Beach Closures at Presque Isle State Park: Past, Present, and Future Conference Proceedings

Cosponsored by:

Pennsylvania Sea Grant

Pennsylvania Department of Environmental Protection

Erie County Department of Health

Pennsylvania Department of Conservation and Natural Resources

Regional Science Consortium at Tom Ridge Environmental Center

and

United States Environmental Protection Agency

April 16-17, 2007
Erie, Pennsylvania

Preface

The Beach Closures at Presque Isle State Park: Past, Present, and Future Conference Proceedings was prepared with the goal of capturing all the thoughts and ideas from the conference held in Erie, Pennsylvania on April 16-17, 2007. This conference was a first for the area discussing E. coli and beach closures.

A special thanks is extended to all the speakers at the conference, including Rick Diz (Gannon University), Tony Foyle (Penn State Erie), Julie Kinzelman (Racine Department of Health), Harry Leslie (Presque Isle DCNR), Ron Lybrook (Pennsylvania Department of Environmental Protection), Steve Mauro (Mercyhurst College), Scott White (Erie County Department of Health), Richard Whitman (US Geological Survey), and Sue Zurad-Koppes (Erie County Department of Health).

Table of Contents

Introduction

On April 16-17, 2007, the Tom Ridge Environmental Center at Presque Isle State Park in Erie, PA held a conference to discuss the beach closures due to high E. coli counts at Presque Isle State Park.

The goal of the conference was for the Presque Isle officials and other local departments to get feedback on the current management practices for beach closures at the park. The feedback came from several experts who shared their experiences, opinions, and ideas on beach closures with park officials and local departments.

The conference was conducted in a workshop format with presentations and an open discussion with a panel of experts.

PROTOCOL FOR SAMPLING BEACHES, Presque Isle State Park, 2007

Revised to follow Title 28, Chapter 18 conditions

Below is the protocol for sampling the beaches at Presque Isle State Park that will be implemented for the 2007 swimming season. This protocol is in compliance with Title 29 Health and Safety, Part II Local Health, Chapter 18, Public Swimming and Bathing Places. In summary, Title 28 enacts the use of E. coli as a sampling indicator, with a maximum of 235 E. coli per 100 milliliters for single samples, and a geometric mean of 126 per 100 milliliters.

Samplers will consist of a trained student intern team who will be responsible for all sample collections and the lab delivery. The samplers will be trained by the Erie County Department of Health and Park officials prior to the swimming season.

Regulation samples will be taken between noon and 2:00 PM on Sundays and Mondays during the swimming season except during holiday weekends or when weather conditions do not reflect peak use. A regulatory sample will be taken prior to the swimming season. Three separate samples will be taken at each of the nine (9) permitted beach areas as delineated on the Presque Isle Bathing Permit, which was filed with the Department of Environmental Resources Community of Environmental Control in 1957 (three permitted beach areas are no longer used for swimming). One sample will be taken approximately fifty (50) feet in from each end of the beach, and the third will be taken in the center of the beach areas. All three samples will be taken during the same visit to the beach and will not be spread throughout the day. Each sample shall be taken from water that is approximately 30 inches deep and at a midpoint between the bottom and the surface of the water. The lab will run separate tests for each of the three samples taken at each beach area. The final count for that particular beach will be the arithmetic mean for the three sample averages taken. The final count will be referred to as a sample throughout this protocol. Sporadic anomalies will not be included in the arithmetic mean to determine the final beach count but the anomaly will be reported to the park. Attempts will be made to determine the cause of that anomaly and re-samples may be taken.

The Dean and Dixon Q-test will be used to determine statistically if an anomaly has occurred. This test relates the extreme sample range to the range between the suspect result and its nearest neighbor. If properly applied, the Q-test results in a 90% confidence level for data rejection. It should be noted that the Q-test would only be judiciously applied when the laboratory suspects an anomalous sample result. It would not be employed to routinely discard any one of the three sample results. Since the statistical analysis of small (i.e. 3 samples) data sets is difficult, bacteria counts from adjacent beaches will be included in the is analysis when possible. Exceptions would be beach 1 West and Beach 11.

The sample results will be incorporated into a 30-day running geometric mean, which will be calculated for each beach. The Erie County Department of Health is responsible for calculating the geometric mean.

The 30-day running geometric mean is based on samples taken during the last 30 days and is not based on a calendar month. A minimum of five samples taken on five different days is necessary to run the geometric mean. Samples taken on the first day of the swimming season will start the 30-day running geometric mean.

Due to historical data collected and intensive studies done previously, samples collected that do not accurately reflect that water quality of the Presque Isle swimming areas or do not reflect times of peak usage of the beach will not be applied to the 30-day running geometric mean. These samples will still be used as regulatory samples to close beaches if the counts exceed a density of E. coli of 235 per 100 milliliters of water and the beaches may not be re-opened until approval to re-open the beach is received from Erie County Department of Health.

The Erie County Department of Health Lab will monitor the most recent samples to determine the Geometric Mean of the current week plus the prior week. If this Geometric Mean exceeds 126 per 100 milliliters for that period, the Lab will notify the Park so precautionary measures can be taken, if deemed necessary. The Erie County Department of Health Director will be notified for discussion and input. This procedure does not replace established 30-day Geometric Mean, but provides a management tool for precautionary measures.

Samples will be taken to the Erie County Department of Health Lab in Erie as soon as possible after collection, and will be processed within six hours of collection. Scheduled water samples will not be taken if the beaches are closed, but samples will be taken the following day or when the beaches are reopened.

For beach closing/opening, the Lab will be responsible for immediately notifying one of the following persons at Presque Isle State Park: (1) the Park Operations Manager I, (2) the Assistant Park Manager in charge of lifeguards or (3) any other Assistant Park Manager. The Park will verify that one of the following persons at the Erie County Department of Health has been notified: (1) the Director of Environmental Health, (2) Environmental Health Supervisor, (3) the Director of Health Department, or (4) Aquatic Biologist. Presque Isle State Park must contact the Erie County Department of Health for approval to reopen beaches closed for conditions 1, 2, and 3 as outline in the "Closing A Beach Section."

The park will also be responsible for contacting news media and other interested parties of closures. When the Erie County Department of Health web site is operational, notification will be accomplished thought the web site, and email notification by ECDH.

The water in bathing beaches should be considered contaminated for bathing purposes when one of the following conditions exist:

1. When officials determine through visual inspection that a substance is being discharged or may be discharged into the water and is or may be hazardous to the health of persons using the bathing beach. The beach will be closed and sampling will begin to determine the bacteria count. Depending on the source, samples may have to be analyzed for other contaminants. Samples taken during the time the beach is closed because of this type of closure will not be counted towards compliance and will not be included in the 30-day running geometric mean provided that the source of the contamination is identified and eliminated or other

controlled to the satisfaction of the Department.

2. When the E. coli density of any sample collected at a bathing beach exceeds 235 per 100 milliliters.

3. Whenever the most recent entry of a sample results causes the 30-day running geometric mean of all regulatory samples exceed 126 per 100ml.

4. If the first few sample results taken prior to the start of the swimming season are greater than 235 per 100 ml, the beach should be closed until the running geometric mean, using a minimum of five (5) samples, is less than 126 per 100ml.

5. Beaches may be closed at the onset of high wave activity immediately following a hot, calm period of weather in anticipation of high bacteria counts. Historical data has indicated that during these conditions that a high bacteria count will be experienced immediately at the onset of high wave activity with the levels decreasing back to safe standards within several hours. The beaches may be reopened two hours after closure for this condition if the waves are not creating unsafe swimming conditions. Samples will be collected during this type of closure only for additional data to monitor and verify if this procedure is correct.

6. Samples taken during this condition will not be considered "regulatory" and are not included as part of the 30-day running geometric mean. If samples taken when a beach is reopened are greater than a count of 126, indicating thath assumption for reopening was not valid, future reopening will not be allowed until approved by Erie County Department of Health.

OPENING BEACHES

After a bathing beach has been closed due to conditions 1, 2, and 3 as stated above under "Closing A Beach," a re-sampling of the bathing beach will occur for three consecutive days, weather conditions and lab operations permitting. Bathing beaches will be reopened after closure when a visual survey of the beach area indicated the conditions which were responsible for the closure are no longer present and when:

1. For a Type 1 and 2 closure, the first re-sample after a closure, which does not exceed 235 E. coli per 100ml. For a Type 2 closure, the sample which closes a beach and all re-samples taken will be incorporated into the 30-day running geometric mean.

2. For a Type3 closure, the beach may be re-opened following the receipt of the first sample indicating an E. coli density of not more than the geometric mean of 126 per 100 ml. The beach may remain open while the remaining samples are collected and analyzed as long as no sample exceeds an E. coli density of 235 per 100ml. and the running geometric mean does not exceed 126 per 100ml. The sample which closed the beach and all re-samples taken will be incorporated into the 30-day running geometric mean.

3. If the conditions responsible for closing the beach cannot be identified and eliminated or controlled to the satisfaction of the Department, the beach may not be reopened until the 30-day running geometric mean does not exceed 126 E. coli per 100ml.

ANALYTICAL PROCEDURES

Samples will be analyzed for the presence of E. coli using the procedure outlined in "Standard Methods for the Examination of Water and Wastewater" the 20th Edition, published jointly by the American Public Health Association and the American Water Works Association, as amended, or in accordance with any other method approved by the United States Environmental Protection Agency for the testing of E. coli in water samples taken from waters designated for primary contact recreation.

The molecular alternative method of analysis of E. coli DNA using Quantitative Polymerase Chain Reaction (QPCR) may be used by Park and Health officials in determining proactive preventive beach closings. Selected representative beaches may be sampled and analyzed using the QPCR method when weather and site conditions would indicate high E. coli concentrations may be present. Results of QPCR analysis would be non-regulatory, but could be used in conjunction with historical data to trigger a Type 1 or Type 5 closure, or a reopening.

TELEPHONE LISTING

Erie County Department of Health……..(24 hour number)		451-6700
	Fax	451-6775
Director of Environmental Health	Doug Range	Office: 451-6743
Supervisor of Environmental Health	Karen Tobin	Office: 451-6754
Director of Department of Health	Andy Glass	Office: 451-6701
Aquatic Biologist	Douglas Ebert	Office: 451-6745
Lab Director	Scott White	Office: 451-6758
		Lab: 451-6713
Presque Isle State Park…….833-7424		
Park Operations Manager I	Harry Leslie	Office: 833-2650
Park Manager 3	Holly Best	Office: 833-2945
Park Manager 3	Charlie Meade	Office: 835-5034
Park Manager 3	Dorothy Krupa	Office: 833-0252
Erie Area Convention and Visitor Bureau……454-7191		
John Oliver/Emily Beck		Office: 454-7191
Pennsylvania Department of Health…….(724) 662-6068		
		Fax: (724) 662-6086
Michelle Hughes/Ben Zimmer		(724) 662-6086
Dennis Wilson, DOH, Harrisburg		(724) 787-4366
		Fax: (717) 787-4790

Presque Isle State Beach Sampling Form Instructions

Each beach sampling for is divided in half length-wise, which allows two beach areas with three (3) samples each to be recorded on one form.

Below are instructions that should be adhered to when filing out the form.

1. Collectors: Fill in the Collector's name.
2. Data Samples: Fill in the Date the samples are taken.
3. Agency: Check off the agency for whom the collection is sampling.
4. Beach: Place the beach number or name to the right of the word "Beach."
5. Monitoring Only: Check off only if this sample is not a regulatory sample and/or will not be included in the running geometric mean. This monitoring data will not be inputted into the computer.
6. Samples for re-opening: Check off if the beach is closed and the samples are being taken to determine if the beach can be re-opened. The "yes" box must checked off and samples must be taken for high E. coli count for a minimum of five (5) consecutive says, if a beach is closed for a high E. coli count.
7. Day ___ of Five (5): Fill in the day of sampling if the beach is closed due to high E. coli counts. Day one starts on the actual day that the beach was closed and the re-sample taken.
8. Fill in the time the sample is taken, the water temperature in Fahrenheit, wind directions, wave height in feet and if it is raining or not, or the number of days since the last rain. Water temperature will be taken at beach 1 West, Beach 7, and Beach 11.
9. Bather Load: May be obtained from a lifeguard or by estimating the number of people in the water using a head count of bathers in relation to those on the beach.
10. Park Comments: Should indicate any unusual observations such as the number of gulls present, Filamentous algae or other conditions which may affect sample results.
11. The Lab telephone number, Lab I.D., E. coli count, Lab comments, Arithmetic mean and the current Geometric Mean will be filled out by the lab. The collector will put a "W" , "C" and "E" above each of the Lab numbers for each beach area.

Beaches:
All beaches are sampled at three different locations. The eastern most lifeguard chair, the center of the chairs and the western most chair are suitable markers for sampling. Bottles should be labeled with beach name, area of beach (W-west, C-center, E-east) and the date. These labels should be prepared and attached to the sample bottles prior to taking the samples.

When taking samples, start at beach 11 and work westward towards the neck of the peninsula.

Beach Samples
2007 Summer Season

Permit Area	Beach Sample Name	Location of Beach Samples
1	Beach 1	Three samples taken at the bathing area of Beach 1 West Extension. Three samples taken at Beach 1 West. Three samples taken at Beach 1
2	Barracks	Three samples taken at Barracks Beach (West, Center, East)
3	Unguarded section of Beach 2 (West)	No samples taken in this area
4	Beach 2	No samples taken in this area
5	Unguarded Beach 5	No samples taken in this area
6	Beach 6	Three samples taken at Beach 6 (West, Center, East)
7	Beach 7	One sample taken at the West end of Beach 7 One sample taken midway between West end and concrete jetty One sample taken at concrete jetty
8	Beach 8	One sample taken at the East end of Beach 7 One sample taken just East of the Beach 8 concession stand One sample taken at the East end of Stone Jetty
9	Mill Road Beaches	One sample taken at the West end of Short Jetty One sample taken at Saw Mill Beach One sample taken at the East end of Goddard Beach
10	Lighthouse Beach	No samples taken in this area
11	Beach 9	Three samples taken at Beach 9 (West, Center, East)
12	Beach 10	Three samples taken at Beach 10 (West, Center, East)
13	Beach 11	Three samples taken at Beach 11 (West, Center, East)


PRESQUE ISLE STATE PARK
Park Office
Accessible
Public Phone
First Aid
Interpretive Center
Restrooms
Picnic Area
Picnic Pavilion/Picnic Area
Playground
Food Concession & Beachhouse
Beach (Guarded Areas)
Boat Launch
Marina
B.L. Boat Landing
Lighthouse
Hiking Trail
Multi-Purpose Trail
Other Trails
Breakwater Locations
BOATERS NOTICE
• Mooring to Breakwaters is NOT Permitted
• Beaching of Boats Along Presque Isle Shoreline is Permitted EXCEPT within 100 Ft. of Designated Swimming Areas and at The Gull Point Natural Area Area between April 1 and November 30
SAFETY NOTICE
• Swim ONLY within 100' of Lifeguard
• Please Stay OFF Breakwaters
• Ice Conditions Not Monitored
• Ice Dunes are Unstable, Please Stay OFF
• Please DO NOT Feed Wildlife, Gulls, Geese
• In-Line Skating IS NOT Permitted on Park Roadways
SCALE: 1" = APPROX. 0.38 MILE
1 KILOMETER
1/2 MILE
GULL POINT NATURAL AREA
CLOSED to all public use from APRIL 1 through NOVEMBER 30
LAKE ERIE
PRESQUE ISLE BAY
Mill Road Beaches
Goddard
Presque Isle Lighthouse & Exhibit
No.9 Pine Tree
Sunset Point
No.10 Budny
Gull Point Kiosk
Observation Platform
Ainsworth Saw Mill
Short Jetty
Stone Jetty
Maintenance Area
Ecological Reservation
Thompson Circle
THOMPSON BAY
No.8 Pettinato
Rotary Pavilion
No.7 Waterworks
Lifeguard Headquarters
Picnic Shelters
No.6
Canoe Portage Tr.
MARINA LAKE
Boat Fuel
Marina Office
West Pier
East Pier
Cookhouse Pavilion
Ferry Dock & B.L.
Waterworks
Niagara
Playfield
Park Office
Swan Cove Parking Lot
Sturgeon Bay Parking Lot
B.L. #1
B.L. #3
B.L. #4
B.L. #5
B.L. #6
Canoe & Boat Rental
Pontoon Boat Tours
Lagoons
Frys Landing
MISERY BAY
Scenic Boat Tours
Perry Monument & Exhibit
WARNING Submerged Piling
No.11
North Pier Light
North Pier
South Pier
U.S. Coast Guard Station
Multi-Purpose Trail
Observation Platform
Barracks
Stull Interpretive Center and Nature Shop
Vista 3 Parking Lot
Vista 2 Parking Lot
Vista 1 Parking Lot
No.1
1 West
Park Entrance Gate
Tom Ridge Center at Presque Isle (under construction)
Waldameer Amusement & Water Park
Scott Park
MILLCREEK TOWNSHIP
MILLCREEK TOWNSHIP LINE
To PA 5, US 20, I-79 & I-90
Erie Yacht Club
CITY OF ERIE
Liberty Park
Bicentennial Tower
Dobbins Landing
Erie Intermodal Transportation Center
Flagship Niagara & Maritime Museum
Port of Erie Marine Terminal
Lampe Marina
East Ave
Erie Land Lighthouse
Hamot Hospital
Discovery Square
Firefighters Museum
Watson-Curtze Mansion & Planetarium
Gannon University
Warner Theater
Erie Civic Center
Jerry Uht Ballpark
Erie Playhouse
Roadhouse Theater
Frontier Park
Cascade Creek
To I-79

Conference Presentations

Sue Zurad Koppes

Bathing Beach Contamination Study at Presque Isle 1988-1991

Abstract: Sue Zurad Koppes from the Erie County Department of Health summarized three reports from 1989-1990. The purpose of the Presque Isle State Park Bathing Beach Contamination Investigation was to determine the source or sources of periodic high fecal coliform counts which, at times, have caused bathing beaches to be closed. The most significant conclusion of the investigation was that high fecal coliform counts in bathing beach water appear to be caused by the incubation and multiplication of these bacteria in shoreline sand during hot, calm weather and their suspension in the water at the onset of higher wave activity. Fecal coliforms and specifically E. coli were shown to multiply using shoreline material from Presque Isle State Park as a
substrate.

Weekly fecal coliform levels correlated with weekly water temperatures and bather loads. Sea gull counts could be seen to influence fecal coliform levels under some conditions. "Lag" periods of about an hour are sometimes seen between an increase in water temperature, bathers or sea gulls and the resultant increase in fecal coliform levels.

During periods of rainfall, fecal coliform levels from streams west of Presque Isle increase drastically. Depending on currents, high fecal coliform levels from these streams may influence beach fecal coliform levels at least as far away as Beach 8.

Beach replenishment sand imported to Presque Isle for the 1988 beach nourishment program was eliminated as a direct source of gross fecal contamination. However, nutrients detected in replenishment materials may aid in the growth of fecal coliforms.

Ground water tests showed levels of up to >60,000 fecal coliforms/100mL in shoreline ground water. Counts decreased with increased distance inland toward sand mound sewage treatment plant systems, with counts of <10 fecal coliforms per 100mL from monitoring wells near the sand mounds. This indicated that the sand mounds were not a significant source of coliform contamination.

Data from past years was evaluated. Differences in reported fecal coliform levels from year to year were due to changes in sample collection and reporting methods, as well as changes in actual fecal coliform levels. Differences in numbers of beach closings from year to year were also influenced by the number of samples collected annually and bathing beach regulations in effect.

Saturday, June 4, 1988

Bacteria continue to plague park beaches

By BILL McKINNEY
Weekender staff reporter

Bacteria problems continue to plague Presque Isle State Park, forcing park officials to close a second beach in as many days.

Tests of water samples taken Thursday off Beach 10 revealed fecal coliform counts of just over 1,100 per 100 mililiters of water.

Fecal coliform are bacteria found in the wastes of warm-blooded animals. The count is used to indicate the possible presence of organisms that might carry disease to humans.

Beaches are closed whenever a coliform count is 1,000 or higher on a single day or averages 200 or more for five tests taken within 30 days.

John Toth, director of the Erie County Health Department, said test results he received Friday indicated counts were down on all beaches but 10, where it shot above the maximum, and Beach 1.

He said Beach 1 counts were still high but seem to be coming down.

Beach 7, which was ordered closed on Thursday because of a bacteria count of 1,200, was reopened Friday.

"We're continuing to pick up batteries of samples," Toth said. "I also just reviewed the operating reports on the park's aerobic septic systems, and groundwater samples (from test wells around the sand mounds) show nothing.

"We'll be interested in the results from the next batch since they were picked up after a period of heavier rest room use."

Park records indicate numerous accidental overflows into different mounds during the month of May, most of which were caused by stuck flush valves.

Toth said health specialists also questioned Millcreek officials Friday about township plumbing facilities but were told the sewage lift stations near Presque Isle had experienced no problems.

He said some water samples taken from streams in the area showed elevated bacteria counts but nothing he could link to what is happening on park beaches.

Toth said the department is continuing to investigate the possibility that heavy siltation caused by dumping of fill material on beaches may be creating an environment along the shoreline the promotes the spread of bacteria.

Stanley Prazer, a member of the Presque Isle Advisory Committee and retired chief of the City of Erie Water Bureau, said there is no mystery as far as he is concerned.

"We had tests showing fecal coliform in the gravel that the U.S. Army Corps of Engineers has been laying on our beaches," Prazer said. "The health department told us it was only 13 to 16 counts per 10 grams of sand and that there was no standard for sand.

"So do some mathematics. Multiply the lower count by the tons of sand being put down and you get a possible count of between 187 and 189 billion coliform colonies spread next to the water.

"You've seen the coffee-brown water stain spreading outward from these so-called replenished beaches. How can anyone say they don't know where the water contamination is coming from now?"

Edward Donn, chairman of the advisory committee, said he believes the present battery of park tests being conducted by the health department under a small state grant is not sufficient.

With both human health and Erie County's tourism economy at stake, Donn said it is time for an all-encompassing study to find and eliminate the source of the beach pollution.

During a strategy session of the advisory committee Friday, Donn said he asked members to "get their thoughts together on how a macro study of the Presque Isle area could be conducted.

"I think it's time for the state Department of Environmental Resources to get involved with some real funding for the kind of study that will put a crew out there in boats, for however long it takes, testing the effects of temperature, current, and the different discharges.

"We've got to know what's causing this and we've got to stop it."

Monday, June 13, 1983

Beach pollution study urged

By TOM WEBER
Of the *Erie Daily Times*

A long-term study should be begun immediately to pinpoint sources of pollution that affect bathing beaches at Presque Isle State Park, members of the park advisory committee and area legislators concluded at a Friday afternoon meeting.

The lengthy meeting of the advisory committee was attended by state Reps. Karl Boyes, Italo Cappabianca and Bernard Dombrowski, who have previously sent aides to represent them at meetings of the advisory committee.

The proposal for a long-term study came in response to a report from committee members Paul Knuth and Stan Prazer which blamed the U.S. Army Corps of Engineers' sand replenishment program for the high bacteria counts that have closed three park beaches in recent weeks.

Knuth, an Edinboro University geologist, and Prazer, retired head of the Erie city water bureau, both claimed that bacteria are being carried to Presque Isle aboard truckloads of gravel-like upland sand that is spread on beaches during the annual $1.3 million replenishment project.

Prazer noted that the only Presque Isle beaches that were ever closed due to pollution before the beach replenishment program began in 1977 were Beach 11, which has been periodically closed because of overflows at the Erie Wastewater Treatment Plant, and Beach 1, where he said the water is occasionally polluted by sewage outflows into creeks to the west of the peninsula.

"The beaches on the north lake side of the peninsula were never closed before 1977 because of bacteria," Prazer said. "Now, we are permitting contaminated material with clay in it to be placed on our beaches. Literally billions of colonies of bacteria are being dumped out there.

"There is no question that the upland sand is the cause of fecal coliform pollution of our beaches," he said.

The comment drew criticism from Terry Fabian, director of the Office of Natural Resources for the state Department of Environmental Resources. Fabian termed Prazer's statement "an absurd conclusion," saying there was no scientific data to confirm that the bacteria problem is related to the sand replenishment program.

"We have an obligation in DER to get the data and find out what is causing the high coliform counts," Fabian said.

A short-term study of bacterial contamination at park beaches is being conducted this year by the Erie County Department of Health under a grant from the state Coastal Zone Management Program, but committee chairman Ed Donn said the study is limited to sand trucked onto the peninsula by Corps of Engineers contractors.

"We need to know much more," Donn said. "We need to know if it is the aerobic (sewage treatment) tanks on the park itself, whether it is an infusion of pollutants from the bay, and whether it is being brought in here with the sand."

Cappabianca, Boyes and Dombrowski said they would support a special appropriation for a definitive study of pollution sources along the bay and lake shores.

"An in-depth study of the bay and the entire Presque Isle peninsula would give you the kind of data that you need," Cappabianca said. "We are being hypnotized by the media coverage of this problem, and we need some real answers."

In other business Friday, advisory committee members heard a presentation from concessionaire David Parker, who operates a boat livery, the gas dock at the Presque Isle Marina, and the winter cross-country skiing concession at the state park.

Parker is asking the Bureau of State Parks for permission to install soft drink vending machines at five locations on Presque Isle. Provisions would be made at each of the vending machine installations to collect beverage cans for recycling, with the proceeds from recycled cans going to support educational programs at Presque Isle, Parker said.

Also, Parker said he is asking for permission to begin a sailboat rental business at a location on the neck of the peninsula.

DER team will probe park beach pollution

By BILL McKINNEY
Morning News staff reporter

The Pennsylvania Department of Environmental Resources will send a scientific team to Erie next week to begin an intensive search for the cause of high levels of bacteria that keep closing Presque Isle State Park beaches.

Beaches 7, 9 and 10 were closed last Thursday because of high counts of fecal coliform, bacteria found in the waste of warm-blooded animals. Beaches 7 and 10 were also closed the first week of the swimming season because of high coliform counts.

Coliform counts are used in tests to predict the possible presence of disease-causing organisms called pathogens.

Edward Donn, chairman of the Presque Isle Advisory Committee, said state environmental officers in Harrisburg met last Friday and again on Monday to discuss the park's continuing problem.

"Terry Fabian of DER told me that they are sending a team of aquatic biologists and other DER experts up here to take a close look at what's going on," Donn said.

"They said they're going to do what they called a supplemental study aimed at arriving at a broader understanding of the high coliform counts."

The state team will meet with officials from the Erie County Health Department, which is conducting its own set of tests at Presque Isle, tests that appear to point toward beach replenishment fill as the cause.

There continues to be disagreement about how much of a risk these high counts might pose to human health, with health director John Toth believing the bacteria may be reproducing without producing pathogens.

State officials will work with health authorities while pursuing their own testing program, Donn said, in hopes of arriving at a short-term conclusion about causes of the pollution.

At the same time the DER team will also be drafting specifications for what Donn termed "a long-term macro study" to identify all of the elements that might cause trouble at the park in the future.

"Our state assemblymen have already promised us they would work on getting up to $100,000 set aside to pay such a study," Donn said.

"From the looks of things, we're going to need it."

7 Presque Isle beaches closed because of high bacteria counts

8/23/89

By BILL McKINNEY
Morning News staff reporter

Presque Isle State Park officials closed seven beaches Tuesday based on pollution in water samples collected by park lifeguards on Sunday.

Tuesday's action marked the highest number of pollution-related closings the park has ever experienced, according to lifeguard chief Frank Pettinato who has worked at Presque Isle for more than 50 years.

Erie County Health Department officers said samples taken in three beach areas on Sunday came back either above the one-day limit for fecal coliform bacteria or above the five-day mean limit.

Pettinato, after checking with assistant park superintendent Obie Derr, said a total of seven individual beaches had to be closed because of the sample results.

Beaches closed include Beach One, Beach One East, Beach One West, Short Jetty Beach, Sawmill Beach, Ainsworth Beach and Beach Eight.

In addition, county health officers said coliform counts at three other Presque Isle beaches were elevated, although not to the point of closing those areas.

Health officials have theories about why beaches have been closed so frequently over the last two years, but they also say they still do not know which theories are accurate.

"It may be a combination of a lot of factors," Deputy Health Director Henry Suroviec said Tuesday afternoon. "It may not be a matter of attaching blame to just one problem."

Suroviec and Mark Fedorchak, a Health Department environmental specialist, said they are certain of only one thing — that the sand mound septic systems, installed parkwide amid much controversy, are not responsible.

Suroviec said he believes part of the reason beaches are being closed more frequently is simply that state park officers are testing the lake water more often.

"They only have to test it once a week and I think they're testing as often as three times a week now," he said.

That does not explain why so many samples are being returned showing high bacteria counts.

Suroviec and Fedorchak both guessed that weather plays a crucial role in determining whether collected samples show contamination.

"There may be a correlation to what the weather is like on the day samples are collected," Fedorchak said. "It's the only thing we seem able to predict. Bather load doesn't seem to be a factor."

He noted that last Sunday's samples were collected in choppy lake waters, with waves several feet high.

Why should weather affect the bacteria count?

Suroviec acknowledged that beach sand is still a prime suspect.

He said Susan Zurad, who spent the last two years studying pollution problems at Presque Isle for the Health Department, has theorized that sand, particularly upland sand trucked onto the park, has become a breeding ground for bacteria.

Samples taken by the *Morning News* before Zurad's study began showed coliform counts in the thousands in beach sand near the water's edge, where most small children play.

Health Department samples taken later confirmed that finding.

Zurad's theory, Suroviec said, is that some sand contains nutrients that allow bacteria to thrive, turning the water's edge into a kind of gigantic culture dish in which bacteria grow.

During bad weather, wave action may be pulling that contaminated sand out into the lake, suspending the bacteria in the water and resulting in high coliform counts during sampling.

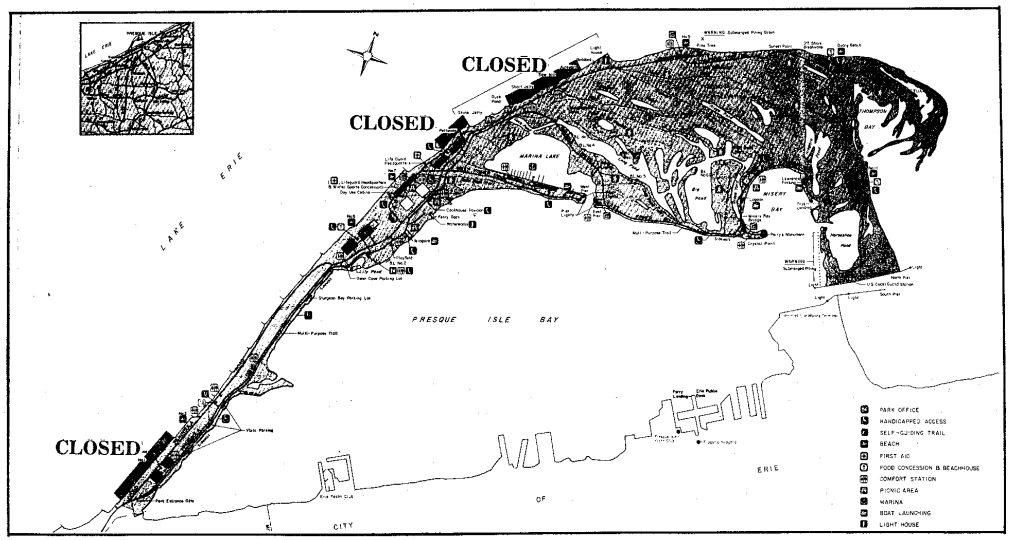
But Suroviec said this scenario is still only a theory.

"We've had nothing yet to implicate the sand as anything other than a possible contributor to the problem, because of nutrients it contains that may allow proliferation of the bacteria," Suroviec said.

He noted that the criteria for closing beaches changed several years ago.

Where once it took 1,000 fecal coliform per 100 mililiters of water to close a beach, beaches are now closed either by hitting that 1,000 mark or by running coliform counts that average over 200 for a five day period.

Suroviec said it is imperative that additional state funding be found to continue the beach contamination studies.



Dark areas along the lake shore of Presque Isle State Park are those closed by the high bacteria levels found in samples taken in recent days.

Millcreek Sun 10/25/89

Health Department Employees Find Number Of Factors In Beach Closings

By Christopher J. Kovski

A report issued by two Erie County Health Department employees has targeted a number of contributing factors to high fecal coliform levels at Presque Isle State Park beaches.

According to Robert Wellington, an aquatic biologist, and Sue Zurad, an environmental protection specialist, the problem can't be reduced to one cause.

"People would like us to come out and say, 'The problem is the sand mounds, or the problem is the sand,'" Wellington said. "But we can't do that. The problem isn't the sand mounds, and it can't be explained simply by blaming it on the sand."

However, Wellington and Zurad have traced part of the problem to the sand. As stated in their report, *The Presque Isle State Park Bathing Beach Contamination Investigation*, "the most significant conclusion of the investigation was that high fecal coliform counts in bathing beach water appear to be caused by the incubation and multiplication of these bacteria in shoreline sand during hot, calm weather and their suspension in the water at the onset of higher wave activity."

According to Zurad, there are a number of sources for the fecal coliform at the peninsula. "Bathers are a source, of course, and seagulls are a source as well," she said. "Three seagulls can produce as much fecal coliform as one person. In addition, there are problems occasionally with overflow pipes used to carry sewage."

Wellington agrees. "There are times when raw sewage has appeared near the bathing beaches," he said. "This only happens when there is a massive amount of rain, but it does happen."

Part of the reason for more beach closings is a change in the guidelines for closing a beach. Prior to 1982, a beach would be closed if there were a fecal coliform count over 200 per 100 milliliters for a 30-day period.

Now, a beach will be closed if there is a single reading over 1,000 or a geometric mean over 200 for five testing days.

According to Zurad, a six-year summary of actual beach closings and the number of closings there would be with the pre-1982 regulations is as follows:

1984: There were no closings.

1985: There was one closing, but there would not have been any with the old guidelines.

1986: There were three closings, one of which would have been closed under the pre-1982 regulations.

1987: There were four closings. Only one of these would not have been closed under the old regulations.

1988: Eight closings, half of which would have closed under the old guidelines.

1989: 15 closings, three of which would have been closed under the pre-1982 standards.

Zurad points out that there is a lot more testing being done now than ever before, which means that more bad samples will be found. As a percentage, though, the numbers have decreased slightly over the past year.

This is the result of an increase in testing from 167 samples collected in 1984 to 544 samples taken in 1989.

The source of the fecal coliform is fairly certain, being birds, people and sewage overflows. In addition, the sediment in the water has higher levels of fecal coliform from settling. If the sediment is stirred up, the level will triple, Zurad said.

But how does this relate to the levels in the sand? If the fecal coliform on the sand is allowed to sit, as it does on hot, calm days, it will multiply. Then when the wind picks up and the wave action increases, washing the coliform back into the water, where the level will register higher for a day or so.

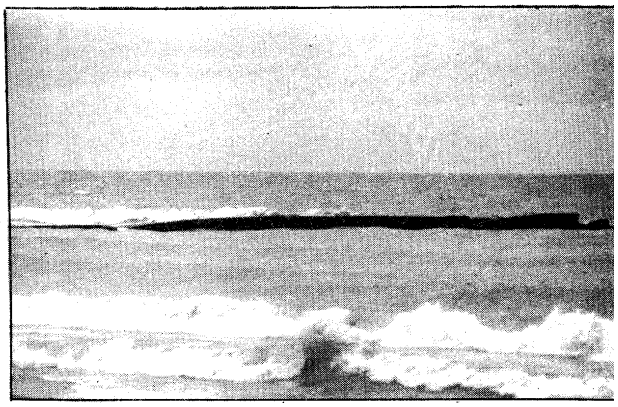
There are a number of variables involved. These include rainfall, which may flush all of the bacteria out at once; the wind direction, intensity and duration, which affect what beaches get the most waves and how far up on the beaches the waves get; the time between rains or heavy winds, which can give the bacteria more growth time; the number of people using the beaches; and the sampling itself, as different people will use different methods, one possibly stirring up the bottom more than the other.

Breakwalls are another item that will contribute to the problem, Zurad said. "I think we'll be sorry about the breakwalls," she said. "This is my personal opinion. The Health Department has no official stand on the breakwalls."

Problems Zurad sees coming up are bacteria and algae growth. "The Corps of Engineers has stated in its own reports that the water temperature behind the breakwalls will increase," she said. "This will be a better growth environment for bacteria and algae."

In addition to this effect of the breakwalls, Zurad questions the safety factors and beach damage. "The most intelligent way to construct the breakwalls would be to start at the downdrift end," she said. "But the way it is being done leaves two areas hit with downdrift erosion. If they complete the breakwall by the Nature Center, there will be three areas."

Wellington also questions the safety of the breakwalls. "People may try things like swimming out to the rocks," he said. "I'd hope they wouldn't try it, but some people probably will."



Although the water velocity may stay the same, breakwalls slow down the water flow and raise the temperature behind the breakwall, according to a study by the Army Corps of Engineers.

Earlier in the summer, there was a pond that formed on Budny Beach. This pond was posted with signs declaring it contaminated, although it wasn't. "This didn't help, because it made people think the water was worse than it is," Zurad said. To help lower the number of beach closings, Zurad and Wellington have a number of suggestions:

Get rid of upland sand. The Corps of Engineers has already stated it will have to use more sand than it previously thought for beach replenishment.

If the use of the sand will be continued, dump it all before the bathing season. "The earlier it is done, the better," Wellington said. "This will give the silt in the upland sand a chance to wash out." Also, there are aesthetic and safety factors. "I think one problem with the tourists is the dump trucks," Zurad said. "These trucks are spitting out exhaust, making noise, and speeding along the roads."

A change in the guidelines may also help. "These guidelines are not applicable to Lake Erie," Wellington said. "Lake Erie is like a small ocean. These guidelines are for enclosed, smaller bodies of water."

Changes in the testing would help as well. If there were three tests done at different times each testing day at a beach, with the closing coming only if two or more samples are bad, there would be a more accurate reading of the water quality. "Many times, by the time a beach is closed, the contaminated water is miles away," Wellington said. "If more than one sample would be bad, it would probably mean that the water was more stagnant, which would justify closing the beach."

Finally, Wellington said, don't feed the seagulls. "They are too tame, and they are hanging around the beaches," he said. "Even the Audubon Society agrees with us on this."

Harry Leslie

Beach Management by DCNR

Abstract: Presque Isle State Park is a 3200 acre sand spit peninsula located on the southern shore of Lake Erie along the Pennsylvania coast immediately west of the city of Erie. Presque Isle's Waterfront Operation consists of 13 permitted beaches representing 2.86 linear miles of guarded swimming beaches operated from Memorial Day weekend through Labor Day each year. The "Peninsula" is Pennsylvania's only seashore type recreational facility that provides surf type swimming and water sport activities.

Beach operations consist of 65 trained life guarding staff to monitor the beaches for public safety, and 6 to 10 summer college interns, which perform various water quality monitoring, and beach cleaning duties.

Each year after winter ice-out, Presque Isle beaches are cleaned of washed-in debris and litter by hundreds of volunteers, prison crews, and park maintenance employees with heavy equipment. Annual sand nourishment contracts funded 50/50 by the Commonwealth of Pa. and the U.S. Army Corps of Engineers distribute on average 38,000 cubic yards of new sand, and 20,000 cubic yards of re-distributed sand from tombolo build-up behind several breakwater structures. Presque Isle's beaches are protected by the largest off-shore segmented breakwater project in the world, completed from 1989 to 1992, for a cost of $24 million dollars, consisting of 55 segmented break- waters stretching 5 linear miles along Presque Isle's shoreline.

Beach Grooming operations take place daily by park maintenance crews throughout the summer swimming season, utilizing a Barber beach groomer, a Cherrington beach groomer, and a York rake towed behind a 4-wheel drive tractor. Park interns, as well as lifeguard staff also perform daily cleaning operations along the shoreline to remove any washed-in dead fish or dead birds. Additional park laborers remove garbage and litter at beaches and parking lots several times a day as needed.

Water Quality monitoring for e-coli bacteria takes place on a regulatory basis twice weekly at all beaches on Sundays and Mondays throughout the season. Three 100 ml samples are taken at each beach. Samples are then taken to a lab operated by the Erie County Dept. of Health and plated for 24-hour cultures. Final counts for each beach are determined by the arithmetic mean of the three samples taken at each beach.

Prior to the 2007 swimming season, regulatory beach closures occurred when; e-coli density of any beach exceeds 235/100ml, when the 30 day running geometric mean e-coli count exceeds 126/100ml, by visual inspection by a park official of a beach after rain events and plumes of discolored water are observed along the shoreline, and onset of high wave activity following hot calm periods of weather. Non-regulatory closures occurred for lightning events, high wave activity, and/or other safety related conditions.

The public is notified of beach closures by several layers of signage posted throughout the park,

through news media announcements to radio, TV, and newspaper outlets, through direct public contact by lifeguard staff that are posted on closed beaches, and through Internet postings at the DCNR/Pa. State Parks website, and the Earth 911.org website.

Beaches are re-opened following a regulatory closure of high e-coli counts; when the first resample (of five required re-samples) after a closure that does not exceed 235/100ml, or for geometric mean closures, the first re-sample that lowers the mean below 126/100ml. Public notification of re-opening beaches is through the same procedures as described earlier for closure of a beach.

During the 2007 swimming season, the Pa. Dept of Health has permitted the Erie County Dept. of Health to implement a pilot program for the water quality monitoring protocol for Presque Isle beaches. This protocol is similar to the state of Wisconsin's program of a two-tiered swimming advisory. Beaches will be posted as "Swimming Advisory" when e-coli counts exceed 235/100ml through 999/100ml. Swimming is still permitted at a beach posted with a "Swimming Advisory" and precautions are listed on special signage designed for the pilot program that states:

- Avoid swallowing lake water; parents monitor your children
- Wash your hands before handling food
- Avoid swimming if you have a compromised immune system, an open cut or wound, if you are pregnant, or if you are experiencing illness
- Minimize water contact if lake levels are high, heavy rains have just ended, or strong winds are blowing from the west.

E-coli counts that are at or exceed 1000/100ml, the beach will be posted as "Restricted Swimming" and no one will be permitted to swim at that beach until the first re-sample that is recorded below 1000 count. Beaches are still posted with a lifeguard during "Restricted Swimming" events for public notification and public safety.

Also new for 2007 is an electronic sign board purchased through the EPA Better Beaches grant money, that is installed at the park entrance that gives current Swimming Advisory information to park visitors on a real time basis. Finally, research continues in 2007 with implementing a QPCR testing protocol that is in conjunction with known predictive model threshold events that would provide a real-time water testing protocol that would provide highly accurate water quality information within 3 hours of taking a water sample.

Presentation:

Overview of Presque Isle

- 3200 acre peninsula on southern shore of Lake Erie – Pennsylvania's only "seashore"
- National Natural Landmark
- "Top 10 Birding Locations in USA"
- Average annual attendance is around 4 million visitor days per year

Presque Isle Waterfront Operation

Thirteen (13) designated beach locations representing 2.86 linear miles of guarded swimming beaches along 7 miles of Presque Isle Shoreline on Lake Erie.

65 Seasonal Waterfront Staff

- Lake Erie Lifeguards
- Lake Erie Lifeguard Supervisors
- Lake Erie Lifeguard Managers

Responsible for: Guarding beaches, First Aid, First Response, ATV Beach Patrols, Jet Ski Beach Patrols, and daily lifeguard and fitness training

Interns

- 6-8 Seasonal Interns

Responsible for: beach water sampling program and daily fish and avian mortality cleanup operations along beaches.

Annual Preparation of Beaches

- Annual Spring Clean-up, over 500 volunteers
- Albion prison crews
- Heavy Equipment and Park Crews

Beach Grooming Equipment

Barber Beach Groomer

York Rake

Cherrington Beach Groomer

Annual Beach Nourishment

Annual Beach Nourishment

- 50/50 cost share with U.S. Army Corps of Engineers.
- Distribute new sand (average 38,000 cubic yards/year).
- Re-distribute tombolo sand behind breakwaters (average 20,000 cubic yards/year.

Critical Issues:

- Federal funding disappearing.
- Piping Plover Critical Habitat Designation.

Protocol for Beach Sampling

- Regulatory sampling required twice weekly: between Noon and 2 PM on Sundays and Mondays.
- Three 100 ml samples taken at each beach.
- Lab runs test on each sample from each beach.
- Final count is the arithmetic mean of the three samples of that beach.

PROTOCOL FOR SAMPLING BEACHES, Presque Isle State Park, 2007

Revised, to Follow Title 28, Chapter 18 conditions

Below is the protocol for sampling the beaches at Presque Isle State Park that will be implemented for the 2007 swimming season. This protocol is in compliance with Title 29 Health and Safety, Part II Local Health, Chapter 18, Public Swimming and Bathing Places. In summary, Title 28 enacts the use of E. coli as a sampling indicator, with a maximum of 235 E. coli per 100 milliliters for single samples, and a geometric mean of 126 per 100 milliliters.

Samplers will consist of a trained student intern team who will be responsible for all sample collections and the lab delivery. The samplers will be trained by the Erie County Department of Health and Park officials prior to the swimming season.

Regulation samples will be taken between noon and 2:00 PM on Sundays and Mondays during the swimming season except during holiday weekends or when weather conditions do not reflect peak use. A regulatory sample will be taken prior to the swimming season. Three separate samples will be taken at each of the nine (9) permitted beach areas as delineated on the Presque Isle Bathing Permit, which was filed with the Department of Environmental Resources Community of Environmental Control in 1957 (three permitted beach areas are no longer used for swimming). One sample will be taken approximately fifty (50) feet in from each end of the beach, and the third will be taken in the center of the beach area. All three samples will be taken during the same visit to the beach and will not be spread throughout the day. Each sample shall be taken from water that is approximately 30 inches deep and at a midpoint between the bottom and the surface of the water. The lab will run separate tests for each of the three samples taken at each beach area. The final count for that particular beach will be the arithmetic mean for the three sample averages taken. The final count will be referred to as a sample throughout this protocol. Sporadic anomalies will not be included in the arithmetic mean to determine the final beach count but the anomaly will be reported to the park. Attempts will be made to determine the cause of that anomaly and re-samples may be taken.

The Dean and Dixon Q-test will be used to determine statistically if an anomaly has occurred. This test relates the extreme sample range to the range between the suspect result and its nearest neighbor. If properly applied, the Q-test results in a 90% confidence level for data rejection. It should be noted that the Q-test would only be judiciously applied when the laboratory suspects an anomalous sample result. It would not be employed to routinely discard any one of the three sample results. Since the statistical analysis of small (i.e. 3 samples) data sets is difficult, bacteria counts from adjacent beaches will be included in this analysis when possible. Exceptions would be Beach 1 West and Beach 11.

The sample results will be incorporated into a 30-day running geometric mean, which will be calculated for each beach. The Erie County Department of Health is responsible for calculating the geometric mean.

The 30-day running geometric mean is based on samples taken during the last 30 days and is not based on a calendar month. A minimum of five samples taken on five different days is necessary to run the geometric mean. Samples taken on the first day of the swimming season will start the 30-day running geometric mean.

Due to historical data collected and intensive studies done previously, samples collected that do not accurately reflect the water quality of the Presque Isle swimming areas or do not reflect times of peak usage of the beach will not be applied to the 30-day running geometric mean. These samples will still be used as regulatory samples to close beaches if the counts exceed a density of E. coli of 235

Beach Closures Occur

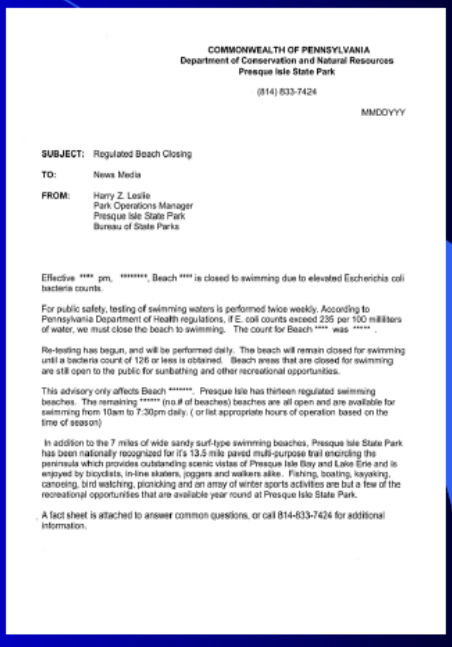
- E-coli density exceeds 235/100 ml.
- 30-day running geometric mean exceeds 126/100 ml.
- Visual inspection by park officials.
- Onset of high wave activity following hot calm periods of weather.
- Non-regulatory closings for lightning, high waves, or safety related conditions.

Notification of Closures

Signage

Media Notifications

- Park Staff sends out press releases regarding beach closures.
- Lifeguard staff updates the "Times News On Call" every morning and when there is a closing or opening.



COMMONWEALTH OF PENNSYLVANIA
Department of Conservation and Natural Resources
Presque Isle State Park

(814) 833-7424

MMDDYYY

SUBJECT: Regulated Beach Closing

TO: News Media

FROM: Harry Z. Leslie
Park Operations Manager
Presque Isle State Park
Bureau of State Parks

Effective **** pm, ********, Beach **** is closed to swimming due to elevated Escherichia coli bacteria counts.

For public safety, testing of swimming waters is performed twice weekly. According to Pennsylvania Department of Health regulations, if E. coli counts exceed 235 per 100 milliliters of water, we must close the beach to swimming. The count for Beach **** was ***** .

Re-testing has begun, and will be performed daily. The beach will remain closed for swimming until a bacteria count of 126 or less is obtained. Beach areas that are closed for swimming are still open to the public for sunbathing and other recreational opportunities.

This advisory only affects Beach ********. Presque Isle has thirteen regulated swimming beaches. The remaining ****** (no.# of beaches) beaches are all open and are available for swimming from 10am to 7:30pm daily. (or list appropriate hours of operation based on the time of season)

In addition to the 7 miles of wide sandy surf-type swimming beaches, Presque Isle State Park has been nationally recognized for it's 13.5 mile paved multi-purpose trail encircling the peninsula which provides outstanding scenic vistas of Presque Isle Bay and Lake Erie and is enjoyed by bicyclists, in-line skaters, joggers and walkers alike. Fishing, boating, kayaking, canoeing, bird watching, picnicking and an array of winter sports activities are but a few of the recreational opportunities that are available year round at Presque Isle State Park.

A fact sheet is attached to answer common questions, or call 814-833-7424 for additional information.

Lifeguards Posted on Duty

Websites

www.Earth911.org

Site is updated every week with beach closure and opening information.

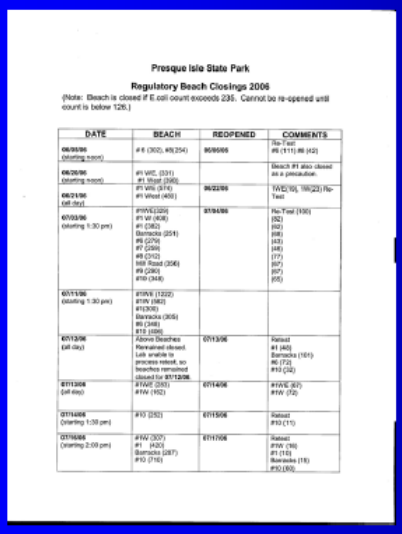
www.visitPAparks.com

Park staff posts information on beach closures in the "park advisory" section.

Re-opening Beaches

- Re-sampling for three consecutive days
- First sample after closure that does not exceed 235 e-coli per 100 ml.
- Geometric mean closures – beach reopens after first re-sample that bring mean below 126 per 100 ml.
- Notifications of beach re-opening same as beach closure.

2006 Beach Closing Statistics

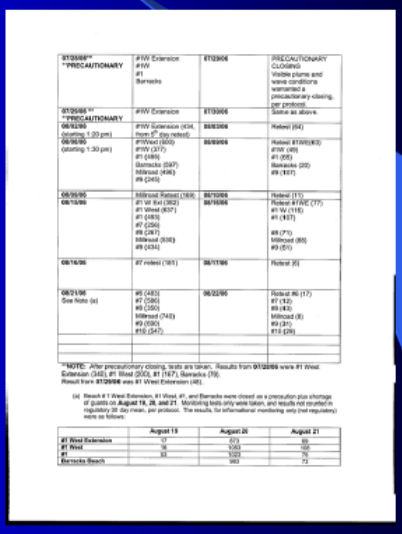


Presque Isle State Park

Regulatory Beach Closings 2006

(Note: Beach is closed if E.coli count exceeds 235. Cannot be re-opened until count is below 126.)

DATE	BEACH	REOPENED	COMMENTS
06/05/06 (starting noon)	# 6 (302), 4/5(254)	06/06/06	Re-Test #6 (111) #5 (42)
06/20/06 (starting noon)	#1 WC, (331) #1 West (346)		Beach #1 also closed as a precaution.
06/21/06 (all day)	#1 WN (674) #1 West (466)	06/22/06	TWO (10), 19(.22) Re-Test
07/03/06 (starting 1:30 pm)	#1W/E (1202) #1 WI (408) #1 (382) Barracks (251) #6 (279) #7 (299) #8 (312) Mill Road (304) #9 (290) #10 (348)	07/04/06	Re-Test (100) (52) (42) (58) (43) (48) (17) (67) (67) (65)
07/11/06 (starting 1:30 pm)	#1W/E (1222) #1W (562) #1(308) Barracks (305) #6 (348) #10 (498)		
07/12/06 (all day)	Above Beaches Remained closed. Lab unable to process retest, so beaches remained closed for 07/13/06	07/13/06	Retest #1 (40) Barracks (101) #6 (72) #10 (32)
07/13/06 (all day)	#1W/E (355) #1W (152)	07/14/06	#1W/E (67) #1W (72)
07/14/06 (starting 1:30 pm)	#10 (252)	07/15/06	Retest #10 (11)
07/16/06 (starting 2:00 pm)	#1W (307) #1 (420) Barracks (287) #10 (716)	07/17/06	Retest #1W (39) #1 (10) Barracks (19) #10 (80)



07/25/06* **PRECAUTIONARY	#1W Extension #1W #1 Barracks	07/26/06	PRECAUTIONARY CLOSING Visible plume and wave conditions warranted a precautionary closing, per protocol.
07/25/06 ** **PRECAUTIONARY	#1W Extension	07/26/06	Same as above.
08/12/06 (starting 1:30 pm)	#1W Extension (434, from 5th day retest)	08/13/06	Retest (64)
08/20/06 (starting 1:30 pm)	#1W/West (600) #1W (377) #1 (486) Barracks (567) Millroad (496) #9 (245)	08/20/06	Retest #1W/E(63) #1W (48) #1 (68) Barracks (20) #9 (107)
08/20/06	Millroad Retest (169)	08/15/06	Retest (11)
08/15/06	#1 W Ext (382) #1 West (637) #1 (483) #7 (296) #8 (367) Millroad (636) #9 (434)	08/16/06	Retest #1W/E (77) #1 W (116) #1 (107) #9 (71) Millroad (80) #9 (51)
08/16/06	#7 retest (181)	08/17/06	Retest (6)
08/21/06 See Note (a)	#5 (483) #7 (586) #9 (350) Millroad (748) #9 (636) #10 (547)	08/22/06	Retest #6 (17) #7 (12) #9 (43) Millroad (8) #9 (31) #10 (28)

**NOTE: After precautionary closing, tests are taken. Results from 07/25/06 were #1 West Extension (346), #1 West (500), #1 (167), Barracks (70). Result from 07/26/06 was #1 West Extension (48).

(a) Beach # 1 West Extension, #1 West, #1, and Barracks were closed as a precaution plus shortage of guards on August 19, 20, and 21. Monitoring tests only were taken, and results not counted in regulatory 30 day mean, per protocol. The results, for informational monitoring only (not regulatory) were as follows:

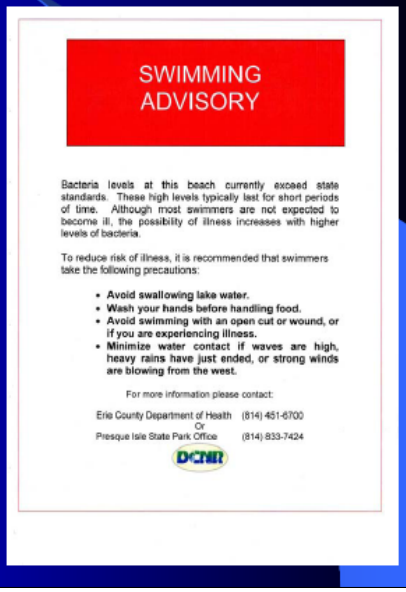
	August 19	August 20	August 21
#1 West Extension	17	573	89
#1 West	16	1353	185
#1	83	1023	76
Barracks Beach		983	73

2006 Statistics

- One of our worst seasons on record for closures.
- Many heavy rain events with significant storm water runoff.
- One of the worst years for clodophora blooms, with MANY MORE beaches affected for LONGER.

Beach Protocol Requested Changes for 2007

- Posting of beaches as "Advisory" as opposed to closed.
- Use of QPCR as a preemptive tool until actual cultured samples are complete.
- Re-sampling after a closure event for 3 consecutive days vs. 5 days.
- First re-sample below 235 e-coli used for open swimming vs. 126.



SWIMMING ADVISORY

Bacteria levels at this beach currently exceed state standards. These high levels typically last for short periods of time. Although most swimmers are not expected to become ill, the possibility of illness increases with higher levels of bacteria.

To reduce risk of illness, it is recommended that swimmers take the following precautions:

- **Avoid swallowing lake water.**
- **Wash your hands before handling food.**
- **Avoid swimming with an open cut or wound, or if you are experiencing illness.**
- **Minimize water contact if waves are high, heavy rains have just ended, or strong winds are blowing from the west.**

For more information please contact:

Erie County Department of Health (814) 451-6700
Or
Presque Isle State Park Office (814) 833-7424

DCNR

Questions?

Department of Conservation and Natural Resources

Scott White

Beach Monitoring Program and Development of State Standards

Abstract: Scott White from the Erie County Department of Health presented the State Standards for bathing beach contamination.

§ 18.28 Bathing Beach Contamination

(a) Use of a bathing beach found to be contaminated shall be discontinued until written approval to reopen the bathing beach for swimming or bathing is obtained from the Department. The permittee shall prominently post legible signs measuring at least 8" by 11" at all entrances to the bathing beach area informing the public that the bathing beach is closed and that swimming or bathing is prohibited. The approval will be given by the Department when the Department finds that the waters of the bathing beach are no longer contaminated.

(b) The water in bathing beaches will be considered contaminated for bathing purposes when one of the following conditions exists:

(1) The Department determines that substance is being discharged or may be discharged into the water and is or may be hazardous to the health of persons using the bathing beach.

(2) The E.coli density of a water sample taken from the bathing beach exceeds 235 per 100 milliliters.

(3) The E.coli density in all water samples taken from the bathing beach, in any 30-day period during the bathing beach's operating season, exceeds a geometric mean of 126 per 100 milliliters.

Authority

The Provisions of this § 18.28 amended under the Public Bathing Law (35 P.S. § § 672-680d); the Local Health Administration Law (16 P.S. § § 12001-12028); and section 1920-A of The Administrative Code of 1929) (71 P.S. § 510-20).

Source

The provisions of this § 18.28 adopted September 18, 1971, effective September 18, 1971, 1 Pa.B. 1921; amended June 19, 1981, effective June 20, 1981, 11 pa.B. 2133; amended July 16, 2004, effective July 17, 2004, 34 Pa.B. 3695. Immediately preceding text appears at serial pages (216884) to (216885).

Cross References

This section cited in 28 Pa. Code § 18.23 (relating to recirculation and filtration); and 28 Pa. Code § 18.30 (relating to water samples).

Ron Lybrook

Tributary Studies (Creek Sweep)

Abstract: During the 2006 swimming season at Presque Isle State Park, various beaches were closed on 17 days because levels of *E. coli* bacteria exceeded the standard of 235 colony forming units per 100 milliliters of sample (*CFU/100ml)*. The beaches at Presque Isle State Park are a valuable recreational, economic, and cultural resource for the citizens of the commonwealth. Elevated bacteria levels in beach waters create potential human health risks and beach closing result in economic impacts to the park and the Erie community.

Typical beach monitoring programs include routine testing for fecal indicator bacteria (FIB), a gastrointestinal bacteria group that includes, among other groups, *Escherichia coli* (*E. coli*), *Bacteroides fragilis* (*Bacteroides*) and *Enterococci sp*. The presence of FIB in surface waters is used as an indicator of other pathogenic bacteria and triggers beach closings. To study the causes of the beach closings, a task force was formed with representatives from DEP, DCNR, PAF&BC, the Erie County Department of Health, the Regional Science Consortium at the Tom Ridge Environmental Center at Presque Isle, Pennsylvania Sea Grant, Erie County Conservation District and the Erie Area Convention and Visitors Bureau. One focus of the task force was to assess potential FIB sources influencing water quality within the western portion of Lake Erie watershed and how it impacts the beaches at Presque Isle State Park.

The assessment involved a three-phased approach to identify potential FIB sources that may be impacting Presque Isle beaches. The first phase was *Creek Sweep*, a one-day event where 68 samples were collected from streams, stormwater control facilities and beaches; an evaluation of regulated sewage discharges; and a basic stream corridor assessment to identify illicit discharges. Phase II of the assessment compared *Creek Sweep* results to historic water quality data from three reference Water Quality Network stations. Certain sites on Elk Creek and Walnut Creek were sampled again for FIB as part of Phase III of the assessment. The samples were used for DNA Polymerase Chain Reaction testing (PCR testing) to determine whether the FIB were from animal or human sources.

The results of the assessment show that FIB are prevalent throughout most surface waters in varying degrees. FIB levels within the western area of the Lake Erie watershed, as compared to reference watersheds; however, are much higher suggesting a contributing pollutant source. Samples collected from tributary streams, stormwater discharges and point source discharges are all contributing sources, but the predominant loading is from non-point source pollution associated with stormwater runoff. Further, PCR DNA testing shows that FIB is from both animal and human sources. The presence of human specific *Bacteroides* DNA confirms human waste as a contributing source to the bacteria loading within the watershed.

The assessment did generally quantify the loading and identified potential sources of FIB in the Lake Erie watershed study area, but it did not determine the impact of the FIB loading on Presque Isle beaches and further study is needed. With the interest of public health and safety

put first and foremost, a strategy of "the best defense is a good offense" is recommended. That is, attempt to eliminate direct sources of FIB within the watershed and employ methods to reduce conditions that harbor *E. coli* at Presque Isle beaches. Specifically, the *E. coli* Task Force is encouraged to:

- Continue its research on FIB sources, monitoring and control programs.
- Partner with local and regional agencies to share resources, gain new knowledge and direct initiatives.
- Continue monitoring and compliance efforts at regulated sewage discharges and Municipal Separate Storm Sewer Systems, as point source discharges remain to be a contributing factor of FIB.
- Continue surveillance within the watershed to identify and eliminate other illegal discharges.
- Employ beach-grooming activities that minimize the proliferation of FIB within beach sands.
- Start collecting data on the beach conditions concurrent with *E. coli* sampling to develop indicators for a predictive model for FIB.

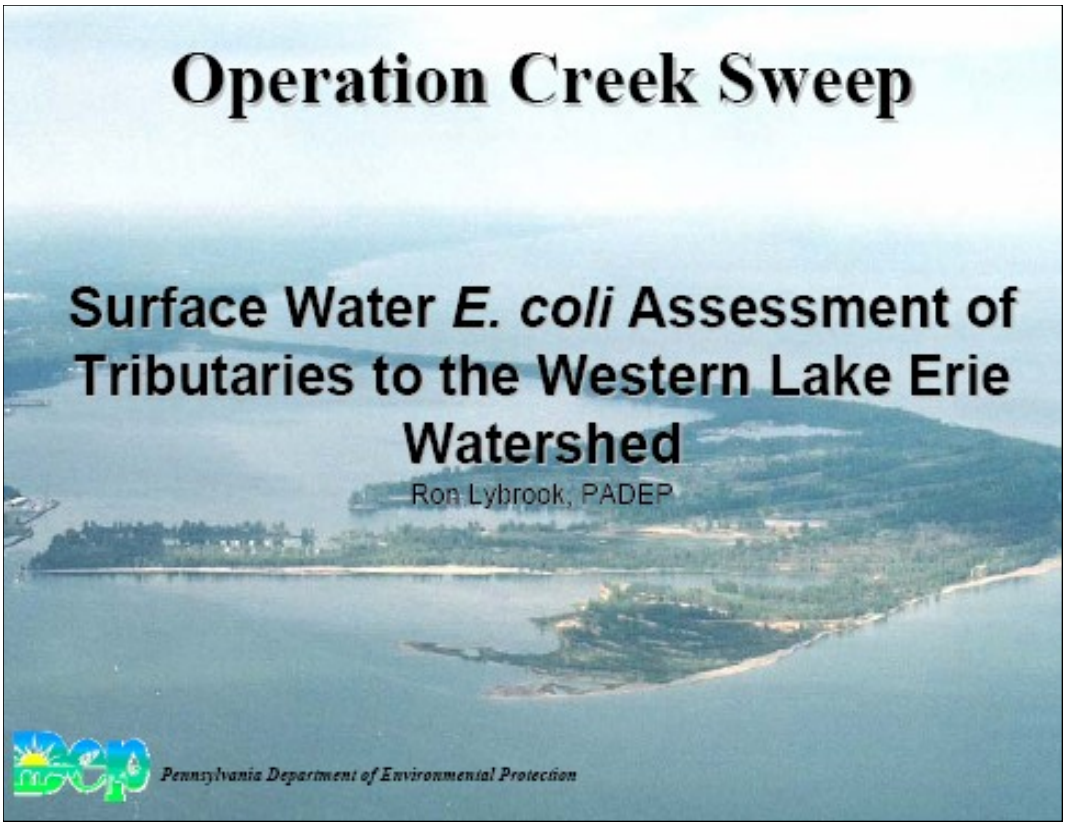
Meanwhile, further study is necessary to identify the predominant sources of FIB within the watershed. Additional FIB sampling coupled with PCR testing should be done at specific points within the watershed to identify the source areas and contributing species. It may also be possible to correlate trends of precipitation, wind, stream flow and sediment loading to make a predictive model of FIB levels.

From the results of the assessment it is known that tributary streams are one possible sources of FIB to Lake Erie, but their fate and transport is unknown. The impacts of FIB on Presque Isle beaches from streams tributary to Lake Erie should be further assessed.

A new indicator for FIB should be considered. One possibility is a rapid DNA PCR method to identify human strains of *E. coli* or *Bacteroides* as the indicator for beach closings, rather than culturing the bacteria. A second option would be to use a chemical indicator of sewage pollutions. Many studies have been conducted showing that pharmaceuticals or caffeine can be used as indicators of human sewage pollution. These options could significantly decrease the turnaround time of testing, providing accurate results and a quick determination of the actual risk to the public.

.

Presentation:



Operation Creek Sweep

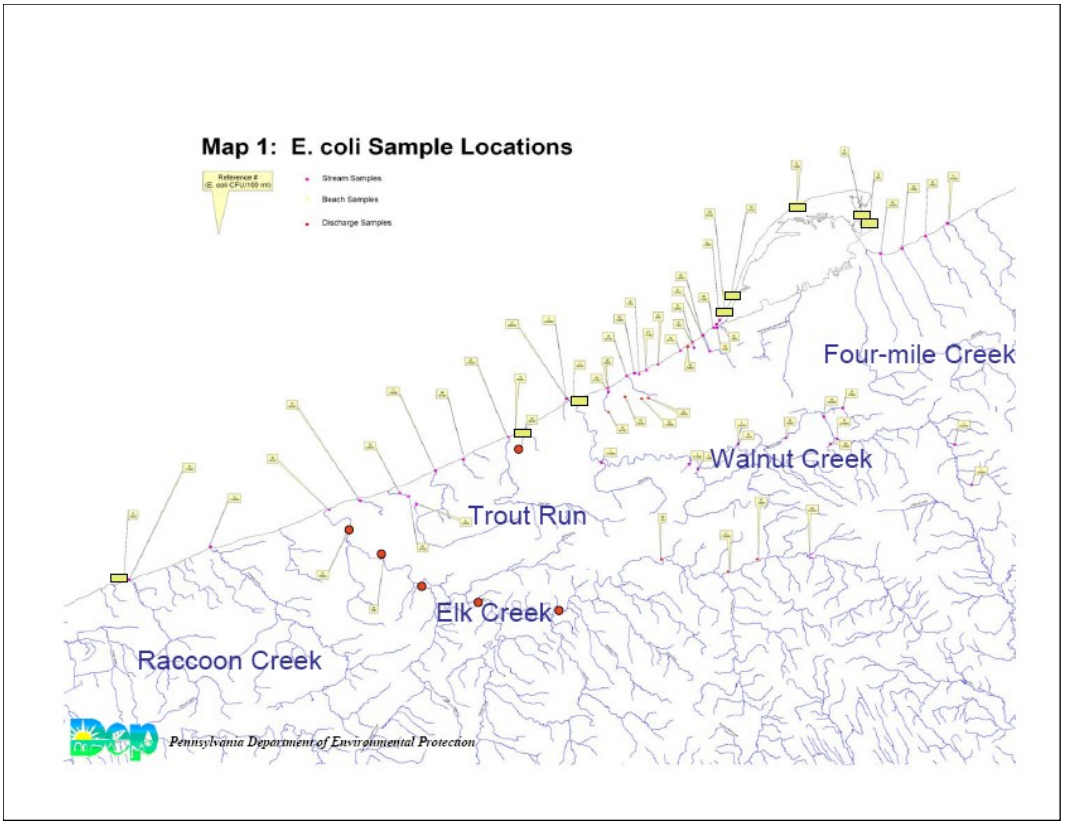
Assess FIB sources within the western portion of Lake Erie watershed

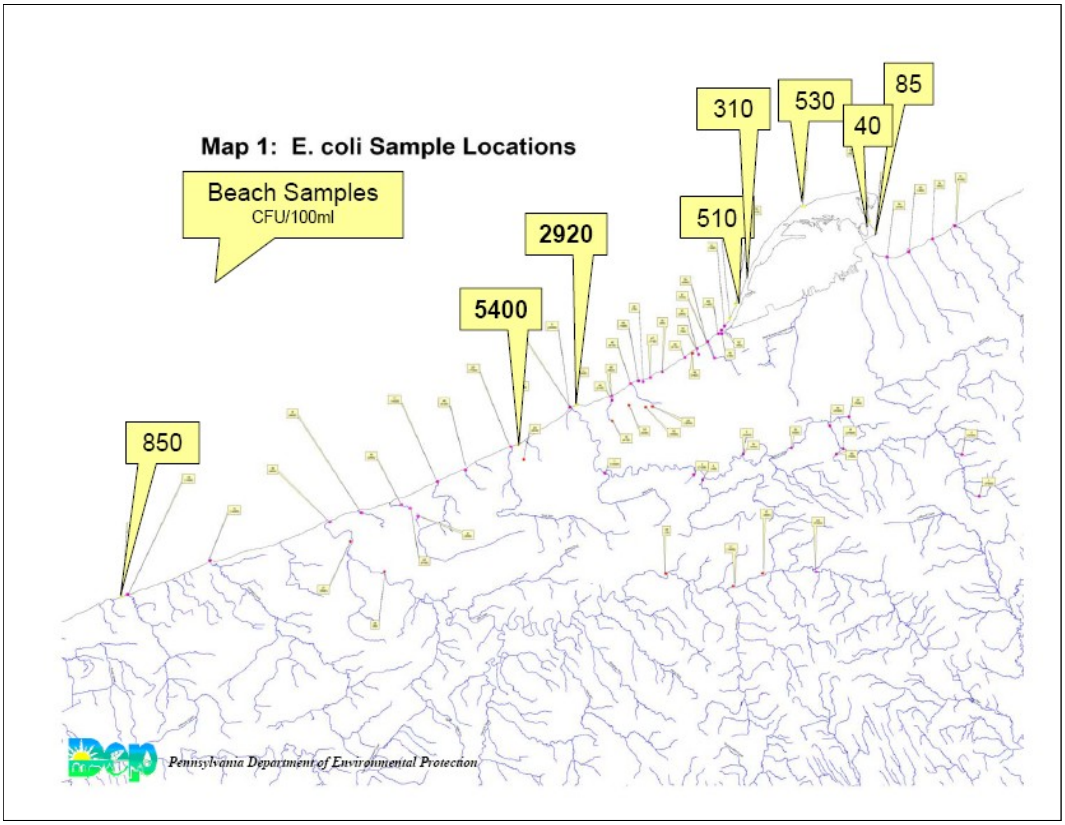
Pennsylvania Department of Environmental Protection

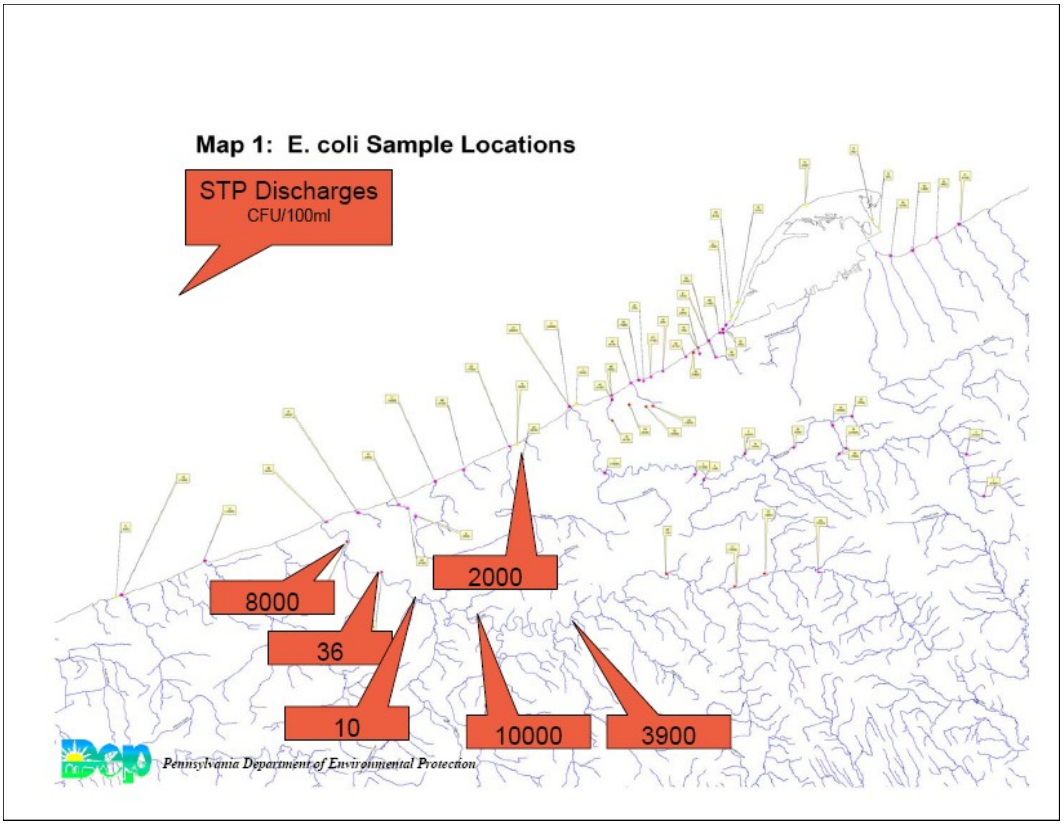
Operation Creek Sweep

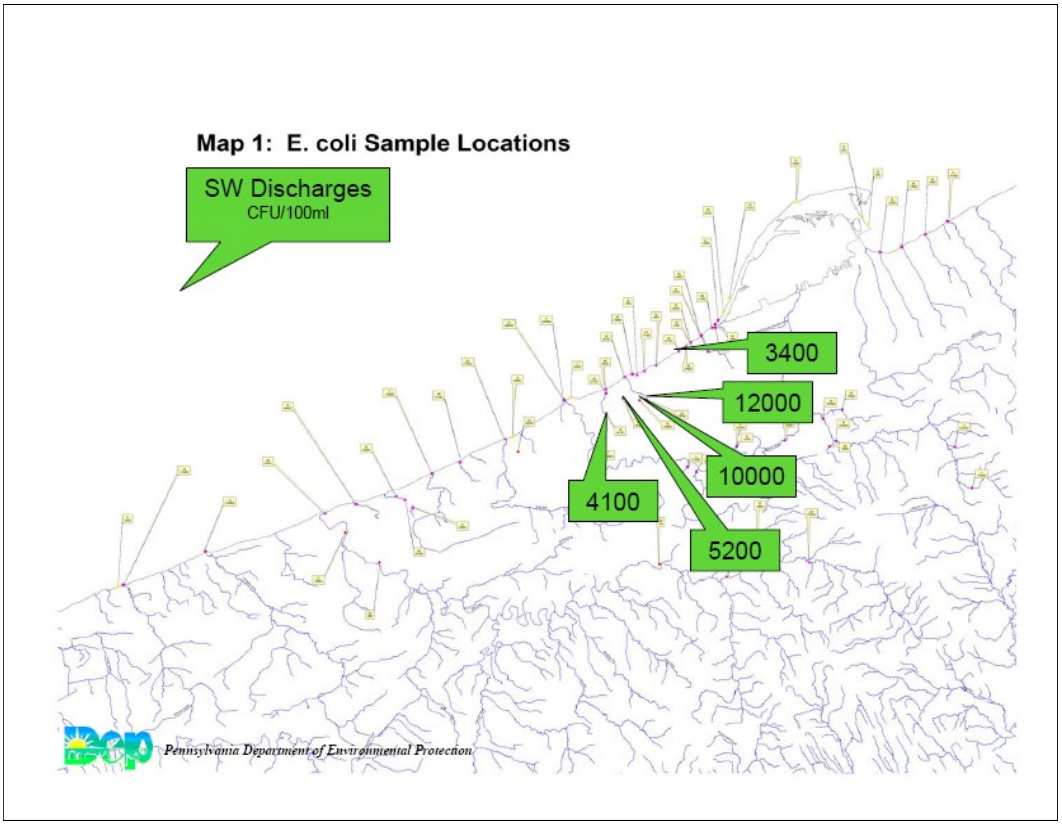
Phase I: One-day sampling event with 68 samples collected at streams, beaches, stormwater, and sewage discharges; stream corridor assessment to identify illicit discharges; compare to historical data.

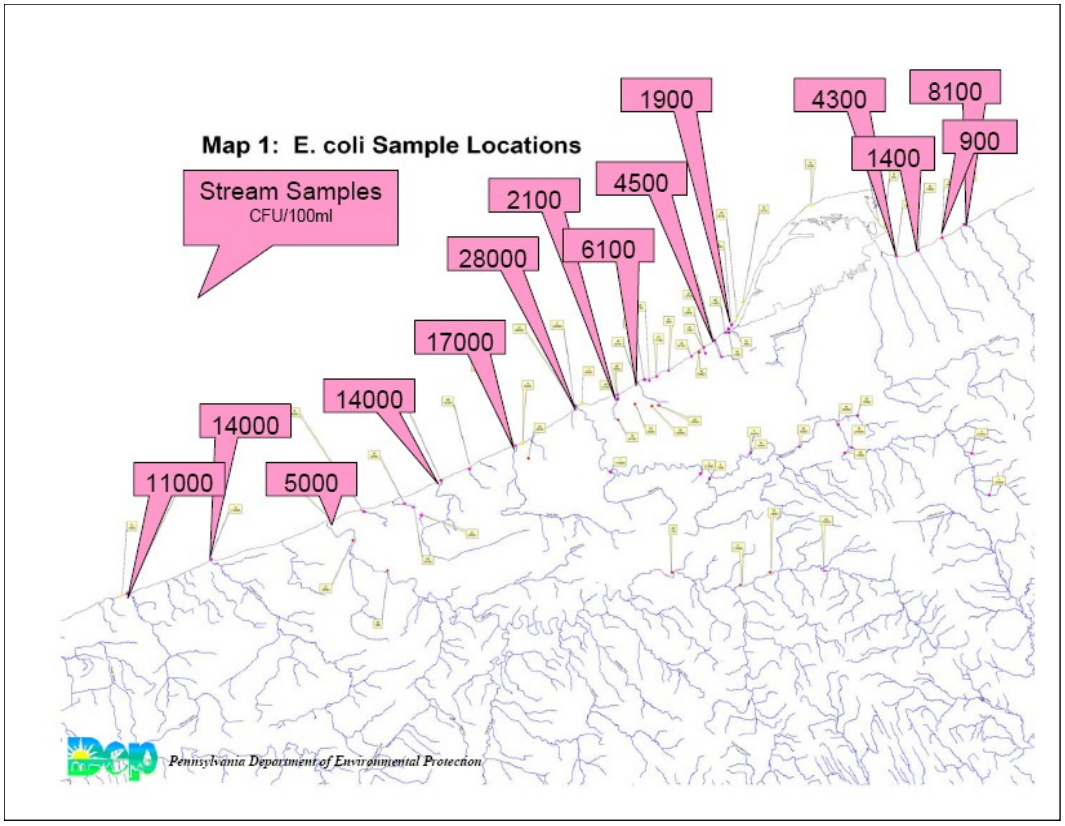
Pennsylvania Department of Environmental Protection

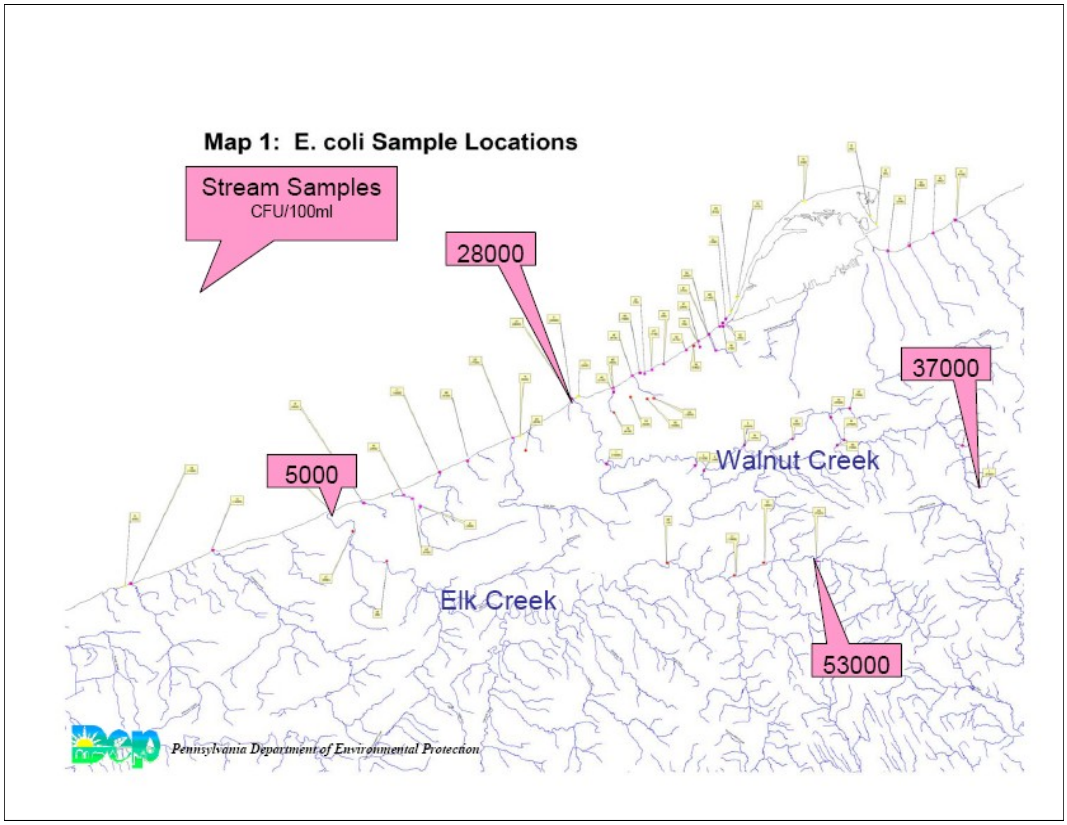

Map 1: E. coli Sample Locations
Reference # (E. coli CFU/100 ml)
Stream Samples
Beach Samples
Discharge Samples
Four-mile Creek
Walnut Creek
Trout Run
Elk Creek
Raccoon Creek
Pennsylvania Department of Environmental Protection


Map 1: E. coli Sample Locations
Beach Samples
CFU/100ml
850
5400
2920
510
310
530
40
85
Pennsylvania Department of Environmental Protection


Map 1: E. coli Sample Locations
STP Discharges
CFU/100ml
8000
36
10
2000
10000
3900
Pennsylvania Department of Environmental Protection


Map 1: E. coli Sample Locations
SW Discharges
CFU/100ml
3400
12000
10000
4100
5200
Pennsylvania Department of Environmental Protection


Map 1: E. coli Sample Locations
Stream Samples
CFU/100ml
1900
4300
8100
900
1400
4500
2100
6100
28000
17000
14000
14000
11000
5000
Pennsylvania Department of Environmental Protection


Map 1: E. coli Sample Locations
Stream Samples
CFU/100ml
28000
37000
5000
Walnut Creek
Elk Creek
53000
Pennsylvania Department of Environmental Protection

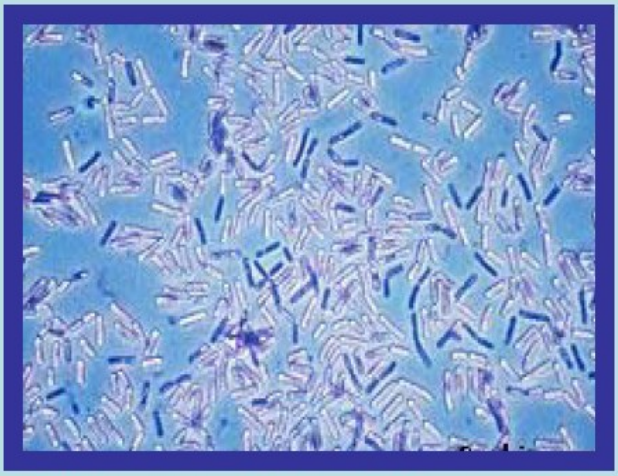
Operation Creek Sweep

Phase 1 Results:

- Historical review shows FIB are present in most surface waters
- FIB levels in the western Lake Erie watershed, as compared to reference watersheds, are much higher
- *E. coli* counts are significantly lower during dry weather stream flow as compared to wet weather stream flow
- Contributing sources are both non-point and point source
- Predominant loading seems to be from non-point source pollution associated with stormwater runoff

Pennsylvania Department of Environmental Protection

Operation Creek Sweep



Specific FIB sources: Natural? Sewage? Agricultural?
Determine human vs. non-human

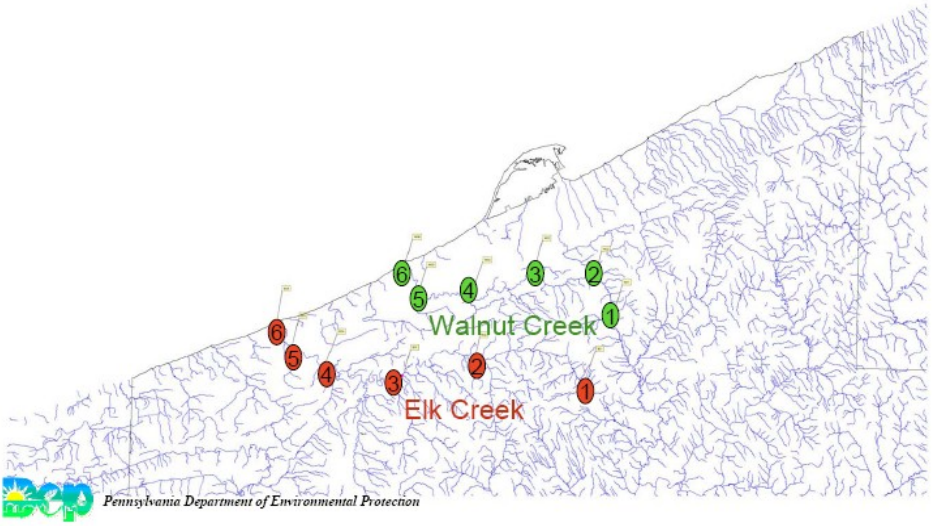
Pennsylvania Department of Environmental Protection

Operation Creek Sweep

Phase 2: Sampling at six locations on both Elk Creek and Walnut Creek for PCR-DNA analysis to identify source type, human vs. non-human

Pennsylvania Department of Environmental Protection

Map 2: PCR Sample Locations



Pennsylvania Department of Environmental Protection

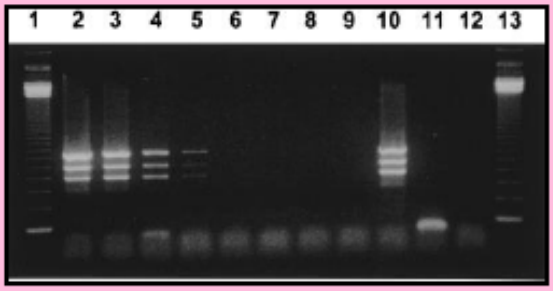
Operation Creek Sweep

Phase 2 Results:

- FIB are present from both human and non-human sources
- FIB contributions are throughout stream reach
- Results are not quantitative--no comparison to plate count

Pennsylvania Department of Environmental Protection

Operation Creek Sweep



Phase 3: Focused eight sampling events at six locations on Walnut Creek for PCR-DNA analysis to identify source type and relative abundance

Pennsylvania Department of Environmental Protection

Operation Creek Sweep

Sample locations selected by:

Sewage disposal methods

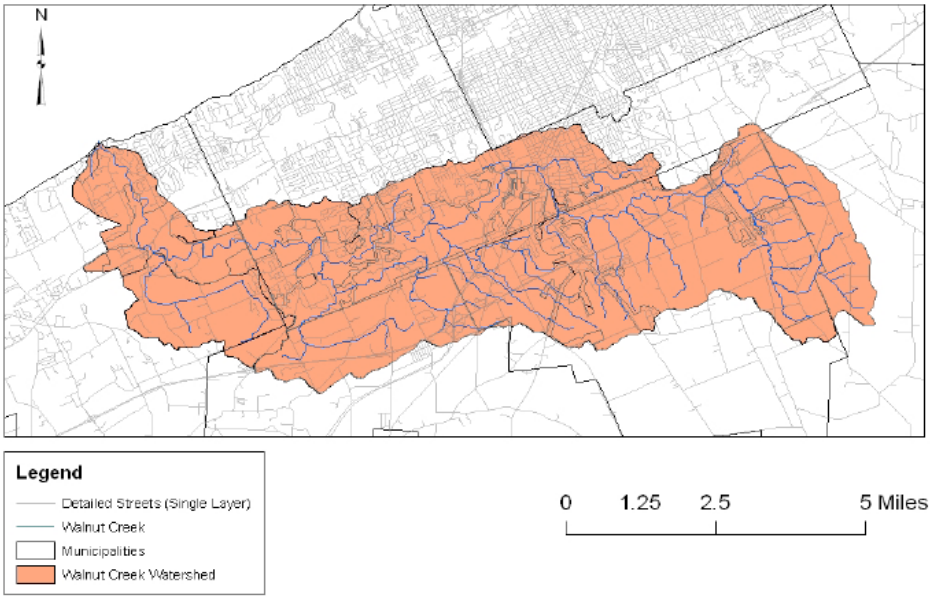
- Septic systems
- STPs
- Public sewers

Land use

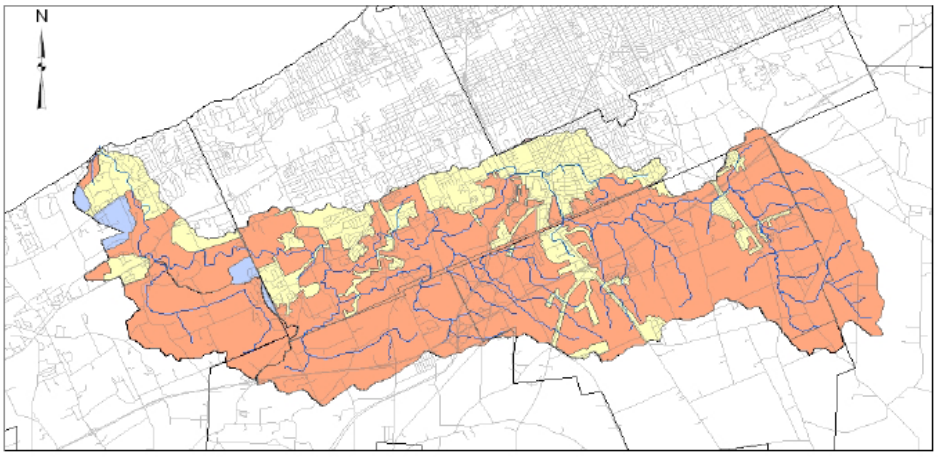
- Commercial
- Residential
- Agricultural

Pennsylvania Department of Environmental Protection

Walnut Creek Watershed



Walnut Creek Watershed Sewers

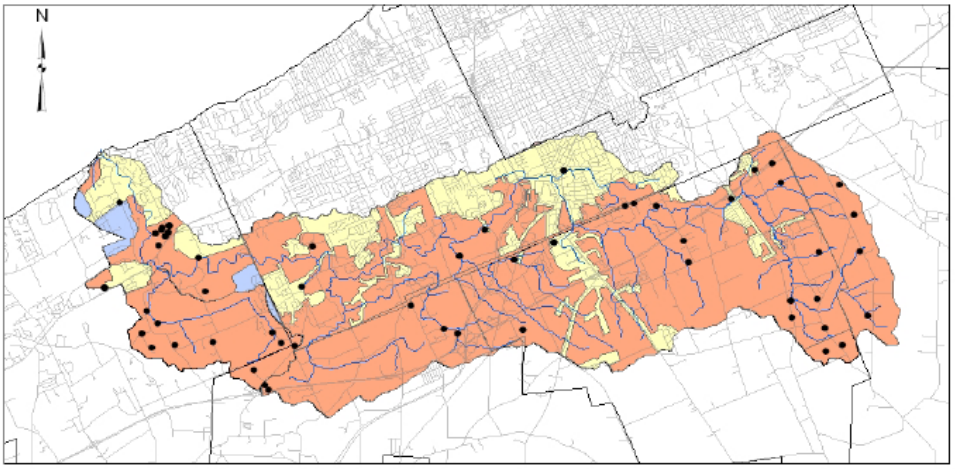


Legend

- Detailed Streets (Single Layer)
- Walnut Creek
- Municipalities
- Not Sewered
- Proposed Sewers
- Existing Sewers

0 1.25 2.5 5 Miles

Walnut Creek Sewers and Discharge Points



Legend

- Detailed Streets (Single Layer)
- Walnut Creek
- Municipalities
- Not Sewered
- Proposed Sewers
- Existing Sewers
- Discharge Points (Sewage)

0 0.5 1 2 Miles

Operation Creek Sweep

Sample locations selected by:

Sewage disposal methods

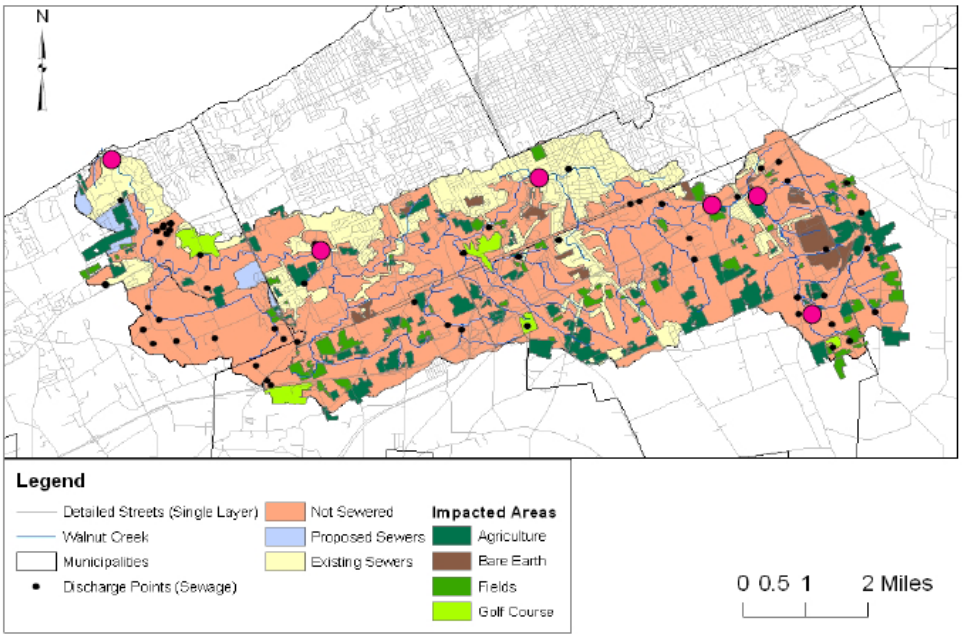
- •Septic systems
- •STPs
- •Public sewers

Land use

- •Commercial
- •Residential
- •Agricultural

Pennsylvania Department of Environmental Protection

Walnut Creek



Operation Creek Sweep

Phase 3 Results (pending):

- Pinpoint predominant source type
  (sewage vs. agricultural vs. natural)
- Address sewage problems
- Address agricultural problems
- Determine *E. coli* loading to Lake Erie
- Data for predictive modeling

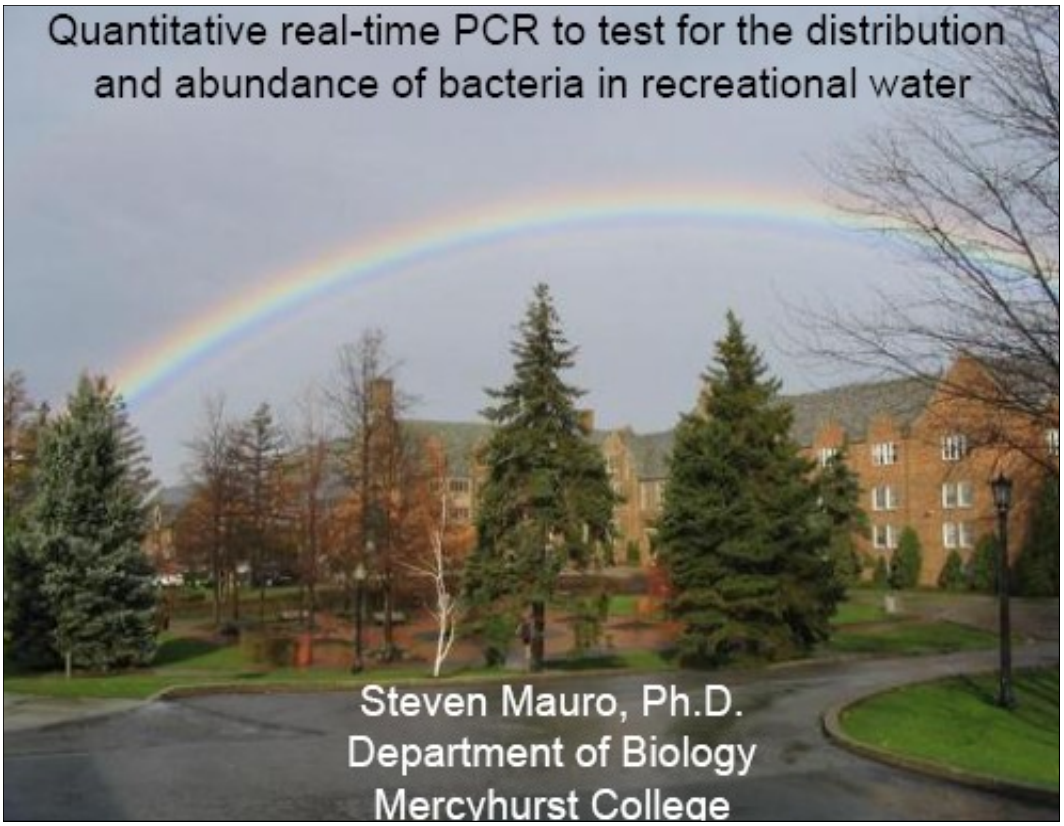
Pennsylvania Department of Environmental Protection

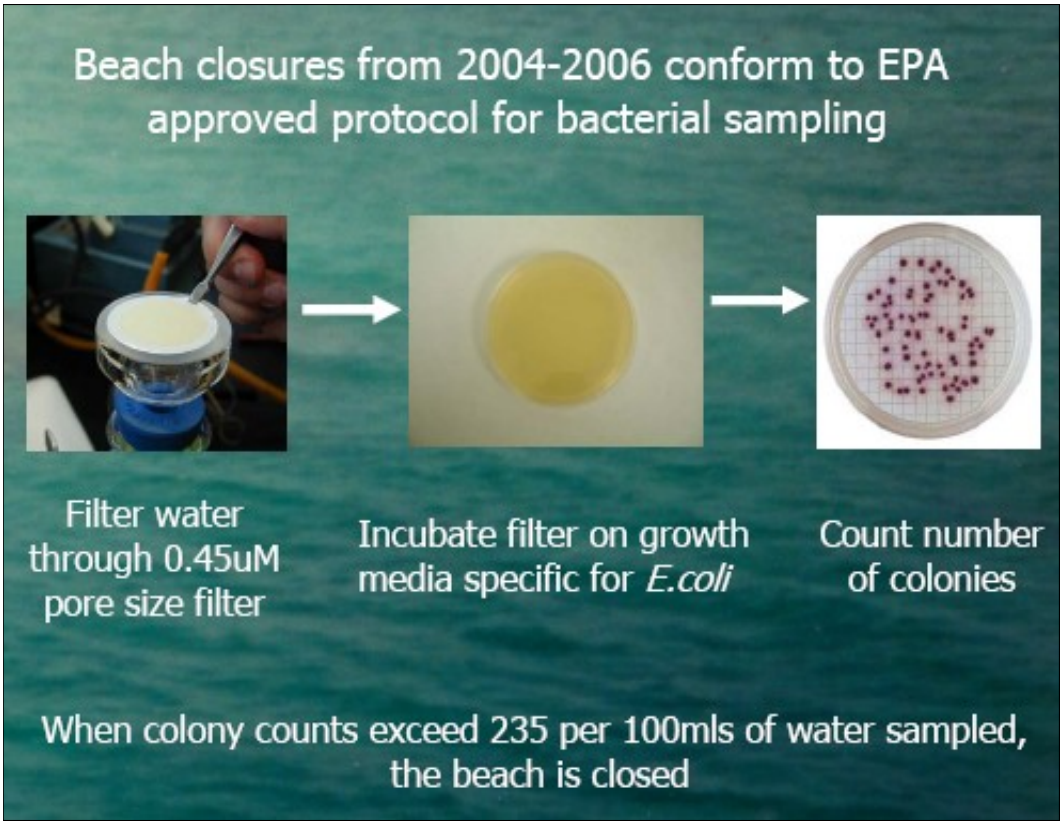
Steve Mauro

Real Time PCR

Abstract: We are participating in several research projects that are aimed at using real-time PCR to better understand and address high *E.coli* levels in the beach waters of Presque Isle State Park. In particular, we are investigating: 1.) the human contribution of bacterial contamination in the tributaries west of Presque Isle State Park, 2.) if raking sand in the surf zone of the beaches reduces bacterial load in the waters where the sand was manipulated and 3.) if a quantitative PCR based protocol can be developed to predict *E.coli* levels in a timeframe that will allow same day testing and beach closure actions. Our preliminary results demonstrate high *E.coli* levels in several western tributaries, several of which have bacteria arising from human contribution. We are currently processing data that will give us insight into where this pollution is originating. We have also found evidence for high bacterial loads in the surf zone sand at beaches 2,6, and at the lighthouse. By manipulating the sand, we have found that the amount of bacteria increases in the sand but decreases in the water, although this test will have to be repeated to validate these results. Lastly, we are finding a fairly strong correlation between the amount of *E.coli* determined from standard plating methods and the amount of *E.coli* determined from real-time PCR. This correlation needs to be expanded using samples that have *E.coli* counts that are above 235 cfu/100mls water sampled by the plating method before a final protocol can be adopted that supplements current protocols for beach closure actions.

Presentation:





There are advantages and disadvantages associated with this sampling scheme

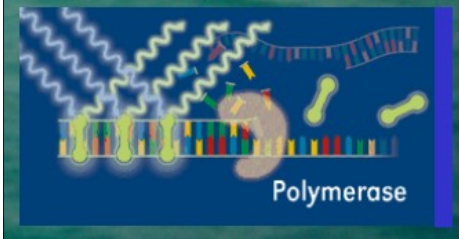
Advantages	Disadvantages
- Uniform sampling protocol	-Time between sampling and results is approx. 24 hours
- Ease of execution	-Does not directly test for pathogenic microorganisms
- Cost effective	-Does not test for other sources of microbial pollution

A molecular alternative- Analysis of DNA by Polymerase Chain Reaction (PCR)

http://www.dnalc.org/ddnalc/resources/animations.html

- This method is fast (5 hours) and specific (any pathogen on filter)
- However, the abundance of DNA is not easy to determine

A new age approach- Combining PCR with fluorescent dyes to make PCR quantitative (QPCR)



SYBR green intercalates into synthesized DNA

Fluorescence measured with QPCR machine

Protocol to concentrate and purify DNA in a water sample

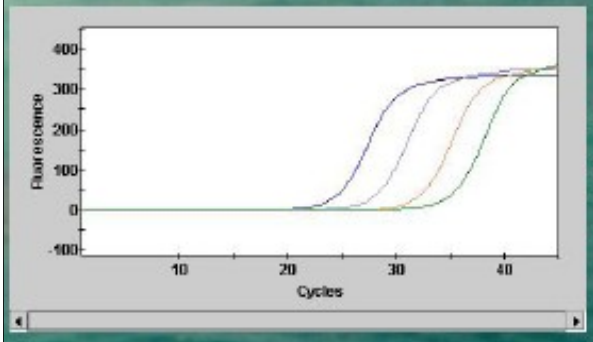
Filter water through 0.45uM pore size filter

Elute DNA from filter by a rapid boil

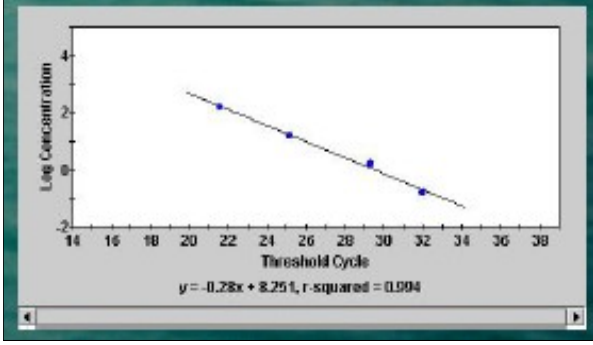
Isolate DNA with kit

This process of DNA isolation can be completed in approximately one hour

Test of DNA primers for linear amplification

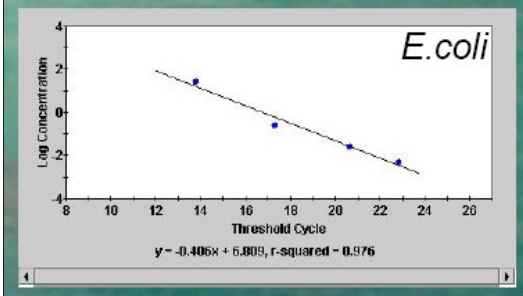


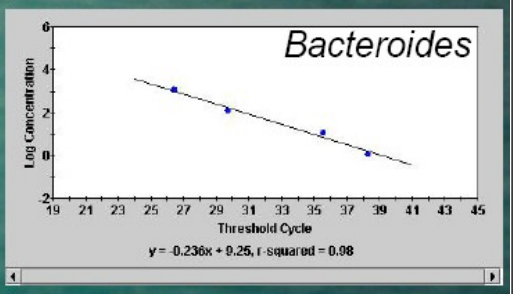
Primers that will amplify *Enterococcus* DNA on a dilution series of DNA isolated from *Enterococcus faecalis*

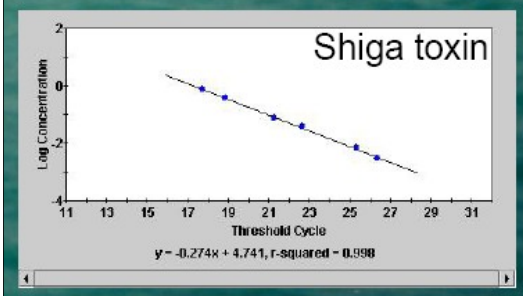


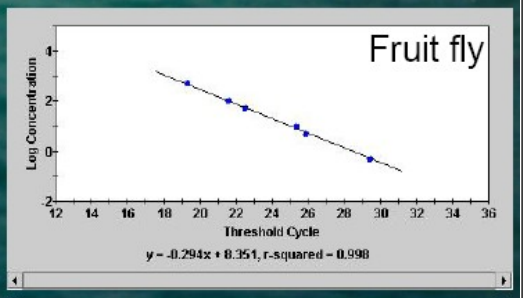
The graph shows linear amplification with this primer set

Linear amplification of dilution series is possible with primer sets designed to target other organisms

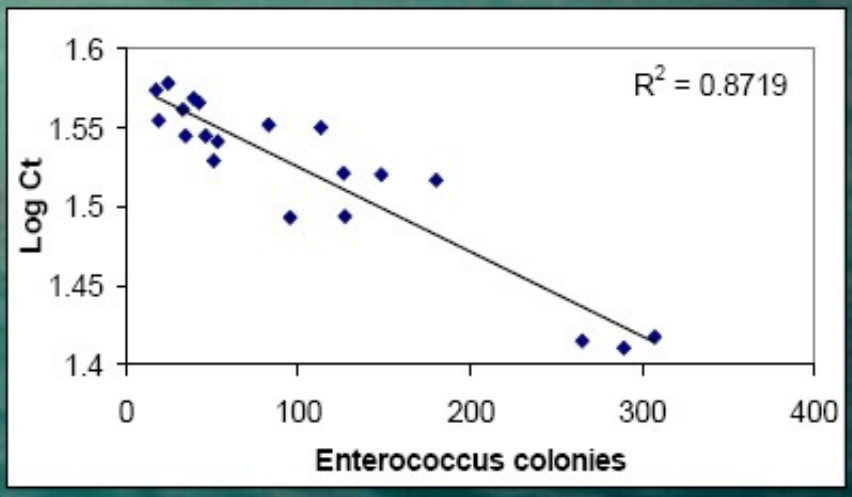








Comparison of *Enterococcus* colonies to CT values using primers specific for *Enterococcus*



Results show a strong correlation between the number of *Enterococcus* colonies and the amount of *Enterococcus* DNA in different samples

Summary of bacterial studies

-QPCR is a technique that can determine the relative abundance of targeted DNA in a water sample in a timeframe of under 3 hours

-The DNA that can be targeted include general (*E.coli* and *Enterococcus*) or specific (pathogenic *E.coli*, human vs. non-human *Bacteroides*) classes of bacteria

-Results indicate a strong correlation between DNA analysis of *Enterococcus* DNA by QPCR and the number of *Enterococcus* colonies by plating assays

Future work

Determine the spatial and temporal distribution of indicator and pathogenic bacteria in the beach waters of Presque Isle State Park

Acknowledgements

Mercyhurst College

All local/national organizations interested in addressing bacterial contamination in Presque Isle beach waters

Scott White

Presque Isle Beach Sanitary Survey and USGS Modeling Efforts

Abstract: The use of *E. coli* as an indicator of recreational water quality has been largely effective in determining when fecal contamination is present; however, there are drawbacks with using it as the *only* indicator. Concentrations of *E. coli* may change significantly between the time of sample collection and the reporting of results (anywhere from 18-24 hours). A more rapid method that some managers of recreational waters have adopted is the use of water-quality and environmental variables as surrogates for fecal-indicator bacteria that include, for example, precipitation, wind speed and direction, streamflow, and turbidity to predict, or forecast, when concentrations of fecal-indicator bacteria will exceed recreational standards. These emerging techniques may supplement the use of *E. coli* as an indicator of fecal contamination.

The U.S. Geological Survey (USGS), in cooperation with the Erie County Health Department (ECHD), studied the use of water-quality and environmental variables in beach-specific predictive models as surrogates for *E. coli* in forecasting the bacteriological health of Presque Isle Beach 2 in Erie, Pa. The study was based on *E. coli* concentrations and other water-quality and environmental data collected at Presque Isle Beach 2 during the 2004 and 2005 recreational seasons. All variables statistically related to *E. coli* concentrations were included in the initial regression analyses, and after several iterations, only those explanatory variables that made the models significantly better at predicting *E. coli* concentrations were included in the final models.

Models were developed for the 2004 data, the 2005 data, and the combined 2004-2005 dataset. Combining the 2004 and 2005 data yielded a significantly better model for predicting *E. coli* exceedance probabilities that included the explanatory variables turbidity log, rain weight, wave height (calculated), and wind direction.

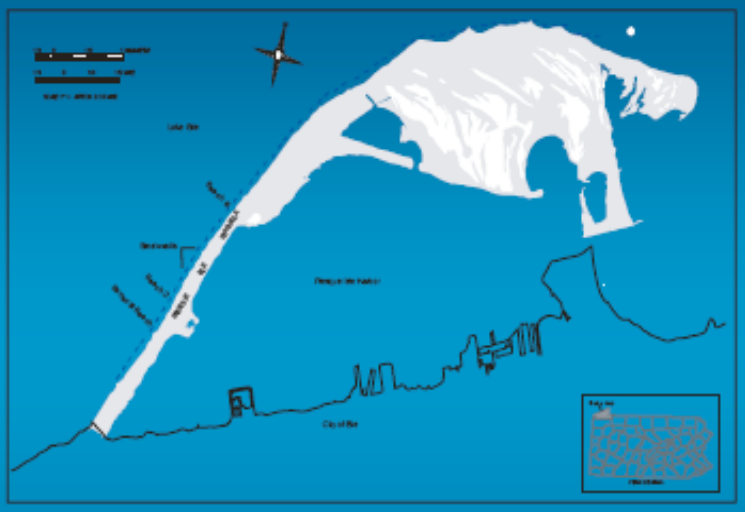
Presentation:

Predicting *Escherichia coli* at Presque Isle Beach 2 in Erie, Pennsylvania

Presque Isle Beach Sanitary Survey Workshop
Tom Ridge Environmental Center
April 16, 2007, Erie, PA

Scott White, ECHD Environmental Supervisor
Tammy M. Zimmerman, USGS Hydrologist

USGS



LOCATION OF PRESQUE ISLE BEACH 2 AND SURROUNDING BEACHES, ERIE, PENNSYLVANIA (modified from PaDCNR, 2006).

USGS

Beach advisories or closings are issued on the basis of recreational water-quality standards for *Escherichia coli* (*E. coli*) bacteria.

PROBLEM:

Concentrations of *E. coli* at permitted Presque Isle beaches

- occasionally exceed the recreational water-quality standards.
- may change significantly between the time of sample collection and the reporting of results (18 – 24 hours).

USGS

COOPERATIVE AGREEMENT

The U.S. Geological Survey, in cooperation with the Erie County Health Department, studied the use of water-quality and environmental variables in beach-specific predictive models as surrogates for *E. coli* in forecasting the bacteriological health of one Presque Isle beach near Erie, Pa.

USGS

Beach 2, east (looking west)

USGS

Presque Isle Beach 2 project

- Data was collected and compiled during the 2004 and 2005 recreational sampling seasons (Memorial Day to Labor Day)
- Statistical relations between *E. coli* and selected water-quality and environmental variables were determined
- Regression equations were developed to provide predictive models for *E. coli* concentrations (2004 model, 2005 model, and combined 2004-2005 model)
- Predicted concentrations were used to develop probabilities that the single-sample maximum bathing-water standard for *E. coli* would be exceeded.

USGS

Data collection

USGS

WATER-QUALITY DATA

- *E. coli* bacteria
- pH
- Dissolved oxygen
- Specific conductance
- Water Temperature
- Turbidity

USGS

ANCILLARY DATA

- Number of birds
- Beach debris
- Boat activity
- Estimated wave height (0-2ft, 1-3ft, 2-4ft, 3-5ft, or 4-6ft)
- Streamflow (USGS Brandy Run nr. Girard, Pa streamflow-gaging station)

USGS

ENVIRONMENTAL DATA

- Rainfall
- Wave height (calculated)
- Wind speed
- Wind direction
- Current speed
- Current direction

USGS

Statistical correlations found between $\log_{10}$ *E. coli* and the following continuous variables:

- Log_{10} turbidity
- Wave height (calculated)
- Wind speed
- Current speed

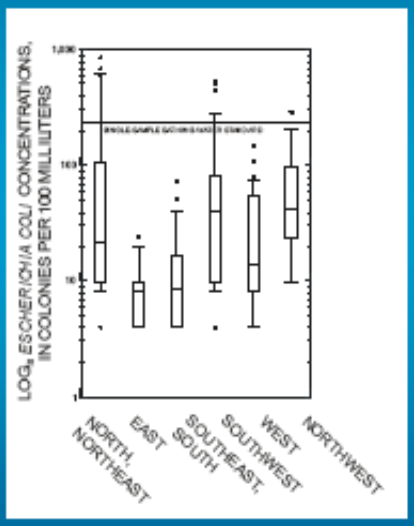
NOTE: Weak correlations were also found between $\log_{10}$ *E. coli* and streamflow variables and rain variables.

USGS

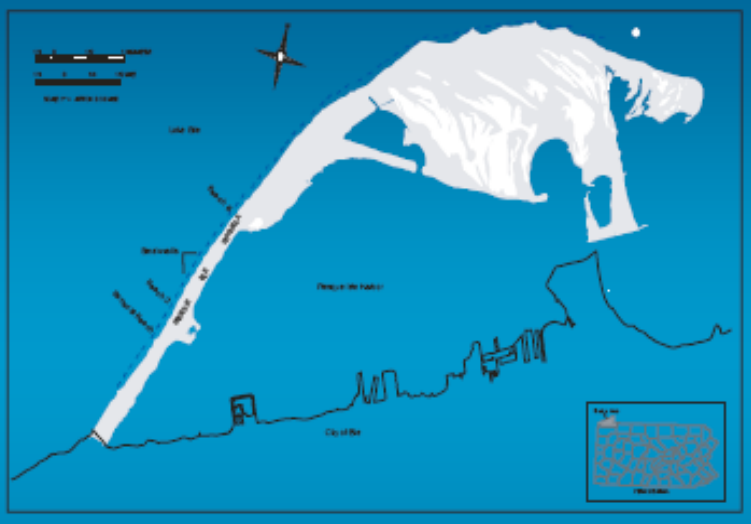
Statistical relations were also found between $\log_{10}$ *E. coli* and categorical variables

Log_{10} *E. coli* concentrations by wind direction

NOTE: Higher median *E. coli* concentrations were observed when winds were from the southwest or northwest directions.



USGS

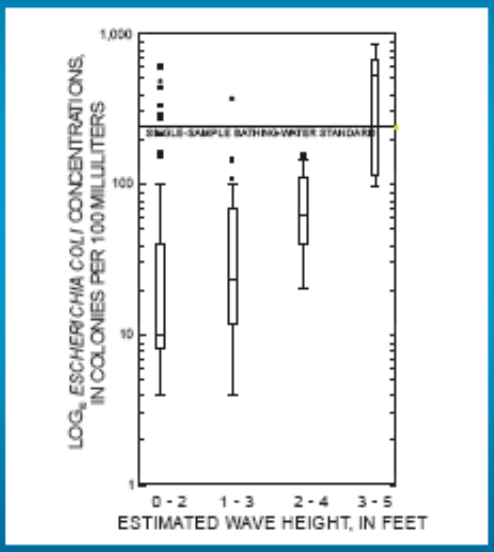


LOCATION OF PRESQUE ISLE BEACH 2 AND SURROUNDING BEACHES, ERIE, PENNSYLVANIA (modified from PaDCNR, 2006).

USGS

Log_{10} *E. coli* concentrations by estimated wave height

NOTE: In general, median *E. coli* concentrations increased as wave heights increased



USGS

Regression equation to predict *E. coli* concentrations (combined 2004-2005 dataset)

E. coli = 12.206 + 3.310 $\log_{10}$ turbidity + 1.183rain weight + 2.318wave height* + 0.662wind dir

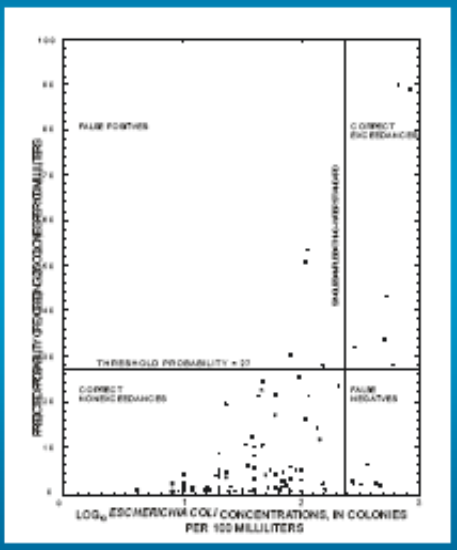
where

wave height* is the wave height (calculated) variable.

USGS

Log_{10} *E. coli* concentrations and probability of exceeding 235 colonies per 100 milliliters

NOTE: Predicted *E. coli* concentrations were used to develop probabilities that the *E. coli* standard would be exceeded



USGS

SUMMARY

- Correlations exist between log_{10} *E. coli* and log_{10} Turbidity, wave height (calculated), wind speed, current speed, and wind direction
- Weak correlations exist between log_{10} *E. coli* and streamflow variables and rain variables
- Statistical relations exist between log_{10} *E. coli* and wind direction and estimated wave height
- Significantly higher concentrations of log_{10} *E. coli* were observed when winds were from the southwest or any north direction (highest median *E. coli* concentrations were observed when winds were from northwest or southwest)

USGS

SUMMARY -- continued

- Median $\log_{10}$ *E. coli* concentrations generally increased as wave heights increased.
- 2004-2005 bacteria predictive model developed for Presque Isle Beach 2 included the explanatory variables $\log_{10}$ Turbidity, rain weight, wave height (calculated), and wind direction
- Overall, the 2004-2005 model was 94 percent accurate (156 of 166 samples) in predicting bacteria concentrations
- The model was good at predicting when bacteria concentrations would be below the standard (150 of 154 samples correctly predicted).
- The model was not so good at predicting when bacteria concentrations would be above the standard (only 6 of 12 samples correctly predicted).

USGS

CLOSING COMMENTS

•For determining beach closures, the model is one tool that can be used in the decision-making process

•Data from additional years of sampling would provide information to better characterize the bacteriological quality of Beach 2 by covering a broader range of climatic conditions

USGS

Follow-up study

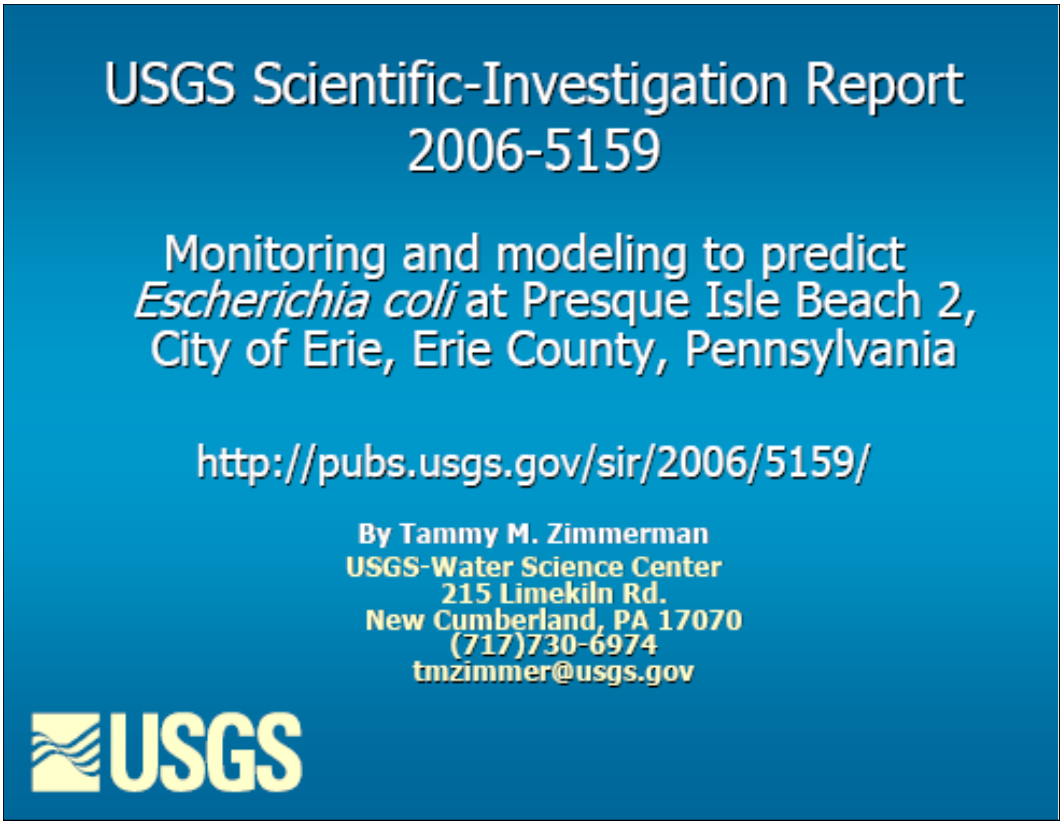
- Use 2006 data and subsequent years of data (at least one independent year of data) to test/validate the current predictive model that was developed using 2004 and 2005 data.
- Re-analyze *E. coli*, ancillary, and environmental data to include 2006 data and subsequent years of data (2004-2006 data and beyond) for refinement of the 2004-2005 model.
- Compare modeling results to current method of determining bacteriological quality of beaches.
- Use real-time information to "WEBCAST" or "NOWCAST" beach water-quality conditions.

USGS

Additional information on "NOWCAST"

- Similar to a weather forecast
- Forecasts if current conditions exceed bacteria standards
- Quicker than current method (previous day's *E.coli* conc.) to determine beach advisories/closings
- NOWCAST in place for Huntington Beach in Ohio
- Info available at http://www.ohionowcast.info

USGS


USGS Scientific-Investigation Report
2006-5159
Monitoring and modeling to predict
Escherichia coli at Presque Isle Beach 2,
City of Erie, Erie County, Pennsylvania
http://pubs.usgs.gov/sir/2006/5159/
By Tammy M. Zimmerman
USGS-Water Science Center
215 Limekiln Rd.
New Cumberland, PA 17070
(717)730-6974
tmzimmer@usgs.gov
USGS

Rick Diz

Watershed and Near Shore Lake Erie Modeling

Abstract: Research Plan

Modeling the Transport of *Escherichia coli* Bacteria From Selected Watersheds to the Near-shore Pennsylvania Waters of Lake Erie with Implications for Bacterial Contamination of Presque Isle Beaches

Principle Investigator: Harry R. Diz, Ph.D., PE, Associate Professor
Department of Environmental Science & Engineering, Gannon University

Background

The beaches of Presque Isle State Park, Erie, PA, like many other Great Lakes beaches, have had far too many occasions when high bacterial counts have forced closure of the beaches to bathers. The park is the most visited state park in Pennsylvania and each year draws hundreds of thousands of beach-goers from hundreds of miles away. It is the only Lake Erie beach access for most citizens in the entire region.

The park is operated by the state parks division of the Pennsylvania Department of Conservation and Natural Resources. Responsibility for public health in the area, and the testing of the waters along the bathing beaches, rests with the Erie County Department of Health. The long history of coliform contamination of the beaches is not understood. It has been suggested that the source of the bacteria is the abundant wildlife of the area, including a large community of waterfowl (the local-source hypothesis). Others have suggested that bacteria are exported during storm events from streams to the west of the park, are transported by wind-driven currents eastward along the Lake Erie shoreline, and are drawn into the surf area of the beaches (the remote-source hypothesis). Both mechanisms may be occurring under various climatic conditions, and in order to provide beach managers with the best possible understanding and management tools to protect the public health, a coordinated study of these possibilities is proposed. Once the source, transport, and fate of the bacteria are understood, intervention strategies may be developed and implemented.

The goal of this component of the overall study will be to investigate the remote-source hypothesis by modeling the release and transport of coliform bacteria from selected watersheds to Lake Erie, and then transport along the Pennsylvania Lake Erie shoreline. The watersheds to be studied are those of Elk Creek and Walnut Creek. These are the largest watersheds which discharge water and sediments to Lake Erie just to the west of the Presque Isle peninsula, and have been previously identified by the PA DEP and Erie County Department of Health as being the most likely major sources of coliform bacterial contamination. The successful implementation of the model(s) will aid in the explanation of the occasional appearance of unacceptably high concentrations of coliform (especially *E. coli*) bacteria in the bathing waters of the beaches of Presque Isle State Park.

Methodology

The modeling effort will consist of two phases. The first and more fundamental phase will be to model the generation and transport of *E. coli* bacteria from the watersheds. Models used for this phase would be the GIS-based BASINS system developed by the US EPA. The non-point source water quality model Hydrologic Simulation Program Fortran (HSPF), integrated into the BASINS system, will generate time series output of data for hydrology, sediment transport, and bacterial loads for each of the two targeted watersheds. Data already obtained by this and other researchers will be used to calibrate HSPF so as to produce an accurate simulation.

The output from HSPF will be used as input information for the second phase of the modeling, the nearshore Lake Erie hydrodynamic model. For this application, a hydrodynamic model such as the Environmental Fluid Dynamics Code (EFDC) linked to the Water Quality Analysis Simulation Program (WASP) will be used to simulate transport and fate of bacterial along the Lake Erie shoreline. These models are capable of two- or three-dimensional application. To provide field data to calibrate these models, it will be necessary to collect water samples during the summer bathing season of 2007 at strategic locations along the Pennsylvania Lake Erie shoreline.

For the data to be timely, it will be necessary to mobilize a team of researchers and a vessel such that the team can collect samples on short notice once during and/or shortly after a storm event begins. This will need to be done for at least three storms over the course of the summer season. The goal of the sample collection effort would be to collect samples in a set of radiating transects out from the mouth of the two streams and in the nearshore waters leading to the bathing beaches of Presque Isle. Samples will be collected on the day following a rain event, and again the very next day at the same sites.

Sample Collection Methods and Locations

Water samples will be collected from the deck of the research vessel using a Kemmerer Water Sampler. Samples will be obtained with the sampler from 1 meter below the surface. Prior to each sample collection, the sampler will be disinfected by rinsing with a diluted bleach solution. Once placed into the lake waters, any remaining bleach solution on the sampler will be washed away thus avoiding the chance of harm to the collected sample. Once a sample has been obtained with the Kemmerer, the water will be transferred directly into a pre-sterilized sample bottle and marked with the sample location ID, the date and time of collection. Water will also be collected separately for measurement of total and volatile suspended solids. Water temperature, dissolved oxygen concentration, specific conductance will be recorded for each sample location using a Hydrolab multi-sonde instrument.

The following tables present the sample identifiers and locations. The prevailing wind and current in this area is from west to east. Therefore sample locations were selected to the west of the bathing beaches of Presque Isle. The selected locations represent an array at the mouth of each of the two major Lake Erie tributaries (Elk Creek and Walnut Creek) west of the Presque Isle peninsula as well as several locations arrayed along the shoreline between the stream mouths and the bathing beaches to the east. Based on the initial results, the locations of some sites may be changed, and some sites may be added or removed from the list as experience dictates.

Table 1. Sample locations off the mouth of Elk Creek.

	Latitude (north)				Longitude (west)		
ID	**deg**	**Min**	**Sec**		**deg**	**Min**	**Sec**
ECmouth	42	01	46		80	22	18
EC1	42	02	05		80	23	11
EC2	42	02	19		80	23	52
EC3	42	02	17		80	22	30
EC4	42	02	43		80	22	42
EC5	42	02	19		80	21	49
EC6	42	02	51		80	21	21
EC7	42	03	39		80	18	45

Table 2. Sample locations off the mouth of Walnut Creek.

	Latitude (north)				Longitude (west)		
ID	**deg**	**Min**	**Sec**		**deg**	**Min**	**Sec**
WCmouth	42	04	46		80	14	26
WC1	42	04	55		80	15	7
WC2	42	05	05		80	15	50
WC3	42	05	11		80	14	40
WC4	42	05	35		80	14	53
WC5	42	05	18		80	14	08
WC6	42	05	48		80	13	50

Table 3. Sample Locations along the Lake Erie shoreline west of Walnut Creek and east of Presque Isle.

	Latitude (north)				Longitude (west)		
ID	**deg**	**Min**	**Sec**		**deg**	**Min**	**Sec**
LE1	42	05	15		80	13	28
LE2	42	06	04		80	11	30
LE3	42	06	34		80	11	50
LE4	42	07	22		80	12	14
LE5	42	07	03		80	09	41
LE6	42	07	28		80	10	06
LE7	42	08	03		80	10	35

The following figure portrays the sample locations as labeled positions using an image from the Google Earth system.

Figure 1. Sample locations off the mouth of Elk Creek, Walnut Creek, and along the PA Lake Erie shoreline. No scale is provided, but the sites located farthest offshore are about 1 to 2 miles from the shoreline.

Sample Handling and Custody

Once water samples for coliform analysis have been placed in pre-sterilized bottles, they will be placed in an ice chest until return to the dock at the end of the sampling day, when the samples will be transferred to laboratory personnel from the Regional Science Consortium (RSC) at the Tom Ridge Environmental Center. A manifest will be created listing each sample collected and its essential information. RSC personnel will then be responsible for custody of the samples and for analysis of the samples for *E. coli* according to approved methodology.

Samples for suspended solids analysis will be retained by this investigator. Those samples will be returned to the Gannon University laboratory for analysis according to Standard Methods for the Examination of Water and Wastewater.

Data generated from the coliform measurements of the samples by RSC personnel will be communicated to this researcher for use in calibration of the EFDC computer model.

Tony Foyle

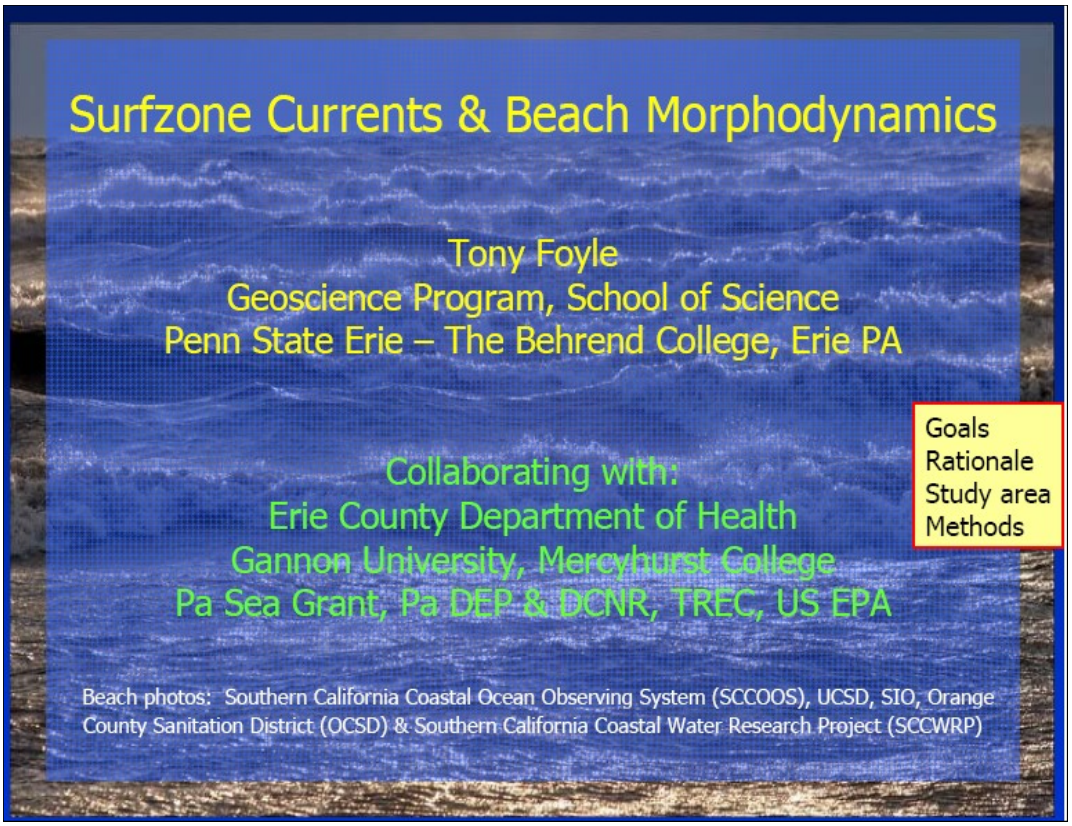
Near-shore Current Studies

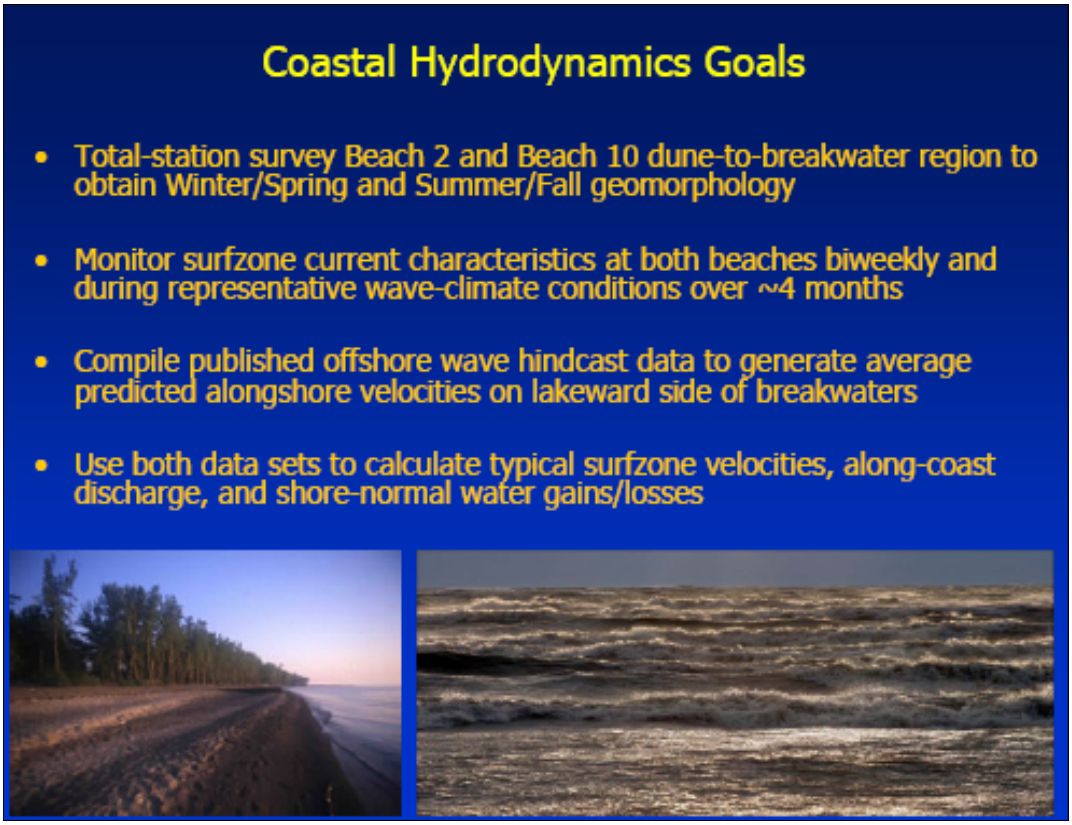
Abstract: Coastal water quality management decisions are facilitated by characterization of the nearshore waves and currents that transport contaminants and sediment along the shoreline. As part of a proposed 2007 beach monitoring program at Presque Isle State Park's Beaches 2 and 10, we propose to monitor the hydrodynamic setting of both beaches with (1) topographic surveys of the dune-to-breakwater region to obtain Spring and Fall geomorphology, (2) weekly to bi-weekly current meter surveys to capture normal wave-climate conditions over the summer months, and (3) analysis of published offshore wind, wave and current data to characterize hydrodynamic conditions in the nearshore beyond the breakwaters that drive events in the surfzone.

Beaches 2 and 10 are hydrodynamically distinct. Beach 2 is fronted by 45 m-long offshore breakwaters constructed in the early 1990s that are located approximately 60-80 m offshore with 100 m gaps between breakwaters. The bathymetry is expected to be dominated by shoreline-parallel trends while beach cusps and salients are well developed. A permanent outer bar is present at the ~4m isobath while a more mobile inner bar is present at the 2m isobath. Historically, the Beach 2 site is erosional at timescales of decades to centuries. Beach 10 is characterized by 40 m-long offshore breakwaters constructed during the late 1970s that are located 50-100 m offshore with 50-80 m-wide gaps between the breakwaters. The bathymetry is expected to be dominated by shore-normal trends. Beach cusps and salients are less well developed, partly due to regular beach nourishment which also allows a much wider beach. The nearshore is expected to have a complex multi-barred bathymetry. At timescales of decades to centuries, Beach 10 is accretional because it is less exposed to prevailing WSW winds than Beach 2.

The proposed hydrodynamics analysis will allow calculation of typical surfzone velocities, along-coast water flux, and shore-normal water gains/losses at Beaches 2 and 10 under representative spring through fall conditions. This in turn will allow estimation of (a) along-coast transit times for water in the surf zone, (b) contributions or losses of water to the near-shore through breakwater gaps, and (c) typical bacterial transit times between their potential source locations and their arrival at Presque Isle beaches.

Presentation:



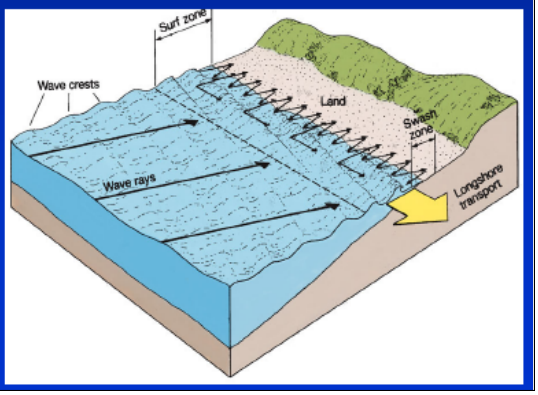


Rationale?

- Velocity and discharge data will allow prediction of along-coast transit times for water in the surf zone
- Contributions or losses of water to the nearshore through the breakwater gaps can be estimated from box-model balancing
- If bacterial origins (offshore? breakwater guano? western creeks?) and representative concentrations in the surfzone are known, then .....
- Typical times between bacterial introduction to coastal waters and their arrival at Presque Isle beaches can be estimated and acted upon

General Beach Morphodynamics Considerations

- Longshore current: the most important transport mechanism for sediments, nutrients, bacteria, etc.
- Not measurable from L. Erie wave-based models
- Driven by wave power (speed, height, breaker α_b)
- Velocities are temporally and spatially very variable. Many reasons:
  - Rip currents and undertow
  - Edge waves
  - Seiche effects
  - breakwater diffraction & reflection
  - Complex nearshore bathymetry
  - Eddies
  - Afternoon sea-breeze effect
- Discharge varies temporally
- Severe/expensive instrument locality

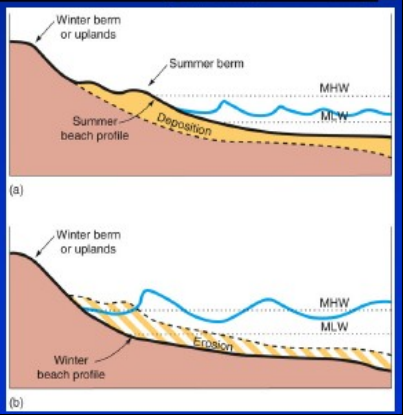


Presque Isle Beaches – A Conceptual model

Beach 2	Beach 10
• Offshore 45 m-long breakwaters and 100 m-wide gaps	• Offshore 40 m-long breakwaters and 50 & 80 m-wide gaps
• 8-100 m from groin or shoreline	• 10-30 m from shoreline
• Shoreline~parallel bathymetry	• Shoreline~normal bathymetry
• Cusp + salient rhythmicity	• Much wider beach
• Permanent outer bar in 4m water	• Lower-gradient bathymetry
• Transient inner bar in 2m water	• Complex multi-bar system
• Fast longshore current -> erosion	• Shoreline-breaker angle larger = slower longshore current -> deposition

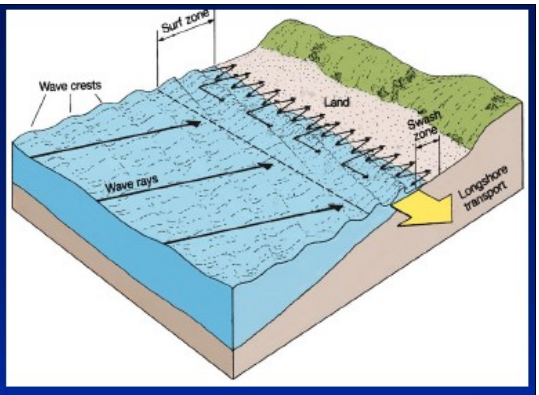
Methods 1
Topography & bathymetry

- Beach topography
- Surfzone bathymetry
- Lake level determines cross-sectional area of the surf zone, hence discharge
- Spring morphology (large X-area?)
- Fall morphology (smaller X-area?)



Methods 2
Longshore Current

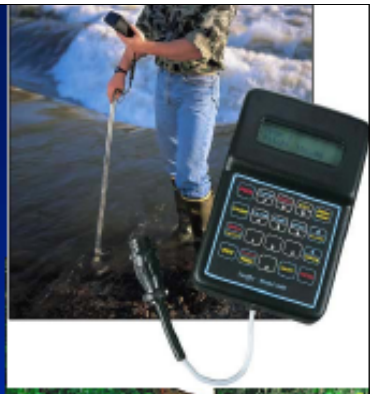
1. Current meters
2. Lagrangian drifters
3. Eco-friendly dyes
4. Possible ADCP?

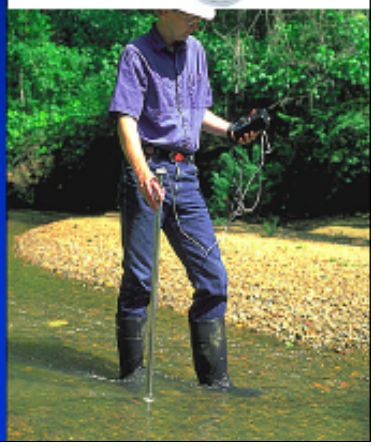


Methods 2
Longshore Current

- **1 Current meters**

- USGS-type propeller driven
- Precisely balanced cup spindle or fin is rotated by the current - rotation rate proportional to velocity
- Two simultaneous sample sites on cross-surfzone transects at the Beaches 2 and 10 cells
- Records long-term average current speed
- K





Methods 2
Longshore Current

- **2 Lagrangian drifters**
- Really: low-cost tennis balls or oranges
- Timed "voyages" in the surf zone with GPS unit or Total Station position-fixing
- Will yield averaged surfzone velocities for a sample period

Methods 2
Longshore Current

- **3 Eco-friendly dyes**
- Rhodamine, an EPA approved dye for use in groundwater, lake, and ocean work.
- Plume-front positioning with Total Station or GPS units

Methods 2
Longshore Current

- **4 ADCP?**

- Determines velocities at different depths using acoustic transducers, internal electronics and the Doppler-shift concept.
- Sited between a cell's breakwater set on ~2 m isobath
- Continuous recording for day-to-week periods
- Provides additional control on on-offshore water movements in the top 1 meter of the water column

Any Questions?

Spare 1: SCCOOS Experiment Description

- Management decisions can depend on accurate characterization of the waves and currents that transport pollutants and sediment along the shoreline.
- Used a month's observations of breaking-wave driven alongshore currents to validate and calibrate a model that is applied routinely to predict real time alongshore currents in the surfzone. A related goal was to better understand how breaking waves mix surfzone waters, a process that determines the dilution of pollution.
- Used two steps to model surfzone currents. (1) the properties of waves approaching the beach were first predicted and (2) specialized models were then used to simulate wave breaking and the generation of surfzone currents.
- Observed deep water spectra were transformed numerically to coastal locations, close to the shoreline but well seaward of the surf zone.
- A second numerical model simulated wave shoaling and breaking between 10m depth and the shoreline, and the associated generation of alongshore currents in the surf zone. (Model accuracy degraded by irregular or poorly known bathymetry and errors in the estimated incident waves).
- Detailed, near real-time predictions of breaking wave height and surfzone-averaged alongshore currents are now available every 100m for a 5km alongshore reach at Huntington Beach

Spare 2: SCCOOS Products

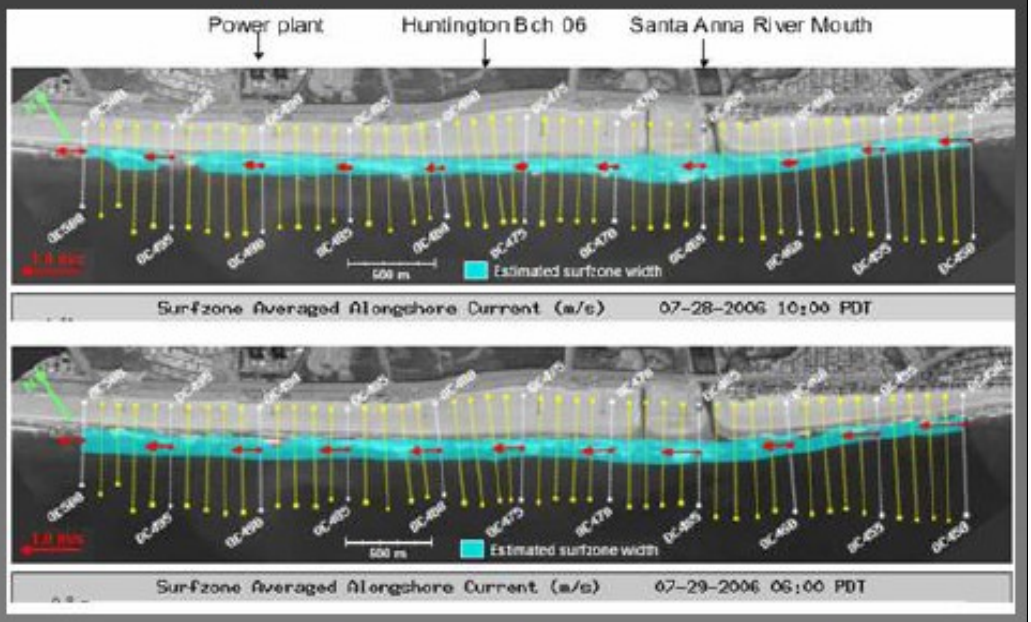


Figure 3: Real time predictions of average alongshore currents in the surf zone for a 5km stretch of Huntington Beach : (top) weak currents (~20 cm/s) on 7/28/06, and (bottom) moderate currents (~50 cm/s, about 40km/day) on 7/29/06.

Spare 3: SCCOOS Products

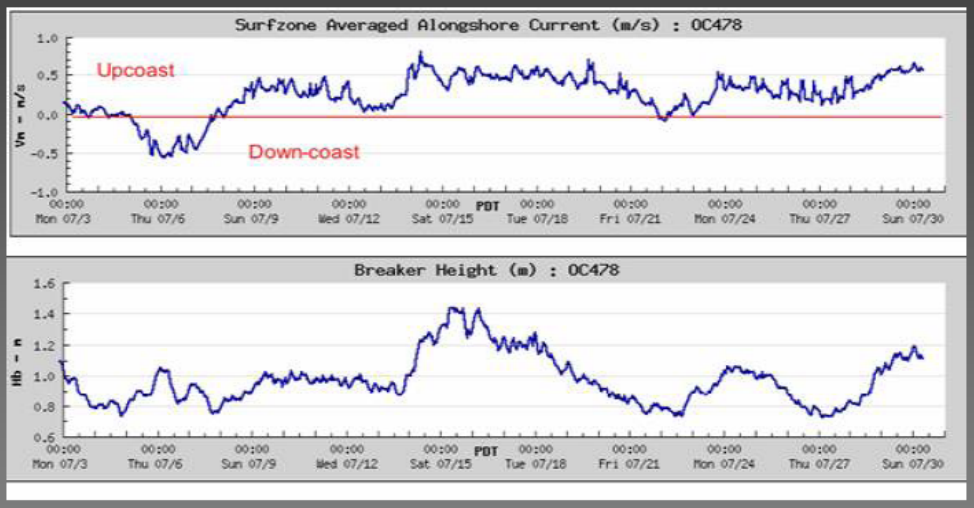


Figure 4: Time series of (top) average surfzone alongshore current and (bottom) breaker height at transect OC478, the location of the HB06 main transect (Figures 3 and 5). A downcoast current pulse on 07/6 is driven by locally generated wind seas arriving from the northwest. The dominant upcoast (northerly) flow is driven by longer swell arriving from the southwest.

Spare 4: Current Meters Gen Info

- 1. For the rotating USGS-type ("AA) cup devices, a precisely balanced cup spindle is rotated by the current. The rotation rate is proportional to the velocity and is determined by counting the number of rotations over a specific time period. Revolutions are monitored manually with a headset or with a digital readout device. Calibration curves then convert these rotation rates to velocities. These devices do not need to be calibrated in the field, but need to be kept lubricated and clear of bio- and sediment-fouling.
- 2. General Oceanics-type flowmeters use a spiral rotating fin and internal trigger counters to record revolutions over a given time interval. Revolution rate is then converted to speed using a calibration curve. Field calibration is not needed.
- 3. For magnet-tipped propellor type current meters, a rotating magnetic propeller in a protected housing triggers a very small electrical impulse as the magnetic tip passes through a pick-up coil. This signal is sent to a digital recorder that converts the revolution rate/voltages to the current speed. These devices give direct LCD read-outs of current speed and are factory calibrated.
- 4. For electromagnetic current meters (eg. Marsh McBirney's Flowmate 2000), water flow through the device's flow cylinder uses Faraday's principle of electromagnetic induction to generate a voltage signal that is converted by electronics in the data collector into a current speed. This device is calibrated at the factory and does not require field calibration. The conductivity sensor does need to be kept clear of bio- and sediment-fouling.
- 5. With no moving parts, the typical ADP unit determines velocities at different elevations in the water column using acoustic transducers, internal electronics, and the Doppler-shift concept. The device converts acoustic frequency data to current velocities internally for subsequent downloading. The device is factory calibrated and does not require recalibration, field calibration, or factory maintenance. It does need to be kept clear of bio- and sediment-fouling.

Julie Kinzelman

Applying Beach Management to Racine's North Beach

Abstract: Racine's North Beach was an underutilized community asset often plagued by water quality advisories in the 1990's. Beginning in 2000 the City of Racine, spurred by public interest, began research and remediation efforts to improve water quality and enhance the lakefront. The City of Racine Departments of Health and Public Works partnered with environmental consultants, federal agencies, and local academic institutions to conduct water quality research and monitoring to investigate contamination sources. Local pollution sources identified as a result of source tracking studies included storm water discharge, surface run-off, and the large resident population of gulls. High waves preceded 82% of water quality advisories, irrespective of precipitation, indicating the potential for poor water quality to occur during both wet and dry weather. As a result of these efforts, storm water infrastructure improvements have been made, constructed wetlands have been installed, and alternative beach management techniques (beach sand manipulation and waste management) have been employed. Volunteers have placarded storm drains throughout the city. Water quality advisories have dropped from a high of 62 days per bathing season in 2000 to three in 2006. In 2004 Racine's North Beach was certified as a "Blue Wave" beach, one of only two beaches possessing this designation on the Great Lakes. Citizens have continued to remain engaged and involved through *Earth Day* and *Make a Difference Day* events and the *Alliance for the Great Lakes* "Adopt-A-Beach" program. The North Beach Oasis provides concessions and entertainment. The Kids Cove playground, a 100% volunteer community-based effort, offers over 20,000 square feet of recreational space for children. The newly dedicated Lake Michigan Pathway provides 9.8 miles of paved surface for biking and hiking along the lakefront. Racine's North Beach has gone from an underutilized asset to a focal point for the community and a tourist destination.

Presentation:

Successful Beach Management Requires:

- Sound Science
  - Public/Academic Partnerships
- A Team Effort at the Municipal Level
  - Research Scientists, Public Health Officials, Department of Public Works, Parks and Recreation
- Public Interest/Concern
- Political Will
- Effective Communication

Sound Science

- UW-Milwaukee WATER Institute:
  microbial source tracking
- UW-Parkside:
  hydrogeology
- United States Geologic Survey
  predictive modeling
- US EPA
  real-time PCR techniques
- National Park Service
  wetland science

Municipal Team – City of Racine

- Research Scientist: in-house or contracted
- Public Health Officials: Laboratory (sample analysis), Division of Environmental Health (result reporting, PIO)
- Department of Public Works: storm water management, infrastructure
- Parks, Recreation, and Cultural Services: implementation of best management practices, lifeguards, beach safety
- Wastewater Utility

Public Interest/Concern

- Citizens of Racine
- Keep Our Beaches Open
- Sustainable Racine
- S.C. Johnson

Political Will
Mayor Gary Becker

- Great Lakes and St. Lawrence Cities Initiative – Board Member
- Wisconsin Coastal Management Council – Chair
- Great Lakes Regional Collaboration – Chair, Sustainable Development Strategy Team

Effective Communication

- Communicating results of research findings to scientific community
- Communication between municipal departments to craft effective solutions
- Communication with the Office of the Mayor and elected officials
- Communicating health risk to the public
- Communication by the public to elected officials - feedback

Spatial Distribution and Microbial Source Tracking Studies

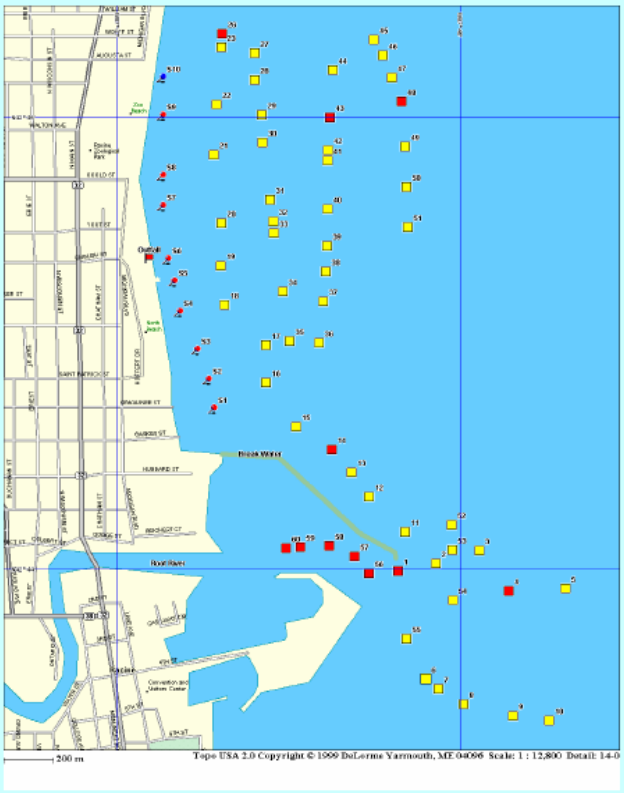
- Identify Point and Non-Point Pollution Sources
- Determine Relative Contribution of Bacterial Indicators under Varying Environmental Conditions
- Aid in Targeting Remediation Efforts

Potential Pollution Sources

- Indirect or Non-Point Source
  - Run-off (Urban, Agricultural, Industrial, Landscape)
  - Boaters
  - Bathers
  - Algae
  - Animals (Gulls, Geese, Dogs, etc.)
  - Sediments (Beach Sand)
- Direct or Point Source
  - CSO, SSO
  - Storm Water Discharge/Storm Water Outfalls
  - Rivers and Creeks

Wet Weather Events

Probable sources of *E. coli*



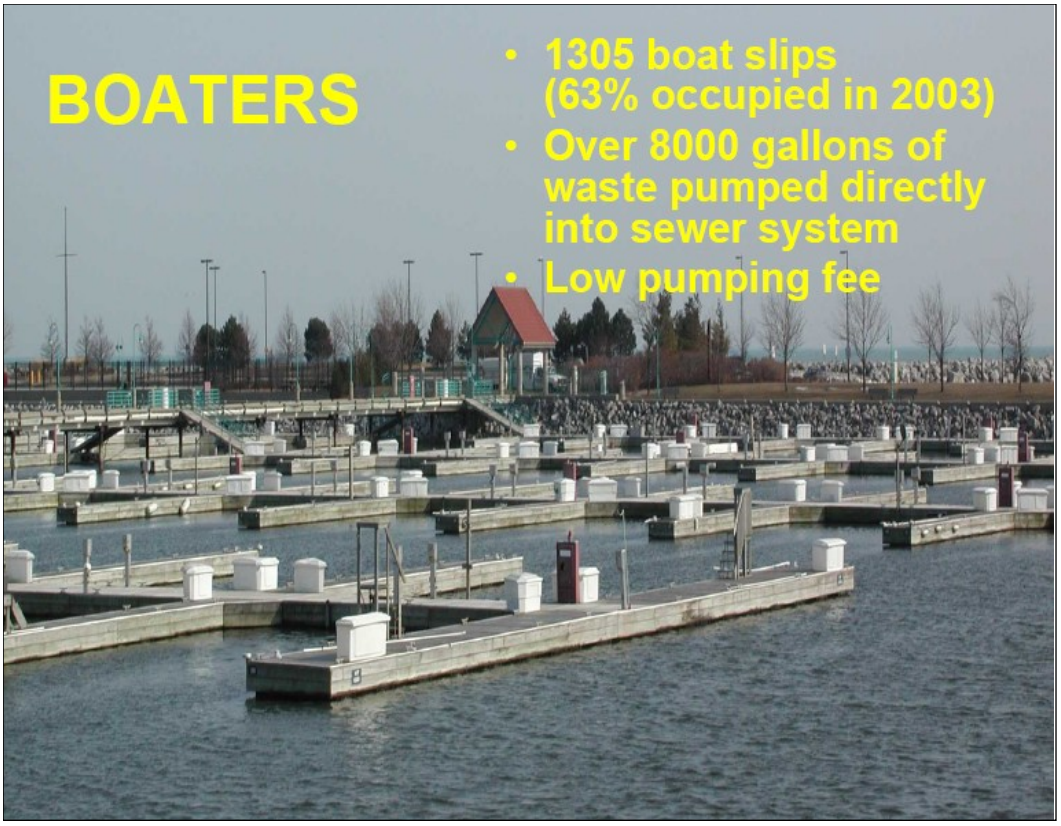
2004 Spatial Distribution Study

80 samples by wading or boat

Pre-rainfall, Rainfall, and Post-rainfall samples

Root River *E. coli* Densities – 2004		
SITE	**MEAN *E. coli* MPN/100 ml**	**RANGE**
Johnson Park (R1)	1518	10 – 14,136
Horlick Dam (R2)	1431	10 – 12,997
Cedar Bend (R3)	3705	0 – 12,997
Washington Park Storm Outlet (R4)	38,856	0 – 198,628
Water Street Storm Outlet (R5)	18,020	100 – 173,287
State Street Bridge (R6)	1372	63 – 11,199
Chartroom (R7)	1098	20 - 9804

Dry Weather Impacts



Bathers

- Adequate toilet and shower facilities
- Appropriate number of waste receptacles which are emptied frequently
- Good public education

Algae (*Cladophora*)

- Algae contains bacterial indicators
  - E. coli ≥ 25,000 cfu/ml
  - enterococci = 800 cfu/ml
- Bacteria may be transient or persistent
- If indicators are persistent in algae they may contribute to FIB burden
- Stranded & submerged algal mats may also contain pathogens like *Salmonella* [Ishii]

2004 Algae Study

CONCENTRATION OF BACTERIAL INDICATORS IN ALGAE - 2004				
Date	*E. coli* cfu/g		Enterococci cfu/g	
	Stranded Mats	Submerged Mats	Stranded Mats	Submerged Mats
6/15/04	25000	451	1	1
6/16/04	400	725	1	1
6/21/04	400	431	280	50
6/23/04	733	400	15	6
6/28/04	1933	1300	363	320
6/29/04	333	650	800	400
6/30/04	3266	1700	1	1

Beach Sands

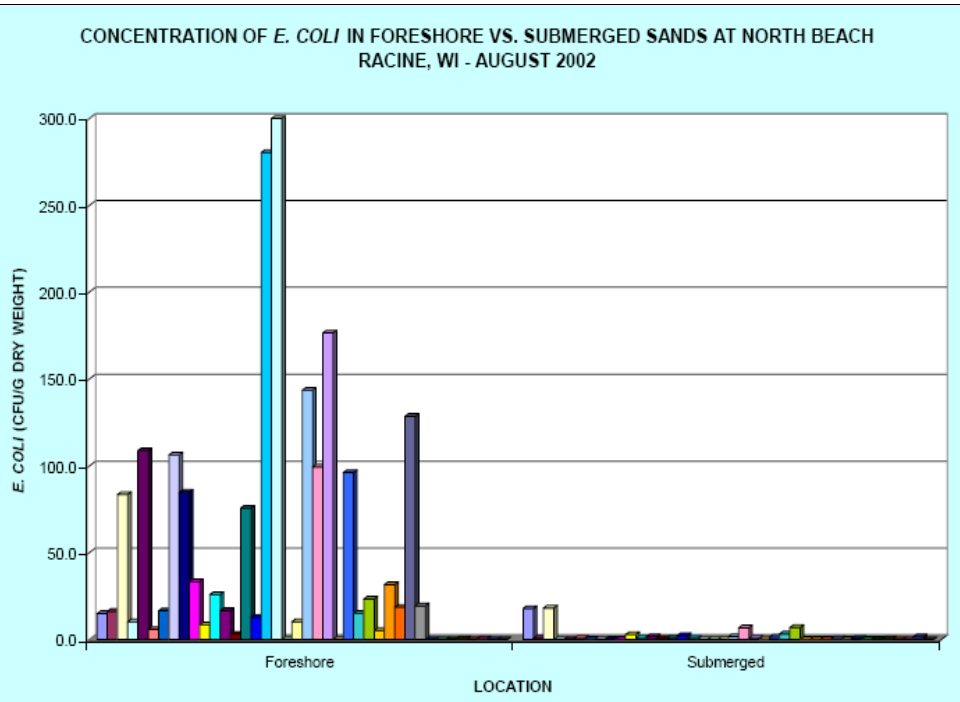
Fecal Contamination of Beach Sands

- Beach sands may be an important diffuse non-human source of fecal indicator bacteria to coastal waters
- FIB can be easily eluted from beach sands in fresh & seawater via tides, wave backrush or submarine groundwater discharge [Boehm, Kinzelman]
- Gull feces is a source of FIB to beach sands also pathogens such as *Campylobacter* [Kinzelman, McLellan]
- Genes for ***E. coli*** pathotypes have been found in beach sands – *mdh*, *eae* (intimin), *stx1* (shiga-toxin) [Alm]
- Bacterial indicators of water quality may persist in beach sands, biofilms? [Ferguson]

Bacterial Indicators in Sand

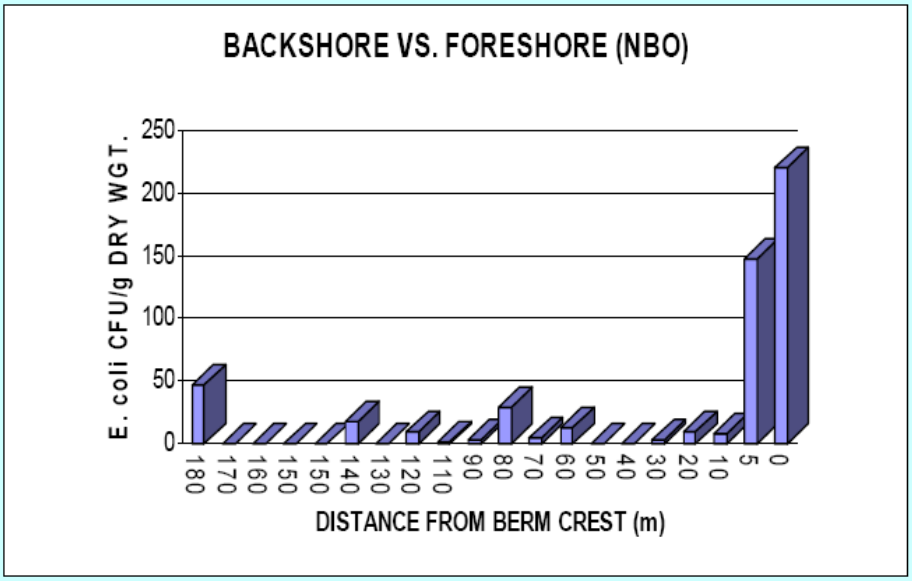
Location	N	Range *E. coli* (cfu/g)	Median *E. Coli* (cfu/g)	Mean *E. Coli* (cfu/g)
FORESHORE	172	0.0 - 718.9	15.0	33.3
SUBMERGED	172	0.0 - 23.2	0.4	1.4

Distribution of *E. coli* (cfu/g dry wgt.) in foreshore and submerged sediments using combined data from all four North Beach sites (N1-N4) (2002). [cfu = colony forming unit]



Mean daily *E. coli* concentration for combined data (N1 – N4) demonstrating the distribution of *E. coli* in foreshore (one meter from berm crest) in comparison to submerged sand from August 2002 (paired data color-coded by day).

Density of *E. coli* in relation to distance from shore beginning at furthermost point from shore (180 m) (NBO = North Beach Oasis cafe,) (post-RAINFALL).



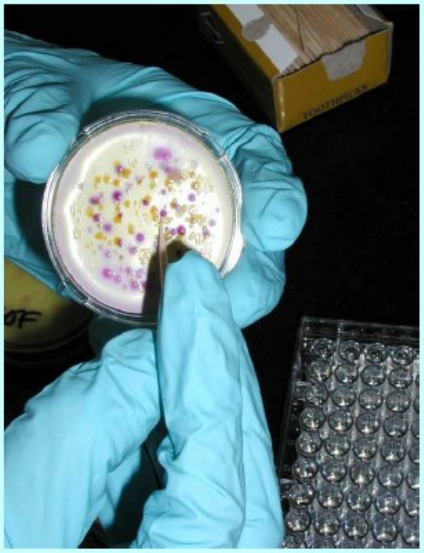
Bacterial Source Tracking

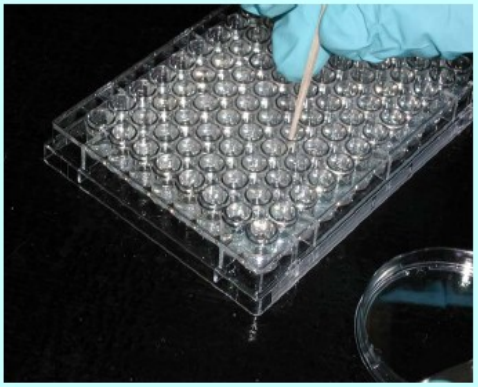
- Test choice depends on level of discrimination
- Screening tools can distinguish between human and non-human sources
- More complex tests can discriminate between host source, i.e. human, gull, dog, cow, etc.
- What question were we really trying to answer?

What question are you trying to answer?

- For storm water it may be enough to know if it is human or non-human
- For runoff in rural areas you may want a more discriminatory test (septic discharge or agricultural runoff)
- In mixed sources it may be better to screen first and then discriminate
- Is cost an issue?

Preparing samples for ARA

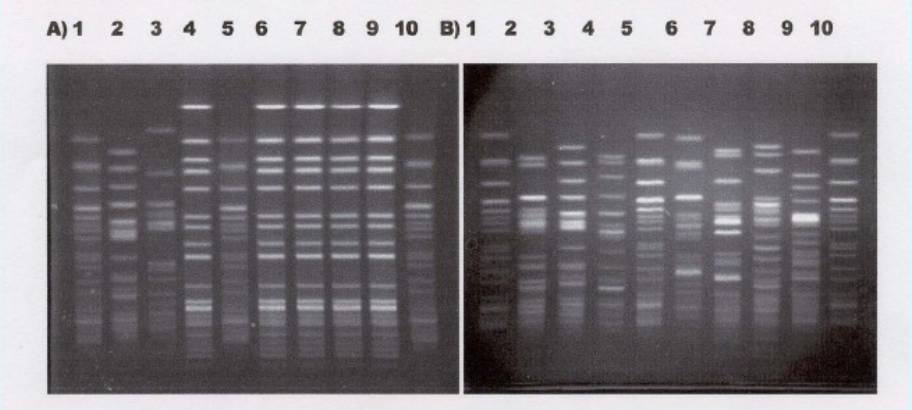




- Screening tool
- Library independent
- Relatively inexpensive

PCR Techniques

- Potential Target Organisms - ***E. coli***, *Enterococcus,* ***Bacteroides****, Bifidobacterium*
- Library Dependent, more expensive



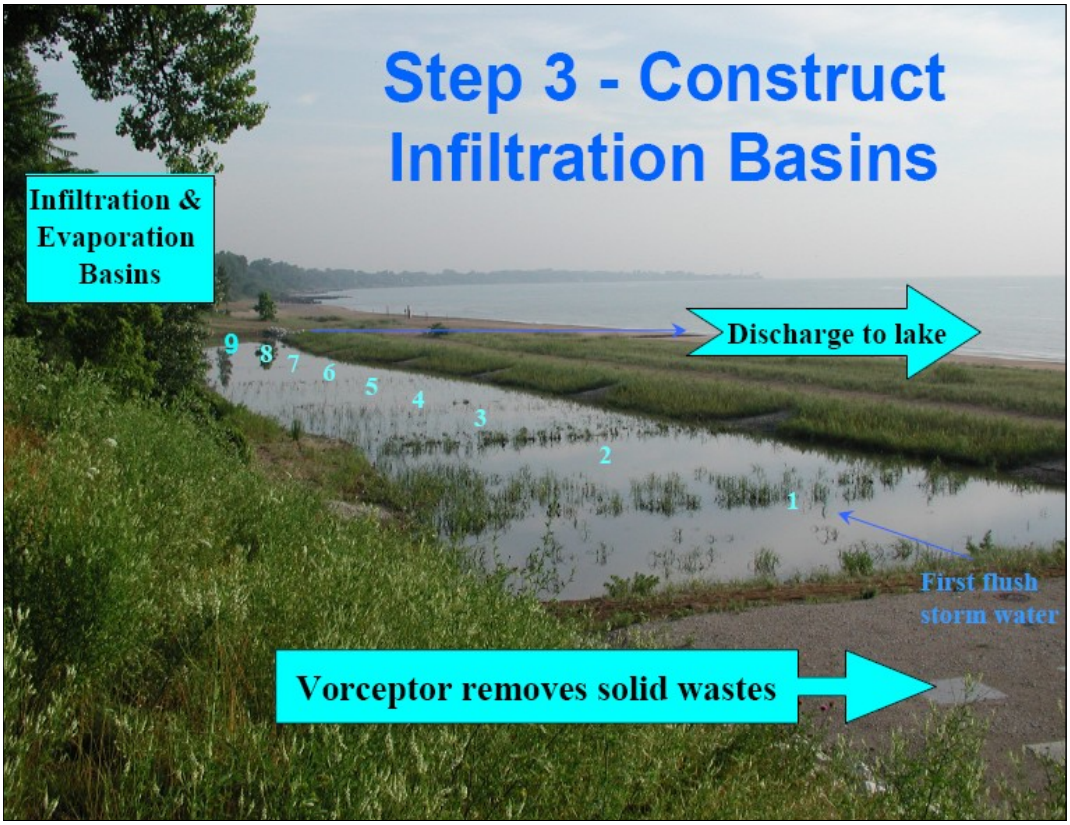
Sources Identified in Racine, WI

- **Local influences are predominant (spatial distribution)**
- **Primarily beach sands and storm water discharge (spatial distribution)**
- ***E. coli*** **in beach sands likely due to gulls (ARA, PCR)**
- **Storm water may have mixed human and non-human sources – human specific *Bacteroides* detected in some samples (ARA + *Bacteroides*)**
- **Some potential for riverine influences under right conditions – also mixed human and non-human sources (ARA + *Bacteroides*)**
- **Regional influences unlikely (spatial distribution)**

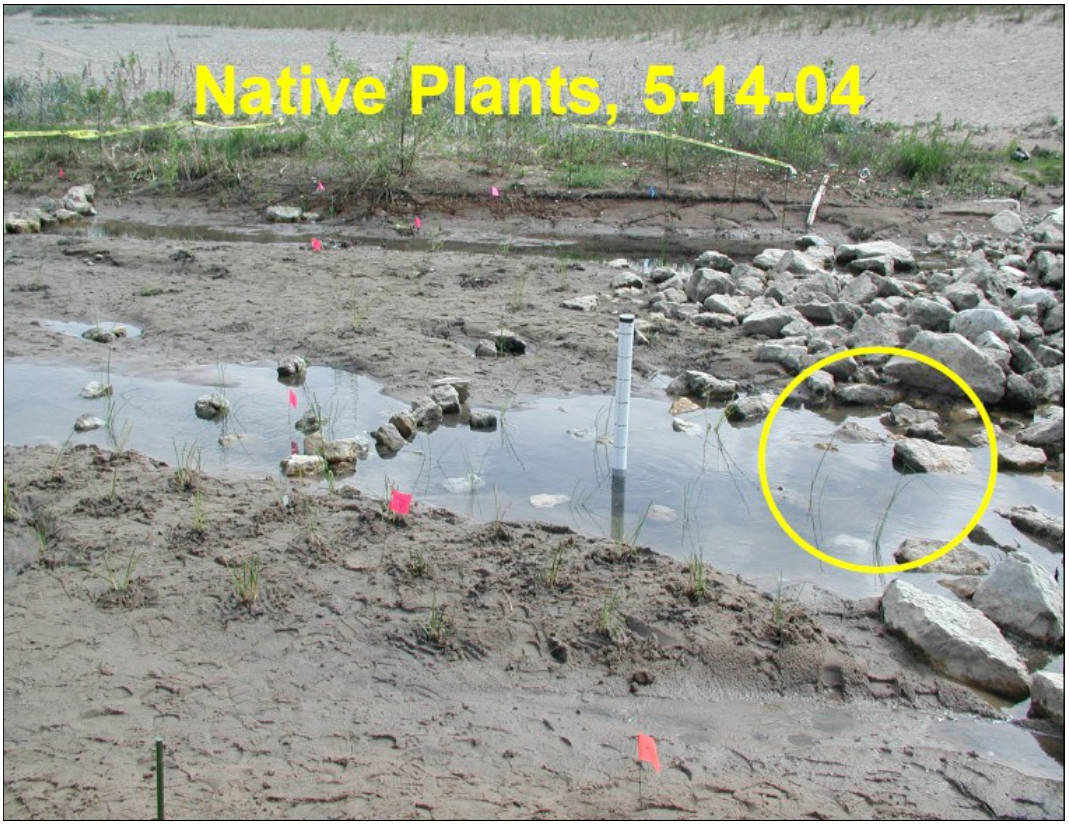

Municipal Remediation Measures
• Reduce Impacts of Storm Water
• Reduce Amount of E. coli In Beach Sands


Step 1 -Outlet Relocated
X


Step 2 - Chamber Installation
Oil Baffle Wall
High Flow Control
Inlet
Grit Chamber
Low Flow Control
11. 7. 2000


Step 3 - Construct Infiltration Basins
Infiltration & Evaporation Basins
Discharge to lake
9
8
7
6
5
4
3
2
1
First flush storm water
Vorceptor removes solid wastes


Step 4 – Installation of Wetland Plants at the Overflow Site
REINSTITUTING NATIVE PLANTS AND RETAINING STORM WATER MAY REDUCE THE POTENTIAL FOR BACTERIAL CONTAMINATION

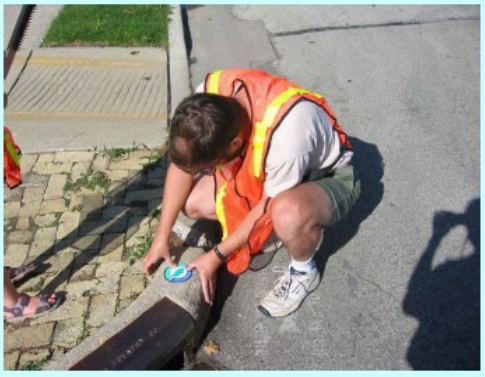

Native Plants, 5-14-04

Comparison of Bacteriological Storm Water Quality Before and After Re-engineering

Bacteriological Storm Water Quality Pre- and Post-Installation								
E. coli per 100 ml (cfu or MPN) *one occurrence	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
N	15	29	46			16	14	14
Mean	1171	2151	9661			458	3244	2420
Median	700	1000	3000			455	448	41
Minimum	100	1	100			52	10	0
Maximum	4300	20000	50000			1203	24192*	24192*

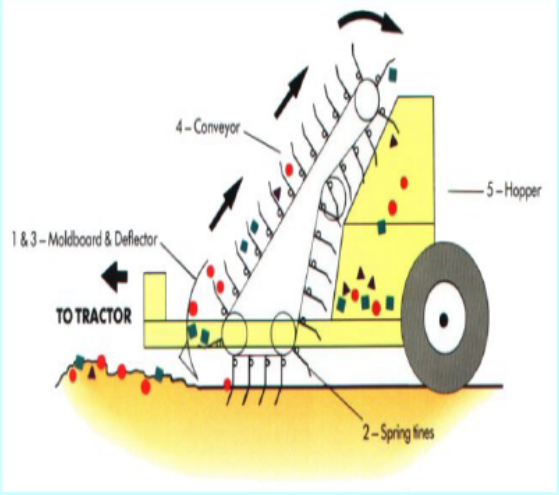
Volunteers Assisted in Planting (public interest)…

and in Stenciling Storm Drains throughout the City…



STORM SEWER STENCILING
BY
KEEP OUR BEACHES OPEN

Surf Rake Specifications
© H. Barber 2002



- **1 & 3. The moldboard** levels uneven areas in the sand.
- **2. Spring tines** rake debris from the sand toward **Deflector Plate (3.)**
- **4. Conveyor** hydraulically raises waste to hopper
- **5. Hopper** holds debris until it can be dumped

Beach Grooming is Important!

- Helps to remove plant & animal material that can attract scavengers
- Removes materials that may be harmful to beach patrons like broken glass

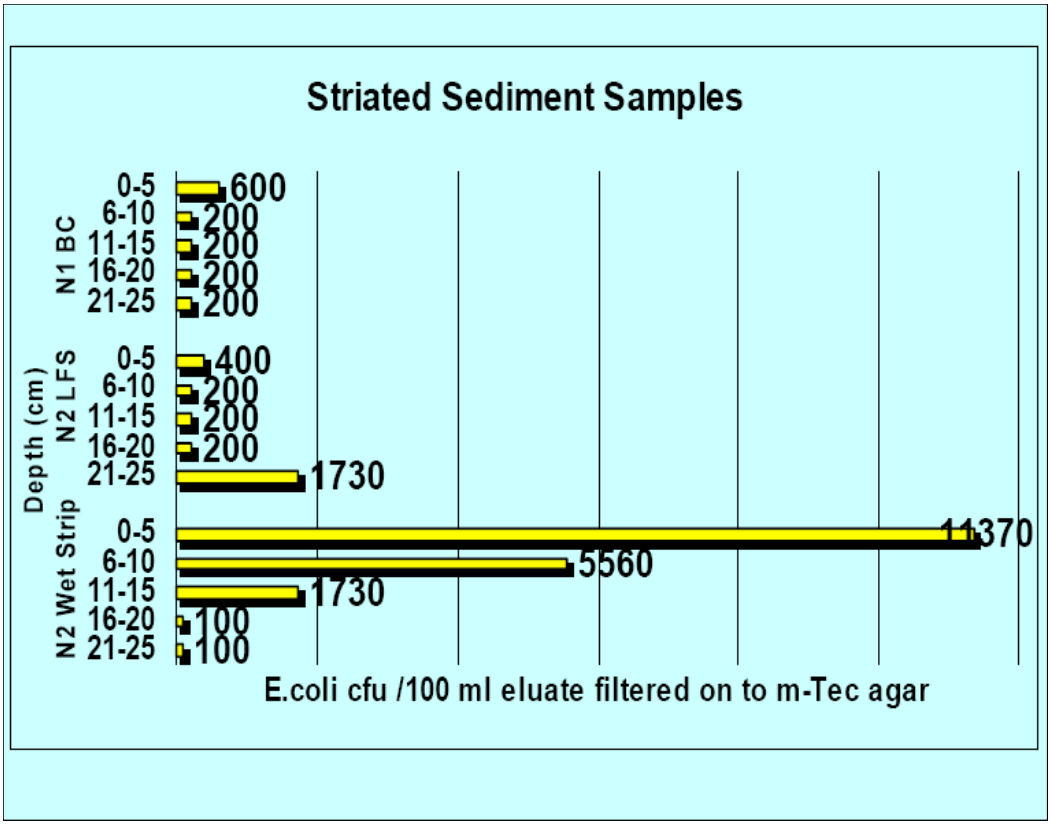
Alternative beach management practices may reduce, rather than increase, the onshore bacterial burden

GROOMING STUDY

- Used Actual Equipment
- 2 Treatments
- Status Quo vs. Deeper Grooming w/o Finisher
- Bacterial Density Varied Based on Sand Condition

Beach Slope - Fine Tuning the Process. . .

- Highest levels of *E. coli* were found in the area behind the lifeguard stand and at the berm crest
- *E. coli* content in beach sands was influenced by the moisture content



Re-Grading the Beach

What's Next?

- Real-time monitoring using PCR (Cepheid SmartCycler) - results in about 2 hours
- *E. coli* and enterococci
- Bathing water
- Storm water discharge
- Wastewater through the treatment process
- Result = Increased capacity to determine pollutant loading and track sources

The Enactment of City Ordinances Can Enhance Best Management Practices and Public Education Can Improve Personal Practices

SEAGULLS, GEESE, AND RECREATIONAL WATER QUALITY

Ring-billed and herring gulls are a common site in parking lots and Great Lakes coastal areas

The number of Canada geese have increased over the last 50 years and resident, or urban, populations are becoming a nuisance in some areas

Recent research has shown that feces from water fowl can contribute to recreational water quality advisories

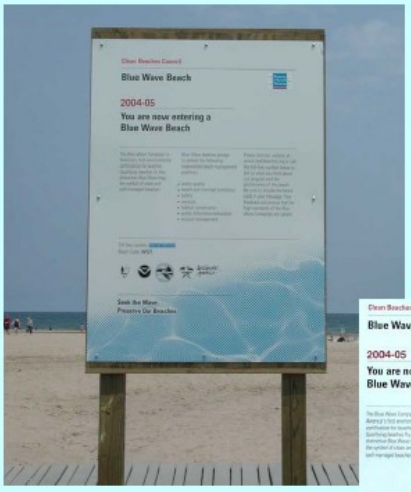
Racine's shoreline is home to various water fowl such as ring-billed and herring gulls and Canada geese. While the presence of shore birds can add to the ambience of a coastal visit, large populations can adversely impact water quality. For example, one gram, or a pea-sized piece of gull feces, contains over 3 million *E. coli* bacteria. *E. coli* is used as an indicator of recreational water quality on bodies of fresh water like Lake Michigan because of its presence in the intestines of animals and people. One way to reduce the number of nuisance water fowl at the beach, and reduce swimming advisories, is to remove debris, especially debris resulting from food and beverages. The City of Racine grooms the beach to remove debris but all visitors should do their part to keep the beaches clean. Other deterrents include not feeding the birds (Ord. Sec. 10-73) and using the beaches.

The Parks Department grooms the beaches to remove waste left by previous visitors and potentially hazardous debris

A typical load of debris collected by the beach groomer

Waste left on the beach by previous visitors often includes food related items which attract wildlife

Blue Wave Campaign – Restoring Public Confidence



Clean Beaches Council
Home of the Blue Wave Campaign

- Certification program recognizing good management practices, environmental stewardship, and effective public communication regarding water quality
- Partner organization of *International Blue Flag*
- Good for tourism & local economy
- North Beach is *first* WI beach to receive designation & *second* certified Great Lakes beach in the US
- Co-Sponsored by Sustainable Racine and Office of the Mayor

BLUE WAVE CAMPAIGN

Contact Information

- For information regarding the storm water management and the bike path:

  Richard Jones

  Commissioner of Public Works / City Engineer
  (262)636-9121
  richard.jones@cityofracine.org

- For information regarding beach management practices such as grooming and grading:

  Donnie Snow
  Director
  (262) 636-9131
  donnie.snow@cityofracine.org

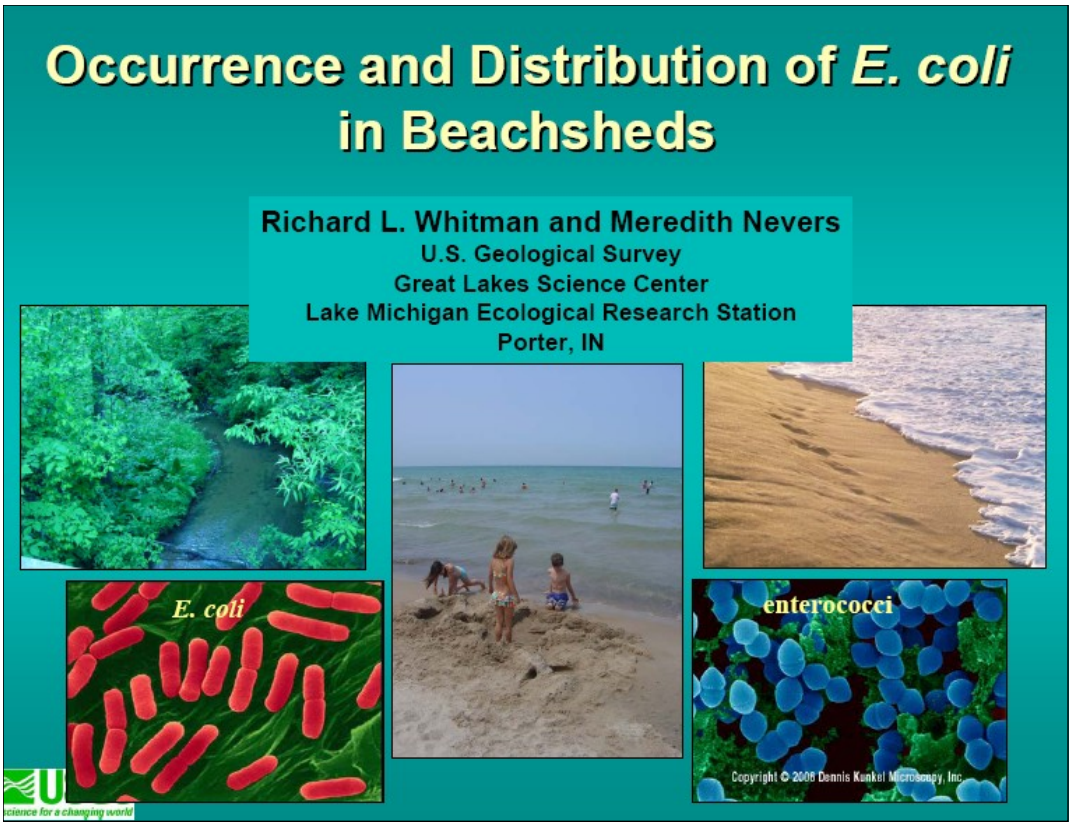

Acknowledgements
City of Racine Departments of Health, Public Works, and Parks, Recreation and Cultural Services
Paul Burdick
Sustainable Racine
Office of the Mayor
Dr. Richard Whitman, USGS
Dr. Sandra McLellan, UW-Milwaukee WATER Institute
Drs. Dan Mason and Joy Marburger, NPS
Dr. John Skalbeck, UW-Parkside
Keep Our Beaches Open
St. Catherine's High School Environmental Science Club
WI DNR
Root-Pike Watershed Initiative Network
S.C. Johnson Fund
WI Department of Health and Family Services

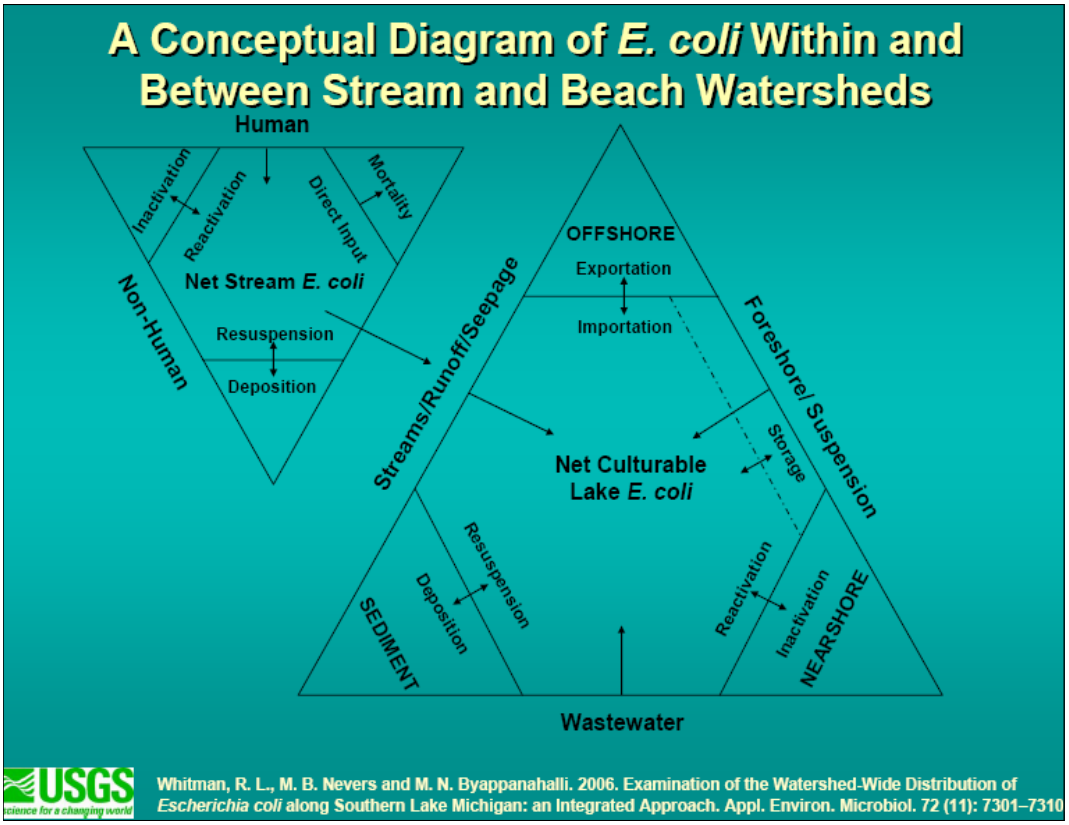
Richard Whitman

Occurrence and Distribution of E. coli in Beachsheds

Abstract: Beaches along the Indiana coast of Lake Michigan have experienced an increase in the number of beach closures due to high levels of *E. coli* bacteria, an indicator of potential sewage contamination and associated pathogens. Research on Burns Ditch, Portage, Indiana, has shown that it contributes significant amounts of *E. coli* and associated bacteria to the near shore beach areas of southern Lake Michigan, but the extent of impact on the nearby beaches from increased bacteria counts has not been determined. The current monitoring program has been proven inadequate, particularly if samples are collected only periodically. The relationship between the high counts of bacteria in Burns Ditch, particularly during rain events, and *E. coli* counts at the beach has not been established, despite the known releases of untreated sewage into the waterway during measurable rainfall events. By examining indicator bacteria counts daily in Burns Ditch, and the four beaches to the west, along with ambient hydrometeorological conditions at several fixed stations, a multi-beach predictive model was developed that characterizes *E. coli* abundance and movement. The model developed incorporated lake conditions and ditch conditions during north and south winds and could explain 41% of the variation in E. coli. This was superior to current monitoring model, which often explains less than 1% of the E. coli variation. Model calibration and validation are imperative components of predictive modeling exercises due to seasonal and yearly variation. Predictive models may be a useful alternative to daily beach monitoring.

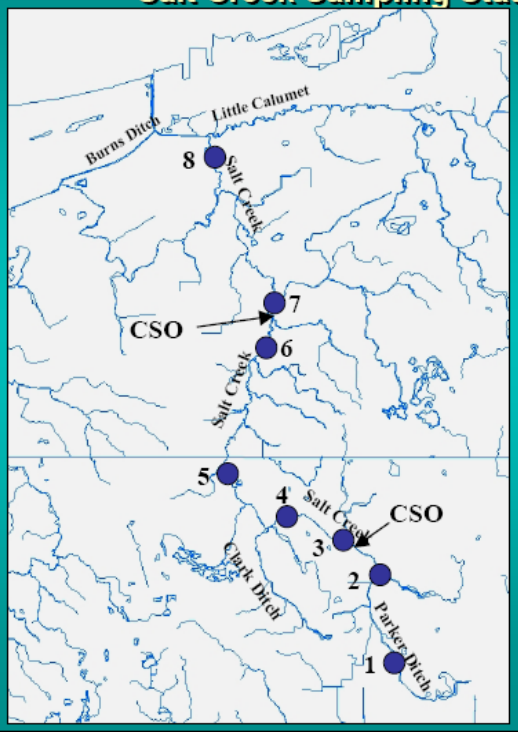
Presentation:





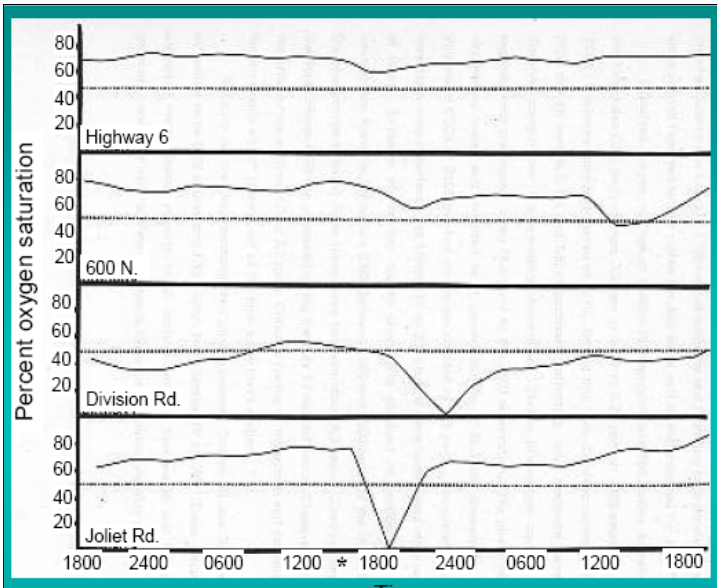
Evidence of Sewage Release

Salt Creek Sampling Stations



Whitman, R. L. 1981. Environmental quality assessment of Salt Creek Porter County, Indiana

USGS science for a changing world



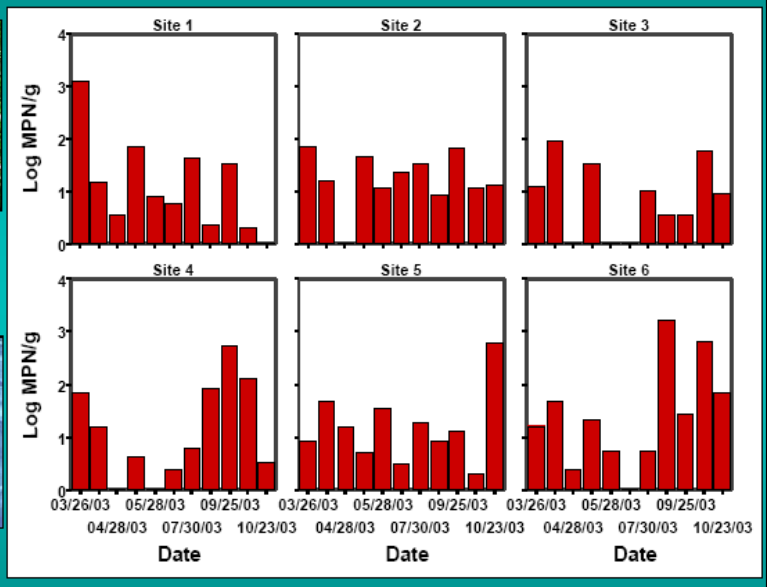
Two Day Diurnal Analysis of Oxygen Saturation, Salt Creek

Station	Distance from origin (km)	Disatnce from CSO (km)
Division Rd.	5.6	-5.1
Joliet Rd.	6.9	0.5
600 N.	14.4	12.6
Highway 6	17.4	17.4

* Rainfall event (0.2 in) July 26, 1980 from 1500 to 1640 h

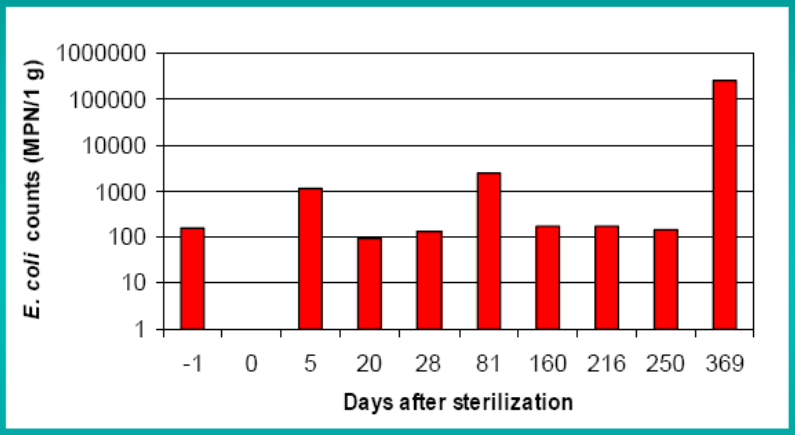
Whitman, R. L. 1981. Environmental quality assessment of Salt Creek Porter County, Indiana

E. coli is Commonly found in Forest Soils in All Seasons



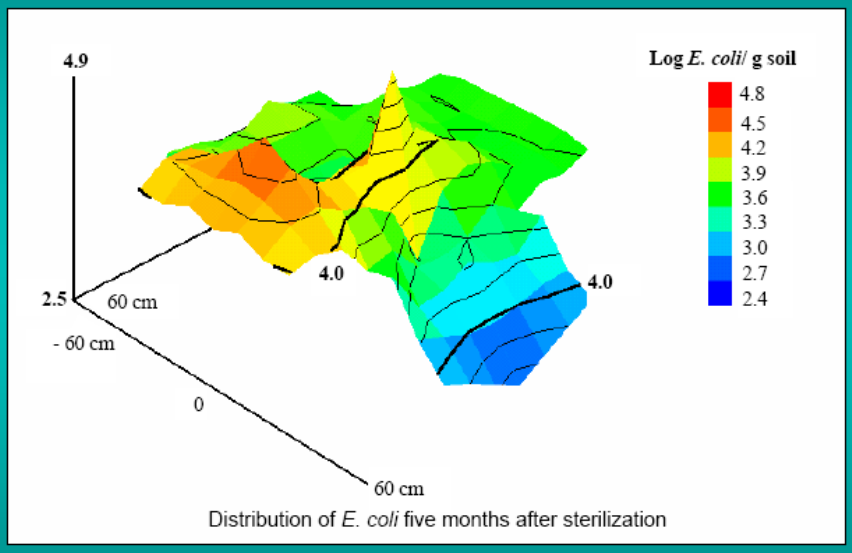
Byappanahalli M. N., R. W. Whitman, D. A. Shively, M. J. Sadowsky and S. Ishii. 2006. Population structure, persistence, and seasonality of autochthonous *Escherichia coli* in temperate, coastal forest soil from a Great Lakes watershed. Environmental Microbiology 8 (3), 504–513.

Recovery and Persistence of Soil *E. coli*



Adapted from: Whitman, R. L., M. B. Nevers and M. N. Byappanahalli. 2006. Examination of the Watershed-Wide Distribution of *Escherichia coli* along Southern Lake Michigan: an Integrated Approach. Appl. Environ. Microbiol. 72 (11): 7301–7310.

Distribution of Soil *E. coli*



Distribution of *E. coli* five months after sterilization

Whitman, R. L., M. B. Nevers and M. N. Byappanahalli. 2006. Examination of the Watershed-Wide Distribution of *Escherichia coli* along Southern Lake Michigan: an Integrated Approach. Appl. Environ. Microbiol. 72 (11): 7301–7310.

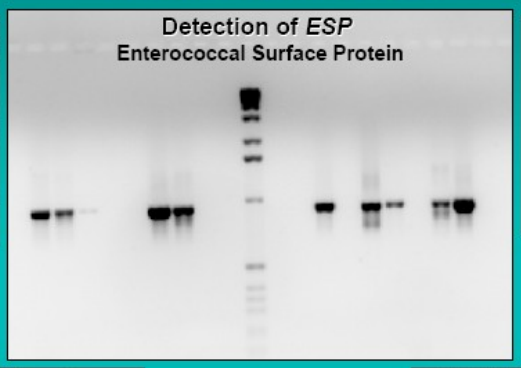
E. coli of Stream Water and Sediments are Correlated

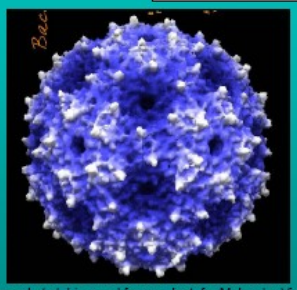
Stream Water-A
Stream Sand-B
Margin Sand-C
Sand @ 1 m from margin-D
Soil @ 4 m from margin-E

Connected Lines Indicate Significant Correlation (Spearman rho, p=0.05, n=15)

Whitman, R.W., M. Fowler, D.A. Shively and M.N. Byappanahalli. 2002. Distribution and characterization of E. coli within the dunes creek watershed, Indiana Dunes State Park. Report for: Indiana Department of Natural Resources, Indiana Dunes State Park.

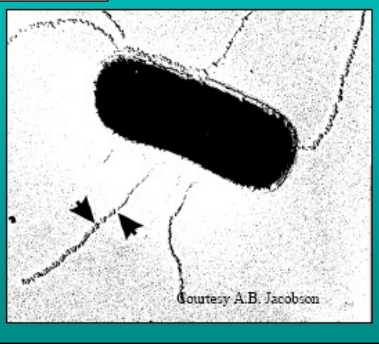
Storm Run-off Increases Detection of Human Markers



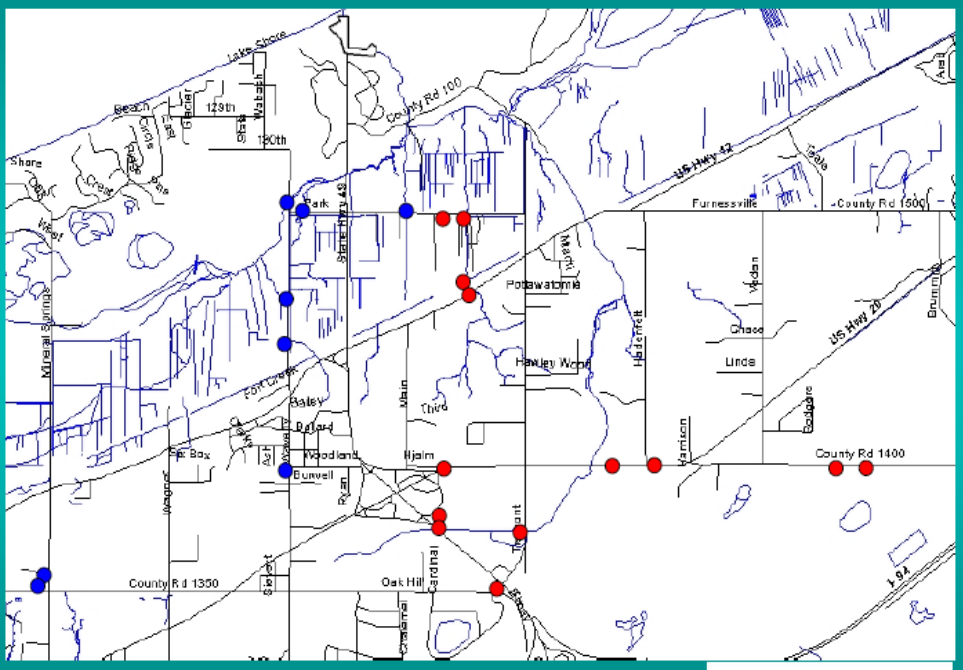


Valegard et al. Licensed for use, Inst. for Molecular Virology.
(linked to http://www.bocklabs.wisc.edu/images/ms2.jpg). 20 July 2001.

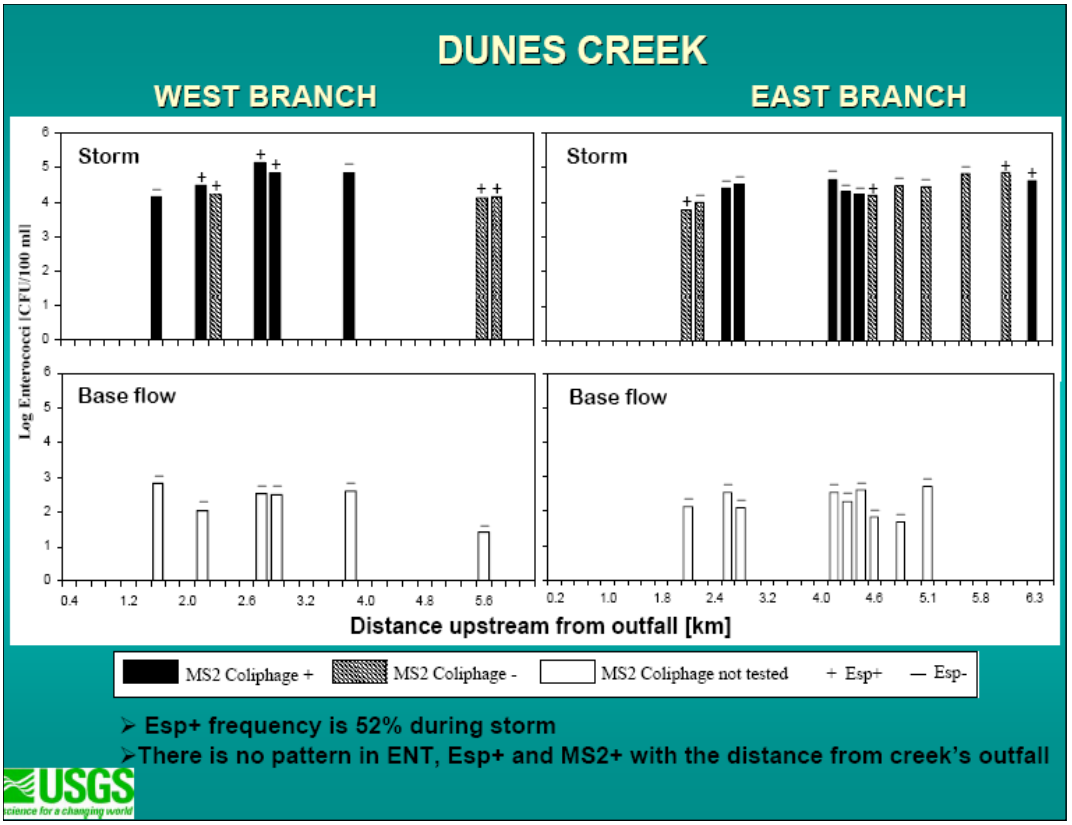
The detection of Male Specific FRNA Coliphage

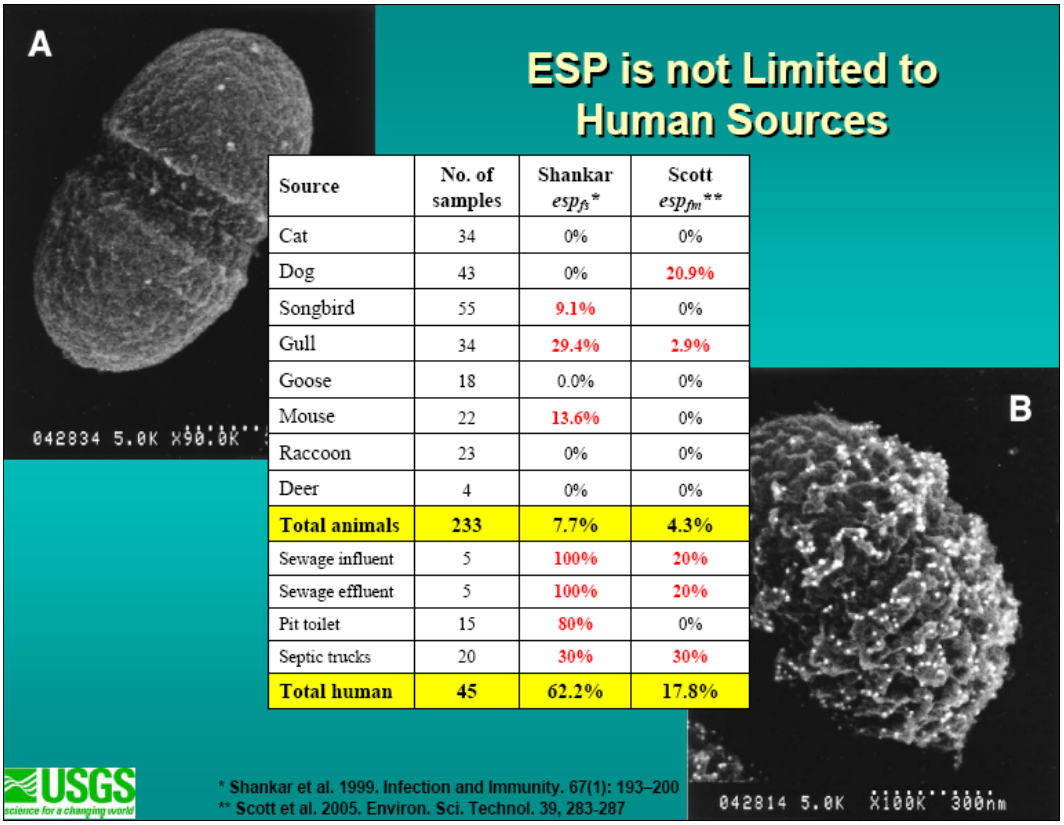


Dunes Creek Watershed

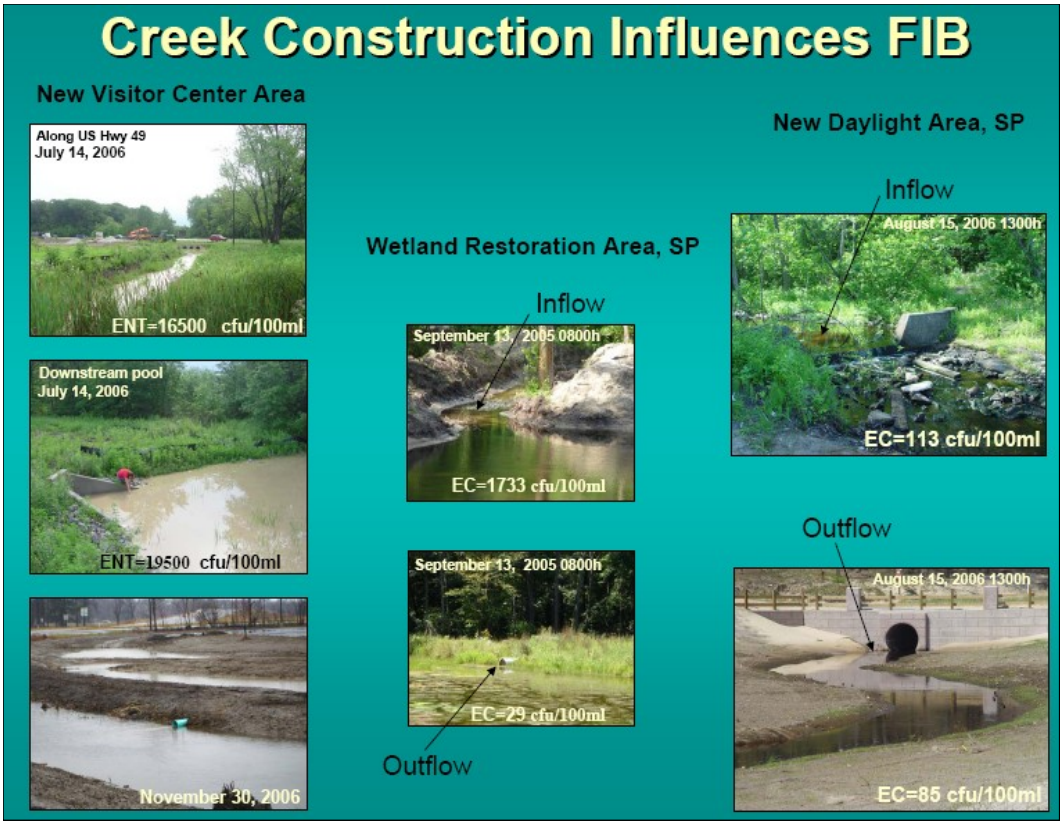


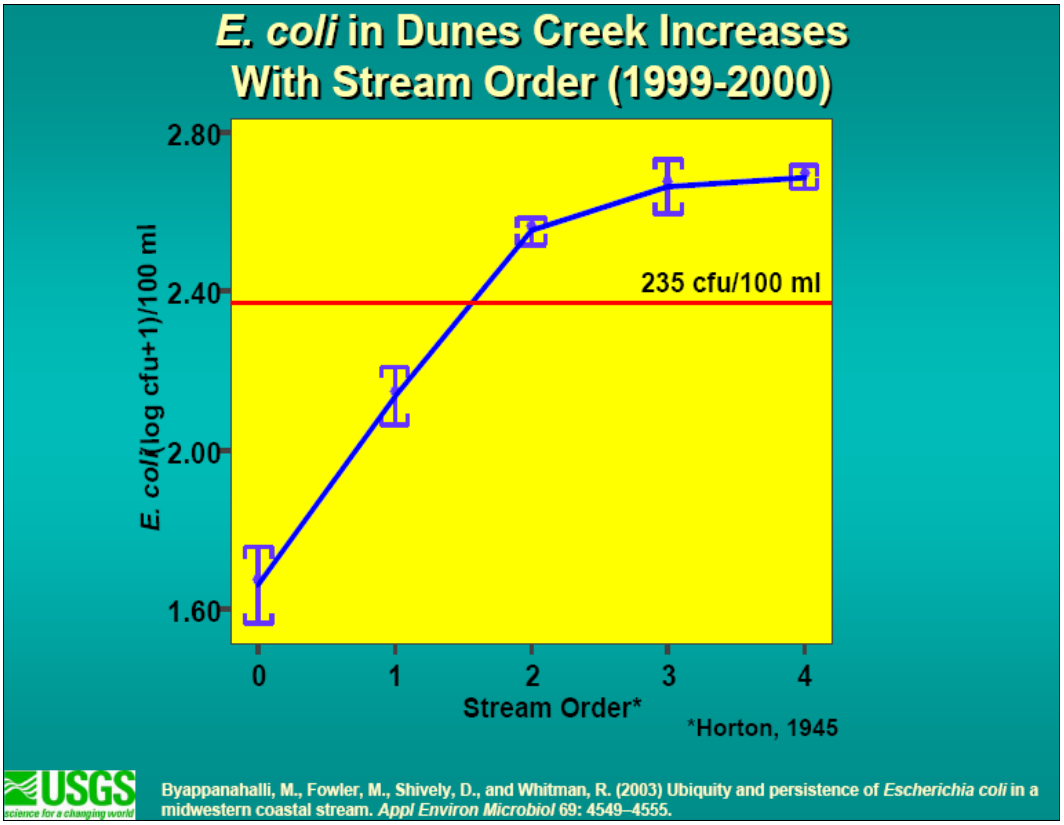
USGS science for a changing world





Source	No. of samples	Shankar esp_{fs}*	Scott esp_{fm}**
Cat	34	0%	0%
Dog	43	0%	20.9%
Songbird	55	9.1%	0%
Gull	34	29.4%	2.9%
Goose	18	0.0%	0%
Mouse	22	13.6%	0%
Raccoon	23	0%	0%
Deer	4	0%	0%
Total animals	**233**	**7.7%**	**4.3%**
Sewage influent	5	100%	20%
Sewage effluent	5	100%	20%
Pit toilet	15	80%	0%
Septic trucks	20	30%	30%
Total human	**45**	**62.2%**	**17.8%**

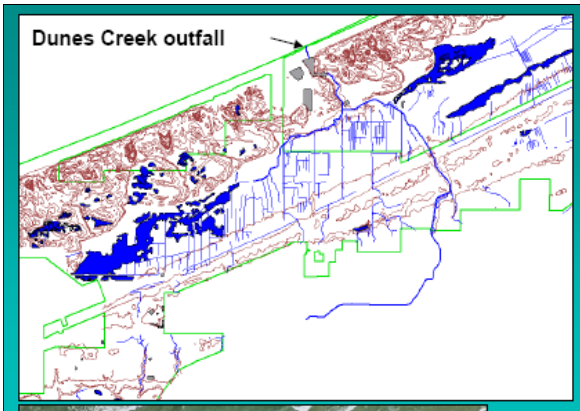

Creek Construction Influences FIB
New Visitor Center Area
Along US Hwy 49
July 14, 2006
ENT=16500 cfu/100ml
Downstream pool
July 14, 2006
ENT=19500 cfu/100ml
November 30, 2006
Wetland Restoration Area, SP
Inflow
September 13, 2005 0800h
EC=1733 cfu/100ml
September 13, 2005 0800h
EC=29 cfu/100ml
Outflow
New Daylight Area, SP
Inflow
August 15, 2006 1300h
EC=113 cfu/100ml
Outflow
August 15, 2006 1300h
EC=85 cfu/100ml

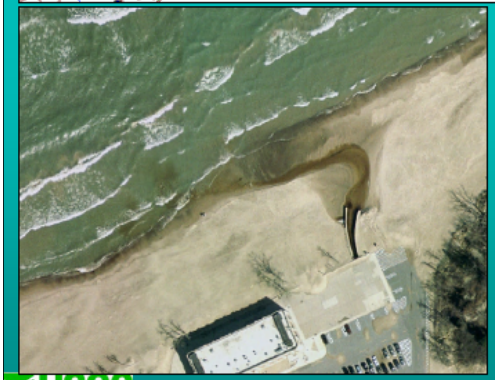

E. coli in Dunes Creek Increases With Stream Order (1999-2000)
2.80
2.40
2.00
1.60
E. coli (log cfu+1)/100 ml
235 cfu/100 ml
0
1
2
3
4
Stream Order*
*Horton, 1945
USGS
science for a changing world
Byappanahalli, M., Fowler, M., Shively, D., and Whitman, R. (2003) Ubiquity and persistence of Escherichia coli in a midwestern coastal stream. Appl Environ Microbiol 69: 4549–4555.

Sources of Beach *E. coli*




USGS science for a changing world





USGS science for a changing world

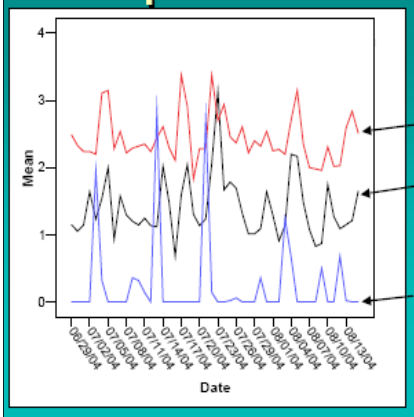
Dunes Creek Impacts State Park Beach Water

E. coli relationship	r Significance
East Side vs. West Side	0.291 <0.0001
East Side vs. Dunes Creek	0.403 <0.0001
West Side vs. Dunes Creek	0.319 <0.0001

Whitman, R.W., M. Fowler, D.A. Shively and M.N. Byappanahalli. 2002. Distribution and characterization of E. coli within the dunes creek watershed, Indiana Dunes State Park. Report for: Indiana Department of Natural Resources, Indiana Dunes State Park.

Burns Ditch Outfall at Ogden Dunes

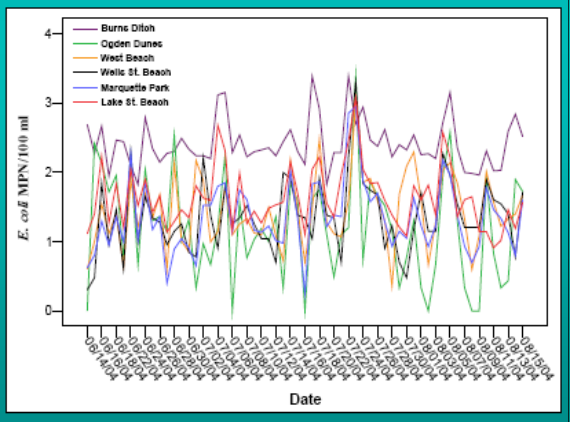
Impact of Burns Ditch on Westward Beaches



Burns Ditch log *E. coli*

Mean log beach *E. coli*

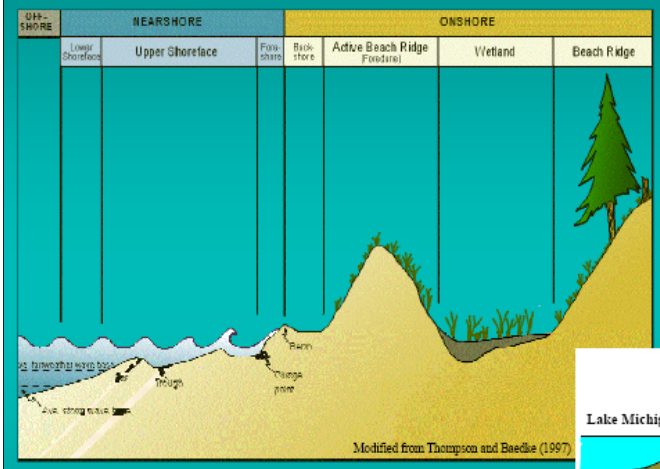
Total precipitation



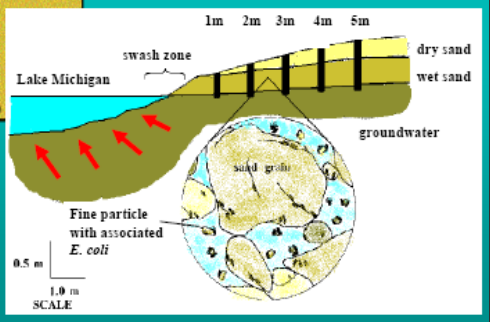
Nevers, M. B., and R. L. Whitman. 2005. Nowcast modeling of *Escherichia coli* concentrations at multiple urban beaches of southern Lake Michigan. Water Res. 39:5250–5260.

USGS science for a changing world

Local Non-Point Sources



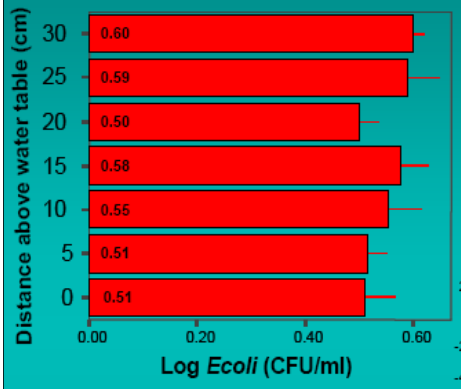
Bacteria can be integrated into foreshore sand from human and animal waste and plant material.

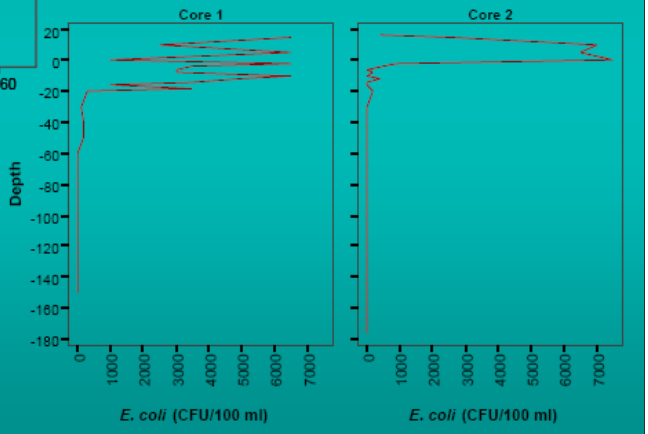


Sand harbors *E. coli* where it may persist and grow, making foreshore sand a potential sink or source to beach water.

USGS science for a changing world

Vertical Distribution of Sand *E. coli*





USGS science for a changing world

Whitman R. L., M. B. Nevers and M. N. Byappanahalli. 2006. Examination of the Watershed-Wide Distribution of *Escherichia coli* along Southern Lake Michigan: an Integrated Approach. Appl. Environ. Microbiol. 72 (11): 7301–7310.

E. coli in Sands Collected in Lake Water and 1 to 5 m Inland From Shore

ANOVA

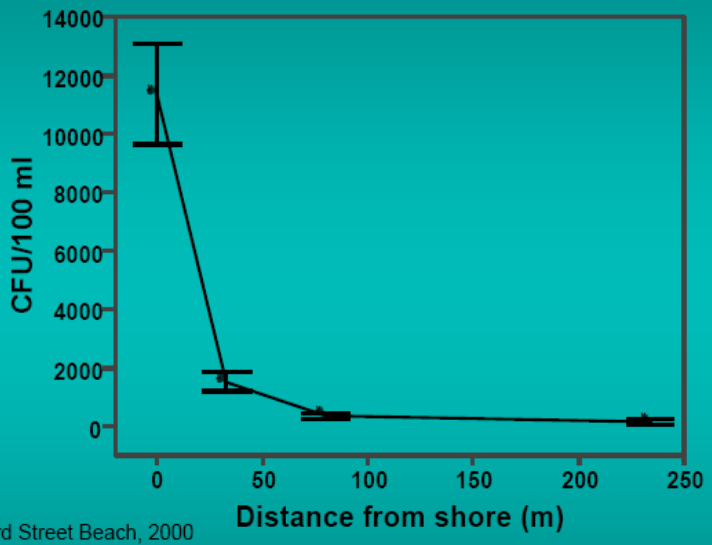
Log *E. coli* (CFU) in sand per 100 cc					
	sum of squares	df	mean square	F	Sig.
Between groups	9.041	5	1.808	4.457	0.001
Within groups	57.609	142	0.406		
Total	66.65	147			

Log *E. coli* (CFU) in sand per 100 ml

Duncan			
Distance		Subset for alpha = 0.05	
	N	1	2
lake water	25	1.9526	
5 m	25		2.42
4 m	25		2.4761
3 m	25		2.5335
2 m	25		2.7252
1 m	23		2.6307

Adapted from: Whitman, R. L., M. B. Nevers and M. N. Byappanahalli. 2006. Examination of the Watershed-Wide Distribution of *Escherichia coli* along Southern Lake Michigan: an Integrated Approach. Appl. Environ. Microbiol. 72 (11): 7301–7310.

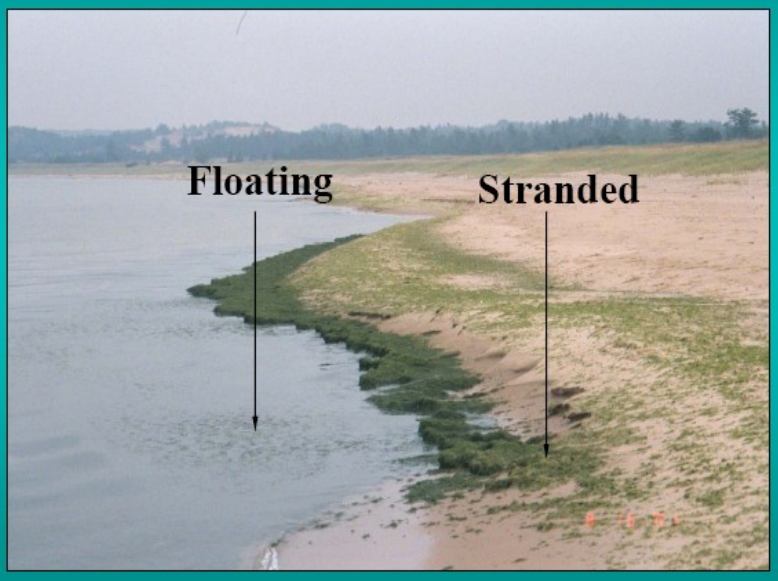
E. coli Concentrations are Highest in Sand and Diminish in Water With Distance From Shore



Chicago 63rd Street Beach, 2000

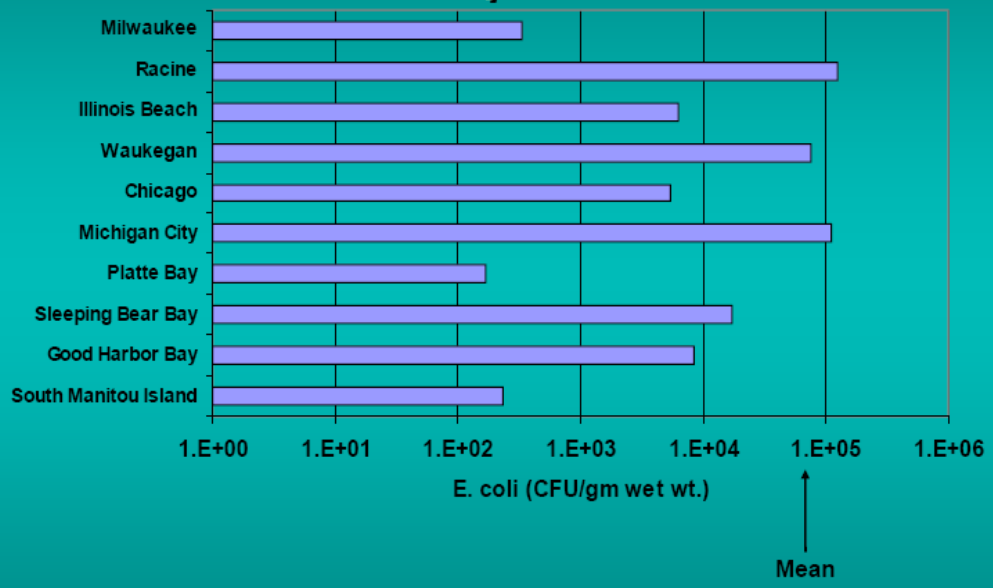
Whitman, R.L., Nevers, M.B., 2003. Foreshore sand as a source of Escherichia coli in nearshore water of a Lake Michigan beach. Appl. Environ. Microbiol. 69, 5555–5562.

Cladophora Commonly Accumulates in the Great Lakes



USGS science for a changing world

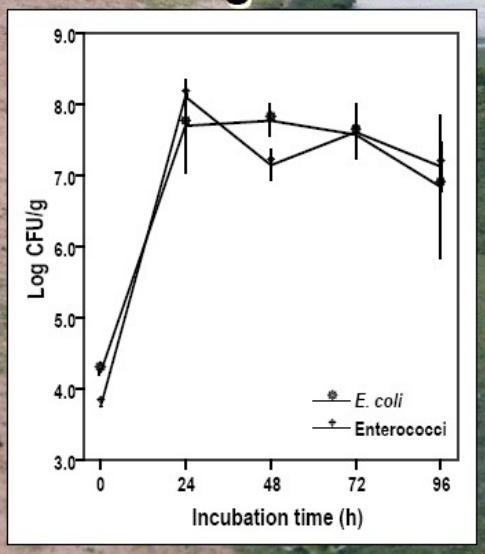
Concentration of *E. coli* Washed From *Cladophora*



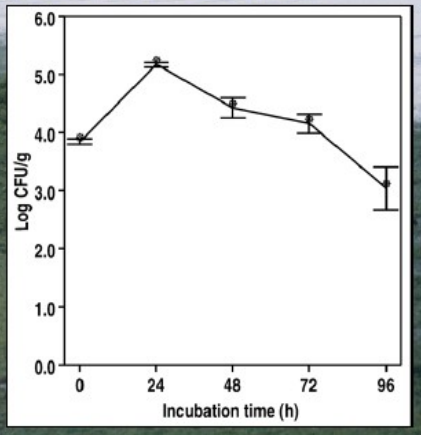
USGS science for a changing world

Whitman, R.L., Shively, D.A., Pawlik, H., Nevers, M.B. and Byappanahalli, M.N. (2003) Occurrence of Escherichia coli and enterococci in Cladophora (Chlorophyta) in nearshore water and beach sand of Lake Michigan. Appl. Environ. Microbiol. 69, 4714-4719.

Cladophora Harbors *E. coli* and May Be Integrated into Foreshore Sand



Persistence of *E. coli* and enterococci in Cladophora mats



Growth of *E. coli* in *Cladophora*-laden sand

Byappanahalli, M. N., D. A. Shively, M. B. Nevers, M. J. Sadowsky, and R. L. Whitman. 2003. Growth and survival of *Escherichia coli* and enterococci populations in the macro-alga *Cladophora* (Chlorophyta). FEMS Microbiol. Ecol. 46:203–211.

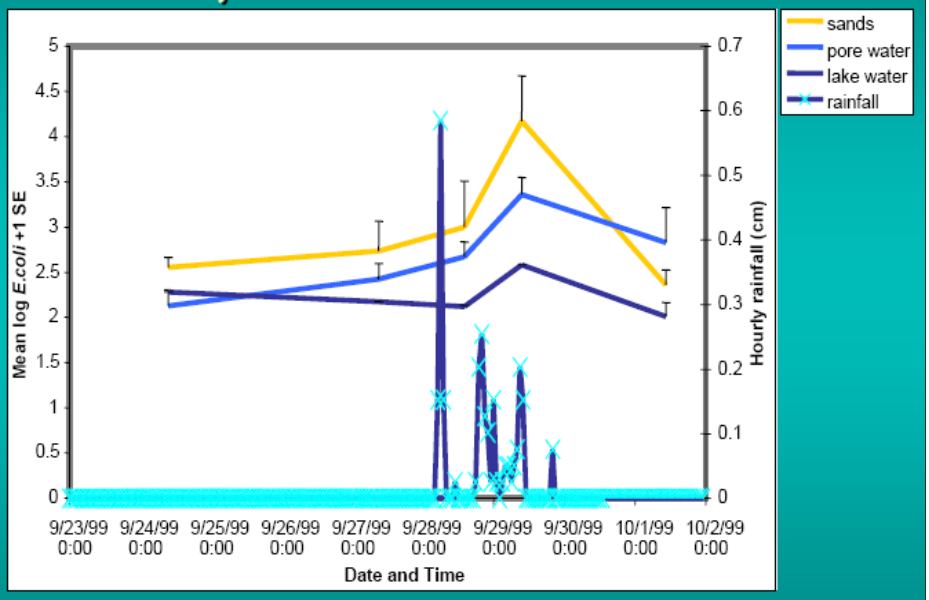
Gulls May Increase *E. coli* Concentrations in Sand and Beach Water

	# gulls lagged 1 day, P-values
Foreshore sand	0.000*
Submerged sand	0.046
45 cm water AM	0.004*
90 cm water AM	0.001*

Critical p value Bonferroni corrected =0.006

Whitman, R.W., T.G. Horvath, M.L. Goodrich, M.B. Nevers, M.J. Wolcott and S.K. Haack. 2001. Characterization of *E. coli*

E. coli concentrations of lake water, pore water, and sand with rainfall

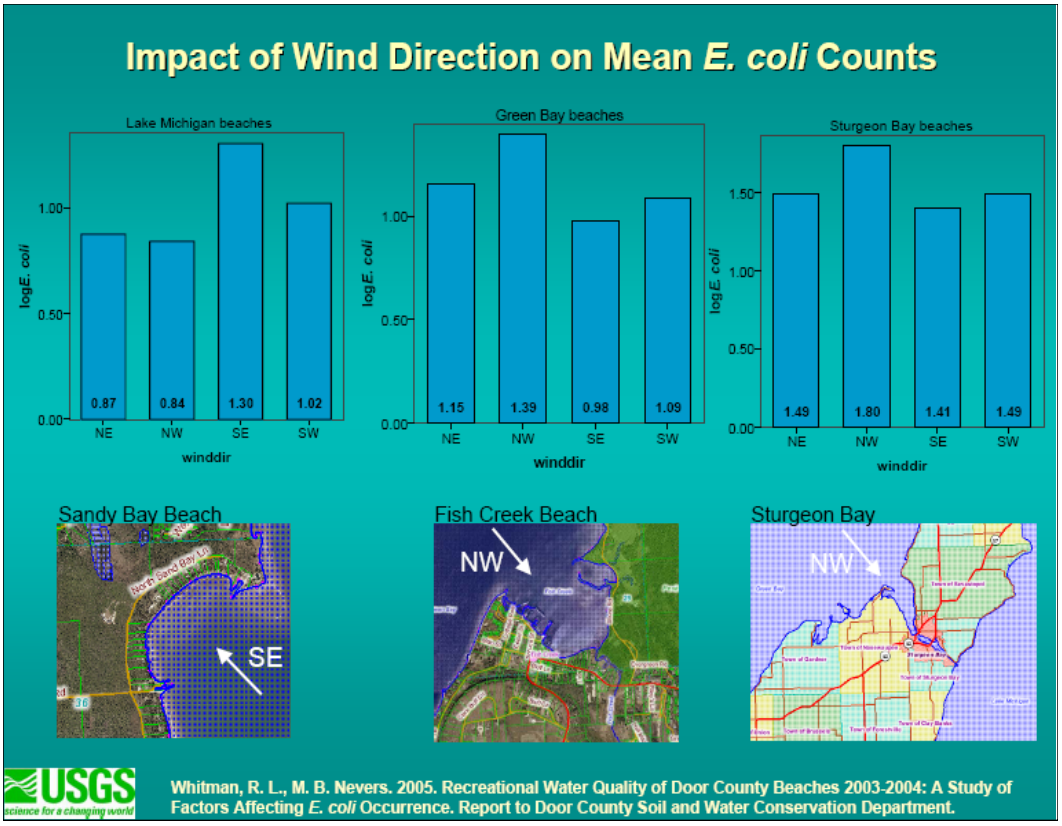


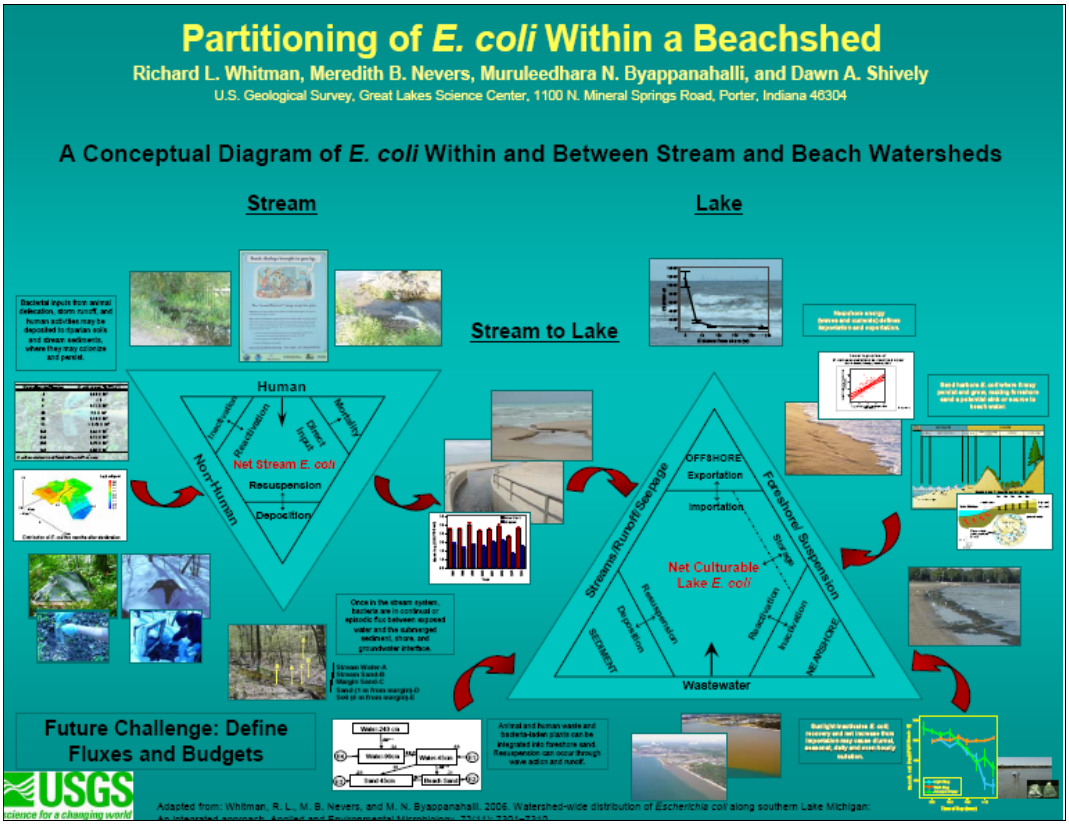
USGS science for a changing world

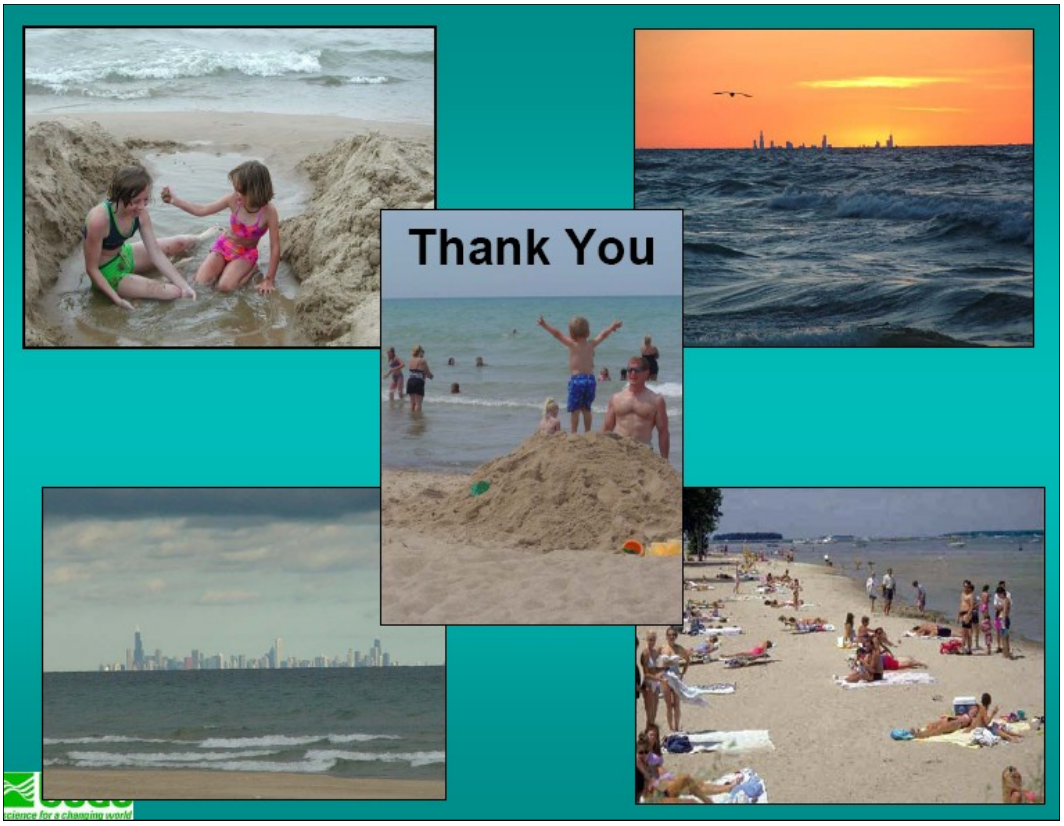
Whitman R. L., M. B. Nevers and M. N. Byappanahalli. 2006. Examination of the Watershed-Wide Distribution of *Escherichia coli* along Southern Lake Michigan: an Integrated Approach. Appl. Environ. Microbiol. 72 (11): 7301–7310.

Nearshore Energy (waves and currents) Can Influence Sources

USGS science for a changing world


Impact of Wind Direction on Mean E. coli Counts
Lake Michigan beaches
Green Bay beaches
Sturgeon Bay beaches
logE. coli
winddir
NE
NW
SE
SW
0.87
0.84
1.30
1.02
1.15
1.39
0.98
1.09
1.49
1.80
1.41
1.49
Sandy Bay Beach
Fish Creek Beach
Sturgeon Bay
NW
SE
USGS
science for a changing world
Whitman, R. L., M. B. Nevers. 2005. Recreational Water Quality of Door County Beaches 2003-2004: A Study of Factors Affecting E. coli Occurrence. Report to Door County Soil and Water Conservation Department.


Partitioning of E. coli Within a Beachshed
Richard L. Whitman, Meredith B. Nevers, Muruleedhara N. Byappanahalli, and Dawn A. Shively
U.S. Geological Survey, Great Lakes Science Center, 1100 N. Mineral Springs Road, Porter, Indiana 46304
A Conceptual Diagram of E. coli Within and Between Stream and Beach Watersheds
Stream
Lake
Stream to Lake
Human
Non-Human
Net Stream E. coli
Resuspension
Deposition
Net Culturable Lake E. coli
Streams/Runoff/Seepage
Foreshore Suspension
OFFSHORE
Exportation
Importation
SEDIMENT
NEARSHORE
Wastewater
Future Challenge: Define Fluxes and Budgets
USGS
science for a changing world
Adapted from: Whitman, R. L., M. B. Nevers, and M. N. Byappanahalli. 2006. Watershed-wide distribution of Escherichia coli along southern Lake Michigan.



Richard Whitman

Lake Michigan Ecological Research Station
Great Lakes Science Center
Porter, IN

Phone: (219) 926-8336 ext. 424
Fax: (219) 929-5792
Email: richard_whitman@usgs.gov

USGS
science for a changing world

Panel Discussion

A panel of experts from federal and local government organizations provided comments on the activities undertaken at the Presque Isle State Park beaches and the proposed future projects. The panel highly recommended as a first step that a matrix of proposed projects be developed to organize the efforts of the many organizations involved in E. coli related research. They also recommended a thorough analysis of potential pollution sources in the watershed including a categorical review of the Park's beaches; identification of sewer outfalls, septic discharges, and other wastewater outlets; evaluation of bathing load; and source tracking using multiple methods such as markers and spatial sampling.

Other recommendations made by individual panelists included:

- Addressing the issue of birds on the beach as a source of E. coli by enacting a city ordinance against feeding the birds, increasing the number of trash receptacles, or using overhead wires to discourage the birds from landing on the beach.

- Investigate the impact of resuspended sediment as a source of E. coli particularly when reversal in water currents or wind direction occurs.

- Water samples should be collected consistently in terms of technique and timing. The recommended timing for sampling is in the early morning before sunlight deactivates the bacteria.

- Split water samples should be collected and analyzed using multiple methods (e.g. Q-PCR, plating, etc.).

- The majority of studies done on E. coli indicate that sources are local.

- As sources are identified begin remediation and do not wait until all possible contributors are known. Implement rain gardens, retention basins, and porous pavement to slow the flow of water.

- Include in the investigation sampling of stormwater outfalls during dry weather and groundwater.

- The streams feeding into the Lake need to be monitored for flow.

References

Erie County Department of Health. *Presque Isle State Park-Bathing Beach Contamination Report*. June 1989.

Erie County Department of Health. *Presque Isle State Park-Bathing Beach Contamination Report*. June 1990.

Erie County Department of Health. *Presque Isle State Park-Bathing Beach Contamination Report*. June 1991.

The Pennsylvania Code: Bathing Beach Contamination. <http://www.pacode.com/secure/data/028/chapter18/s18.28.html>

Pennsylvania Department of Conservation and Natural Resources: Presque Isle State Park Map. <http://www.dcnr.state.pa.us/stateparks/parks/presqueisle_maps.aspx>

Attendees

Heidi Bauman
MN Pollution Control Agency
525 S. Lake Ave, Suite 400
Duluth, MN 55802
Phone: 218-723-4953
E-mail: heidi.bauman@pca.state.mn.us

Holly Best
Presque Isle State Park
301 Peninsula Dr.
Erie, PA 16505
E-mail: hbest@state.pa.

Salvatore Cali
University of Illinois
UIC-SPHW 2121 W. Taylor St
Chicago, IL 60613
Phone: 312-996-5722
E-mail: scali@uic.edu

Jerry Covert
Regional Science Consortium
301 Peninsula Dr., Suite 9
Erie, PA 16505
E-mail: jbcovert1@regsciconsort.com
Phone: 814-835-6975

Eliza Czolowski
DEP
230 Chestnut St
Meadville, PA 16335
Phone: 814-332-6876
E-mail: czolowe@allegheny.edu

Rob Darner
USGS
6480 Doubletree Ave
Columbus, OH 43229
Phone: 614-430-7700
E-mail: radarner@usgs.gov

Justin Dewitte
IL Dept. of Public Health
525 W. Jefferson St
Sprigfield, IL 62761
Phone: 217-782-5830
E-mail: Justin.dewitte@illinois.gov

Rick Diz
Gannon University
530 Shawnee Dr.
Erie, PA 16505
Phone: 814-871-7633
E-mail: diz@gannon.edu

Doug Ebert
ECDH
606 W. 2nd St
Erie, PA 16507
Phone: 814-451-6745
E-mail: c-debert@state.pa.us

John Finster
ECDH
95 Franklin St
Buffalo, NY 14127
Phone: 716-858-7762
E-mail: finsterj@erie.gov

Tony Foyle
Penn State Erie
PSU– Erie Station Rd
Erie, PA 16563
Phone: 814-898-6277
E-mail: afm11@psu.edu

Donna Francy
USGS
6480 Doubletree Ave
Columbus, OH 43229
Phone: 614-430-7769
E-mail: dsfrancy@usgs.gov

Andy Glass
ECDH
606 W. 2nd St.
Erie, PA 16507
Phone: 814-451-6701
E-mail: aglass@ecdh.org

Jim Grazio
PA DEP
301 Peninsula Dr., Suite 4
Erie, PA 16505
Phone: 814-217-9636
E-mail: jagrazio@state.pa.us

Sara Grisé
PA Sea Grant
301 Peninsula Dr., Suite 3
Erie, PA 16505
Phone: 814-217-9011
E-mail: sng121@psu.edu

Drew Howard
Gannon University
9388 Falls Rd.
Girard, PA 16417
Phone: 814-734-6566
E-mail: drewhoward@hotmail.com

Julie Kinzelman
City of Racine, WI
730 Washington Ave.
Racine, WI 53403
Phone: 262-636-9501
E-mail: juliekinzelman@cityofracine.org

Sally Kohler
PIAC
341 Shenley Dr
Erie, PA 16505
Phone: 814-455-1490

Sue Koppes
ECDH
606 W. 2nd St
Erie, PA 16507
Phone: 814-451-6700

Maryann Lafaire
US EPA—Region 5
77 W Jackson Blvd, M-9J
Chicago, IL 60604
Phone: 312-353-8685
E-mail: lafaire.maryann.epa.gov

AJ Lang
1026 Villa Sites
Harborcreek, PA 16421
Phone: 814-899-7100
E-mail: berttree@hotmail.com

Beth Leamond
US EPA
1200 Penns Ave NW MC4305T
Washington, D.C. 20460
Phone: 202-566-0444
E-mail: leamond.beth@epa.gov

Harry Leslie
Presque Isle State Park
301 Peninsula Dr, Suite 1
Erie, PA 16505
Phone: 814-833-7424
E-mail: hleslie@state.pa.us

Ron Lybrook
DEP
230 Chestnut St.
Meadville, PA 16335
Phone: 814-332-6894
E-mail: rlybrook@state.pa.us

Marti Martz
PA Sea Grant
301 Peninsula Dr., Suite 3
Erie, PA 16505
Phone: 814-217-9015
E-mail: mam60@psu.edu

Ed Masteller
TREC
301 Peninsula Dr
Erie, PA 16505
Phone: 814-217-9016
E-mail: e11@psu.edu

Steven Mauro
Mercyhurst College
5134 Mary Jo's Way
Erie, PA 16509
Phone: 814-824-3619
E-mail: smauro@mercyhurst.edu

Nicole Melkerson
Allegheny College/Regional Science Constortium
2422 Poplar St
Erie, PA 16502
Phone: 440-479-3096
E-mail: melkern@allegheny.edu

Meredith Nevers
USGS
1100 N. Mineral Springs Rd
Porter, IN 46304
Phone: 219-926-8336
E-mail: mnevers@usgs.gov

Eric Obert
PA Sea Grant
301 Peninsula Dr., Suite 3
Erie, PA 16505
Phone: 814-217-9018
E-mail: eco1@psu.edu

Ken Priest
Berrien Co. Health
S. m139 P.O. Box 706
Benton Harbor, MI 49023
Phone: 269-927-5623
E-mail: kpriest@berriencohlthdept.org

Jeff Quiril
ECDH
606 W. 2nd St
Erie, PA 16507
Phone: 814-451-7847
E-mail: jquiril@ecdh.org

Sean Rafferty
PA Sea Grant
301 Peninsula Dr., Suite 3
Erie, PA 16505
Phone: 814-217-9013
E-mail: sdr738@psu.edu

David Rockwell
USEPA
77 W. Jackson Blvd.
Chicago, IL 60604
Phone: 312-353-1373
E-mail: Rockwell.david@epa.gov

Mary Jo Rutkowski
DCNR
2727 E. 34th St.
Erie, PA 16505
Phone: 814-833-5049

Darrin Schaer
Berrion Co.
3880 Park
EA Claire, NC 40111
Phone: 269-944-5587
E-mail: dischaer@ameritech.net

Pamela Scharfe
Huron County Health Unit
777220 Lundun Rd, RR#5
Clinton, ON (Canada)
Phone: 519-482-3416
E-mail: pscharfe@huroncounty.ca

Amy Smith
ECCD
1927 Wager Rd
Erie, PA 16509
Phone: 814-825-6405

Erin Stuart
DEP
230 Chestnut St
Meadville, PA 16335
Phone: 814-332-6876
E-mail:estuart@state.pa.us

Bill Swift
Lake Latoka
420 Latonka Dr
Mercer, PA 16137
Phone: 724-475-6715

Freda Tarbell
DEP
230 Chestnut St
Meadville, PA 16335
Phone: 814-332-6816
E-mail: ftarbell@state.pa.us

Judy Taylor
DEP
230 Chestnut St.
Meadville, PA 16335
Phone: 814-332-6650
E-mail: jutaylor@state.pa.us

Gary Wall
USGS
425 Jordan Rd
Troy, NY 12180
Phone: 518-285-5621
E-mail: grwall@usgs.gov

Bob Wellington
ECDH (retired)
924 Sill Ave
Erie, PA 16505
Phone: 814-833-8760
E-mail: bobsbluewing@hotmail.com

Scott White
ECDH
606 W. 2nd St.
Erie, PA 16507
Phone: 814-451-6758
E-mail: c-swhite@state.pa.us

Richard Whitman
USGS
1100 N. Mineral Spring
Porter, IN
Phone: 219-926-8894
E-mail: rwhitman@usgs.gov

Holly Wirick
US EPA Region 5
77 W. Jackson
Chicago, IL 60613
Phone: 312-353-6704
E-mail: wirick.holiday@epa.gov