Many factors, such as CSOs, sanitary sewer overflows, storm sewer and urban runoff, wet weather and beach sand may be contributing to the elevated *E. coli* densities observed. Further monitoring at the beaches and creek will continue to characterize and help to identify the issues that may be impacting these sites.

In 2011, the NEORSD entered into a consent decree with the United States Environmental Protection Agency, Ohio EPA, Department of Justice, and the Ohio Attorney General's Office to reduce the volume of raw sewage that discharges into the environment during rain events. This 25-year CSO control program will help reduce the number of CSO overflows, and thus bacteria, into Lake Erie and Euclid Creek. Bacteriological sampling results from 2012-2014 will serve as baseline data for this program, as new CSO controls are implemented in the coming years. It is anticipated that the water quality at the beaches and Euclid Creek will improve as these CSO controls come online, which will help NEORSD to better identify other possible sources and causes of the elevated *E. coli* densities at the beaches.

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Analytical Services Division – Completed analysis for all bacteriological sampling.

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Ishii, S., Hansen, D. L., Hicks, R. E., and Sadowsky, M. J. (2007). Beach sand and sediments are temporal sinks and sources of *Escherichia coli* in Lake Superior. Environmental Science and Technology. 41: 2203-2209.

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