



Guidance for County Recreational Water Quality Monitoring and Notification Programs

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Chapter 1: Introduction

Introduction

The purpose of this document is to provide guidance for county health departments in developing EPA compliant recreational quality monitoring and public notification programs and to comply with revised regulations for Designated Natural Bathing Areas. (COMAR 26.08.09.01) The U.S. Congress through the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000 has made standardization and improvement of coastal recreational water quality monitoring a priority. The state of Maryland has elected to create a guidance document that will be appropriate for both the coastal marine water areas that will be regulated by the EPA under the BEACH act and the freshwater beaches that will not be under the purview of this federal legislation. Responsibility for monitoring recreational water quality has been delegated by Maryland Department of the Environment (MDE) to the counties. Therefore, considerable flexibility exists for counties to develop, implement, evaluate, and revise their individual recreational water quality monitoring and notification programs.

The purpose of recreational water quality monitoring for microbial contamination is to reduce the incidence of human disease that arises from contamination of recreational water areas with fecal matter. Most of the epidemiological work on recreational waterborne disease has focused on the risk of contracting acute gastroenteritis due to the unintentional ingestion of water while recreating (Pruss, 1998). For this reason, the EPA has based its 1986 water quality indicator thresholds on the risk of gastroenteritis although other types of disease have been associated with recreating in contaminated waters (EPA, 2002). A full review of the relevant epidemiological literature is summarized in the EPA's 2002 *National Beach Guidance and Required Performance Criteria for Grants*.

In developing a recreational water quality monitoring programs, it is important to be aware of the appropriate interpretation of water quality indicator levels. The purpose of water quality indicator testing is to measure the concentration of a bacterial indicator species that is not necessarily a pathogen but whose levels are associated with fecal contamination and human disease (EPA, 2002). The EPA recommends states change from fecal coliforms to enterococci and/or *E. coli* as their recreational water quality indicator species since water concentrations of the latter two are more consistently associated with human disease in bathers, specifically gastroenteritis (EPA, 1986). Maryland has already adopted the new indicators. High levels of these bacterial indicators suggest water contamination with human or animal fecal matter and resulting potential risk to human health due to the human pathogens associated with fecal matter.

This document outlines standardized steps to help counties develop rational recreational water quality monitoring and notification programs that will be in compliance with EPA directives. The tasks involved in these steps will be delineated in the remainder of this document. The steps are summarized as follows:

Step 1 Identifying and listing beaches.

Step 2 Prioritizing beaches to create a tiered sampling and notification system. A prioritization checklist has been developed by MDE to aid counties with this process.

Step 3 Standardizing the procedures for collection and analysis of recreational water samples. The timing and indications for repeat water sampling and the planned interpretation of abnormal results should be included in this standardized protocol.

Step 4 Developing protocols for intra and interagency communication (including the transfer of water quality data). These protocols should document the chain-of-communication in the case of an advisory or beach closure.

Step 5 Developing protocols for public notification and risk communication.

References

Pruss A. 1998. Review of epidemiological studies on health effects from exposure to recreational water. *Intl J Epidemiol* 27:1-9.

U.S. Environmental Protection Agency. 1986. *Ambient Water quality Criteria for Bacteria*, EPA 440/5-84-002. Office of Regulations and Standards, Washington, DC.

U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

Chapter 2: Identifying and Prioritizing Beaches

Step 1: Identify and list beaches within your county that will be included in the county's recreational water quality monitoring program.

Part A

Identify all beaches, areas immediately adjacent to beaches, and other recreational water areas where you believe it would be worthwhile, if resources existed, to conduct microbial monitoring and advisory posting so citizens can make informed decisions about the risks they face when recreating at these areas. Not all beaches are permitted so it is important to identify other recreational water areas where county officials are aware of frequent use and where water quality monitoring and advisory posting is necessary for citizens to make informed decisions concerning the risks they face when recreating at these areas.

Part B

Determine if the county has legal authority to regulate all of the listed beaches and eliminate those for which the county does not have authority to administer a water quality monitoring and notification program.

Part C

Compile a final list of beaches to be included in county's recreational water quality monitoring and notification program. Submit the list of beaches to MDE who will compile a master list of Maryland's recreational waters. As a requirement of Beach grants acceptance, Maryland must give EPA this list and update it as necessary.

Step 2: Prioritizing Bathing Beaches.

Once the counties have created an initial list of beaches to be monitored, the next step will be to prioritize the beaches to guide the allocation of resources within the county's monitoring and notification program. Beaches will be classified into three categories: high priority (Tier 1), medium priority (Tier 2), and low priority (Tier 3). The purpose of the prioritization is to aid counties in creating a tiered monitoring and notification program in order to maximize the public health benefit of their programs given the finite level of resources available. In the 2002 *National Beach Guidance and Required Performance Criteria for Grants*, the EPA recommends that high priority (Tier 1) beaches be monitored at least once a week during the swimming season. Medium (Tier 2) and low priority (Tier 3) beaches may be monitored less frequently depending on pollution and use risk factors as well as local jurisdiction discretion (EPA, 2002).

The *Beach Evaluation and Classification Checklist* located in Appendix 2-A at the end of this chapter is designed to assist counties in prioritizing beaches according to their public use level, potential sources of fecal matter contamination, prior water quality monitoring results, and importance to the local economy. The checklist aims to guide county officials in their evaluation and prioritization of their counties' beaches. The calculated checklist score should be placed in the context of the beach manager's knowledge of the area when determining the final priority score. The beach manager's local knowledge of usage patterns, point and non-point sources of pollution, pollution levels in tributaries, community attitudes, swimmer reports, hospital records, and other local historical records should also be taken into consideration. The EPA recommends the following factors be considered when prioritizing beaches for monitoring:

- (1) Amount of rainfall in the area
- (2) Frequency of known and potential sources such as combined sewer overflow or sanitary sewer overflow
- (3) Density of bathers
- (4) Occurrence of failing or malfunctioning septic systems, and
- (5) Public comment (EPA, 2002).

The *Beach Evaluation and Classification Checklist* will serve as a standardized way to document sanitary surveys for bathing beaches and should be updated periodically so it remains current with present environmental conditions. Please read the instructions for the checklist carefully. The entire checklist does not have to be completed for those beaches that should clearly be classified as high priority (Tier 1) based on several key characteristics highlighted in the shaded boxes.

References

U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

Appendix 2-A: Beach Evaluation and Classification Checklist

Inventory and Prioritization of Recreational Bathing Areas

The Maryland Department of the Environment is currently developing a statewide beach monitoring and notification program that will meet the requirements of the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000.

The checklist below represents an early step in the program. Its ultimate purpose is to help counties efficiently allocate their monitoring and public notification resources by prioritizing beaches according to risk of fecal matter contamination and use level. By participating in this step, counties with coastal beaches become eligible for EPA beach program developmental and implementation funds. Because Maryland is standardizing its beach monitoring programs statewide, non-coastal counties should also participate in this step.

The checklist addresses pollution sources, ecological factors, and use patterns that influence microbial contamination and disease risk at beaches. Local knowledge of a beach's history and setting is critical to the process. A provision is made for the county to apply professional judgment in determining the classification of a beach as high priority (Tier 1), medium priority (Tier 2), or low priority (Tier 3). In the future, when the program is fully implemented, there will be a requirement for public comment on the final list of beaches and their classifications.

Step 1: Identify all beaches, areas immediately adjacent to beaches, and other recreational water areas where you believe it would be worthwhile, if resources existed, to conduct microbial monitoring and posting so that citizens can make informed decisions about the risks they face when recreating at these areas. Fill out a separate questionnaire/worksheet for each beach you identify.

Step 2: Complete the following location and contact information

Date of Evaluation _____

Name of Beach/Recreational Water Area _____

Name of Waterbody _____

Type of Waterbody (circle) Ocean Estuary Lake Pond River Quarry Other _____

Permitted Beach (circle) Yes No

Appendix 2-A: Beach Evaluation and Classification Checklist

Location: _____

Beginning of Beach

Latitude _____ Longitude _____

Ending of Beach

Latitude _____ Longitude _____

Other Location Notes _____

Nearest City or Town _____ County _____

Responsible Authority (County Office) _____

Address _____

Phone _____

Fax _____

E-mail _____

If applicable, list sampling station locations. If you require more space, please write on the back of survey.

Sampling Station Name _____

Latitude _____ Longitude _____

Sampling Station Name _____

Latitude _____ Longitude _____

Sampling Station Name _____

Latitude _____ Longitude _____

Step 3: In the attached worksheet, answer the questions that have shaded boxes. Most of the answers can be obtained from your knowledge of the area, prior water quality monitoring reports, and prior sanitary surveys. Please note some answers have checks (√) that represent reasonable default entries if local county data are not available.

Step 4: Count the total number of MEDIUM (Tier 2) and HIGH (Tier 1) values in the shaded boxes. If the combined number of MEDIUM (Tier 2) and HIGH (Tier 1) values is **4 or more** and the value for the first question – the estimated average number of users on peak use days – is either MEDIUM (Tier 2) or HIGH (Tier 1), then complete the worksheet by marking HIGH (Tier 1) as the preliminary priority level in **Step 7** and proceed to **Step 8**. Otherwise, go to **Step 5**.

Step 5: Complete the remaining questions in the worksheet.

Appendix 2-A: Beach Evaluation and Classification Checklist

Step 6: Count the number of NOT KNOWN, LOW (Tier 3), MEDIUM (Tier 2), and HIGH (Tier 1) values in the worksheet. Enter the counts in the table below. Multiply the number of MEDIUM (Tier 2) and HIGH (Tier 1) values times two, as indicated.

Significance Value	<u>Count</u>
NOT KNOWN	= _____
LOW (Tier 3)	= _____
MEDIUM (Tier 2) in unshaded boxes + (MEDIUM (Tier 2) in shaded boxes x 2)	= _____
HIGH (Tier 1) in unshaded boxes + (HIGH (Tier 1) in shaded boxes x 2)	= _____

Step 7: Identify the preliminary priority level for water quality monitoring and other disease prevention activities at the beach. The preliminary priority level equals the Significance Value with the highest Count in Step 6. If “Not Known” has the highest score then the beach is unclassifiable due to inadequate information.

Preliminary priority level based on the worksheet:

Circle one: UNCLASSIFIABLE LOW (Tier 3) MEDIUM (Tier 2) HIGH (Tier 1)

Step 8: If the worksheet produces a priority that your agency feels is too high or too low based on the history of the beach, potential pollution, use level, etc., the priority level can be changed. Circle the classification level that is most appropriate and provide a brief justification for the change.

Recommended priority level:

Circle one: UNCLASSIFIABLE LOW (Tier 3) MEDIUM (Tier 2) HIGH (Tier 1)

Justification: _____

Step 9: Complete the following:

The prioritization was performed by (print name) _____

Title _____

Agency _____

Address _____

Signature _____

Date _____

Evaluation Criterion	Significance							
	Inconclusive	√	LOW (Tier 3)	√	MEDIUM (Tier 2)	√	HIGH (Tier 1)	√
Bather Use Level								
Estimated average number of bathers on <u>peak-use</u> days (summer weekends and holidays)	Not known		Less than 100 bathers per day		Between 100 and 1000 bathers per day		More than 1000 bathers per day	
Approximate land area of beach open to bathers (length x width at high tide)	Not known		Less than 500 square meters		Between 500 and 5000 square meters		More than 5000 square meters	
Average number of days per bathing season	Not known		Less than 30 days		Between 30 and 150 days	√	More than 150 days	

Historical Water Quality								
Percentage of calendar month geometric means that exceeded Maryland standard during the last 3 swimming seasons*	Not known		Less than 5%		Between 5% and 25%		More than 25%	
Percentage of single samples that the exceeded Maryland standard during the last 3 swimming seasons**	Not known		Less than 5%		Between 5% and 25%		More than 25%	
Percentage of post-rainfall single samples that exceeded Maryland standard during the last	Not known		Less than 5%		Between 5% and 25%		More than 25%	

3 swimming seasons**						
Swimmers report health effects from this beach	Not known		No health problems noted		One report per year	More than one report per year
<p>* Thresholds for geometric means: fecal coliform 200 MPN/100 ml; E. coli 126; enterococci, estuarine 35, freshwater 33</p> <p>** Thresholds: fecal coliform, 400 MPN/100 ml; estuarine enterococci, 104; freshwater enterococci, 61; E. coli 235.</p> <p>See regulations COMAR 26.08.09 for complete standards information. See also Table 3.2 in this document.</p>						
Pollution Threats: Human Fecal Matter Sources						
Combined sewer overflows (CSOs) occur within 5 mile area	Not known		No		--	Yes
Impacts from storm drains	Not known		None		Unlikely	Likely
Impacts from failing sewer infrastructure	Not known		None		Unlikely	Likely
Estimated average density of bathers <u>in water</u> at peak season	Not known		Less than 5 per 100 meters squared		Between 5 and 25 per 100 meters squared	More than 25 per 100 meters squared
Nearest wastewater treatment plant that discharges to surface waters.	Not known		More than 5 miles away		Between 1 and 5 miles away	Less than 1 mile away
Distance to nearest sewage pump station	Not known		More than 5 miles		1-5 miles	Less than 1 mile
Approximate number of septic systems within 3 miles of beach	Not known		None		Less than 100	More than 100
Are sanitary facilities for the public accessible and adequately maintained during peak season?	Not known		Easily accessible and well-maintained		Not easily accessible or not well-maintained	Nonexistent/in accessible or inadequately maintained
Number of marinas	Not known		None		1	>1
Pleasure craft in the near vicinity	Not known		None		Occasional	Frequent

Pollution Threats: Animal Fecal Matter Sources						
Livestock waste due to animals with direct access to water's edge or from storm runoff	Not known		No threat to water quality		Moderate threat to water quality	Major threat to water quality
Wildlife waste due to animals with direct access to water's edge	Not known		No threat to water quality		Moderate threat to water quality	Major threat to water quality

or from storm runoff							
Domestic animal waste from pets on beach or runoff from homes/parks	Not known		No threat to water quality		Moderate threat to water quality		Major threat to water quality
Number of point source discharges of animal fecal matter from concentrated animal feeding operations or other sources within 3 miles of this beach	Not known		None		1-2		>2

Beach Structure and Ecological Factors							
Estimated impact of rainfall on beach water quality	Not known		None		Medium		High
Usual maximum water temperature during the swimming season	Not known		Less than 65 °F		Between 65 and 80 °F	√	More than 80 °F
Water exchange in swimming area is	Not known		Constant or significant		Moderate		Low

Chapter 3: Water Quality Monitoring and Assessment

The purpose of monitoring and assessment is to accurately capture water quality data that can be used by the county health departments to develop coherent policies regarding sampling, monitoring of known pollution sources, beach usage, and risk communication during the swimming season (Memorial Day to Labor Day). Predictive models, based on sound scientific practices, can also be used in assessing a bathing area's suitability for primary contact recreation and risk prevention decisions. Sanitary survey and sampling requirements to be conducted by the local approving authority prior to opening a bathing beach for the swimming season will continue in accordance with Regulation .06 under COMAR 26.08.09 Public Bathing Beaches. Maryland is currently revising its regulations regarding public bathing beaches. Improvements and updates of the regulations will bring Maryland into compliance with requirements of the BEACH Act and recommendations of the *National Beach Guidance and Required Performance Criteria for Grants*.

Tiered Sampling Design

Sampling protocols should take into consideration four key concerns: (1) periods of recreational use of the waters, (2) the nature and extent of use during certain periods, (3) the proximity of the waters to known point sources and non-point sources of pollution, and (4) any effect of storm events on the waters (EPA, 2002). The goal of water quality monitoring and assessment is to have in place a sampling protocol, based on the priority characterization of the beach, which will provide appropriate protection for recreational water users. The EPA's recommended tiered sampling design is summarized in Table 3-1 below.

Table 3-1: Maryland Tiered Sampling Design for Beach Managers

Adapted from U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

	When to conduct basic sampling	When to conduct additional sampling	Where to collect samples	What depth to sample
High Priority (Tier 1)	<p>At least 1 month prior to start of swimming season until end of swimming season. (Memorial Day to Labor Day)</p> <p>Sampling frequency is one or more times per week during swimming season.</p>	<p>After a heavy rainfall, particularly if a valid preemptive standard is not in place.</p> <p>After a sewage spill or major pollution event where potential exists that indicator levels may be expected to exceed standards. Beach closure is required when a sewage spill or major leaks are suspected.</p> <p>Upon lifting an advisory or reopening after closure. Additional sampling should be conducted to determine whether a public notification could be discontinued. Accelerated sampling in this case may be advisable.</p> <p>After a water quality standard is exceeded, counties must immediately issue a public notification or resample if there is reason to doubt the accuracy of the sample. If a sample result is determined to be accurate and standards are being exceeded, the counties must issue a public notification.</p>	<p>Midpoint of typical bathing area & near known and potential pollution sources.</p> <p>For short beaches, one sample at a point corresponding to each lifeguard chair, or one for every 500 meters of beach.</p> <p>For long beaches (> 8 km or 5 miles), sample at most highly used areas, and spread out samples along the entire beach.</p>	<p>Knee depth (Knee deep is 0.5 meters, taking the sample at 0.3 meters below the surface of the water. EPA 2003)</p>
Medium Priority (Tier 2)	<p>At least 1 month prior to start of swimming season until end of swimming season.</p> <p>Sampling frequency is once every other week during the swimming season.</p>	<p>After a heavy rainfall, particularly if a valid preemptive standard is not in place.</p> <p>After a sewage spill or major pollution event where potential exists that indicator levels may be expected to exceed standards. Beach closure is recommended when a sewage spill or major leaks are suspected.</p> <p>Upon lifting an advisory or reopening after closure. Additional sampling should be conducted to determine whether a public notification could be discontinued. Accelerated sampling in this case may be advisable.</p> <p>After a water quality standard is exceeded, counties must immediately issue a public notification or resample if there is reason to doubt the accuracy of the sample. If a sample result is determined to be accurate and standards are being exceeded, the counties must issue a public notification.</p>	<p>Midpoint of typical bathing area & near known and potential pollution sources.</p> <p>For short beaches, one sample at a point corresponding to each lifeguard chair, or one for every 500 meters of beach.</p> <p>For long beaches (> 8 km or 5 miles), sample at most highly used areas, and spread out samples along the entire beach.</p>	<p>Knee depth (Knee deep is 0.5 meters, taking the sample at 0.3 meters below the surface of the water. EPA 2003)</p>

Table 3-1 (continued)

	When to conduct basic sampling	When to conduct additional sampling	Where to collect samples	What depth to sample
Low Priority (Tier 3)	<p>At least 1 month prior to start of swimming season until end of swimming season.</p>	<p>After a heavy rainfall, particularly if a valid preemptive standard is not in place.</p>	<p>Midpoint of typical bathing area. & near known and potential pollution sources.</p>	<p>Knee depth (Knee deep is 0.5 meters, taking the sample at 0.3 meters</p>

	<p>Sampling frequency is once per month. Areas should be sampled to determine whether they should be reclassified or dropped from the program.</p>	<p>After a sewage spill or major pollution event where potential exists that indicator levels may be expected to exceed standards. Beach closure is recommended when a sewage spill or major leaks are suspected.</p> <p>Upon lifting an advisory or reopening after closure. Additional sampling should be conducted to determine whether a public notification could be discontinued. Accelerated sampling in this case may be advisable.</p> <p>After a water quality standard is exceeded, counties must immediately issue a public notification or resample if there is reason to doubt the accuracy of the sample. If a sample result is determined to be accurate and standards are being exceeded, the counties must issue a public notification.</p>	<p>For short beaches, one sample at a point corresponding to each lifeguard chair, or one for every 500 meters of beach.</p> <p>For long beaches (> 8 km or 5 miles), sample at most highly used areas, and spread out samples along the entire beach.</p>	<p>below the surface of the water. EPA 2003)</p>
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Sample Collection and Transport

Adherence to sample collection protocols is crucial in obtaining accurate sample results as well as ensuring the integrity of the water quality monitoring process. Proper collection and preservation of samples, adherence to chain-of-custody protocols, and thorough documentation is important to ensure the validity of sampling results and establish the legality of sample collections. The following recommended steps for sample collection are taken from the EPA’s 2002 *National Beach Guidance and Required Performance Criteria for Grants*, Appendix J:

1. **Only use properly sterilized, prelabeled collection containers.**
2. **Identify the sampling site on a chain-of-custody tag, if required, or on the bottle label and on a field log sheet.**
3. **Remove the bottle covering and closure just before obtaining each sample and protect them from contamination. Be careful not to touch the inside of the bottle itself or the inside of the cover.**
4. **The first sample to be prepared is the trip or field blank (at least one per sampling day for routine sampling is recommended). Open one of the sampling bottles and fill it with 100 mL of sterile buffered dilution when collecting freshwater, estuarine, or marine water samples. Cap the bottle and place it in a cooler.**
5. **To collect the surface water samples, carefully move to the first sampling location. If wading in the water, try to avoid kicking up bottom material at the sampling station. You should be positioned downstream of any water current to take the sample from incoming flow.**
6. **Open a sampling bottle and grasp it at the base with one hand and plunge the bottle mouth downward into the water to avoid introducing surface scum. Position the mouth of the bottle into the current away from your hand and away from the side of the sampling platform or boat. The sample should be taken in knee-deep water. Knee deep is 0.5 meters, taking the sample at 0.3 meters below the surface of the water. If the**

water body is static, an artificial current can be created by moving the bottle horizontally with the direction of the bottle pointed away from you. Tip the bottle slightly upward to allow air to exit and the bottle to fill.

- 7. Remove the bottle from the waterbody.**
- 8. Pour out a small portion of the sample to allow an air space for proper mixing of the sample before analysis. The bottle should be filled to the shoulder of the sample bottle.**
- 9. Tightly close the stopper.**
- 10. Enter specific details to identify the sample on a permanent label. Take care in transcribing sampling information to the label. The label should be clean, waterproof, non-smearing, and large enough for the necessary information. The label must be securely attached to the sample bottle but removable when necessary. Preprinting standard information on the label can save time in the field. The marking pen or other device must be non-smearing and maintain a permanent legible mark.**
- 11. Complete a field record for each sample to record the full details on sampling and other pertinent remarks, such as flooding, rain, or extreme temperature, that are relevant to interpretation of the results. This record also provides a back-up record of sample identification.**
- 12. Place the samples in an insulated container (cooler, ice chest) and transport them to the laboratory as soon as possible. Adhering to sample preservation and holding time limits is critical to the production of valid data. Bacteriological samples should be iced or refrigerated from 1 to 10 degrees centigrade during transit to the laboratory. Insulated containers, such as plastic or Styrofoam coolers, are preferable to ensure proper maintenance of storage temperature. Care should be taken to ensure that sample bottles are not totally immersed in water during transit or storage. To keep bottles dry, place sample bottles in a waterproof storage bag and then place in cooler. Samples should be examined as soon as possible after collection. Do not hold samples longer than 6 hours between collection and initiation of analysis. Do not analyze samples that exceed holding time limits.**
- 13. Water samples for analyses of other parameters should be collected in separate appropriate containers at the same time and analyses performed as specified in the particular methods.**
- 14. After samples have been collected from a station, wash hands and arms with alcohol wipes, a disinfectant lotion, or soap and water, and dry to reduce exposure to potentially harmful bacteria or other microorganisms (EPA, 2002).**

The chain-of-custody is important, particularly in instances where reliability of evidence in legal cases is an issue. In these instances, adherence to established chain-of-custody protocols is necessary to ensure the integrity of the sampling and analysis process. The EPA recommends the Air Force Center for Environmental Excellence standards for chain-of-custody which defines a sample as being under a person's custody when: (1) the sample is in his or her possession, (2) the sample is in his or her view, after being in his or her possession, (3) the sample was in his or her possession and he or she locked it up, or (4) the sample is in a designated secure area (Air Force Center for Environmental Excellence, 2001). Meticulous documentation on the chain-of-custody form and other required paperwork is essential to

protect the integrity of the sample. For a detailed chain-of-custody checklist see the EPA's 2002 *National Beach Guidance and Required Performance Criteria for Grants*, Appendix J.

Indicators

Maryland will follow recommendations in the EPA's *Ambient Water Quality Criteria for Bacteria* (1986) regarding *E. Coli* and enterococci as the currently accepted best indicators of fecal contamination. The change in indicator organisms resulted from research indicating that *E. Coli* and enterococci were better correlated with gastrointestinal symptoms than fecal coliforms (Pruss, 1998). The two measures of water quality are taken into consideration when assessing a designated beach area are: (1) steady-state geometric mean – a geometric average occurring over a specified period of time, and (2) single sample maximum allowable density – maximum allowable measurable density of indicator bacteria for a single water sample. To ensure optimal safety for the recreating public, MDE requires Tier 1 and Tier 2 recreational water areas meet the water quality standards for a “designated beach area” and Tier 3 recreational water areas to meet the water quality standards for moderate full body contact recreation. The “designated beach area” criterion applies the smallest confidence level (75%), which corresponds to the most stringent single sample maximum allowable density for indicator bacteria. Moderate full body contact recreation criterion applies to a confidence level of 82%. Table 3-2 summarizes the EPA's criteria for indicator organism densities adapted for Maryland.

Table 3-2: Criteria for Indicator Organism Densities

Adapted from U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

Tier 1 and Tier 2 Beaches	Steady-state Geometric Mean	Single Sample Maximum for a Designated Beach Area (upper 75% CL)*
Fresh Water**		
	(colony forming units/100 ml)	(colony forming units/100 ml)
Enterococci	33 CFU	61 CFU
<i>E. Coli</i>	126 CFU	235 CFU
Marine Water***		
Enterococci	35 CFU	104 CFU

* No single sample should exceed this limit.

** Based on a risk of 8 swimmers per 1,000 developing gastroenteritis.

*** Based on a risk of 19 swimmers per 1,000 developing gastroenteritis.

Tier 3 Beaches	Steady-state Geometric Mean	Single Sample Maximum for Moderate Full Body Contact Recreation (upper 82% CL)*
Fresh Water**		
	(colony forming units/100 ml)	(colony forming units/100 ml)
Enterococci	33 CFU	78 CFU
<i>E. Coli</i>	126 CFU	298 CFU
Marine Water***		
Enterococci	35 CFU	158 CFU

* No single sample should exceed this limit.

** Based on a risk of 8 swimmers per 1,000 developing gastroenteritis.

*** Based on a risk of 19 swimmers per 1,000 developing gastroenteritis.

A simple way to calculate the geometric mean is to take the n^{th} root of n samples as follows:

Sample 1	20	Number of samples = 5	Take 1/# of samples: = 1/5 = 0.2	Take product raised to 1/# of samples: Geometric mean = (10,440,000) ^{0.2} Geometric mean = 25.336
Sample 2	40			
Sample 3	15			
Sample 4	30			
Sample 5	29			
Product: 20x40x15x30x29	10,440,000			

Example taken from U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

A “running” geometric mean can be calculated each time after new sample results are returned from the lab. When an Enterococci value is less than the laboratory reporting limit (less than 10), use the value 1 to calculate the single sample maximum value and/or steady-state value. When an E. Coli

value is less than the laboratory reporting limit (less than 1), use the value 1 to calculate the single sample maximum value and/or steady-state value. The interpretation of the EPA's current water quality criteria for the indicator species enterococcus and *E. Coli* is summarized as follows:

Fresh water beaches

Recreational water quality standards are not being met if the steady-state geometric mean indicator density for enterococci exceeds 33 and/or the steady-state geometric mean indicator density for *E. Coli* exceeds 126 (5 measurements taken evenly spaced over a 30-day period). Recreational water quality standards are not being met if the single sample maximum allowable density for enterococci exceeds 61 and/or the single sample maximum allowable density for *E. Coli* exceeds 235 in Tier 1 and 2 beaches. For Tier 3 beaches, recreational water quality standards are not being met if the single sample maximum allowable density for enterococci exceeds 78 and/or the single sample maximum allowable density for *E. Coli* exceeds 298.

Marine water beaches

Recreational water quality standards are not being met if the steady-state geometric mean indicator density for enterococci exceeds 35 (5 measurements taken evenly spaced over a 30-day period). Recreational water quality standards are not being met if the single sample maximum allowable density for enterococci exceeds 104 for Tier 1 and Tier 2 beaches. For Tier 3 beaches, recreational water quality standards are not being met if the single sample maximum allowable density for enterococci exceeds 158.

Assessment of Data and Response to Exceedances

- (1) When results of the samples show an indicator organism density that exceeds the water quality standard, the county health department must issue a public notification or resample, if there is reason to doubt the accuracy or certainty of the first sample. If subsequent sampling results are determined to be accurate and standards are being exceeded, prompt public notification of the advisory or closure is required. If a known pollution source exists i.e. combined sewer overflow, failing sewer infrastructure, wastewater treatment discharge, etc, the county must close the beach and provide prompt public notification thereof.
- (2) The beach may be opened or advisory lifted only after subsequent bacteriological sampling results in indicator densities that satisfy the applicable water quality standards.
- (3) When an emergency health hazard is caused by any dangerous contaminant or condition, the approving authority or MDE may immediately order the beach closed and summarily the suspension of the operating permit (for Permitted Designated Natural Bathing Areas) and shall promptly provide the permittee written notice of the suspension, the finding and the reasons that support the finding, and an opportunity to be heard. Public notification procedures must be implemented.

Staffing/Training for Beaches Monitoring

Many counties may require additional staffing for their seasonal recreational water monitoring and public notification programs. Through the use of EPA Implementation Grant money, MDE will provide financial assistance to counties expressing a need for seasonal staffing to implement a satisfactory monitoring program. The county must demonstrate need in requesting assistance. Through and memorandum of understanding (or similar) document, MDE and the county will arrange for the exchange of funds to provide sufficient seasonal staffing for the county health department, and will be taken on a case-by-case basis.

Training for all seasonal staff will be coordinated through MDE, in order to provide consistent training statewide for all seasonal staff. Training will be provided to teach beach monitoring field staff the proper methods and techniques for taking bacteriological samples. In addition, proper QA/QC practices will be taught for sampling, data management, field note-taking, etc. Each seasonal staff member must demonstrate proficiency in all aspects required of them before being allowed to begin actual sampling for his/her respective county.

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Chapter 4: Chain-of-Communication and Reporting

Communication protocols are necessary to ensure the timely and accurate flow of information regarding water quality monitoring. Standardized communication procedures that establish a formal chain-of-communication are an effective means of allowing systematic review of sampling results, managing dissemination of information, targeting key stakeholders, and maintaining credibility of the responsible authorities. Public notification and risk communication strategies will be discussed in detail in Chapter 5. The following section specifically addresses the flow information between interested parties through a formal chain-of-communication.

A key element in establishing efficient communication protocols is to clearly define job duties and responsibilities for personnel involved in recreational water monitoring at the local level. When job duties and responsibilities are clearly defined, the flow of information can be more effectively managed. Three key factors in managing the information flow are determining (1) who needs to receive the information, (2) how the message should be communicated, and (3) how the orderly flow of information should proceed. Determining the information requirements of key stakeholders and specifying who will communicate the message are important prerequisites for establishing the chain-of-communication. Key stakeholders include, but are not limited to, the following: the county health officer or designated authority, Department of Recreation and Parks, beach manager/operator, local government officials, the general public, community and business organizations, local media, EPA, and MDE. In addition to a chain-of-communication protocol for disseminating information on recreational water quality, a forum for public comment on the county water quality monitoring and notification program is necessary to comply with EPA grant requirements.

Designation of an experienced spokesperson with credibility in the community and good working relationships with key stakeholders will facilitate the risk communication process (McComas and Trumbo, 2001). A framework for a chain-of-communication strategy in the event of water quality exceedances detected during routine sampling is depicted in Appendix 4-A at the end of this chapter. In this example, the chain-of-communication proceeds through three distinct steps summarized as follows:

Step 1 Sanitarian fills out field sample forms (which also serves as chain of custody form) and transmits the sample to the DHMH laboratory, either personally or by courier.

Step 2 DHMH laboratory reports sampling results to the county environmental health division and MDE.

Step 3 Generalized sampling results in the event of exceedances, the health risks posed, and the subsequent action plan are communicated to key stakeholders (Risk Communication).

In Step 1, the sanitarian (or field sampler) fills out the forms. The samples are then transported to the DHMH lab by the sampler or by courier. The field form must be signed and time noted when samples change possession. In Step 2, DHMH reports the sample results to the county representative. Fax, email, phone call, are all appropriate methods to relay results. Measures must be taken to eliminate transcription errors and to maximize data quality assurance. Key stakeholders in Step 3 are also notified directly in the case of pollution events or imminent exceedances of water quality standards, when advisories are lifted, when beaches are reopened, or when any significant events occur that the county environmental health division feels necessary to communicate. Phone

calls, faxes, emails, posted signs, websites, are all appropriate methods for public notification. Since each county and each bathing area is different, the responsible county authority will choose the appropriate notification method and procedure.

Reporting

MDE is required to submit to the EPA an annual data report on recreational water quality monitoring. Counties are encouraged to develop a system for submitting timely data reports to MDE in electronic form. The EPA specifies that:

The state or local government must adequately identify measures for prompt communication of the occurrence, nature, location, pollutants involved, and extent of any exceeding of, or likelihood of exceeding, applicable water quality standards for pathogens and pathogen indicators. The state or local governments must identify how this information will be promptly communicated to EPA. States only must identify how this information will be promptly communicated to a designated official at the local government for the area adjoining the coastal recreational waters for which the failure to meet applicable standards is identified (EPA, 2002).

MDE will be responsible for notifying EPA of all monitoring and activity data including notification of exceedances and actions taken by the local health department. Specific “one-time” and recurring” data elements are detailed in Appendix E of the EPA’s 2002 *National Beach Guidance and Required Performance Criteria for Grants*. The EPA envisions all compliance and data reports being submitted on their Central Data Exchange (CDX) system (EPA, 2001). Microsoft Access and Oracle are recommended applications for compiling data reports because of their compatibility with the CDX system. The format for data submission to the EPA is currently under development. MDE will update counties as additional information becomes available.

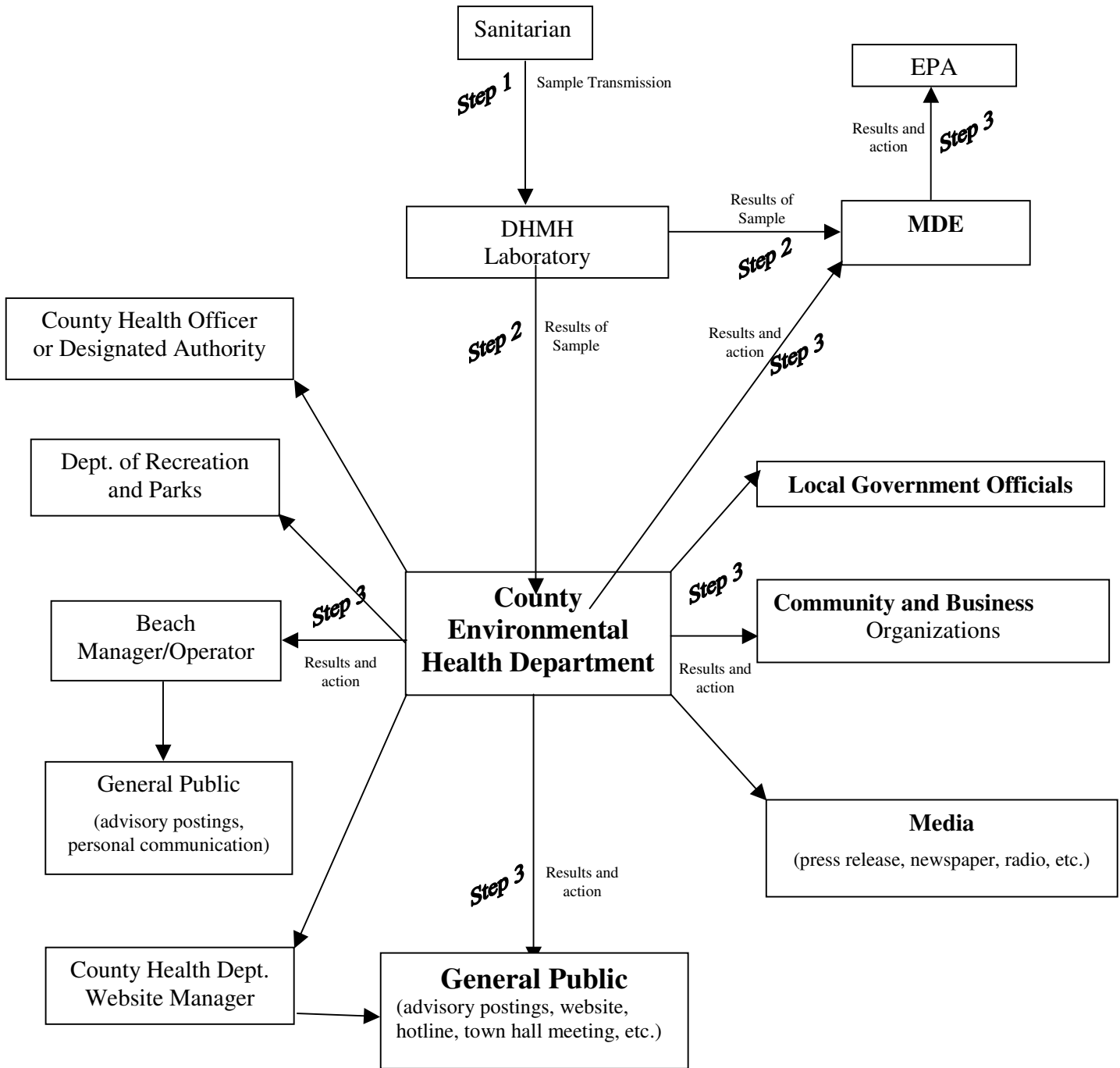
Appendix 4-B gives an example of a hypothetical “notification roster” environmental health offices may find useful in initiating notification procedures.

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Appendix 4-A: Framework for Information Flow in the Chain-of-Communication



Appendix 4-B: Example Notification Roster

Notification Roster for Initiating Notification Procedures (Environmental Health Office)

<u>County Health Officer</u> - Jane Doe	(410) 123-4576
<u>Department of Recreation and Parks</u> - John Doe	(410) 231-6789
<u>Beach Manager/Operator</u> - Depends on beach	(410) xxx-xxxx
<u>County Health Department Website Manager</u> - Mark Smith	(410) 234-5678
<u>City Council President</u> - Mary Jones	(410) 345-6789
<u>Head of the Beachside Community Association</u> - Bob Johnson	(410) 456-7890
<u>President of the Chamber of Commerce</u> - Lisa Washington	(410) 567-8901
<u>KXRY Television</u>	(410) 678-9012
<u>Q98 Radio</u>	(410) 789-0123
<u>Beachside Times Newspaper</u>	(410) 890-1234
<u>Maryland Department of the Environment</u>	(410) 537-3000

Chapter 5: Public Notification and Risk Communication

This chapter is designed to assist counties in developing public notification and risk communication plans in the event of actual or imminent exceedances of recreational water quality standards or to improve upon existing plans already in place.

The National Research Council (1989) defined risk communication as, "...an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management." The U.S. Department of Health and Human Services (1994) adopted a modified definition put forth by Vincent Covello, the director of the Center for Risk Communication, Columbia University who states that risk communication is, "...the purposeful exchange of information about the existence, nature, form, severity, or acceptability of risk." Both definitions imply that risk communication is an interactive process that is participatory in nature where decision-making concerning acceptable and tolerable risk depends largely on input from the local community.

The purpose of risk communication, in the context of local recreational water quality monitoring, is for county health departments to convey information to the public and engage key stakeholders in a dialogue which will allow interested parties to understand risk and make informed decisions regarding recreational water use. Risk communication thus allows key stakeholders to make educated health related decisions under conditions involving a given amount of uncertainty (Nicholson, 2000). Ideally, the decision making process should be a collaborative effort between government agencies, citizen's groups, business organizations, and the public at large (Maibach and Holtgrave, 1995).

Clearly defining the goals and objectives of a risk communication strategy is an important first step in developing an effective plan (Maibach and Holtgrave, 1995). Early identification and targeting of key stakeholders will improve the efficiency of the planning process (Forrest, 1998). Numerous channels exist for public notification and risk communication. Among them are town hall meetings, public service messages, television, radio, newspaper, press releases, news conferences, hotlines, advisory/closing postings, news letters, brochures, fact sheets, information packets, websites, and video tapes (Ng and Hamby, 1997). Whichever methods are used, certain basic rules of risk communication should be followed:

- **Accept and involve the public as a legitimate partner.**
- **Plan carefully and evaluate your efforts.**
- **Listen to the public's specific concerns.**
- **Be honest, frank, and open.**
- **Coordinate and collaborate with other credible sources.**
- **Meet the needs of the media.**
- **Speak clearly and with compassion (EPA, 1988).**

It is estimated that approximately one half of adults in the U.S. have limited ability to process and understand complex prose, documents, and quantitative information. Recent immigrant status and low educational level appear to account for this observation (U.S. Department Education, 2002). Therefore, it is important to make written language and oral communication as simple, clear, and concise as possible. In addition, visual aids accompanying written and quantitative data may enhance the understanding of the public health message (Lipkus and Hollands, 1999).

The U.S. Department of Health and Human Services (1994) has identified six critical process steps in health risk communication planning:

- Step 1 Analyze the communication situation – involves collecting and analyzing information on both external and internal factors.**
- Step 2 Establish communication objectives – describe expected outcomes and impacts.**
- Step 3 Analyze and select audience – identify key stakeholders and determine their concerns and needs**
- Step 4 Design, develop, and pretest a prototype message.**
- Step 5 Select and implement a diffusion strategy – determine the process through which information will be communicated.**
- Step 6 Perform process and outcome evaluation – evaluate the process and outcomes and refine plans as necessary.**

Counties have wide latitude in developing public notification and risk communication programs based on their specific objectives and the needs of key stakeholders. EPA criteria for acceptable public notification and risk communication plans require the following areas be adequately addressed:

- (1) Measures to notify the public, local governments, and the EPA.**
 - Problem assessment and audience identification – Define objectives of the plan, the target audience, and the most effective means of communicating the public health message.**
 - Types of notification – Advisories and closings should include a general heading; reason for the advisory or closing; time and duration of the advisory or closing; location involved; environmental health division's and contact number.**
 - When to notify key stakeholders – In accordance with the established chain-of-communication and county health department response plan upon review and confirmation of laboratory data.**

- **How to notify key stakeholders – Town hall meetings, public service messages, television, radio, newspaper, press releases, news conferences, hotlines, advisory/closing postings and signs, news letters, brochures, fact sheets, information packets, websites, and video tapes (Ng and Hamby, 1997).**
 - **When to remove notification/reopen beaches – At the discretion of the counties in accordance with established sampling protocols based on appropriate risk assessment. Counties should use the channels in the established chain-of-communication to inform key stakeholders of an advisory lifting or beach reopening.**
 - **Evaluation of notification program effectiveness – Counties should conduct periodic review of effectiveness of the public notification and risk communication plan. Key issues in evaluation are determining whether the program achieves the health department’s stated objectives, adequately meets the needs of the community, and is properly assessed in terms of process management during the implementation phase. Pre-implementation surveys to determine public knowledge and attitudes regarding recreational water quality monitoring and post-implementation surveys to gauge reaction to public notification and risk communication efforts are important for program development, implementation, evaluation, and revision. Periodic internal reviews with key staff members can assist in process evaluation for all stages of program development.**
- (2) Notification report submission and delegation – The EPA collects and analyzes state recreational water quality data. Reporting requirements are currently being determined. MDE will update county health departments when the EPA finalizes its data reporting requirements.**
- (3) Identify opportunity for the public to review and comment – Review may include staff, local government officials, business groups, concerned citizens, and other relevant stakeholders (EPA, 2002).**

Table 5-1 summarizes the EPA’s public notification and risk communication performance criteria adapted for Maryland.

Table 5-1: Summary of EPA’s Public Notification and Risk Communication Performance Criteria Adapted for Maryland

Adapted from U.S. Environmental Protection Agency. 2002. *National Beach Guidance and Required Performance Criteria for Grants*, EPA-823-B-02-004. Office of Water, Office of Science and Technology, Washington, DC.

Performance Criteria	
General Requirements (county level)	Specific Requirements (county level)
Public notification and risk communication plan: Develop a written public notification and risk communication plan. The plan should describe the county health department’s efforts and measures to inform the public of the potential risks associated with water contact activities in recreational waters that do not meet applicable water quality standards.	<ul style="list-style-type: none"> • Identify measures to promptly notify MDE and local government officials when indicator bacteria levels exceed a water quality standard. • Identify measures to notify the public of exceedances of water quality standards. • Develop a process for prompt electronic reporting of recreational water quality monitoring results and subsequent actions to MDE.
Notification Measures: Develop procedures to adequately notify the public that recreational waters are not meeting or are not expected to meet applicable water quality standards.	<ul style="list-style-type: none"> • Identify measures to notify the public when a water quality standard has been exceeded. • Immediately issue a public notification or resample for bacterial exceedances of a water quality standard. • Promptly notify the public of water quality standard exceedances when there is no reason to doubt the accuracy of the sample. • Post a sign or functional equivalent when a water quality standard is exceeded.
Measures to notify MDE: Identify measures for promptly communicating to key stakeholders the occurrence, nature, location, pollutants involved, and extent of any exceedances of, or likelihood of exceeding, applicable water quality standards. County health departments should identify how this information will be promptly communicated to a designated official of the local government for the areas adjoining the recreational waters for which the failure to meet applicable standards is identified.	<ul style="list-style-type: none"> • Identify procedures to ensure prompt communication between the DHMH laboratory and the county environmental health division regarding sampling results. • Identify measures to notify MDE when a water quality standard is exceeded. • Identify procedures to submit to MDE an annual summary of exceedances of water quality standards and subsequent actions taken to notify the public (EPA requires MDE to report this information on an annual basis).
Notification report submission and delegation: MDE is required to notify EPA in an annual report of county-level notification plan changes and any changes in delegation of responsibilities.	<ul style="list-style-type: none"> • Report to MDE actions taken to notify the public when water quality standards are exceeded. • Promptly report notification data to the public. • Annually submit required notification data elements such as advisory date, location, duration, and cause to MDE.

*The above general and specific performance criteria requirements can be included in a county-level, written recreational water quality monitoring and notification plan.

The EPA (2002) recommends the following information be included in advisory and closing notifications:

Sign

- “Warning,” “Advisory,” “Beach Closed,” or similar language.
- Reason for advisory or closing.
 - For preemptive advisory or closing: “Heavy rainfall has occurred. Beach is closed/under advisory for the next 24 hours due to predicted elevated bacteria levels.”
- Name of beach, city, county, or miles of area affected.
- Agency’s name and contact number.

Press release or public notice

- Attention-getting title.
- Reason for advisory or closing.
 - For preemptive advisory or closing: expected high bacteria levels.
- What is the health risk and why.
- Name of beach, city, county, or miles of area affected.
- Agency’s name and contact number, for both readers and journalists.

Hotline

- “An advisory has been issued for...”
- Reason for advisory or closing.
 - For preemptive advisory or closing: expected high bacteria levels.
- What is the health risk and why.
- Name of beach, city, county, or miles of area affected.
- Agency’s name and contact number.

Internet

- A list of beaches, cities, and counties, along with their respective status (open, closed, or under advisory).
- Reason for advisory or closing.
 - For preemptive advisory or closing: expected high bacteria levels.
- What is the health risk and why.
- Miles or area affected.
- Agency’s name and contact number.

- **Description of monitoring and notification program.**
- **Links to beach and environmental agencies and the health department.**
- **Maps, photographs, graphics.**
- **Opportunities for volunteer involvement in beach program.**
- **Reference list of materials and guides for beach users.**

Appendix 5-A at the end of this chapter gives examples of recommended beach advisory and closing signs from the California Department of Health Services (2000, 2001). Appendix 5-B gives an example of a beach posting for a Maryland beach (EPA, 2001).

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Appendix 5-A: Example Beach Advisory and Closing Signs

Adapted from California Department of Health Services. 2000. *Draft Guidance for Salt Water Beaches*. 2001. *Draft Guidance for Fresh Water Beaches*. Environmental Management Branch, Environmental Health Services Section

Warning!

Storm drain water may cause illness.
No swimming in storm drain water.

Detailed information and contacts...*

Warning!

Contaminated storm drain water.
No swimming in storm drain water.

Detailed information and contacts...

Warning!

Contaminated water.
Swimming not advised.

Detailed information and contacts...

Warning!

Water contaminated by wildlife.
Swimming not advised.

Detailed information and contacts...

Warning!

Water contaminated by birds.
Swimming not advised.

Detailed information and contacts...

Warning!

Untreated sewage spill. Beach closed.

Detailed information and contacts...

Warning!

Closed to swimming.
Beach/Swimming area is contaminated and
may cause illness.

Detailed information and contacts...

Warning!

Water contaminated by animals.
Swimming not advised.

Detailed information and contacts...

*Detailed information and contacts may include expected time and duration of the advisory or closing, location involved, environmental health division's contact number, and any additional pertinent information.

Appendix 5-B: Example Beach Posting

Example taken from U.S. Environmental Protection Agency. 2001. *Draft – National Beach Guidance and Performance Criteria for Recreational Waters*, EPA-823-R-01-005. Office of Water, Office of Science and Technology, Washington, DC.

Hart-Miller Island Beach Reopened to Swimming Effective Immediately

Hammerman Beach at Gunpowder Falls State Park Remains Closed Through the Weekend

Chase, MD (August 24, 2000) – After receiving consistent good results from bacteria testing, the beach at Hart-Miller Island has been reopened to swimming. Results from the bacteria tests which have been conducted show that the water is safe for swimming.

The beach at the Hammerman area of Gunpowder Falls State Park will remain closed through the weekend as a result of continued high levels of bacteria.

Hart-Miller Island is located in the Chesapeake Bay near the mouth of the Middle River. It encompasses 244 acres and is accessible only by boat. The western shore of the island offers safe mooring and access to a 3,000-foot-long sandy beach. The island is part of the North Point/Gunpowder Falls State Park management area.

Gunpowder Falls State Park encompasses more than 15,000 acres along the Gunpowder River Valley. For more information, please call the park's headquarters at 410-592-2897.

Posted August 25, 2000