Adopt-a-Beach™ Quality Assurance Project Study Plan

Alliance for the Great Lakes

July 17, 2009

Project Managers:

Jamie Cross (Overall Program & MI Outreach)

Todd Brennan (WI Outreach)

April Mather (OH Outreach)

Frances Canonizado/Abby Crisostomo (IL, IN Outreach)

Quality Assurance Managers:

Stephanie Smith

Lyman Welch

Joel Brammeier

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3. *Distribution List*

   All Project Managers & Quality Assurance Managers will receive a copy of the QA Project Plan.

4. *Project/Task Organization*:

   Lyman Welch, as the Manager of Water Quality Program, will maintain the official, approved QA Project Plan, as well as working on projects to reduce sewage overflows, protecting recreational waterways, eliminating mercury and addressing pharmaceutical pollution. Lyman is a former attorney with the Chicago law firm of Mayer, Brown & Platt. Most recently, he served as Associate Director & General Counsel of the Mid-Atlantic Environmental Law Center at Widener University Law School in Wilmington, Delaware.

   Joel Brammeier, acting President for the Alliance for the Great Lakes, will continue to supervise this project. Since 2000, Joel has focused the Alliance's work on restoration of urban habitats and protection of the Great Lakes from the impacts of invasive species. Joel's current work includes implementing coastal habitat recovery along the Illinois shoreline and eliminating transfer of aquatic species between the Great Lakes and the Mississippi River. Joel received his Master of Science degree from the University of Michigan's School of Natural Resources & Environment in 1998 and his Bachelor of Science from Valparaiso University in 1996.

   Stephanie Smith, Education Program Director at the Alliance for the Great Lakes, will oversee the integration of the public beach component of this project into the Adopt-a-Beach™ program. Stephanie received a master's degree in environmental science, with a concentration in environmental education, from Antioch New England Graduate School in Keene, N.H. She also earned a teaching certificate in middle school general science. After graduate school, Stephanie taught hands-on 8th grade science in Lowell, Mass.

   Jamie Cross has been on staff with the Alliance since 1999, and serves as the acting manager of the Adopt-a-Beach™ program. In her role at the Alliance she supervises all aspects of the Adopt-a-Beach™ program – by which over 7,000 volunteers clean up the coastline along four out of the five Great Lakes. Jamie also manages outreach and training for volunteers in Michigan.

   Alliance outreach staff will manage volunteer outreach, training and beach visit scheduling. Current Alliance outreach staff include: Todd Brennan (WI), April Mather (OH), Frances Canonizado/Abby Crisostomo (IL and IN). Contact information for outreach staff is available on our website here: http://www.greatlakes.org/Page.aspx?pid=590

Data collection and input in the database will be done by volunteers. This information will then be used by Alliance staff, partner organizations (such as the US EPA), state EPA and Departments of Natural Resources, local health departments, volunteers and local municipal beach managers to begin to address these sources of pollution.

5. *Problem Definition/Background*

The Great Lakes, the largest freshwater body in the world, comprise 90% of the United States' fresh surface water and provide enormous ecological, economic, and social assets to area residents and to the hundreds of species that depend on them.

Beyond the environmental damage and health risks posed by pathogenic pollution, beach closings send a signal to residents that the Great Lakes are not healthy. Beaches, for the general public, serve as a barometer to assess the overall health and usability of the Great Lakes. When residents are turned away from beaches due to pathogenic pollution or other types of pollution such as foul smelling algae that can be harmful to human health discourages public use and involvement in them – reinforcing a stereotype that the lake is dirty and something to be avoided rather than cared for.

The Alliance is committed to developing procedures to help clean up our beaches along the Great Lakes. The Great Lakes Regional Collaboration's published strategy for improving Great Lakes health specifically addresses beach water quality. To that end, the EPA is working with states to develop beach sanitary surveys to identify specific sources of contamination at Great Lakes beaches. The Alliance for the Great Lakes developed this Project Study Plan and Adopt-a-Beach ™ Guide in accordance with EPA's Beach Sanitary Survey Tool so that beach managers can identify sources of contamination at their beaches, and address them accordingly. The EPA Beach Sanitary Survey Tool identifies technically sound and consistent approaches to identify pollution sources.

The Alliance for the Great Lakes Adopt-a-Beach ™ Project Study Plan is organized under EPA's recommended structure for QA Project Plans. Where necessary, this document refers to the Alliance's Adopt-a-Beach ™ Guide to further explicate data-gathering procedures. The structure falls into four major categories: project management, measurement/data acquisition, assessment and oversight, and data validation and usability.

6. *Project/Task Description*

The purpose of this study is to monitor beach and water quality through science-based testing and observations and data collection of water quality information such as bacteria, pH, temperature, longshore current, litter, etc. Sample collection

conditions including air temperature, wind direction, wind speed, time of day, sky conditions, wave conditions, current, and sample flow variations (during/post rain event vs. low flow) are considered in the evaluation of causal relationships. Volunteers are encouraged to use their data to evaluate their beach to determine beach needs to improve beach conditions. Visual assessments aid in determining local action for improvement of beach quality.

The year-round Adopt-a-Beach ™ program invites groups and individuals to commit to two to five visits over a year. At each visit, adopters collect and record the litter they find, the conditions at the beach, and test the water for *E. coli* levels using materials provided by the Alliance. Adopters then enter their data into the Alliance's online database. Program data is compiled and reviewed annually and semi-annually by the Alliance. After two or three visits, adopters are encouraged to examine their data and develop an action project to improve conditions at their beach. The Alliance helps adopters with this process.

All samples will be collected at public beaches or private shoreline with owner's permission. Beaches will be selected based on volunteer interest or need. For more precise location data, some volunteers have the ability to use the Global Positioning System (GPS) to calculate where they take their water sample, record their location and include this location in their completed report.

Once volunteers collect data, they can either send completed forms to the Alliance for the Great Lakes headquarters to be entered into a database, or they can enter it themselves in the same secure online database. We encourage adopters to use the online data entry system. Each year, Alliance for the Great Lakes will release a report that highlights important trends in findings. Data will be submitted to state agencies annually as it becomes available in digital form.

7. *Quality Objectives and Criteria*

All Petrifilm will be used or disposed of prior to their expiration dates. Petrifilm, Whirl-Paks and pipettes will be provided by Alliance for the Great Lakes to ensure quality control. See further quality control measures for Petrifilm in the Routine Visit Form Guide, p. 5 (linked below).

Volunteers are given specific instructions on measuring wave height, longshore current, water quality, and other variables in the Routine Visit Form Guide based on EPA measuring standards. Site Coordinator instructions for quality control are also outlined in the Routine Visit Form Guide, p. 14.

8. *Special Training/Certifications*

The appropriate outreach staff is trained by the Alliance to oversee all volunteers.

The majority of volunteers go through in-person trainings which include a PowerPoint presentation and/or onsite training. Training includes testing trainee comprehension through demonstrating what they just learned. All procedures are outlined during the training sessions. During the training, expired Petrifilms are sometimes used or sampling is conducted in the field, which depends on location and weather conditions. All volunteers that register for the program receive a start-up kit which includes the Adopt-a-Beach ™ guide with instructions on monitoring and collection of data. The guide is also downloadable on our web site.

Training also specifies prescribed safety procedures. These include the use of gloves while sampling, cleansing of hands with alcohol wipes, or antiseptic lotion before and after visits, inclusion of a first aid kit at all sites, and exercising extreme caution when children are near the water. Please see attached training presentation (PowerPoint).

Trained team leaders supervise a volunteer's first real sampling event in order to confirm they are doing it correctly. Finally, the Alliance provides annual refresher training for volunteers.

9. Documentation and Records

The reporting format can be found in the Routine Visit Form Guide. Volunteers enter data into the online database or submit their data via the post to Alliance offices. Project managers enter data into the data entry system. Data collected online is downloaded on a regular basis to be stored in the organizational computer filing system. This database is backed up on a regular basis through Alliance general office operations. Quality Assurance Managers are responsible for keeping the most current copy of the approved QA Project Plan which is also provided to Alliance outreach staff. Alliance outreach staff are responsible for sending that QAPP to volunteer team leaders.

Measurement/Data Acquisition

1. Sampling Process Design (Experimental Design)

All field methods and quality assurance steps are specified in the Routine Visit Form Guide before data collection. The data collection is largely based on EPA's beach sanitary survey protocol. Parameters to be sampled were chosen based on relevance to water quality in the Great Lakes system and ease of measurement. The data collection includes information on several parameters relevant to beach water quality, including wave height, longshore current speed & direction, pH, bacteria e. coli & coliform, temperature, odor, and turbidity. Information is also collected on the amount of litter on the beach, oily sheens, algae in the water and along the beach, wildlife and dead birds. Biological assessment is limited to

bacteria testing and counts of wildlife on the beach to align with the EPA beach survey procedure. Fish and macroinvertebrate data are not collected.

The total number of samples is based on the number of volunteers willing to survey the beaches. If volunteers schedule a time to sample and the beach is inaccessible due to weather or other purposes, volunteers will reschedule their visit. For examples of critical data versus data for informational purposes, please refer to the Routine Visit Form Guide.

In addition to data collected on the Routine Visit Form, Alliance volunteers collect data on litter found on the beach. Volunteers use a Litter Monitoring Form to collect information on 46 specific debris items such as cigarettes, tampons, condoms, beverage containers, firework debris, etc. Volunteers also have an option to write in additional items of concern found during their visit.
All data is subject to review by project managers and outreach staff.

2. *Sampling Methods*

Volunteer samplers measure water temperature, pH, Coliform and *E. coli* in water. Coliform bacteria and *E. coli* will be monitored using a Petrifilm, a pipette, and a Whirl-Pak bag. The Alliance provides Petrifilm plates to monitor *E. coli* and coliform bacteria. We use the Petrifilm in a manner that is deemed reliable through a comparative Grand Valley State University study. (Attached). Whirl-Pak bags, small sterile plastic bags, are used to take the water sample, and sterile pipettes are also used to ensure the quality of the test. Expired Petrifilms are discarded. Collection methods and quality control measures are outlined in the Routine Visit Form Guide, pp 5-6.

Measurement methods for wave height, longshore current, bather load, pollution sources, wildlife, speed of current and algae and litter observations can be found in the Routine Visit Form Guide, pp. 3-4, 8-14.

3. *Sample Handling and Custody*

Water samples are collected using sampling pole or by wading out into the water, conscious of water flow and avoiding contamination. Two samples are taken using two separate Whirl-Pak bags to draw water for each Petrifilm. Samples are taken from where water is at least one meter deep. The Whirl-Pak is opened just before collecting the sample to avoid contamination. The water sample is placed on the Petrifilm while at the beach. A sterile pipette is used to withdraw 1 milliliter of water from the Whirl-Pak and is added onto the pink circle of the Petrifilm. Plates are stored in a sealable bag in a dark area and incubated (35°C or 95°F) in a horizontal position with the clear side up for 24+ hours. If temperature cannot be controlled, the Petrifilm is sealed in a bag at room temperature or warmer, out of direct sunlight, for 48 hours. After the sample is taken, the

Petrifilm is placed in a sealable bag. Used Petrifilms are sterilized using one ml of bleach and placed in a sealed plastic bag and disposed of properly in the garbage.

The Routine Visit Form Guide requires samples to be identified by date, time, location and number of volunteers. Volunteers enter this information directly and generally electronically into the Alliance's database.

4. *Analytical Methods*

Quality of the water is assessed using the Environmental Protection Agency's water quality standards for safe swimming (no more than 235 *E. coli* colonies per 100 ml of water).

See the Routine Visit Form Guide for other details of specific performance criteria for general beach conditions, pH and other water quality measures, bather load and pollution sources.

5. *Quality Control*

Petrifilm, Whirl-Paks and pipettes will be provided by Alliance for the Great Lakes to ensure quality control. Alliance staff may conduct reviews of data for outliers or extreme variability and follow-up with volunteers when unusual results are found. Missing data will be listed as "Blank" or "Not Entered" by the data reporting system.

6. *Instrument/Equipment Test, Inspection and Maintenance*

Alliance staff inspects Petrifilm, pipettes, and Whirl-Pak bags before they are sent to volunteers to ensure they are in good working condition and have not expired. Volunteer Team Leaders will check items upon receipt for visible damage.

7. *Instrument/Equipment Calibration and Frequency*

N/A

8. *Inspection/Acceptance for Supplies and Consumables*

Petrifilm, Whirl-Paks and pipettes will be provided by Alliance for the Great Lakes and inspected by staff before shipment to volunteers. Volunteer Team Leaders will check items upon receipt for visible damage.

9. *Non-direct Measurements*

Our volunteers gather most of their data directly; however it is possible to get information on temperature, rainfall, and bather volume through non-direct measurements using beach-based resources (lifeguard data, etc.). We use this

data when it is difficult to measure directly due to volume issues (bathers) or a time-delay in gathering the data (measuring rainfall).
See the Routine Visit Form Guide pp 1, 2 & 8 for further detail.

10. Data Management

Each volunteer team will complete a Routine Visit Form and Litter Monitoring Form during every visit to a collection site. An example of these forms is attached. Once data is collected by volunteers, they enter data into the Alliance's database.

All collected data will be submitted to the appropriate state EPA. We would like to work with Great Lakes states to make the data in our database available for state EPA databases.

Assessment and Oversight

1. Assessments and Response Actions

Assessment scheduling is managed by Alliance outreach staff in each state. Volunteer Team Leaders conduct assessments in the field and document site visit results in online database. The number and frequency of assessment activities depends on volunteer availability.

2. Reports to Management

Volunteer Team leaders may include comments in data reports entered into the database system. Alliance staff reviews the data in preparing annual reports.

Data Validation and Usability

1. Data Review, Verification and Validation

Project Data is reviewed by Alliance staff. Staff reaches out to team leaders if data appears highly variable.

2. Verification and Validation Methods

The Alliance recommends volunteers conduct a follow-up visit and assessment if data shows unusual results. Interpretation of data should include analysis of sample results comparing differences over time at the same sample location.

3. Reconciliation with User Requirements

The Alliance tests for *E. coli* using a method reasonably certain to provide accurate validated data. See attached GVSU study for further information.

Relevant Documents

Adopt-a-Beach™ Routine Visit Form
http://www.greatlakes.org/Document.Doc?id=379

Adopt-a-Beach ™ Litter Monitoring Form
http://www.greatlakes.org/Document.Doc?id=378

Adopt-a-Beach™ Guide
http://www.greatlakes.org/Document.Doc?id=380

Adopt-a-Beach™ Training Presentation (PowerPoint)
To be sent in separate file

Vail, J.H. R. Morgan, C.R. Merino, F. Gonzales, R. Miller, and J. L. Ram. *Enumeration of waterborne Escherichia coli with petrifilm plates: comparison to standard methods*. GVSU Water Resources. March 20, 2003.

QAQC Plan Attachments

Adopt-a-Beach™ Routine Visit Form

http://www.greatlakes.org/Document.Doc?id=379

Adopt-a-Beach ™ Litter Monitoring Form

http://www.greatlakes.org/Document.Doc?id=378

Adopt-a-Beach™ Guide

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Adopt-a-Beach™ Routine Visit Form

Answer these questions during your beach visit. Use our companion Adopt-a-Beach™ Guide for question by question instructions on how to complete the form.

If you have questions about Adopt-a-Beach™, contact *adoptabeach@greatlakes.org*.

What to do with your data:

- Enter your results online in the Adopt-a-Beach™ pages at ***www.greatlakes.org/adoptabeach*** by logging into your personal account.
- If you don't have an Adopt-a-Beach™ account, create an account by visiting Adopt-a-Beach™ at ***www.greatlakes.org/adoptabeach***.
- If you don't have internet access, mail your results to Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417 or fax to 616-850-0765

Beach name and location (city and state)

Adopt-a-Beach™ team name

Team Leader

Visit date

Visit time of day (e.g. 11:00 a.m.)

Number of volunteers

Estimated time spent completing the Routine Visit Form

Describe the boundaries of the beach area you have adopted using fixed objects, street names or other fixed reference points. Some groups have adopted a portion of a beach area and some groups have adopted an entire beach.

I. General Beach Conditions

1. Air temperature (Round to the nearest degree.) _____

☐ **Celsius** ☐ **Fahrenheit** (Check type of measurement taken.)

2. Wind direction ☐ **No wind** ☐ **S** ☐ **SE** ☐ **SW** ☐ **N** ☐ **NE** ☐ **NW** ☐ **E** ☐ **W** (Check the answer that applies.)

3. What is the wind speed? (Circle one of the options below.) *See Beaufort Wind Scale detailed in the Routine Visit Form Guide.

Knots	Under 1	1-3	4-6	7-10	11-16	17-21	22-27	28-27	34-40
Description	Calm	Light air	Light breeze	Gentle breeze	Moderate breeze	Fresh breeze	Strong breeze	Near gale	Gale

4. When was the most recent rain event? (If it lasted more than one day, check the appropriate answer.) Consider that 24 hours = 1 day, 48 hours = 2 days and 72 hours = 3 days.

☐ Less than 24 hours ago ☐ Less than 48 hours ago

☐ Less than 72 hours ago ☐ More than 72 hours ago ☐ I don't know

5. Describe the rain event, if one has occurred in the past 72 hours (3 days).

☐ Misting ☐ Light rain ☐ Steady rain ☐ Heavy rain

☐ No rain event in the past 72 hours ☐ I don't know Other (e.g. snow, hail) describe: _____

6. If it has rained within the past 72 hours and you have a rain gauge at the beach, measure the amount of rain in inches or centimeters. (If you do not have a rain gauge please select no rain gauge.)

_____ in/cm (round to nearest 10th degree) ☐ No rain gauge

7. What are the current sky conditions? (Check one of the options below.)

Sky condition	Sunny	Mostly sunny	Partly sunny	Mostly cloudy	Cloudy
Amount of cloud coverage	No clouds	1/8 to 1/4	3/8 to 1/2	5/8 to 7/8	Total coverage

8. What is the current wave height in feet? (Check one of the options below.) Wave height is determined by measuring the distance between the crest (tallest point of the wave) to the trough (the lowest point of the wave) just lakeward of where the waves are breaking.

☐ No waves ☐ Waves less than 1 foot ☐ 1-2 feet ☐ 3-4 feet

☐ 5-6 feet ☐ 6-8 feet ☐ Over 8 feet

9. Describe the intensity of the waves. (Check one of the options below.)

☐ Calm ☐ Medium ☐ Rough

10. Longshore current: What is the amount of time _____ (in seconds) that it takes your floatable object to travel 10 meters. See Routine Visit Form Guide for instructions on how to measure the longshore current.

To determine the speed of the longshore current use the following equation:

10 meters ÷ by _____ time in seconds = _____ speed in meters per second

Example #1: 10 meters ÷ 30 seconds = .33 meters per second
Summary: Your floatable object moves 10 meters in 30 seconds. Therefore, the speed of the longshore current is .33 meters per second.

Example #2: 10 meters ÷ 40 seconds = .25 meters per second
Summary: Your floatable object moves 10 meters in 40 seconds, therefore the speed of the longshore current is 0.25 meters per second.

11. What is the direction of the longshore current? _____ (The longshore current runs parallel to the beach.)

☐ No current ☐ S ☐ SE ☐ SW ☐ N ☐ NE ☐ NW ☐ E ☐ W

12. Did you measure the longshore current? ☐ Yes ☐ No

13. Comments or resason you did not measure the longeshore current: _____

_____

14. General comments and observations about general beach conditions: _____

_____

_____

II. Water Quality

15. Some adopters may have the ability to measure water pH. If you are one of these adopters, please enter the pH level of the water. _____

16. If a pH reading was taken, please indicate the testing method you used. (Check the appropriate answer.)

☐ pH paper ☐ pH liquid solution ☐ pH meter

17. Bacteria sample results. Please refer to the Adopt-a-Beach™ guide for specific protocol and to determine your results. Your water sample should be taken at the same location in the middle of your adopted beach where 24-30 inches (2 – 2.5 feet) of water depth is first encountered and at 6 inches below the surface. If you are using the Alliance's test kits, fill in: *E. coli* – water (blue dots) and Coliform (red dots). Write in "not tested" for any test you do not conduct and include an explanation in the "comments" section.

Did your team do a bacteria test? ☐ Yes ☐ No

Sample #1

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots				

Sample #2

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots				

18. Comments or resason you did not conduct the water test: _____

_____

Some adopters have the ability to use the Global Positioning System (GPS) to calculate where they take their water sample. If you can use a GPS device to measure your sample location, provide your results here:

_____ ° _____ 'N (Latitude) _____ ° _____ 'W (Longitude)

19. What is the water temperature? _____ (Round to the nearest degree.)

☐ Celsius ☐ Fahrenheit (Check type of measurement taken.)

20. Have you noted any changes in water color from previous visits? (Check the appropriate answer.)

☐ Yes ☐ No ☐ This is our first beach visit

If you have noted a change in color, describe it. _____

21. Describe the odor of the water. (Check one or more of the options below.)

☐ No smell ☐ Sewage ☐ Algae (decaying plants) ☐ Fishy

☐ Sulfur (rotten eggs) ☐ Musty (wet soil) ☐ Other If other, describe: _____

22. Describe the turbidity (cloudiness) of the water. (Check one of the options below.) Observe turbidity at the same location you take your water sample.

☐ Clear ☐ Slightly cloudy ☐ Cloudy ☐ Opaque (solid)

23. Additional observations about water quality: _____

III. Bather Load (Number of people at the beach)

24. For people IN or ON the water, *not on the beach*, describe the type of activity and number of people involved.
(Use the table below to fill in the number of people involved in the activities listed below.)

Type of activity	Sailing/ power boating	Canoeing/ kayaking	Jet skiing	Fishing	Surfing	Windsurfing/ kite boarding	Swimming/ wading	Other (in and on the water)
Number of people engaged in this activity								

If other, describe the type of activity IN or ON the water:

_____

25. What is the total number of people ON the beach, *not in the water*, EXCLUDING YOUR GROUP? _____

26. General comments and observations at the beach:

_____

_____

_____

_____

_____

If you don't have internet access, mail your results to Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417 or fax to 616-850-0765

IV. Potential Pollution Sources

27. Identify any of these features up to 500 feet from the beach boundary that are visible. (See Adopt-a-Beach™ Guide to determine speed of current.)

Is this feature in your beach boundary?	River/Stream/ Channel ☐ Yes ☐ No	Pond(s) ☐ Yes ☐ No	Wetland(s) ☐ Yes ☐ No	Outfall (pipe discharging to the beach) ☐ Yes ☐ No
Amount (Check the answer that applies)	☐ Gushing ☐ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle
Speed of Current (in seconds)				
Water Color	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear
Characteristics (Check all that apply)	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water

If other source (e.g. dump, boat launch), please describe the feature identified: _____

_____

28. Bacteria sample results. If you did not have any features as outlined in question 27, you can skip this question. If you did have any of the features listed in question 27, use one of your *E. coli* test kits provided by the Alliance to test for bacteria in water at the feature listed above. Please refer to Adopt-a-Beach™ Guide #17 for specific protocol and to determine results. If you are using the Alliance's test kits, fill in: *E. coli* – water and Coliform. Write in "not tested" for any test you do not conduct and include an explanation in the "comments" section.

Did your team do a bacteria test for pollution sources listed for question 27? ☐ Yes ☐ No

Sample #1 (from the water feature at your adopted beach.)

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots				

29. General comments about your water test:

_____

_____

Some adopters have the ability to use the Global Positioning System (GPS) to calculate where they take their water sample. If you can use a GPS device to measure your sample location, provide your results here:

_____ ° _____ 'N (Latitude) _____ ° _____ 'W (Longitude)

30. Are there floatables (items floating in the water) present? ☐ Yes ☐ No
If yes, please describe the floatables present. (Circle one or more of the options below.)

Type	Street litter	Food-related litter	Medical items	Resin	Sewage-related	Building materials	Fishing related	Household waste
Example	Cigarette filters	Food packing, beverage containers	Syringes	Tiny plastic pellets	Condoms, tampons	Pieces of wood, siding	Fishing line, nets, lures	Household trash, plastic bags

31. Describe the amount of debris/litter on the beach. (Circle one of the options below.)

Amount	**No Litter**	**Very Low**	**Low**	**Medium**	**High**
Percentage on beach	0%	1-10%	11-20%	21-50%	51% and up

32. Do you see an oily sheen on the water and/or along the beach? (Check the appropriate answer.) ☐ Yes ☐ No

a. If yes, describe. _____

b. Can you identify the source? _____

33. Describe the amount of algae *in the water near the shore* along the length of your adopted area of beach.

Amount	**No Algae**	**Low**	**Medium**	**High**
Percentage	0%	1-20%	21-50%	51% and up

34. Describe the amount of algae *on the beach* along the length of your area of adopted beach.

Amount	**No Algae**	**Low**	**Medium**	**High**
Percentage	0%	1-20%	21-50%	51% and up

35. Describe the type of algae *along the water's edge and on the beach.* (Check one or more options below.)

☐ No algae ☐ Attached to rocks, stringy ☐ Blobs of floating materials

☐ No obvious mass of materials ☐ Matted ☐ Other

If other, describe: _____

36. Describe the color of the algae *along the water's edge and on the beach.* (Check one or more options below.)

☐ No algae ☐ Light green ☐ Blue green ☐ Dark green ☐ Yellow

☐ Red ☐ Brown ☐ Other If other, describe: _____

37. Please describe and count the presence of wildlife and domestic animals on the beach.

Type	Geese	Gulls	Dogs	Other
Number				

If other, describe: _____

38. If you find dead birds along the shoreline, fill in the number found in the appropriate box below.
(Refer to Adopt-a-Beach™ Guide for identification.)

Type	Common loon	Herring gull	Ring-billed gull	Double crested cormorant	Horned grebe	Other
Number found dead						

If other, describe: _____

39. How many dead fish are on the beach? _____

40. If there are other dead animals on the beach (not including fish and birds) list them here.

Type of animal	How many

41. How many garbage and recycling containers are there within 500 feet of your adopted beach boundary?
(If there are no garbage containers on your beach enter 0.)

Garbage Containers	Recycling Containers

42. Describe use and condition of garbage containers at this location. (Check one or more of the options below.)

☐ No garbage cans ☐ Designated carry in carry out policy ☐ Garbage cans present with no lids

☐ Garbage cans present with lids ☐ Garbage cans well maintained ☐ Garbage cans overflowing or knocked over

43. Please add any additional comments or notes about your visit here:

_____

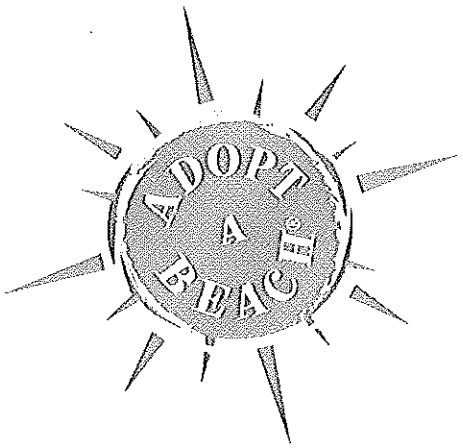
_____

44. Did you take any action as a result of your beach visit? For example: educate other about pollution, contact your park authority to ask them to empty trash cans more frequently.

☐ Yes ☐ No If yes, describe: _____

Thank you for your time and dedication to keeping our beaches and shorelines healthy!

If you don't have internet access, mail your results to Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417 or fax to 616-850-0765



Alliance for the Great Lakes
Adopt-a-Beach™
700 Fulton Ave., Suite A
Grand Haven, MI 49417

Adopt-a-Beach™ Litter Monitoring Form

Please pick up everything you find. Record only the items found on the Litter Monitoring Form.

Pick up "pieces" of items, but do not record these fragments on the data card as this can distort the data totals.

What to do with your data:

- Enter your results online in the Adopt-a-Beach™ pages at **www.greatlakes.org/adoptabeach** by logging into your personal account.
- If you don't have an Adopt-a-Beach™ account, create an account by visiting Adopt-a-Beach™ at **www.greatlakes.org/adoptabeach**.
- If you don't have internet access, mail us your results to the address at left.
- Mail all completed sign-in sheets to the Alliance.

Team Leader:_____ Team Name: _____ Date:_____

Cleanup Site Name (beach, park, etc.): _____ State:_____

Category of Cleanup (choose one): ☐ Great Lakes Coast ☐ Inland (river, lake, stream, tributary, lake)

Type of cleanup: ☐ Shoreline/Beach ☐ River/Stream/Tributary ☐ Lake

Distance cleaned: _____ in miles or kilometers Total weight of trash collected: _____ pounds or kilograms

Estimated time spent on cleanup: _____ Number of volunteers: _____

List animals entangled in debris found during the cleanup. Tell us what they were entangled in (fishing line, rope, net, etc.). Check if they were found dead or alive.

Type of Animal	Entangled in		
_____	_____	☐ Dead	☐ Alive
_____	_____	☐ Dead	☐ Alive
_____	_____	☐ Dead	☐ Alive

What were the most peculiar items you collected?_____

_____

_____

_____

ALLIANCE FOR THE GREAT LAKES
ADOPT A BEACH®
Visit www.greatlakes.org

17 N. State Street
Suite 1390
Chicago, IL 60602

Phone: 312-939-0838 ext. 228
Fax: 312-939-2708
adoptabeach@greatlakes.org

ITEMS COLLECTED: Please pick up ALL debris that you find. Only record information for the items listed below. Keep a count of your items using tick marks and enter the item total in the box.
Example: [8] **Beverage Cans** ____IIII III____

Shoreline and Recreational Activities

- ☐ Bags (paper) _____
- ☐ Bags (plastic) _____
- ☐ Balloons _____
- ☐ Beverage bottles (plastic) 2 liters or less _____
- ☐ Beverage bottles (glass) _____
- ☐ Beverage cans _____
- ☐ Caps, Lids _____
- ☐ Clothing, shoes _____
- ☐ Cups, plates, forks, knives, spoons _____
- ☐ Food wrappers/containers _____
- ☐ Pull tabs _____
- ☐ 6-pack holders _____
- ☐ Shotgun shells/wadding _____
- ☐ Straws, stirrers _____
- ☐ Toys _____

Waterway Activities

- ☐ Bait containers _____
- ☐ Bleach/cleaner bottles _____
- ☐ Buoys/floats _____
- ☐ Fish traps _____
- ☐ Crates _____
- ☐ Fishing line _____
- ☐ Fishing lures/light sticks _____
- ☐ Fishing nets _____
- ☐ Light bulbs/tubes _____
- ☐ Oil/lube bottles _____
- ☐ Pallets _____
- ☐ Plastic sheeting/tarps _____
- ☐ Rope _____
- ☐ Strapping bans _____

Smoking-Related Activities

- ☐ Cigarettes/cigarette filters _____
- ☐ Cigarette lighters _____
- ☐ Cigar tips _____
- ☐ Tobacco packaging/wrappers _____

Dumping Activities

- ☐ Appliances (refrigerators, washers, etc.) _____
- ☐ Batteries _____
- ☐ Building materials _____
- ☐ Cars/car parts _____
- ☐ 55-Gal. Drums _____
- ☐ Tires _____

Medical/Personal Hygiene

- ☐ Condoms _____
- ☐ Diapers _____
- ☐ Syringes _____
- ☐ Tampons/tampon applicators _____

Other Debris/Items of Local Concern

- ☐ Discarded food _____
- ☐ Firework debris _____
- ☐ Drug paraphernalia (crack pipes, bags, etc.) _____
- ☐ Misc. items, describe _____

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Fax: 312-939-2708
adoptabeach@greatlakes.org

Note to team leaders: Please tally your results onto a final data card and enter your data online at www.greatlakes.org/adoptabeach

ALLIANCE FOR THE GREAT LAKES

ADOPT A BEACH®

Photo: Lloyd DeGrane, Alliance for the Great Lakes

Alliance for the Great Lakes

Adopt-a-Beach™ Guide

Question by question instructions to assist adopters in completing the Adopt-a-Beach™ Routine Visit Form and Litter Monitoring Form.

ALLIANCE FOR THE GREAT LAKES

ADOPT A BEACH®

Alliance for the Great Lakes
Routine Visit Guide

Index

Adopt-a-Beach™ Program Contact information:

Michigan: Jamie Cross at 866-850-0745 ext. 12
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Wisconsin: Todd Brennan at 414-559-0317
or *tbrennan@greatlakes.org*

Ohio: April Mather at 216-630-8140
or *amather@greatlakes.org*

Adopt-a-Beach™ program headquarters: 312-939-0838 ext. 228
or *adoptabeach@greatlakes.org.*

Additional information: There is additional information available on our website at *www.greatlakes.org* and follow the Adopt-a-Beach™ sun.

Adopt-a-Beach™ Routine Visit Guide

Use this guide to help you answer the Adopt-a-Beach™ Routine Visit Form questions. Do not write directly on the guide. Put your responses on the Routine Visit Form and enter them online after your beach visit. This guide also includes instructions for completing the Litter Monitoring Form.

If you have questions about Adopt-a-Beach™, contact *adoptabeach@greatlakes.org* or your state coordinator.

Sandy St. Beach — Pebble, MI
Beach name and location (city and state)

Pebble High School 10th grade — Joe Beachy
Adopt-a-Beach™ team name — Team Leader

7/30/2008 — 11:00 am
Visit date — Visit time of day (e.g. 11:00 a.m.)

12 — 2 hours
Number of volunteers — Estimated time spent completing the Routine Visit Form

Describe the boundaries of the beach area you have adopted using fixed objects, street names or other fixed reference points. Some groups have adopted a portion of beach area and some groups have adopted an entire beach.

1/2 mile of either side of the beach pavilion - on the north side, to the parking lot and on the south side, to the bike path.

I. General Beach Conditions

1. Air temperature (Round to the nearest degree.) 76

☐ **Celsius** ☑ **Fahrenheit** (Check type of measurement taken.)

How to measure air temperature: Air temperature is typically measured at 1.5 meters (approximately 2 yards) above grassy surfaces. All air temperature readings are done in the shade. This is necessary to avoid excessive warming of the liquid in the thermometer due to the absorption of sun, which could give you an incorrect reading. If you don't have a thermometer to check for temperature check your local weather for air temperature. Some beaches post this information at their lifeguard stations.

Report air temperature in Fahrenheit or Celsius temperature scales, specifying which one was used. If both scales are available, Celsius is preferred because this scale was developed for and is most commonly used for scientific purposes.

2. Wind direction ☐ **No wind** ☐ **S** ☐ **SE** ☐ **SW** ☐ **N** ☑ **NE** ☐ **NW** ☐ **E** ☐ **W** (Check the answer that applies.)

How to measure wind direction: Wind directions are always reported as the direction from which the wind is coming. In other words, a north wind pushes air from the north to the south. Weathervanes or aerovanes are commonly used at many weather stations and airports to measure both wind direction and speed. The tail orients the instrument into the wind for direction, while the propellers measure the wind speed. Use surrounding objects such as the grass, trees, or other light objects (such as a piece of string held up into the air) affected by wind to determine wind direction.

3. What is the wind speed? (Circle one of the options below.) *See Beaufort Wind Scale for more details.

Knots	Under 1	1-3	4-6	7-10	11-16	17-21	22-27	28-27	34-40
Description	Calm	Light air	Light breeze	Gentle breeze	Moderate breeze	Fresh breeze	Strong breeze	Near gale	Gale

How to complete the wind speed chart: First you will have to determine the speed of the wind. Wind speed can be measured through simple observations using the Beaufort Wind Scale on the next page.

Beaufort Wind Scale

Wind in Knots	Description	Appearance of Wind Effects
Less than 1	Calm	Calm, smoke rises vertically
1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
4-6	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
7-10	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
11-16	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
17-21	Fresh Breeze	Small trees in leaf begin to sway
22-27	Strong Breeze	Larger tree branches moving, whistling in wires
28-33	Near Gale	Whole trees moving, resistance felt walking against wind
34-40	Gale	Whole trees in motion, resistance felt walking against wind

4. When was the most recent rain event? (If it lasted more than one day, check the appropriate answer.) Consider that 24 hours = 1 day, 48 hours = 2 days and 72 hours = 3 days.

☐ Less than 24 hours ago ☐ Less than 48 hours ago

☑ Less than 72 hours ago ☐ More than 72 hours ago ☐ I don't know

5. Describe the rain event, if one has occurred in the past 72 hours (3 days).

How to complete the rain event chart: The answer to this question is based on your general observation and knowledge of the most recent rain event. Check the appropriate answer.

☐ Misting ☐ Light rain ☑ Steady rain ☐ Heavy rain

☐ No rain event in the past 72 hours ☐ I don't know

Other (e.g. snow, hail) describe: _____

6. If it has rained within the past 72 hours and you have a rain gauge at the beach, measure the amount of rain in inches or centimeters. (If you do not have a rain gauge please select no rain gauge.)

_____ in/cm (round to nearest 10th degree) ☑ No rain gauge

How to answer the rain amount question: The rain gauge should measure the precipitation (rain, snow, etc.) that has fallen in the 24 hours prior to your beach visit. Some lifeguard stations have information on rainfall amounts at the beach. If you do not have access to this information, do not answer this question. If you do not have a rain gauge or have access to a rain gauge at your beach, please select no rain gauge.

7. What are the current sky conditions? (Circle one of the options below.)

Sky condition	Sunny	Mostly sunny	Partly sunny	Mostly cloudy	Cloudy
Amount of cloud coverage	No clouds 	1/8 to 1/4 	3/8 to 1/2 	5/8 to 7/8 	Total coverage 

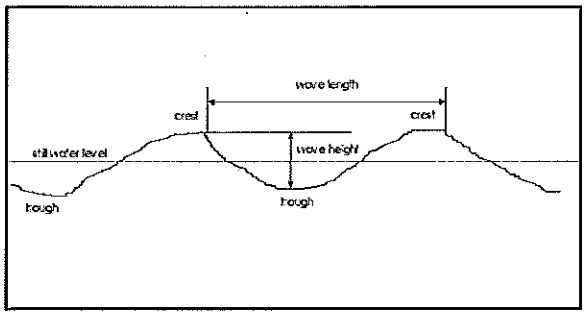
How to complete the sky conditions chart: The answer to this question is based on your general observations of the presence of clouds in the sky. Circle the sky condition that best describes your observations.

8. What is the current wave height in feet? (Check one of the options below.) Wave height is determined by measuring the distance between the crest (tallest point of the wave) to the trough (the lowest point of the wave) just lakeward of where the waves are breaking.

☐ No waves ☐ Waves less than 1 foot ☑ 1-2 feet ☐ 3-4 feet

☐ 5-6 feet ☐ 6-8 feet ☐ Over 8 feet

How to complete the wave height chart: First you must determine the height of the wave. Wave height is determined by measuring the distance between the crest (tallest point of the wave) to the trough (the lowest point of the wave) just lakeward of where the waves are breaking. See diagram below.



How to measure wave height — 2 options

1. While standing on the shore, you can estimate the wave height in feet. Have two observers independently estimate wave height and then average their results. Measure or estimate the height of at least five separate waves and then take the average.
2. If conditions are safe and the temperature is comfortable, you can measure wave height by carrying a graduated stick into the water to just lakeward of where the waves are breaking. Use the stick to record where the wave crest and the following wave trough hit the stick. The difference between the two is the wave height.

Alternately, you can visit the National Oceanic Atmospheric Administration Coast Watch Great Lakes web site at: *http://www.crh.noaa.gov/grr/marine/index.php*, which includes data on wave heights and click on a location near you under "nearshore forecasts". However, this site only records information for locations that have NOAA stations.

9. Describe the intensity of the waves. (Check one of the options below.)

☑ Calm ☐ Medium ☐ Rough

How to describe waves: To answer this question observe the waves at your beach and check the answer that best describes the waves.

To answer questions 10, 11 & 12 see instructions listed under question 14 in this guide "About measuring speed and direction of longshore current".

10. Longshore current: What is the amount of time 120 (in seconds) that it takes your floatable object to travel 10 meters.

To determine the speed of the longshore current use the following equation:

10 meters ÷ by 120 time in seconds = .083 speed in meters per second

Example #1: 10 meters ÷ 30 seconds = .33 meters per second
Summary: Your floatable object moves 10 meters in 30 seconds. Therefore, the speed of the longshore current is .33 meters per second.

Example #2: 10 meters ÷ 40 seconds = .25 meters per second
Summary: Your floatable object moves 10 meters in 40 seconds, therefore the speed of the longshore current is 0.25 meters per second.

11. What is the direction of the the longshore current? (The longshore current runs parallel to the beach.)

☐ No current ☑ S ☐ SE ☐ SW ☐ N ☐ NE ☐ NW ☐ E ☐ W

12. Did you measure the longshore current? ☑ Yes ☐ No

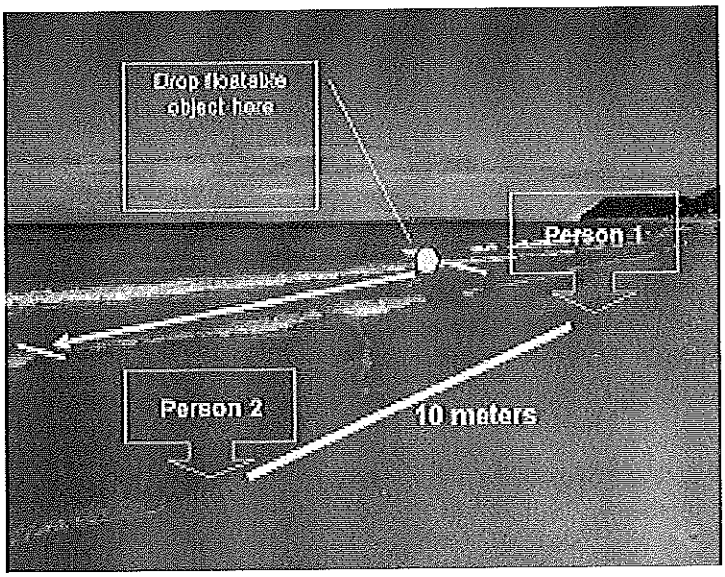
13. Comments or resason you did not measure the longeshore current: _____

_____

About measuring speed and direction of longshore current: Longshore current moves in a direction parallel to the shore. The measurement for longshore current speed is in meters per second. The current direction is reported by which way the water is flowing, for example, a westward current flows to the west.

To determine speed of a longshore current you will need the following materials:

- Meter stick (or other measuring device)
- A floatable object like an orange, tennis ball, baseball or driftwood of similar size and weight. The object you select should be relatively flat so that it has very little wind resistance and can flow freely in the current. Make sure to retrieve your object (if it is not part of the natural beach environment) before leaving the beach.
- Watch with a second hand or digital watch that records seconds



Procedure to measure speed of longshore current:

A. Measure off and draw a 10-meter line in the sand parallel to the water.

B. Position one person at each end of the line you have drawn. The person at the "beginning" of the line should assume the role of time keeper and have a watch with a second hand.

C. Throw your floatable object, just behind the line of breakers, approximately 2 meters outside of your measuring area away from your beginning line. Note: The longshore current is closer to the shore than you might expect! Both people should watch the object as it moves.

D. When the object passes the beginning of the line, the timekeeper starts timing.

E. When the object passes the person stationed at the end of the line, that person tells the timekeeper to stop timing. Record the time.

F. If time permits, repeat this process so you can calculate the average of multiple trials. You can repeat it in a different area along the beach as well.

G. Use the formula for speed = distance in meters ÷ time in seconds, to calculate the speed of the longshore current for all trials, and then calculate the average of the longshore current.

H. This procedure is not foolproof. If your floatable object does not move after a few minutes, try again. If you cannot get this to work at all, it could be because of weather conditions, or there might not be a longshore current at all.

How to measure the direction of the longshore current: Observe the direction that the floatable object (or driftwood) flows in the above procedure. If a current is going from north to south, the current direction is recorded as south or south-going; similarly, a current going from east to west is recorded as west or west-going. (This is the opposite of wind direction, which is recorded as the direction from which the wind is blowing).

14. General comments and observations about general beach conditions: _____

_____

_____

II. Water Quality

15. Some adopters may have the ability to measure water pH. If you are one of these adopters, please enter the pH level of the water. 7.5

How to complete pH question: If this applies to you, enter the pH result. If you are not already determining pH levels at your site, do not answer this question.

16. If a pH reading was taken, please indicate the testing method you used. (Check the appropriate answer.)

☑ pH paper ☐ pH liquid solution ☐ pH meter

How to complete pH testing method question: Check the appropriate answer if you are determining pH levels at your site.

17. Bacteria sample results. Please refer to the Adopt-a-Beach™ guide for specific protocol and to determine your results. Your water sample should be taken at the same location in the middle of your adopted beach where 24-30 inches (2 – 2.5 feet) of water depth is first encountered and at 6 inches below the surface. If you are using the Alliance's test kits, fill in: *E. coli* – water (blue dots) and Coliform (red dots). Write in "not tested" for any test you do not conduct and include an explanation in the "comments" section.

Did your team do a bacteria test? ☑ Yes ☐ No

Sample #1 (from the middle of your adopted beach area)

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots	1	5	Not tested	Not tested

Sample #2 (from the middle of your adopted beach area)

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots	1	5	Not tested	Not tested

18. Comments or resason you did not conduct the water test:

water test was taken at center of adopted beach area

Some adopters have the ability to use the Global Positioning System (GPS) to calculate where they take their water sample. If you can use a GPS device to measure your sample location, provide your results here:

_____ ° _____ 'N (Latitude) _____ ° _____ 'W (Longitude)

How to monitor for *E. coli* using the Alliance's *E. coli* test kit:
The Alliance will provide adopters with an *E. coli* water sampling kit prior to your beach visit. To receive an *E. coli* kit in time for your beach visit please alert the Alliance's Adopt-a-Beach™ team of your beach visit schedule at least two weeks in advance.

The Alliance provides:
- Whirl-Pak bags: small sterile plastic bag used to take the water sample
- Sterile pipettes: used to extract the 1 ml of water from the Whirl-Pak bag
- *E. coli* plates (Petrifilm for *E. coli* and coliform bacteria): Use to place 1 ml of water from your pipette in order to grow bacteria. DO NOT refrigerate your Petrifilm after it arrives in the mail. Store it at room temperate until you take your sample. PETRIFILM EXPIRES. Look for the written expiration date on the film. Discard expired Petrifilms.

You will need to provide:
- Gloves
- Sampling pole to use to take the water sample. This can be made from a fishing pole or an extension rod with a mop handle and alligator clips to hold the sampling bag. A PVC pipe with clips can also be used. You can also take a sample by wading out into the water without a sampling pole.
- Sealable bag to place the Petrifilm in after you have taken the sample

If you don't have internet access, mail your results to Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417 or fax to 616-850-0765

Health and Safety:
- Wear gloves while sampling!
- Cleanse hands with alcohol wipes, or antiseptic lotion.
- Bring a first aid kit with you to your site.
- Exercise extreme caution with students who are near the water.

Taking your water sample:
General: Take two samples using two separate Whirl-Pak bags to draw water for each Petrifilm.
- Wade into the water or put your sampling pole at least 20 feet away from swimmers and animals. If you wade into the water, face the horizon so the waves are less likely to wash bacteria from your body into your water sample.
- Avoid kicking up the bottom sediment of the sampling site. Pathogens can stick to solids, and excessive re-suspension might produce results that exceed local advisory limits.
- Avoid the "swash" zone, the area of low wave or water near the shore.
- Take samples from where water is at least one meter deep.
- To open the Whirl-Pak bag carefully tear off the top just before collecting the sample. Be careful not to touch the top or inside of the bag as bacteria from your hands can alter test results.
- Fill the sampling bag half full with water by sweeping down through the water in a U-shaped motion, 6 inches below the surface, moving away from your body. *(Samples can be collected from a pier or bridge with a sampling pole.)*

Placing your water sample on the Petrifilm: (This should be done while you are at the beach.)
- Open the packaging on the pipette by rolling back the plastic around the bulb side. Be careful not to touch the narrow tip of the pipette as your hands can contain bacteria that can alter test results.
- Use the sterile pipette, to withdraw 1 milliliter of water from the sample. To withdraw water, squeeze the bulb of the pipette and place the narrow end of the pipette in the water sample. Slowly release the bulb until you get 1 milliliter of water. Take the pipette out of the water without releasing the bulb. The water sample will remain in the pipette. Tip the pipette up so the water sample rests in the bulb.
- Carefully peel back the top film of the Petrifilm. Be careful not to contaminate the film by touching it with your fingers.
- Release the 1 milliliter sample onto the center of the pink circle of the Petrifilm.
- Slowly roll the cover of the Petrifilm over the water sample on the pink circle. Do not rub or touch the top of the Petrifilm after you have placed the film on top of the sample as it will alter your results.
- Store the plates in a sealable bag in a dark area and incubate them (35ºC or 95ºF) in a horizontal position with the clear side up for 24+ hours.

Preparation:
- Prepare a warm, dark place (35ºC or 95ºF) to incubate (see below) your sample. If you are not able to incubate your Petrifilm at the recommended temperature, keep the Petrifilm in a sealed bag at room temperature or warmer for 48 hours (as opposed to 24 hours). Keep the Petrifilm in a dark place as direct sunlight can kill the bacteria colonies. Without incubation, it is not as likely that you will see the gas bubbles that form, which confirm that the blue dots are *E. coli* colonies. However, you should still see blue and red dots appear on the Petrifilm which should indicate coliform and *E. coli* bacteria colonies.
- Write the date and sample number in the corner of the Petrifilm plate.
- Observe consistent labeling and recording protocol for samples. On the bag, include the date, time, site, and collector's initials.

Incubation:
Use an incubator or prepare a warm place (35ºC or 95ºF) to incubate your sample If you are not able to incubate your Petrifilm at the recommended temperature, keep the it in a sealed bag at room temperature or warmer, out of direct sunlight, for 48 hours (as opposed to 24 hours).

Reading your *E. coli* test results:
- Bacteria colonies will appear on the Petrifilm as red and blue dots. Blue dots represent *E. coli.* If you don't have any blue dots on your film, *E. coli* is not present in your water sample. Red dots indicate coliform bacteria. The Environmental Protection Agency's water quality standards for safe swimming require that no more than 235 *E. coli* colonies per 100 ml of water be found.
- Each dot represents one bacterial colony.Since only 1 ml of sample was used and colony counts are usually given per 100 ml, multiply each dot by 100 to get the number of colonies per 100 ml.
- Note that water quality tests such as this method are a screening method. High *E. coli* counts suggest further sampling should be done.
- *Disposal:* After counting the bacteria, use a dropper to place one milliliter of bleach on the pink circle. Place in a sealed plastic bag and dispose of it properly.

19. What is the water temperature? 68 (Round to the nearest degree.)

☐ Celsius ☑ Fahrenheit (Check type of measurement taken.)

How to measure water temperature: Place a thermometer in the water for approximately two minutes, or when the thermometer temperature stabilizes. To do this without entering the water, tie a string onto the thermometer and hold onto the string with the thermometer in the water. Record your results and check the type of measurement taken.

20. Have you noted any changes in water color from previous visits? (Check the appropriate answer.)

☐ Yes ☐ No ☑ This is our first beach visit

If you have noted a change in color, describe it. _____

How to note changes in water color: If this is your first Adopt-a-Beach™ visit skip this question. If you have visited your beach more than one time, note any changes you have observed in regard to the color of the water and check the appropriate answer.

21. Describe the odor of the water. (Check one or more of the options below.)

☑ No smell ☐ Sewage ☐ Algae (decaying plants) ☐ Fishy

☐ Sulfur (rotten eggs) ☐ Musty (wet soil) ☐ Other If other, describe: _____

How to complete water odor chart: Take a few minutes to determine how the water smells to you. We have provided you with smells that may be associated with water bodies. Check one or more of the options that apply to your observations. If you have selected "other" use the space below the chart to describe the odor.

22. Describe the turbidity (cloudiness) of the water. (Check one of the options below.) Observe turbidity at the same location you take your water sample.

☐ Clear ☑ Slightly cloudy ☐ Cloudy ☐ Opaque (solid)

Slightly cloudy Cloudy Opaque (solid)

How to complete the turbidity chart: First you must determine the turbidity (cloudiness) of the water to do this stand on the water's edge of your beach and observe the clarity of the water. Use the images below to help you determine turbidity.

23. Additional observations about water quality: foamy at shoreline

How to complete additional observations: List any additional comments you would like to make about your observations related to water clarity.

III. Bather Load (Number of people at the beach)

24. For people IN or ON the water, *not on the beach*, describe the type of activity and number of people involved.
(Use the table below to fill in the number of people involved in the activities listed below.)

Type of activity	Sailing/ power boating	Canoeing/ kayaking	Jet skiing	Fishing	Surfing	Windsurfing/ kite boarding	Swimming/ wading	Other (in and on the water)
Number of people engaged in this activity	2	1					18	

If other, describe the type of activity IN or ON the water: _____

How to complete the activity and number of people involved in the activity chart: Count the number of people engaged in a particular activity and enter the number in the table provided under the correct type of activity. If there is an activity that people are engaged in that is not included in the list, use the section titled "other" and describe the type of activity in the space provided below the chart.

25. What is the total number of people ON the beach, *not in the water*? 75

How to record total number of people at the beach: Count the number of people at the beach. In your count, include the number of people in and on the water. If the beach is large, choose a representative area to use to count the number of people as a base to estimate the rest of the beach. Lifeguards often maintain records of bather density throughout the day. If available, you can also use gate or visitor numbers for that beach.

26. General comments and observations at the beach.

How to list general comments: List any additional observations about the number of people at the beach.

A busy day at the beach for it being 11 am.

IV. Potential Pollution Sources

27. Identify any of these features up to 500 feet from the beach boundary that are visible. (See Adopt-a-Beach™ Guide to determine speed of current.)

Is this feature in your beach boundary?	River/Stream/ Channel ☑ Yes ☐ No	Pond(s) ☐ Yes ☑ No	Wetland(s) ☐ Yes ☑ No	Outfall (pipe discharging to the beach) ☐ Yes ☑ No
Amount (Check the answer that applies)	☐ Gushing ☑ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle	☐ Gushing ☐ Steady stream ☐ Trickle
Speed of Current (in seconds)	0.2 M/sec			
Water Color	☑ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear	☐ Brown ☐ Green ☐ Black ☐ White ☐ Red ☐ Clear
Characteristics (Check all that apply)	☑ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water	☐ Foamy ☐ Algae ☐ Debris ☐ Oily sheen on water

If other source (e.g. dump, boat launch), please describe the feature identified: _____

Boat launch near beach a potential pollution source

How to complete this chart:

1. Observe your beach area within 500 feet of the beach boundary to determine if there are any of the features listed (rivers, streams, ponds,). If there is not a water source, in the column marked "other" write "none." Note: features like those listed are not always associated with potential sources of pollution but it is good practice to examine any of these features as they can carry pollution to your beach.
2. Estimate the amount of water in the source as either: gushing, steady stream or a trickle. Check the appropriate response.
3. Determine the speed of current. See method below.
4. Check the visual characteristics that describe the water source that you have identified.

These visible sources can provide valuable information about the magnitude of the potential pollutant carried by these sources to the beach.

How to measure speed of current: If possible, measure flow in a straight section of the stream or another source that has a stable bottom that is 10 meters in length.

To determine speed of current you will need the following materials:

- Meter stick (or other measuring device)
- A floatable object like an orange peel or other floatable object similar in size and weight. The object you select should be relatively flat so that it has very little wind resistance and can flow freely in the current. Make sure to retrieve your object (if it is not part of the natural beach environment) before leaving the beach.
- Watch with a second hand or digital watch that records seconds.

Procedure to measure speed of current:

1. Measure off and draw a 10-meter line in the sand parallel to the water.
2. Position one person at each end of the line you have drawn. The person at the "beginning" of the line should assume the role of timekeeper and have a watch with a second hand.
3. Throw your floatable object, approximately 2 meters upstream of your measuring area.
4. When the object passes the beginning of your 10-meter line, the timekeeper starts timing.
5. When the object passes the person stationed at the end of the 10-meter line, that person tells the timekeeper to stop timing. Record the time.
6. If time permits, repeat this process so you can calculate the average of multiple trials. You can repeat it in a different area along the beach as well.
7. Use the formula for speed = distance in meters ÷ time in seconds, to calculate the speed of current for all trials, and then calculate the average.

To determine the speed of the current use the following equation:

10 meters ÷ by time in seconds = speed in meters per second

Sample equation #1: 10 meters ÷ 30 seconds = .33 meters per second
Summary: Your floatable object moves 10 meters in 30 seconds, therefore, the speed of the current is .33 meters per second.

Sample equation #2: 10 meters ÷ 40 seconds = .25 meters per second
Summary: Your floatable object moves 10 meters in 40 seconds, therefore the speed of the current is 0.25 meters per second.

This procedure is not foolproof. If your floatable object does not move after a few minutes, try again.

28. Bacteria sample results. If you did not have any features as outlined in question 27, you can skip this question. If you did have any of the features listed in question 27, use one of your *E. coli* test kits provided by the Alliance to test for bacteria in water at the feature listed above. Please refer to Adopt-a-Beach™ Guide #17 for specific protocol and to determine results. If you are using the Alliance's test kits, fill in: *E. coli* – water and Coliform. Write in "not tested" for any test you do not conduct and include an explanation in the "comments" section.

Feature Sample (from the water feature identified at your adopted beach.)

Test type	***E. coli* – water** (blue dots)	**Coliform** (red dots)	**Enterococcus**	***E. coli* – sand**
Number of dots	2	14	Not tested	Not tested

How to monitor for *E. coli* using the Alliance's *E. coli* test kit:
See instructions for Question 17.

Did your team do a bacteria test for pollution sources listed for question 27? ☑ Yes ☐ No

29. General comments about your water test:

_____

_____

Some adopters have the ability to use the Global Positioning System (GPS) to calculate where they take their water sample. If you can use a GPS device to measure your sample location, provide your results here:

_____ ° _____ 'N (Latitude) _____ ° _____ 'W (Longitude)

30. Are there floatables (items floating in the water) present? ☑ Yes ☐ No
If yes, please describe the floatables present. (Circle one or more of the options below.)

Type	Street litter	Food-related litter	Medical items	Resin	Sewage-related	Building materials	Fishing related	Household waste
Example	Cigarette filters	Food packing, beverage containers	Syringes	Tiny plastic pellets	Condoms, tampons	Pieces of wood, siding	Fishing line, nets, lures	Household trash, plastic bags

How to complete the floatables chart: "Floatables" are items found floating in the water that are not natural to the environment. To complete the chart, observe any debris floating in the water during your visit and circle all of the types of debris that apply.

Note: Floatable debris causes problems at beaches because the objects can cause harm to aquatic animals, people, boats, fishing nets, and other objects. Communities also lose money when beaches must be closed or cleaned up, and the fishing industry and recreational and commercial boaters must spend thousands of dollars every year to repair vessels damaged by floatable debris (USEPA, 2002). Floatable debris also can be a source of bacterial contamination to bathing beaches.

31. Describe the amount of debris/litter on the beach. (Circle one of the options below.)

Amount	**Litter**	**Very Low**	**Low**	**Medium**	**High**
Percentage on beach	0%	1-10%	11-20%	21-50%	51% and up

How to complete the debris on the beach chart: Because your team will be conducting a litter cleanup at the beach you do not need to list or describe the debris at your beach in this section. However, you should observe the overall litter conditions at your beach and estimate the amount of debris on your beach. Circle the appropriate amount of litter that is on your beach.

Note: Beach debris or litter can cause problems similar to those caused by floatable debris (described above). The debris can be washed onto the bathing beach and affect wildlife. In addition, the presence of certain materials on the beach, such as medical waste and sewage-related items, can pose an immediate health hazard to beachgoers and can be a source of bacterial contamination to the bathing beach.

32. Do you see an oily sheen on the water and/or along the beach? (Check the appropriate answer.) ☐ Yes ☑ No

a. If yes, describe. _____

b. Can you identify the source? _____

How to answer presence of oil in the water and along the beach: Through general observations, determine if the water has an oily sheen. If an oily sheen is present, try to identify the source, such as a boat or jet ski, bottle in the water, etc.

33. Describe the amount of algae *in the water near the shore* along the length of your adopted area of beach.

Amount	**Algae**	**Low**	**Medium**	**High**
Percentage	0%	1-20%	21-50%	51% and up

How to complete the algae along the water's edge chart: Walk along the water's edge of your visit area and observe the presence of algae in the water. Circle the percentage of algae that is at the water's edge.

Note: Algae can be a nuisance along Great Lakes beaches and shorelines. Decaying algae can produce a foul odor that can deter people from visiting our beaches. Algae have also been suspected of harboring *E. coli*, which can lead to beach closures.

34. Describe the amount of algae *on the beach* along the length of your area of adopted beach.

Amount	Algae	Low	Medium	High
Percentage	0%	1-20%	21-50%	51% and up

How to complete the algae on the beach chart: Stand near the water's edge of your visit area and observe the presence of algae on the beach and in the near shore water. Circle the percentage of algae found.

35. Describe the type of algae *along the water's edge and on the beach.* (Check one or more options below.)

☐ No algae ☑ Attached to rocks, stringy ☑ Blobs of floating materials

☐ No obvious mass of materials ☐ Matted ☐ Other

If other, describe: _____

How to complete the type of algae at your beach location: Observe the algae at your beach location and check all that apply to the physical characteristics of the algae. If you have selected "other," describe what you see in the space provided below the chart.

36. Describe the color of the algae *along the water's edge and on the beach.* (Check one or more options below.)

☐ No algae ☐ Light green ☐ Blue green ☑ Dark green ☐ Yellow

☐ Red ☑ Brown ☐ Other If other, describe: _____

How to complete the color of algae at your beach location: Observe the algae at your beach location and check all that apply to the color of the algae. If you have selected other describe what you see in the space provide below the chart.

37. Please describe and count the presence of wildlife and domestic animals on the beach.

Type	Geese	Gulls	Dogs	Other
Number	0	35	4	2

If other, describe: ducks

How to complete the presence of wildlife and domestic animals chart: Count the numbers of animals present on the beach and in the water. Use the categories in the chart (geese, gulls, dogs) and fill in the number under each category. If you have included numbers in the "other" category, use the space below the chart to describe the type of wildlife present.

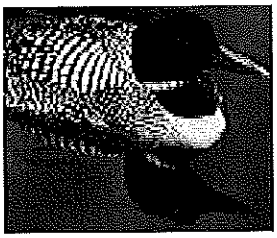
Note: The presence of wildlife and domestic animals at bathing beaches affects water quality. Waste from these animals, whether entering the water directly from waterfowl droppings or indirectly from runoff carrying waste from dogs and other animals, can cause bacterial concentrations to be elevated to the point where recreational standards are exceeded, resulting in beach closures. Data like the types and numbers of animals present at the beach could be used to help identify sources of bacterial contamination and potential best management practices (e.g., pet owner education, better trash management to reduce available food sources at the beach) that could be used to reduce the amount of animal waste reaching the beach.

38. If you find dead birds along the shoreline, fill in the number found in the appropriate box below.

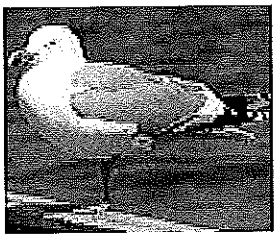
Type	Common loon	Herring gull	Ring-billed gull	Double crested cormorant	Horned grebe	Other
Number found dead	0	1	0	0	0	0

If other, describe: _____

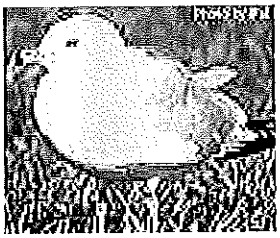
How to complete this dead birds chart: Use the images below to determine the type (species) of bird that you have found on the beach. Count the number of dead birds and fill in the number in each category. If you have selected "other" and know the species of the bird found, use the space below the chart to describe.



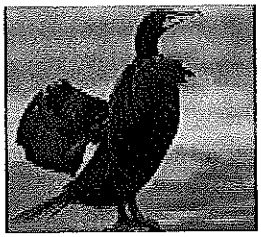
Common loon



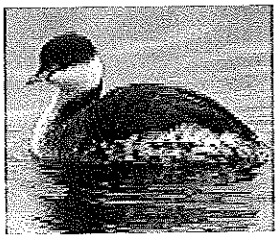
Herring gull



Ring-billed gull
Has a distinct ring around its beak



Double crested cormorant



Horned grebe

Health and safety: Don't remove dead animals from shorelines unless you are prompted to do so by local officials using the proper removal methods.

Note: Decaying birds can contribute to water quality issues at your beach. Some areas along Great Lakes shorelines are experiencing *E. botulism* outbreaks that are killing large numbers of birds at certain times of the year (generally late summer through fall). If you find a large number of dead birds at your beach, the location may be affected by these outbreaks. It is important to determine the number and type of birds that are affected so professionals can track the numbers of species being lost.

39. How many dead fish are on the beach? 1

40. If there are other dead animals on the beach (not including fish and birds) list them here.

Type of animal	How many
turtle	1

How to determine number of dead fish on the beach: Count the number of dead fish that you find along the beach and fill in the number of dead fish found.

Note: Decaying fish can contribute to water quality issues at your beach.

41. How many garbage and recycling containers are there within 500 feet of your adopted beach boundary?
(If there are no garbage containers on your beach enter 0.)

Garbage Containers	Recycling Containers
4	2

42. Describe use and condition of garbage containers at this location. (Check one or more of the options below.)

☐ No garbage cans ☐ Designated carry in carry out policy ☐ Garbage cans present with no lids

☑ Garbage cans present with lids ☑ Garbage cans well maintained ☐ Garbage cans overflowing or knocked over

How to complete the garbage container chart: Observe the garbage cans on your beach and their conditions. Check the appropriate condition for the containers.

Note: If there are no garbage cans present or if containers don't have lids or are in bad condition you may see a relationship between the amount of trash that you find on your beach and the trash cans. Observe the general conditions of the trash cans to determine if they may have an effect on the amount of trash on your beach.

43. Please add any additional comments or notes about your visit here:

Beach looked pretty clean. Our group had a great time and can't wait for our next visit!

44. Did you take any action as a result of your beach visit? For example: educate others about pollution, contact your park authority to ask them to empty trash cans more frequently.

☑ Yes ☐ No If yes, describe: *Students wrote the park district to add recycling bins*

Thank you for your time and dedication to keeping our beaches and shorelines healthy!

Important Additional Information

Responding to potential pollution sources found at the beach:
In most cases when you find a potential pollution source at the beach (e.g. overflowing garbage bin or an outfall pipe discharging water with a high e. coli count), we recommend that you conduct a follow-up visit a few days or a week later to see if the problem has been corrected. You may request additional water quality test kits for follow-up sampling through your state Adopt-a-Beach™ coordinator.

However, if you are witnessing an environmental event that may lead to imminent threat to human health or the environment (e.g. an oil or chemical spill), please report the situation using EPA's toll free National Response Center hotline at 800-424-8802 and also notify your state Adopt-a-Beach™ coordinator.

Contact us: adoptabeach@greatlakes.org

Litter Monitoring Instructions
Instructions for Site Coordinators

Follow the directions below for a successful cleanup! Use the orange Adopt-a-Beach™ Litter Monitoring Form found in your startup kit and available for download online to record your litter data. To find the Litter Monitoring Form, visit *www.greatlakes.org* and follow the Adopt-a-Beach™ sun to the Adopt-a-Beach™ homepage and look for a link to "forms and instructions".

- Divide the participants into small groups of 3 – 4 people (or maintain groups that have been established to collect Routine Visit Form data) to clean up and record litter data.
- Assign one person to record the litter collected in each small group. Request that groups complete both sides of the Litter Monitoring Form.
- Give each group: an Adopt-a-Beach™ Litter Monitoring Form, gloves (one per volunteer or two gloves if they request it), one (or more) bag(s) for litter and one (or more) bag(s) for recyclable items (i.e. plastic bottles, aluminum cans, etc.). Ideally the bags should be different colors to minimize confusion. Find out about recycling practices in your community so you can explain what participants should collect and understand how to dispose of the recyclable items properly.
- As volunteers remove litter, ask them to record their findings by making tally marks next to the debris item on the Litter Monitoring Form. Follow the example on the Form. At the end of the cleanup, make sure each small group records the total number of items their group has found at the end of the cleanup. This number goes in the small box to the left of each item name.
- You (or an individual or group you choose) should be in charge of a **final** Litter Monitoring Form. Note "Final Data" on one of the Forms. At the end of the cleanup, make sure this card has a number total of ALL items picked up by the other small groups.

Additional instructions for volunteers when picking up and recording litter:
- Pick up everything you find that is not a natural part of the environment. If you find animals entangled in debris (fish, birds or other wildlife) record them on the Summary Card but do not touch them or try to dispose of them yourself. Notify your local park district or beach authority about the location of the dead wildlife you have found.
- Record only the items found on the data card.
- Pick up "pieces" of items, but do not record these fragments on the data card as this can distort the data totals. You may make note if you feel you have found an exceptionally high number of fragments, especially if they might pose a danger to humans or wildlife.

- Stress personal safety such as not touching suspicious looking materials, barrels, needles, etc. All barrels, except those that are empty and completely clean, should be reported to your local authorities. Mark down all codes on barrels to assist in identifying the contents. To report an oil or chemical spill, contact the U.S. Coast Guard's National Response Center at (800) 424-8802. If a volunteer finds a medical syringe ask them not to pick it up. Site coordinators can safely dispose of syringes by placing them in an empty bottle with a secure top.

If you do not have access to the Internet send completed forms to:
Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417
or fax to 616-850-0765

If you don't have Internet access, mail your results to Alliance for the Great Lakes, 700 Fulton St. Ste. A, Grand Haven, MI 49417 or fax to 616-850-0765

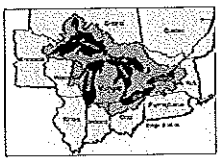
40 YEARS ALLIANCE FOR THE GREAT LAKES

ENSURING A LIVING RESOURCE FOR ALL GENERATIONS

40 YEARS ALLIANCE FOR THE GREAT LAKES

Who is the Alliance for the Great Lakes?

We are a group of volunteers and professionals working for clean water throughout the Great Lakes.



40 YEARS ALLIANCE FOR THE GREAT LAKES

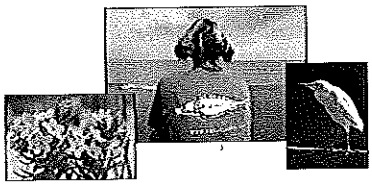
Our mission is to:

Conserve and restore the world's largest freshwater resource using:

- **Policy**
- **Education**
- **Local Efforts**

40 YEARS ALLIANCE FOR THE GREAT LAKES

Ensuring a healthy Great Lakes and clean water for generations of people and wildlife.



40 YEARS ALLIANCE FOR THE GREAT LAKES

A step-by-step guide to the the Alliance for the Great Lakes Adopt-a-Beach™ program

ALLIANCE FOR THE GREAT LAKES
ADOPT A BEACH

40 YEARS ALLIANCE FOR THE GREAT LAKES

The Adopt-a-Beach™ Program

It is a year-round opportunity for families, schools, businesses and community-based groups to conduct litter monitoring and water quality testing along the Great Lakes shorelines.

The Adopt-a-Beach™ Program

- 1991 begun as part of the International Coastal Cleanup
- 2002 year-round program launched
- 2008 Adopt-a-Beach™ next steps - aligned forms with EPA Sanitary Survey

Complete two forms:
1. Routine Visit Form
2. Litter Monitoring Form

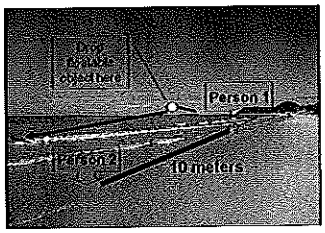
Adopt-a-Beach™ Routine Visit Form: Sections

- General beach conditions
- Water quality
- Bather load (number of people using the beach)
- Potential pollution sources

General Beach Conditions

- Air temperature
- Wind speed and direction
- Rain event information
- Longshore current
- Sky conditions
- Wave Conditions

General Beach Conditions: Measuring the Longshore Current



- Measure 10 meters in the sand
- Drop a piece of driftwood in the water
- Record the time it takes to travel 10 meters
- Calculate the speed of the long shore current

___ distance in meters divided by____ time in seconds = speed of longshore current

Water Quality

- Water chemistry or pH (optional)
- Bacteria sampling
- Water temperature
- Water color
- Presence of algae
- Water observations

Water Quality: Testing for E. coli and Coliform Bacteria

Petrifilm

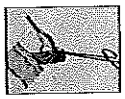
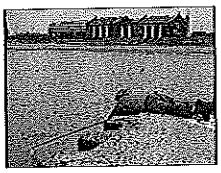
Pipette

Whirl-pak bag

The Alliance provides Adopt-a-Beach™ teams with a water test kit prior to each visit.

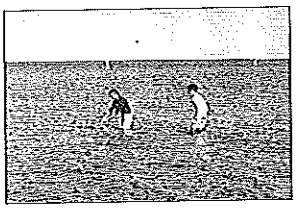
Water Quality: Testing for E. Coli and Coliform Bacteria

Taking the water sample

Water Quality: Testing for E. Coli and Coliform Bacteria

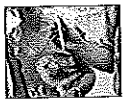
Taking the water sample




Water Quality: Testing for E. Coli and Coliform Bacteria

Using the Pipette

Fill the pipette with one milliliter of water. See mark on the side of the pipette (below the bulb).



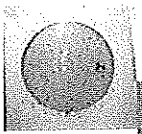
Water Quality: Using the Petrifilm


- Mark Petrifilm with sample date and sample #
- Peel back film
- Drop water sample onto pink dot
- Slowly replace film over pink dot
- Place in sealable bag (flat and out of direct sun)
- Check in 48 hours (24 if incubated)

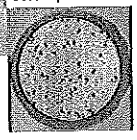
Water Quality: Reading the Petrifilm

Reading your results

Normal



Severely Abnormal



3M Petrifilm:

Count the colonies
(each dot = 1 colony)

Red Dots = coliform bacteria
Blue Dots = *E. coli*

Recommended Action:
If <u>E. coli data</u> for any sample is a more than <u>2 blue dots</u> please call your State Coordinator

Water Quality: Reporting the results

17. Bacteria sample results.

Sample #1

Test type	E coli – water	Coliform	Enterococcus	E. coli – sand
Number of dots	1	5		

Sample #2

Test type	E coli – water	Coliform	Enterococcus	E. coli – sand
Number of dots	2	3		

Bather Load

- Count the number of people IN or ON the water, *not* on the beach; what activities are they engaged in?
- Count the number of people ON the beach, *not* in the water.
- Observations

Bather Load: Water Based Activities

24. For people IN or ON the water, describe the type of activity and number of people involved.
(Use the Table below to fill in the number of people involved in the activities listed below)

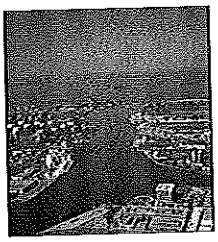
Type of activity	Sailing/power boating	Canoeing/ kayaking	Jet skiing	Fishing	Surfing	Windsurfing/kite boarding	Other
Number of people engaged in this activity	4	1	2				3

If other, describe the type of activity: sand boarding

Potential Pollution Sources

- Look for potential pollution sources
- Trash
- Algae
- Wildlife

Potential Pollution Sources: Identifying Sources



- Rivers, streams, wetlands, outfalls, etc. sources
- Amount of flow
- Speed of flow
- Visible characteristics

Potential Pollution Sources: Presence of Algae

33. Describe the amount of algae *in the water near the shore* along the length your adopted area of beach.

Description	None	Low	Medium	High
Percentage	0%	1-20%	21-50%	51% and up

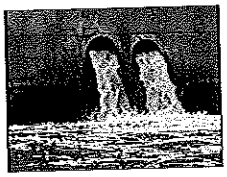
34. Describe the amount of algae *on the beach* along the length your adopted area of beach.

Description	None	Low	Moderate	High
Percentage	0%	1-20%	21-50%	51% and up

Taking Action – Potential Pollution Sources

If you find:
- If E. coli data for any sample is more then 2 blue dots
- Overflowing garbage bin
- 10 or more dead animals
- Personal hygiene items/condoms if present in significant numbers (+30 items)

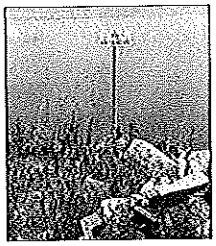
Recommended Action:
- Contact your State Coordinator



Taking Action – Potential Pollution Sources

If you see:
An environmental event that may lead to imminent threat to human health or the environment (e.g. an oil or chemical spill),

Recommended Action:
- Report the situation using EPA's toll free National Response Center hotline at 800-424-8802.
- Notify your state AAB coordinator.



Adopt-a-Beach™ Routine Visit Form

Recommended Group Assignments for Small – Medium sized Groups:

1ST ROUTINE VISIT FORM
GROUP 1 -
- General beach conditions

GROUP 2 -
- Water quality
- Bather load

GROUP 3 -
- Potential pollution sources

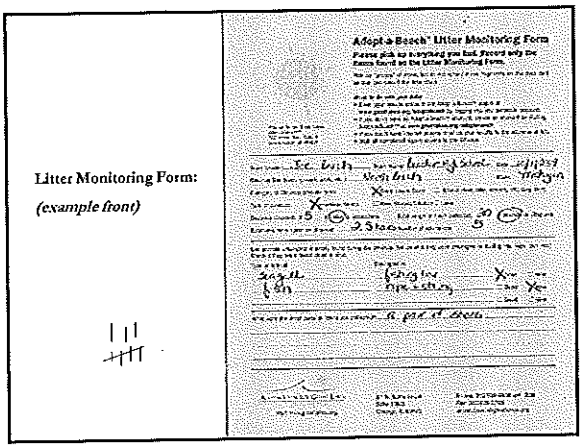
2ND LITTER MONITORING FORM
- Everyone At Once
- In Small Groups of 3
- One Bag Per Group
- One Litter Form Per Group

Litter Removal and Monitoring

- Pick up trash
- Record findings
- Summarize findings
- Dispose of the trash properly

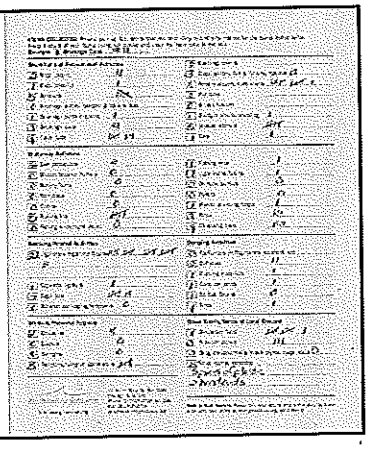
Litter Monitoring Form:

(example front)



Litter Monitoring Form:

(example back)



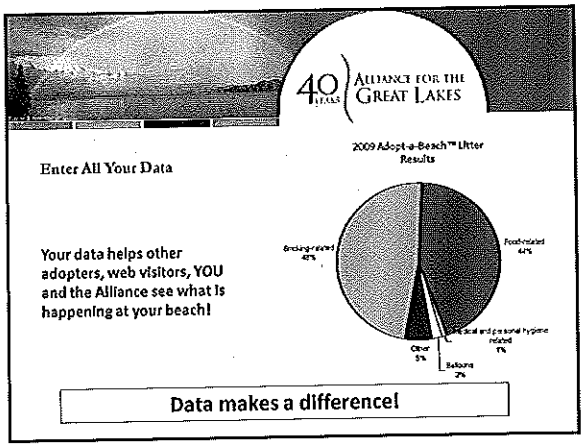
Litter Removal and Monitoring: A Big Note on SAFETY

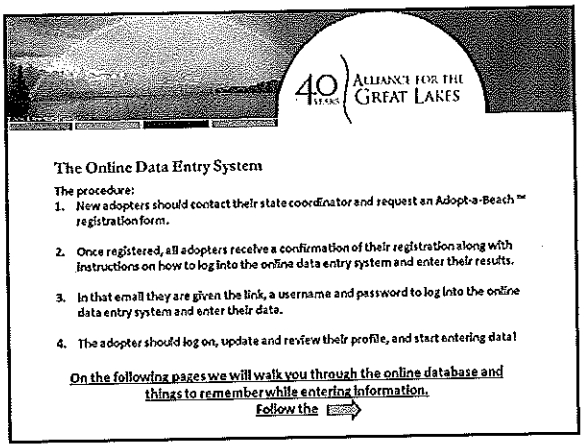
Always use gloves and closed toed shoes.

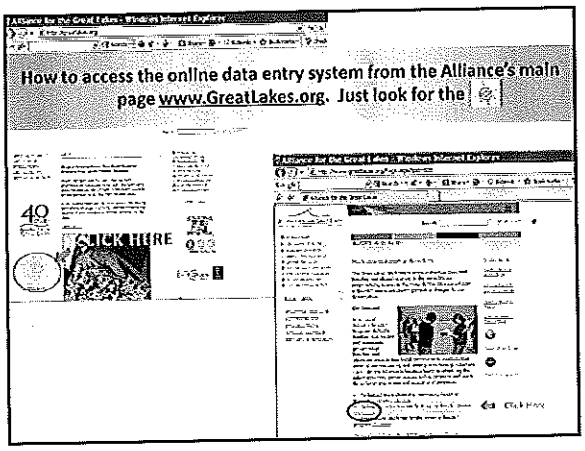
If you're not sure if you should pick it up, DON'T!

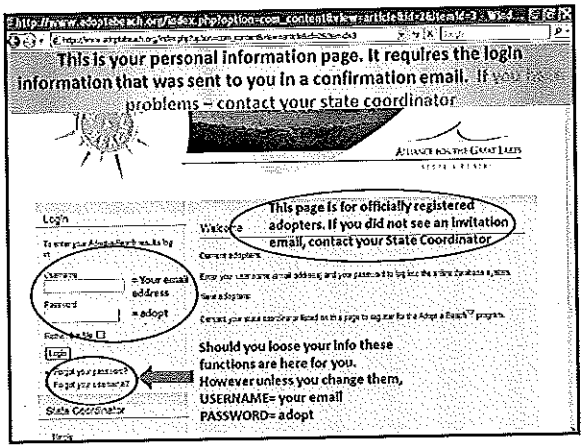
Get help.

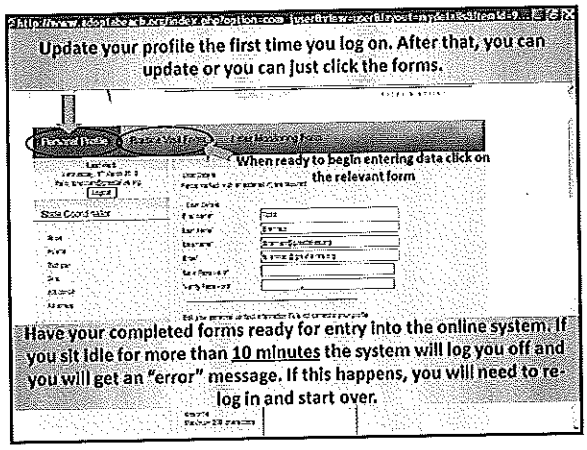
Remember, SAFETY always comes first!

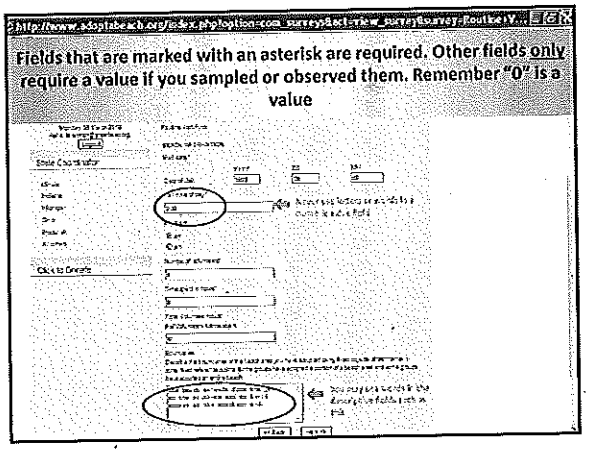

Alliance for the Great Lakes
Enter All Your Data
2009 Adopt-a-Beach™ Litter Results
Your data helps other adopters, web visitors, YOU and the Alliance see what is happening at your beach!
Data makes a difference!

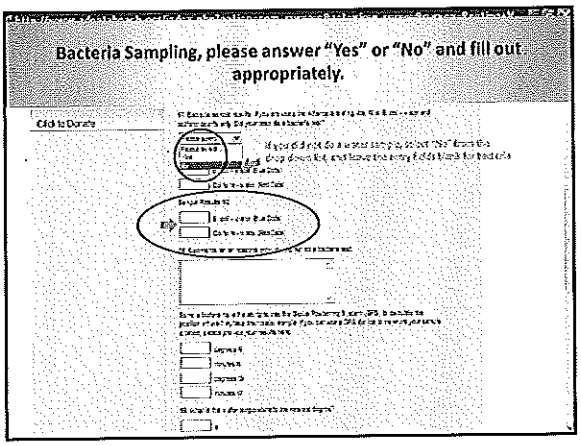

Alliance for the Great Lakes
The Online Data Entry System
The procedure:
1. New adopters should contact their state coordinator and request an Adopt-a-Beach ™ registration form.
2. Once registered, all adopters receive a confirmation of their registration along with instructions on how to log into the online data entry system and enter their results.
3. In that email they are given the link, a username and password to log into the online data entry system and enter their data.
4. The adopter should log on, update and review their profile, and start entering data!
On the following pages we will walk you through the online database and things to remember while entering information.
Follow the

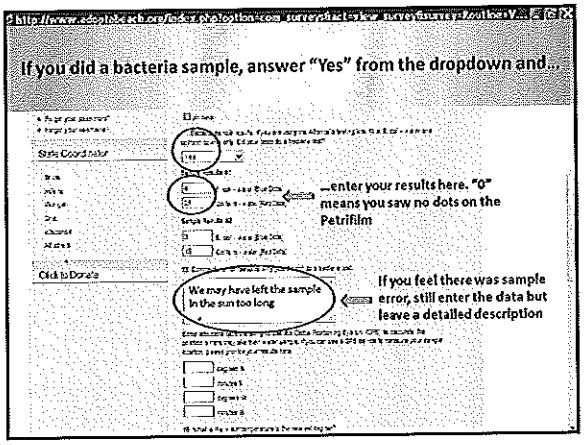

How to access the online data entry system from the Alliance's main page www.GreatLakes.org. Just look for the
CLICK HERE

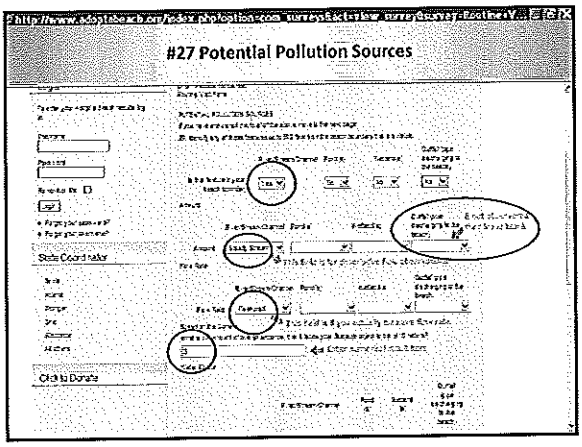

This is your personal information page. It requires the login information that was sent to you in a confirmation email. If you have problems – contact your state coordinator
This page is for officially registered adopters. If you did not see an invitation email, contact your State Coordinator
= Your email address
= adopt
Should you loose your info these functions are here for you. However unless you change them,
USERNAME= your email
PASSWORD= adopt

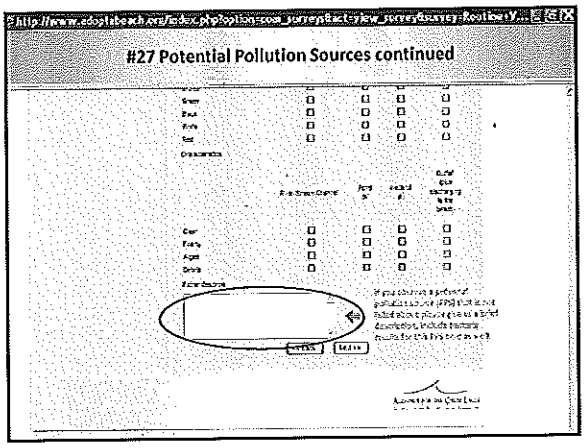

Update your profile the first time you log on. After that, you can update or you can just click the forms.
When ready to begin entering data click on the relevant form
Have your completed forms ready for entry into the online system. If you sit idle for more than 10 minutes the system will log you off and you will get an "error" message. If this happens, you will need to re-log in and start over.

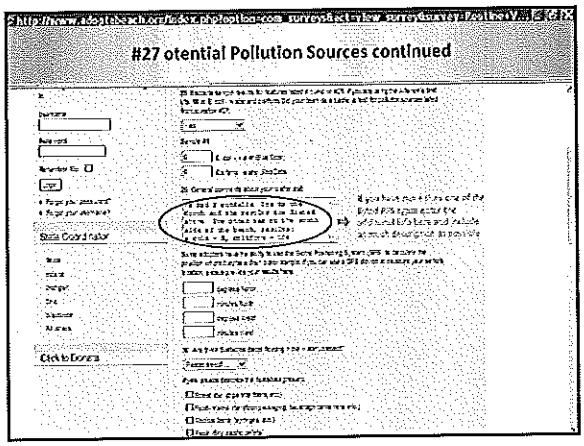

Fields that are marked with an asterisk are required. Other fields only require a value if you sampled or observed them. Remember "0" is a value

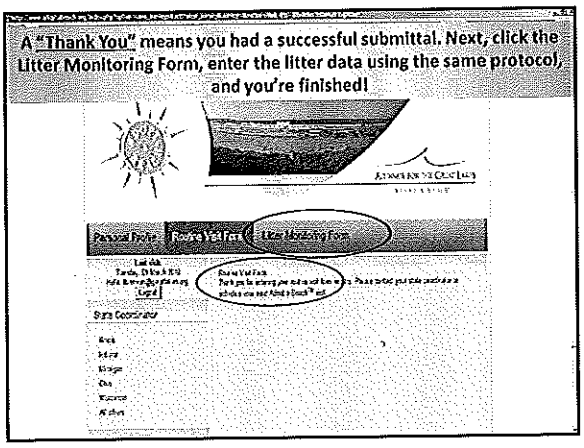

Bacteria Sampling, please answer "Yes" or "No" and fill out appropriately.


If you did a bacteria sample, answer "Yes" from the dropdown and...
...enter your results here. "0" means you saw no dots on the Petrifilm
We may have left the sample in the sun too long
If you feel there was sample error, still enter the data but leave a detailed description


#27 Potential Pollution Sources


#27 Potential Pollution Sources continued


#27 otential Pollution Sources continued


A "Thank You" means you had a successful submittal. Next, click the Litter Monitoring Form, enter the litter data using the same protocol, and you're finished!

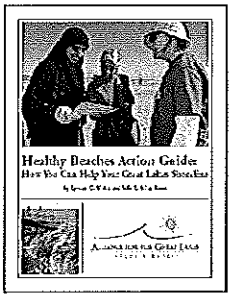
Alliance for the Great Lakes

Taking Action – Next Steps

Healthy Beaches Action Guide

- *Educate Yourself*
- *Start Small*
- *Taking Action*
- *Getting Involved!*

*Available on the AAB web page



Alliance for the Great Lakes

The Adopt-a-Beach™ Program!

Interested in joining the Adopt-a-Beach Program? Sign up today!

Alliance for the Great Lakes

Contact Us!

Still have questions? Want to sign up?

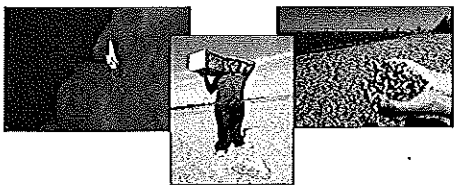
Email us: adoptabeach@greatlakes.org
Call us:
In Illinois & Indiana at 312-939-0838 ext. 227
In Wisconsin at 414-559-0317
In Michigan at 616-850-0745
In Ohio at 216-630-8140

SCHEDULE YOUR FIRST VISIT

Kick off the beach season by scheduling a data collection visit during the Spring Kickoff period: May 1-15, 2010

Alliance for the Great Lakes

Join the Alliance for the Great Lakes!



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Enumeration of Waterborne *Escherichia coli* with Petrifilm Plates: Comparison to Standard Methods

J. H. Vail, R. Morgan, C. R. Merino, F. Gonzales, R. Miller, and J. L. Ram*

Abstract

Escherichia coli is often monitored in environmental waters as an indicator of the possible presence of human pathogens associated with feces. Petrifilm *E. coli*/coliform count plates (3M, Minneapolis, MN), previously validated for enumerating *E. coli* in food, were tested for monitoring *E. coli* in environmental water. *Escherichia coli* counts in environmental water samples enumerated with Petrifilm were significantly correlated ($R > 0.9$; slope = 0.9–1.0; $p < 0.001$) with counts obtained with three commonly used methods, mTEC (Becton Dickinson, Sparks, MD), m-ColiBlue (Hach, Loveland, CO), and Colilert-18/IDEXX Quanti-Tray 2000 (IDEXX, Westbrook, ME). Blue colonies on Petrifilm plates were most reliably identified as *E. coli* when accompanied by gas formation, as determined by characterization of the colonies on MacConkey agar plates (FML Microbiologicals, Mississauga, ON, Canada) and by polymerase chain reaction (PCR) with *E. coli*–specific primers. The main disadvantage of Petrifilm plates for environmental water testing is the small volume (1 mL per sample) that can be tested; however, the plates appear to be suitable for screening and locating sites that exceed criteria for total body and partial body contact. Simplicity of use and storage, reliability, and relatively low cost make Petrifilm plates suitable for volunteer-based and educational water quality monitoring applications, particularly when used as a preliminary screening method to identify problem sites.

High levels of bacteria are a concern for many marine, brackish, and freshwater environments. Elevated levels of bacteria in coastal waters are associated with increased risk of gastrointestinal symptoms for recreational swimmers (Cabelli, 1977; Dufour, 1984; Prüss, 1998; USEPA, 1986). Because of known association with fecal matter, levels of *E. coli* bacteria are a key regulatory measure of the healthfulness of recreational waters (USEPA, 1986, 1999a). For fresh waters, the USEPA recommends criteria of 126 *E. coli* colony forming units (cfu)/100 mL for the geometric mean of five samples over a 30-day period and 235 *E. coli* cfu/100 mL for a single sample, but states set their own standards (USEPA, 1986). For example, in Michigan, rivers, lakes, or streams measuring greater than 300 *E. coli* cfu/100 mL on a single day or more than 130 *E. coli* cfu/100 mL for a 30-day geometric mean are considered out of compliance for total body contact (e.g., beaches); 1000 *E. coli* cfu/100 mL is out of compliance for partial body contact (e.g., fishing, boating) (Rule 62; Michigan Department of Environmental Quality, 1999).

Despite the general awareness of the need for monitoring, many places that are suspected to be out of compliance are not monitored due to perceived high cost and complexity of equipment involved in a local monitoring program. Citizen-based volunteer monitoring programs have been developed in several states, such as Iowa (Seigley, 2001), and have been used for purposes of preliminary screening of local waters for identifying problem areas. However, since *E. coli* enumeration methods generally require expensive media or equipment not generally available to volunteers, a convenient, inexpensive method of *E. coli* enumeration is needed for such programs.

This paper describes the testing of Petrifilm *E. coli*/coliform count plates as a new, convenient method for enumerating *E. coli* in environmental waters. Petrifilm plates have previously been described for use in enumerating *E. coli* in food and dairy products (Curiale et al., 1991; Priego et al., 2000; Russell, 2000; AOAC, 2000a,b), and it therefore seemed reasonable to evaluate whether they may also be useful in water testing. Petrifilm plates consist of plastic films with grids that are coated with Violet Red Bile nutrients, a tetrazolium indicator, and gelling agents. The gel contains a β-glucuronidase indicator for confirmed detection of *E. coli*. The present study is a multilaboratory investigation comparing *E. coli* enumeration of environmental water samples with Petrifilm technology with *E. coli* enumeration by methods frequently used by each participating laboratory. The methods to which Petrifilm enumerations were compared were the mTEC, m-ColiBlue, and Colilert-18/IDEXX Quanti-Tray methods.

Materials and Methods

Water Sample Sources

Each participating laboratory collected environmental water samples near its location. The source sites were chosen to have a range of bacteria levels ranging from near zero up to relatively high noncompliant levels, based on previous experience at the same sites. Water from Ruddiman Lagoon and tributaries, in the city of Muskegon, MI (43°13′ N, 86°17′ W) was enumerated by Petrifilm and m-ColiBlue methods at the Annis Water Resources Institute. Water from a small tributary of the Grand River in Ottawa County, MI in a rural area near the intersection of 68th Avenue and Leonard Street in Coopersville, MI (43°1′ N, 85°57′ W) was enumerated by Petrifilm and mTEC methods at Grand Valley State University. The tributary is located in a rural area mostly occupied by cattle pastures and was sampled just upstream from its confluence with the Grand River. Water from various sites in the middle Rouge River subwatershed in the Rouge River watershed, in several suburbs west of Detroit, MI (42°22′ N, 83°25′ W) were enumerated by Petrifilm and IDEXX Quanti-Tray/Colilert-18 methods at Wayne State University. In addition,

J.H. Vail, Robert B. Annis Water Resources Institute, Grand Valley State University, Muskegon, MI 49441. R. Morgan and R. Miller, Department of Biology, Grand Valley State University, Allendale, MI 49401. C.R. Merino and J.L. Ram, Department of Physiology, Wayne State University, Detroit, MI 48201. Received 1 Mar. 2002. *Corresponding author (jeffram@med.wayne.edu).

Published in J. Environ. Qual. 32:368–373 (2003).

Abbreviations: cfu, colony forming units; PCR, polymerase chain reaction.

E. coli colonies on Petrifilm plates from water obtained from various sites in the Clinton River watershed (42°35′ N, 82°55′ W) were used for further characterization of Petrifilm colonies.

Sampling and Enumeration Procedures

All water samples were obtained with sterile bottles or sterile Whirlpak bags (Nasco, Fort Atkinson, WI), transported on ice, and analyzed within 4 h. Samples were tested in various dilutions, as indicated below, to assure that bacteria concentrations were within the appropriate range for each technique (American Public Health Association, 1998).

Petrifilm Procedure. The methodology for the Petrifilm plates was to (i) inoculate and spread 1 mL of water on the gel (see Fig. 1A), (ii) incubate the plate at a temperature of 35 ± 1°C for 24 ± 2 h, and (iii) count the number of blue colonies associated with a small gas bubble. Coliform colonies appear red surrounded by a bubble, due to an indicator dye and the trapping of gas produced by the coliforms by the upper film of the Petrifilm plate. *Escherichia coli* colonies are characterized by a blue precipitate surrounded by a gas bubble; blue colonies with gas are counted as *E. coli*, while blue colonies without gas are not (AOAC Official Methods, as described by the 3M interpretation guide). An example of the results obtained with one such plate is illustrated in Fig. 1B.

m-ColiBlue24 Analysis. The m-ColiBlue24 membrane filtration broth is USEPA approved for analysis of total coliforms and *E. coli* in drinking water (USEPA, 1999b) for enumerating total coliforms and *E. coli* in a proposed rule for ambient waters (USEPA, 2001). *Escherichia coli* colonies are characterized by a blue color due to a reaction between the enzyme β-glucuronidase and 5-bromo-4-chloro-3-indolyl-β-D-glucuronide. One-milliliter ambient water samples were diluted with 99 mL of sterile buffered dilution water and 100 mL was filtered through a sterile 47-mm nitrocellulose filter with a pore size of 0.45-μm (Millipore, Bedford, MA). The filter was then placed on an absorbent pad pre-soaked with m-ColiBlue nutrient broth in a Petri plate and incubated at 35 ± 0.5°C for 24 h. Blue colonies were counted as *E. coli*. One-milliliter portions of the undiluted water samples were assayed on Petrifilm plates.

mTEC Technique. The USEPA-approved original *E. coli* method was used (Method 1103.1; USEPA, 2000). Nutrient plates were prepared with dehydrated mTEC agar powder. Environmental water samples were serially diluted 10-fold. One-milliliter samples of each dilution were filtered through a sterile 47-mm nitrocellulose filter with a pore size of 0.45 μm (Millipore) and aseptically placed on mTEC agar plates. Similarly, 1-mL samples of the same dilutions were assayed on Petrifilm plates. The mTEC plates were incubated for two hours at 35 ± 0.5°C and then incubated at 44.5 ± 0.2°C for 22 to 24 h. After incubation, the filter membranes were placed on Whatman (Maidstone, UK) filter paper that had been saturated (1.0 mL) with urea substrate media containing 2.0% urea (w/v) and 0.01% phenol red (w/v). Colonies that remained yellow, yellow-brown, or yellow-green were considered *E. coli*.

Colilert-18/IDEXX Quanti-Tray Method. Use of Colilert-18 with Quanti-Tray 2000 trays to enumerate *E. coli* is described in USEPA (2001). Fifty-milliliter ambient water samples from the sampling sites were diluted fivefold. Then, out of 103 mL of the diluted sample, three 1-mL samples were assayed on Petrifilm (1 mL on each plate out of the 103 mL diluted sample), and the remaining 100 mL was added to Colilert-18 and assayed in IDEXX Quanti-Tray 2000 trays, according to the manufacturer's instructions. Quanti-Tray samples were incubated 20 h at 35.5°C, after which fluorescent (β-glucuronidase positive) wells on the Quanti-Tray were counted, to calculate the most probable number (MPN) of *E. coli* cfu/100 mL in the diluted sample, according to a chart supplied by the manufacturer.

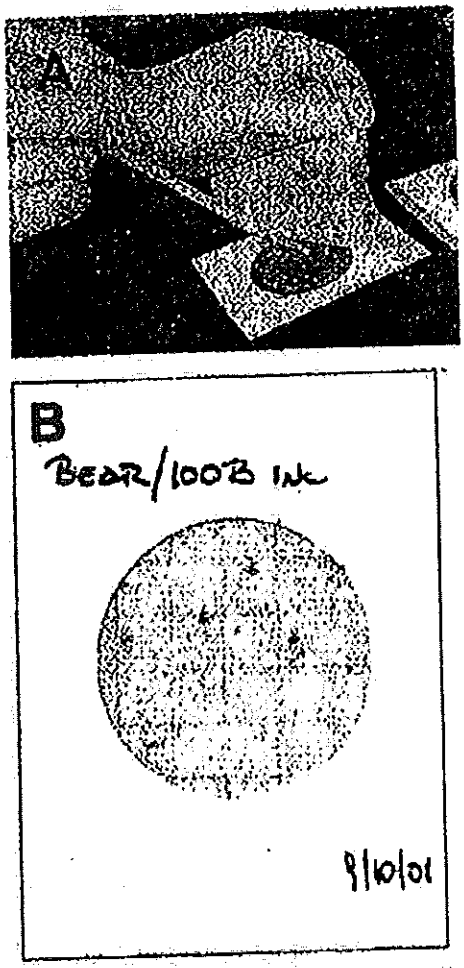

Fig. 1. Application of water to a Petrifilm plate and resultant bacterial growth. (*A*) The top film is lifted while a 1-mL water sample is applied with a sterile transfer pipet. (*B*) Petrifilm plate after a 24-h incubation with a 1-mL environmental water sample. Dark spots in this grayscale image were blue in the original.

Further Characterization of Petrifilm Colonies

Blue colonies were picked from Petrifilm plates with sterile inoculating loops and streaked onto MacConkey agar plates. MacConkey plates were incubated for 24 h at 35.5°C, the presence of pink (i.e., lactose-fermenting, as expected for *E. coli*) colonies was noted, and then well-isolated pink colonies were inoculated into Colilert-18 medium. After culturing for 20 h at 35.5°C, the presence of yellow color and fluorescence was noted, sterile glycerol was added to a final concentration of 14%, and then the culture was frozen until further analysis. For the polymerase chain reaction (PCR), 1 μL of the thawed culture was subjected to thermocycling (anneal, 60°C; synthe-

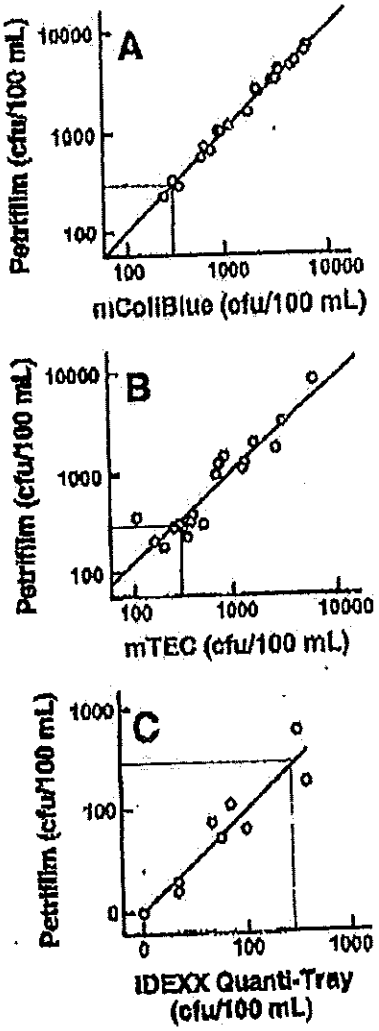

Fig. 2. Comparisons of Petrifilm to three standard methods for *E. coli* enumeration of environmental water samples. Data were normalized to 100 mL and transformed with log[cfu/100 + 10] prior to linear regression. Vertical and horizontal lines in each graph indicate 300 cfu/100 mL, the Michigan maximum whole body contact limit. (*A*) Comparison with the m-ColiBlue method, with 20 water samples from Ruddiman Lagoon and tributaries. The regression line has slope = 1.01, R = 0.995, and $p < 0.001$. (*B*) Comparison with the mTEC method, with 19 water samples from a tributary to the Grand River. The regression line has slope = 0.91, R = 0.93, and $p < 0.001$. (*C*) Comparison with the Colilert-18/IDEXX Quanti-Tray method, with nine water samples from the Middle Rouge River. The regression line has slope = 0.908, R = 0.935, and $p < 0.001$.

sis, 72°C; melt, 94°C; 30 cycles) with the following *E. coli*–specific primers: 298F, 5'-AATAATCAGGAAGTGATGG AGCA-3'; and 884R, 5'-CGACCAAAGCCAGTAAAGTA GAA-3', which amplify a segment of the β glucuronidase gene. Identity of the PCR products was confirmed by sequencing.

Statistics

Regression analysis was done on log-transformed data after multiplication by appropriate factors to take into account the amount of dilution, so that counts in 100-mL volumes were being compared, and adjusted upward a small constant to prevent taking the logarithm of zero. The log transformation used was $\log_{10}$(cfu/100 mL + 10 cfu/100 mL). For Petrifilm, mTEC, and m-ColiBlue assays, in which 1 mL was the volume assayed, the transform was therefore log(counts × 100 + 10). For IDEXX Quanti-Tray assays, in which the assayed volume was 100 mL, the transform was log(most probable number + 10). The means of log-transformed values of duplicate or triplicate assays or the individual log-transformed values when measured without replicates were used in subsequent correlations, and in calculations of method means, standard deviations, and statistical significance with paired t tests. Statistical tests were performed with Sigmastat 2.0 (Jandel Scientific, 1995) software. For linear regression, Petrifilm data was used as the dependent variable and the "standard" measurement method as the independent variable. A repeat of the analysis with a simple log transform and adjusting only the zero count samples to 10 cfu/100 mL to avoid log(0) yielded essentially identical conclusions.

Results

Comparison of Petrifilm Results with Other Enumeration Methods

Comparison with m-ColiBlue. Samples from Ruddiman Lagoon and tributaries were enumerated in triplicate with Petrifilm and in duplicate with m-ColiBlue. Water samples were collected from four sites on five occasions, for a total of 20 water samples. Correlation of the counts obtained with the two methods is illustrated in Fig. 2A. Counts ranged from as low as 200 cfu/100 mL to as high as 7000 cfu/100 mL. Linear regression of counts determined from Petrifilm assays versus counts determined with m-ColiBlue, after log transform, gave a slope of 1.01, R = 0.995, and $p < 0.001$.

The variability of data obtained with the Petrifilm method was assessed by determining the 95% confidence intervals of each triplicate measurement. The 95% confidence intervals averaged 17% of their corresponding mean values.

To test for bias one way or the other for the values determined by Petrifilm versus the m-ColiBlue method, the mean values obtained by each method for each water sample were compared with a paired t test. The overall method means and standard deviations of the log-transformed counts were 3.207 ± 0.451 for Petrifilm and 3.202 ± 0.458 for m-ColiBlue. The mean difference of paired measurements was −0.0054 ± 0.0455, indicating no significant difference between the results obtained with the two tests (p = 0.60, paired t test).

Comparison with mTEC. *Escherichia coli* in water samples from a tributary to the Grand River were enumerated in triplicate with both Petrifilm and mTEC methods. Two water samples were collected on each of nine occasions, and one water sample was collected on a tenth occasion, for a total of 19 samples. Linear regression of the Petrifilm data against the mTEC data, illustrated in Fig. 2B, gave a slope of 0.911, R = 0.933, and $p < 0.001$.

The 95% confidence intervals of Petrifilm triplicates averaged 39% of their corresponding mean values. Similarly, the 95% confidence intervals for the mTEC triplicates averaged 53% of their corresponding means. A

paired *t* test; indicated no consistent differences between paired measurements made with the Petrifilm and mTEC methods on the same water samples ($p = 0.38$; method means: Petrifilm, 2.84 ± 0.46; mTEC, 2.81 ± 0.47; difference between paired samples, 0.035 ± 0.169).

Comparison with Colilert-18/IDEXX Quanti-Tray. Samples collected from nine sites on the Middle Rouge River were diluted fivefold and then enumerated in triplicate by Petrifilm and in one 100-mL sample, by Colilert-18/IDEXX Quanti-Tray. After transformation for comparison of equivalent 100-mL volumes, the regression of the Petrifilm results versus IDEXX results gave a slope of 0.908, $R = 0.935$, and $p < 0.001$ (Fig. 2C). Paired tests by the two methods were not significantly different from one another ($p = 0.80$; method means: Petrifilm, 1.81 ± 0.55; IDEXX, 1.79 ± 0.56; difference between paired samples, 0.018 ± 0.200); however, the average 95% confidence interval for the Petrifilm triplicates was quite large, equal to 101% of the corresponding means. The large 95% confidence intervals, compared with their corresponding means, reflect the fact that several of the water samples had low counts (0–2 colonies per plate) and therefore a variation of one or two colonies per Petrifilm plate produced a large percentage change of this measure.

Gas Formation as a Criterion for Identifying *E. coli* Petrifilm Colonies

As noted in the Materials and Methods, the AOAC Prescribed Method, recommended by 3M, requires that only blue colonies with gas bubble formation be counted as *E. coli*. To determine the importance of this criterion in accurately determining the correct number of *E. coli* colonies, the proportions of gas forming and non-gas-forming blue colonies were counted in several experiments. In addition, gas-forming and non-gas-forming colonies were picked from Petrifilm plates and characterized further.

Proportions of gas-forming and non-gas-forming colonies were determined in four experiments. In one experiment, five water samples collected from Ruddiman Lagoon and tributaries were assayed in triplicate on Petrifilm plates. On the resultant 15 Petrifilm plates a total of 149 blue colonies were present, of which 107 were blue with gas (72%) and 42 blue colonies exhibited no gas formation (28%). For samples from the Middle Rouge River, blue colonies with gas accounted for 64% of a total of 64 blue colonies counted on 27 plates. For water samples from the Clinton River watershed, blue colonies with gas accounted for 86% of 190 blue colonies observed on 27 Petrifilm plates in one study and for 89% of 355 blue colonies observed on 30 plates in another study. On individual plates the proportion of non-gas-forming blue colonies ranged between 0 and 50%.

Blue colonies from Petrifilm plates of two of the above experiments were streaked onto MacConkey plates and the proportion of Petrifilm colonies producing pink colonies on the MacConkey plates was determined (Fig. 3A). For both experiments 100% of the blue colonies with gas produced pink colonies on MacConkey plates. In fact, in most cases, only pink colonies were present on the MacConkey plates. In contrast, for blue colonies without gas, in one experiment (water from Ruddiman Lagoon and tributaries), only 2 of 7 blue colonies without gas produced pink colonies on the MacConkey plates, and in the other experiment (Clinton River samples), only 6 of 13 no-gas blue colonies produced pink colonies of normal morphology. In both experiments, blue colonies without gas yielded a significantly lower proportion of MacConkey plates with pink colonies than observed for blue colonies with gas (Fisher exact test, $p < 0.002$).

Finally, from the Clinton River samples, bacterial clones from Petrifilm blue colonies with gas that were subsequently isolated on MacConkey plates were subjected to PCR with *E. coli*–specific primers. All 16 isolates produced the expected amplified product for *E. coli*, of which 12 are illustrated in Fig. 3B, and subsequently confirmed as coding for the *E. coli* β glucuronidase gene in comparison with a reference sequence (AE000257, Bases 6765 to 7351) in Genbank (data not shown).

Discussion

Although Petrifilm plates have previously been validated for use in detecting *E. coli* contamination of food (Curiale et al., 1991; Priego et al., 2000; Russell, 2000), they have not been tested extensively for use in detecting *E. coli* in environmental waters. The present study provides a comparison of *E. coli* enumeration in environmental water obtained with Petrifilm plates with three commonly used commercially available tests. Petrifilm results were highly correlated ($R > 0.9$) and equivalent (slope approximately = 1.0; no differences on paired *t* test) to mColiBlue, mTEC, and Colilert/IDEXX Quanti-Tray tests. Analysis of differences between blue colonies with and without gas on the Petrifilm plates suggest that due care in evaluating the presence of gas bubbles is necessary in counting colonies. More extensive testing of the Petrifilm method to determine rates of false positives, false negatives, efficacy in additional types of water samples, etc. could provide further validation of the use of Petrifilm plates. Nevertheless, the simplicity of using Petrifilm plates indicates that it may be a suitable method for citizen-based testing and environmental education programs.

Several characteristics of Petrifilm that make it suitable for volunteer-based monitoring of *E. coli* include ease of use, reasonable accuracy, sensitivity in an appropriate range, safety, low cost, ease of storage, and long shelf life. With three simple steps, as outlined in Materials and Methods, the Petrifilm method is easy to perform in both the laboratory and the field. Although the Petrifilm plates in this study were all inoculated in the laboratory, comparable results inoculating Petrifilm plates in the field have been found in our other studies and by volunteers (Ram, 2001). The dry gel on the plates sets up quickly with the addition of water, enabling the plate to be handled without spillage within a minute or two of inoculation. In other experiments with a range of incubation times (24–48 h) and temperatures, we have also found a good correlation with professional tests,

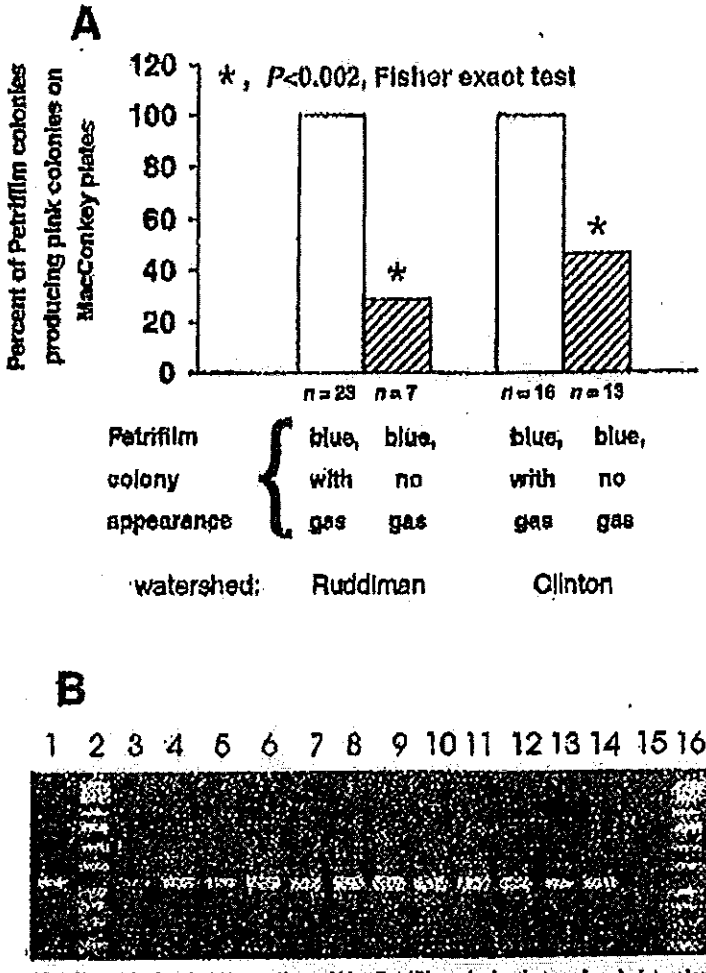

Fig. 3. Characterization of Petrifilm colonies. (*A*) Proportions of blue Petrifilm colonies that produced pink colonies when grown on MacConkey plates, as a function of whether the blue colonies also produced gas. The number of colonies (*n*) streaked onto MacConkey plates from Petrifilm plates used to enumerate *E. coli* from two experiments (Ruddiman and Clinton watersheds) is shown below each bar. *, $p < 0.002$, Fisher exact test. (*B*) Polymerase chain reaction (PCR) products obtained from pink colonies grown on MacConkey plates from the "blue, with gas" Clinton watershed samples in (*A*), amplified with Primers 295F and 984R. Lane 1, *E. coli* positive control; Lanes 3 through 14, amplification of 12 of the isolates; Lane 15, negative control (water instead of bacterial isolate). Sizes of selected bands on the DNA calibration ladders (Lanes 2 and 16) are indicated.

giving needed versatility for volunteer use (C.R. Merino and J.L. Ram, unpublished data, 2001). The overall film packet is compact (7.7 × 10.1 cm), thin (about 1 mm), and stackable, so many plates fit easily into an incubator. The plastic cover sheet readily protects the user from the growing bacterial colonies. The cost, at approximately $1.10 per plate in lots of 500, is less than Colilert but not as inexpensive as mTEC media; however, since Petrifilm does not require filtration apparatus, vacuum source, and space for pouring plates, its convenience may make it preferred in volunteer-based or educational testing situations.

The correlations illustrated in Fig. 2 indicate that Petrifilm plates give a reasonably accurate *E. coli* count. The variability observed with Petrifilm can be considered in relation to compliant levels of *E. coli*. For example, in the high count range (>300 cfu/100 mL), such as those samples analyzed in Fig. 2A and 2B, the 95% confidence interval averaged <40% of the mean, indicating that triplicate measurements having a mean > 500 cfu/100 mL are significantly greater than the Michigan total body contact allowable limit of 300 cfu/100 mL (e.g., a mean of 501 cfu/100 mL would have 95% confidence limits approximately 200 cfu/100 mL greater than and smaller than the mean of 501 cfu/100 mL, placing 300 cfu/100 mL outside the 95% confidence limit, i.e., significantly different). Conversely, in the low count range (<300 cfu/100 mL), such as the samples analyzed in Fig. 2C, the 95% confidence intervals averaged 101% of the mean, suggesting that triplicate measurements averaging <145

cfu/100 mL are significantly less than 300 cfu/100 mL. For preliminary screening of water samples, consistent observations of Petrifilm plates having zero or one colony (corresponding to 0 or 100 cfu/100 mL) would be good indicators that the actual *E. coli* level (as measured by standard enumeration tests) is <300 cfu/100 mL.

These 95% confidence intervals, while substantial, can be compared with the variability inherent in other methods. For example, a membrane filtration measurement of water having 300 cfu/100 mL would typically use a 10-fold dilution to yield 30 cfu on the filter (to be in the count range of the method). As noted in American Public Health Association (1998; Method 9222) "membrane counts really are not absolute" and are assumed to follow a Poisson distribution. For a count on the filter of 30 colonies, the 95% confidence interval would be ±10.9, or 36% of the number counted (American Public Health Association, 1998; Method 9222). For the IDEXX Quanti-Tray, the manufacturer provides a table of 95% confidence intervals. These vary over a broad range of counts; however, a representative comparison for this paper would be the average 95% confidence interval for the samples measured with Quanti-Trays in Fig. 2C, which averaged approximately 55% of their corresponding means, as calculated from the manufacturers' table. Thus, the 95% confidence intervals for the counts obtained with triplicate Petrifilm enumerations were comparable with that obtained with membrane filtration methods and the IDEXX Quanti-Tray in the high count range but were more variable than other methods when *E. coli* densities were <300 cfu/100 mL.

Petrifilm plates appear to be useful as a first step in obtaining environmental *E. coli* isolates. In the present study, blue colonies with gas were easily removed from Petrifilm plates and streaked on other nutrient media to isolate individual clones. The isolates obtained from 16 different Petrifilm colonies in this manner all produced PCR products consistent with their being *E. coli*. In this and other studies (J.L. Ram, unpublished data, 2001), Petrifilm plates have been a convenient first step in obtaining environmental *E. coli* isolates for sequencing.

The main disadvantage of the Petrifilm system is that only 1 mL of water can be used directly, giving less precise measurements in samples containing low numbers of *E. coli*. It may be possible to combine a preliminary concentration step on a filter with the Petrifilm technique; however, this would somewhat negate the simplicity desired for a citizen-based testing method. For improved precision in enumerating water samples with low numbers of *E. coli*, replicates can be used as in the present study. Overall, the simplicity, reliability, and relatively low cost of the Petrifilm plates make them suitable for citizen-based and educational monitoring of *E. coli*, particularly when used as a preliminary screening method to identify problem sites at which more extensive testing can be done by professional water-testing laboratories.

Acknowledgments

We thank Grand Valley State University student Brett Shelngowski for assistance and the Ruddiman Creek Task Force for pilot-testing volunteer-monitoring aspects. We gratefully acknowledge funding provided by NIH Grant GM58905-2, a Scientech (Indianapolis) internship, NSF Grants HRD9973243 and INT-9724918, Wayne State University, and Grand Valley State University.

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