Municipal Guide To Clean Water:

Conducting Sanitary Surveys to Improve Coastal Water Quality

Maine Healthy Beaches Program

March 2010

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The Unites States Environmental Protection Agency (US EPA) initiated the Beaches Environmental Assessment and Coastal Health Act of 2000 in response to the growing concern about public health risks posed by polluted coastal bathing beaches. The Maine Healthy Beaches Program is taking a leading role in this initiative. Program implementation is a partnership between the Maine Department of Environmental Protection, University of Maine Cooperative Extension, and Maine Sea Grant.

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Contents

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Introduction

The greatest cause of coastal water quality impairment is bacteria.[1] Elevated bacteria levels may indicate risks to human health, leading to advisories and/or closures of valued coastal beaches and shellfish growing areas.

Currently, two programs in Maine assess coastal water quality and identify potential pollution sources. The Maine Healthy Beaches (MHB) Program is a statewide effort to monitor water quality and protect public health on Maine's coastal beaches. Funding is provided by the US EPA, and beaches are managed according to established bacteria standards for marine recreational waters (see Table 2). The MHB Program is a unique partnership among municipalities, state parks, the University of Maine Cooperative Extension/Sea Grant, Maine Department of Environmental Protection, nonprofit organizations, and state and federal agencies. In 2009, 28 municipalities and state parks participated in the MHB program with 60 beach management areas routinely monitored Memorial Day through Labor Day.

Keri Lindberg

The second monitoring program to protect public health is the Maine Department of Marine Resources (DMR) Division of Public Health regulation of shellfish growing areas. Shellfish growing areas along the coast are classified to ensure the quality and safety of shellfish for human consumption, based on standards administered by the National Shellfish Sanitation Program, overseen by the Food and Drug Administration.

Disease-causing organisms come from various sources that are not always obvious. Identification and remediation of pollution sources can be complicated, and require special studies and in-depth sanitary surveys. Maine has over 5,500 miles of coastline, and despite these two effective programs, limited resources and staff at all levels has prompted the need to build local capacity for pollution prevention.

This guide is designed to support municipalities and state and federal agency staff in risk assessment of beaches and shorelines, to aid in the identification and remediation of pollution sources, and to preserve coastal water quality on Maine beaches.

The Economic Value of Clean Water

Generating approximately $10 billion in annual economic activity, $3 billion in earnings, and employing 140,000 people, tourism is Maine's largest industry.[2] Tourist spending related to beaches is estimated to be over $500 million, supporting the employment of over 8,000 people.[3]

The shellfish industry contributes approximately $56 million to Maine's economy and employs some 2,500 people.[4]

Both industries are integral components of the Maine economy and way of life. Both depend on clean water and healthy beaches. For example, closures of shellfish growing areas were estimated at $14.8 million in lost sales and $7.9 million in lost income in 2005.[5]

Background on Microorganisms and Fecal Indicator Bacteria

Microorganisms (microbes) are ubiquitous and live almost everywhere on earth. They are almost always microscopic (invisible to the naked eye). Of the many different types of microorganisms, some can cause human illness or even death (Table 1). Microbe populations can change quickly, growing or dying rapidly depending on environmental conditions.[6]

What are the indicators that harmful pathogens could be present?

Microbes are found in the digestive tracts of warm-blooded animals, and bacteria associated with human and animal waste—such as *Enterococci*, total coliform, and *E.coli* or fecal coliform—indicate the possible presence of other, disease-causing pathogens that can cause illness, disease, or even death in humans. Because most pathogens are difficult to detect and expensive to monitor, these "indicator bacteria" are used to measure water quality. While reliance on indicator bacteria comes with some limitations,[7] this strategy is currently the best available for comprehensive public health monitoring programs.

Bacterial pathogens are the leading cause of impairment to rivers, streams, and coastal waters.[1] Pathogens or disease-causing organisms commonly associated with water-related illnesses include bacteria, viruses, and protozoans that live and travel in water. Of greatest concern are pathogens that are released into the environment in large numbers, are highly infectious to humans in small doses, can multiply outside of their host (under favorable conditions), can survive in the environment for long periods of time, and are highly resistant to water treatment.[7] Pathways of exposure to pathogens in recreational waters include ingestion, inhalation, and dermal contact leading to ear, eye, skin, and respiratory illness. Studies have found a strong correlation between human sources of contamination and gastrointestinal (GI) illness.[8, 9] Humans also are exposed to dangerous pathogens when they eat contaminated shellfish (clams, mussels). Shellfish are filter feeders: they take in large quantities of seawater, and as a result they can easily become contaminated by polluted water.

Studies conducted over the past two decades have shown that *Enterococci* survive longer (0-45 days)[10] in salt water compared to other fecal indicator bacteria, and *Enterococci* densities in recreational marine waters are most strongly correlated with GI illness. In other words, as the level of

Table 1. Water-related (waterborne) diseases, associated symptoms and sources.

Disease	Description/Common Symptoms	Source of pathogen
Campylobacteriosis	Acute diarrhea	Dogs, cats, birds, wild animal feces
Gastroenteritis	Vomiting, diarrhea	Cattle feces
Legionellosis	Acute respiratory illness	Aquatic environments
Leptospirosis (Weil's disease)	Fever, jaundice	Urine of livestock, dogs, rodents, wild animals
Salmonella typhi (Typhoid fever)	High fever, diarrhea, ulceration of small intestine	Domestic and wild animal feces
Salmonellosis	Diarrhea	Domestic and wild animal feces, human feces
Shigellosis	Bacillary dysentery	Infected humans
Cholera	Acute diarrhea	Sediments, shellfish, asymptomatic human carriers
Yersinosis	Diarrhea	Animal feces, pork, unpasteurized milk

Human and non-human animals can transmit diseases to humans.[7, 14, 15]

Enterococci bacteria increases, so does the risk of contracting GI illness (a dose-response relationship).[7, 9, 11, 12, 13] Most of the studies used to determine this safety level define "swimming" as submersion of the head in water.[9] The risk of getting sick increases with prolonged exposure or with an increase in the volume and frequency of water swallowed.

During the summer months, the MHB Program routinely monitors coastal beaches for *Enterococci*, a US EPA-approved indicator of fecal contamination for marine recreational waters. Maine has adopted the EPA criterion which considers a single sample bacteria level of greater than 104 bacteria per 100 ml of water unsafe for swimming (Table 2). States may also manage a beach according to the geometric mean value based on five or more samples collected within a 30-day period. Bacteria levels over the safety limit increase a swimmer's likelihood of contracting a water-related illness. Maine uses the Enterolert® methodology of analysis, and results are available 24-28 hours after sample collection.

Catherine Schmitt

Table 2. The US EPA bacteria criteria for marine and freshwater recreational areas.[13]

Contact with:	Single Sample	Geometric Mean
Salt water	104	35
Fresh water	61	33

The single sample value is the number of colony forming units (CFUs) or Most Probable Number (MPN) per 100 ml of sample water. The geometric mean value is a statistical tool that provides a normalized average of individual sample results, based on multiple samples collected within a 30-day period.

Michelle Bailey

Catherine Schmitt

What are the sources of fecal contamination?[6,17]

Potentially harmful microbes arrive at beaches and shorelines from various sources in the watershed. Sources may be point (e.g., straightpipe) or non-point (e.g., stormwater runoff). Point sources of fecal contamination are generally direct conduits of pollution and are considered to impact the beach, even where they discharge to upstream waters. Examples of point or direct sources of contamination include sewer cross-connections to storm drains, wastewater treatment plant outfalls, industrial wastewater outfalls, illegal sewage pipe, combined sewer overflows (CSOs) and overboard discharge units (OBDs).

Non-point source pollution—runoff draining from urban, suburban, and agricultural land—is the leading cause of water quality impairment in the US.[1] Rain washes the land surface, transporting pollutants to rivers, streams, and storm drains, and eventually to coastal waters. These dispersed, diffuse sources of bacteria generally are difficult to identify. Contaminated runoff is linked to the duration, intensity, and frequency of rainfall and storm events, as well as watershed characteristics such as land use and topography. Boaters discharging waste at sea also can be considered non-point sources of pollution at beaches and shellfish growing areas.

These sources are described in more detail in Part III of this guide.

Maine DEP

Sarah Mosley

LaMarr Cannon, Maine NEMO

Part I. Preparing for a Sanitary Survey

What is a sanitary survey?

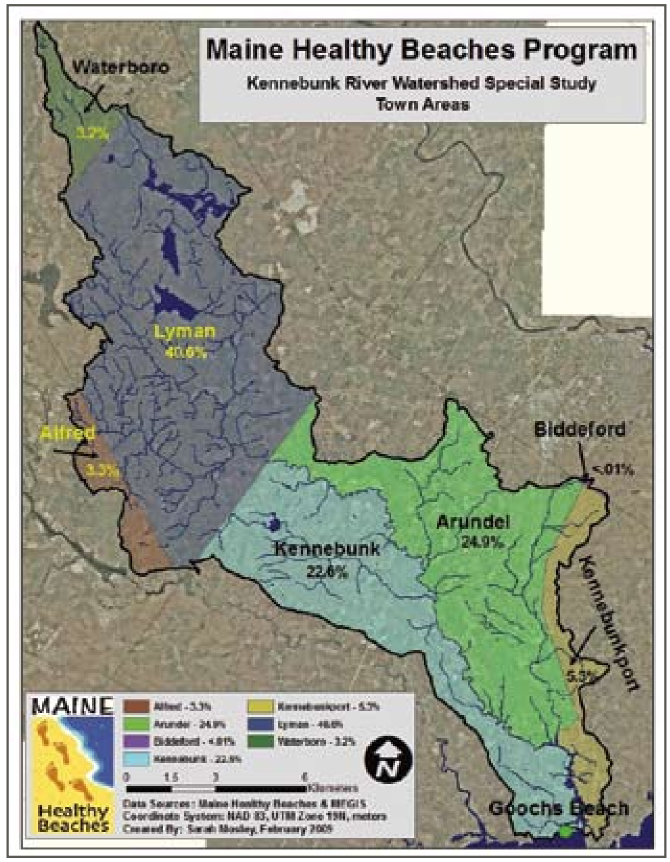
The goal of a sanitary survey is to identify and document sources of bacterial contamination affecting water resources (e.g., coastal beaches, shellfish growing areas, and freshwater inputs to these areas), so they can be eliminated.

Maintaining clean water requires continuous oversight to identify and eliminate sources of pollution. Generally, actual and potential sources of pollution are identified only after water quality problems have been documented. In order to protect public health by preventing pollution-related illnesses, a proactive rather than a reactive approach is essential for maintaining healthy water quality conditions. A sanitary survey is a proactive way to protect human health and the environment. This guide considers all potential sources of bacterial pollution along the shoreline, within the relevant watershed or sub-watershed area, and offshore.

Who conducts a sanitary survey?

The Maine Department of Marine Resources (DMR) conducts routine sanitary shoreline surveys of all potential contaminants 500 feet beyond the shoreline adjacent to shellfish growing areas.[16] The Maine Department of Environmental Protection (DEP) sanitary survey is a house-to-house search of malfunctioning subsurface wastewater disposal systems. The DEP provides watershed survey support to communities and non-profit organizations who are examining a larger array of pollutants impacting water quality.

Sanitary survey work can be completed by a cadre of state agency partners and local municipal staff. In fact, due to the scarcity of resources at all levels, state and local collaboration is necessary to combine available resources for their most effective and efficient use. Municipalities share responsibility with DEP to take the lead and complete the work necessary to identify and remove pollution sources. The local plumbing inspector has the authority to survey properties for malfunctioning subsurface wastewater disposal systems, and this person may be asked to assist DEP/DMR staff in conducting sanitary surveys.



Sarah Mosley

The watershed area draining to a beach and/or shellfish growing area may be shared by multiple towns or entities. A shared watershed underscores the importance of working across town boundaries to find and fix pollution sources.

WHERE TO BEGIN

A sanitary survey is not necessarily a linear process. You may find yourself working backwards or starting in the middle of this guide. All aspects of the survey process outlined in this guide may not be relevant for the particular area(s) of concern. To be efficient and cost-effective, target human sources first! Start at the shoreline and progressively move back into the watershed. Adapt bacteria management strategies to your unique watershed.[18]

Some activities, such as dye-testing septic systems and checking sewer connections, require the expertise and training of professionals like code enforcement officers, plumbing inspectors, and state and federal agency staff. Property surveys should also be completed or supervised by state and/or local officials who have statutory authority to investigate potential pollution sources on private property (see Part IV). Volunteers should not conduct property surveys without the assistance of the local plumbing inspector and/or state agency staff. Other tasks involved in completing a sanitary survey, such as gathering background information, mapping, collecting water samples, and outreach efforts, do not require statutory authority and can be accomplished by volunteers. Monitoring of water quality requires permission from private property owners and training from MHB and/or DMR staff for quality assurance and quality control purposes.

How does the sanitary survey fit in with other water quality management efforts?

The sanitary survey is just one part of an overall water quality management plan. A management plan promoting healthy beaches and shellfish growing areas should include:

- An initial risk assessment of the shoreline and drainage area.
- Development or improvement of a water quality monitoring plan specifically for the identified area.
- A notification plan to communicate risk levels to the public.
- An ongoing sanitary survey of the shoreline and adjacent watershed.
- Cooperation to resolve pollution sources.
- A means of measuring the success of pollution control efforts.
- An effort to educate and increase awareness about land use and local pollution problems.
- A long-term community action plan to protect and improve water quality.

What is the scope of the survey?

Before beginning background research and field data collection, it is usually helpful to define the watershed or drainage area affecting the beach or shellfish growing area of concern. Each bay, beach, pond, stream, etc. has its own watershed or drainage basin encompassing all of the land that drains to it or its outflow point (e.g., mouth of a river, stream, storm drain). Larger watersheds contain many smaller sub-watersheds, and the focus of the sanitary survey will depend on the particular area(s) of concern.[19]

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Is it feasible to conduct a sanitary survey for the entire watershed?

Large rivers, areas with high human population densities, and large watersheds can contain numerous pollution sources. Survey work should be prioritized. For example, the first "tier" of survey work should include areas where contaminants have been documented and have the most direct or greatest impact on coastal water quality. In areas impacted by rivers and streams, the first tier of the survey may encompass the shoreline extending upstream to the head-of-tide region.

How far should the survey extend inland?

Sanitary surveys are not limited to properties that border surface waters, as roadside ditches, storm drains, and seasonal streams serve as conduits for wastewater to beaches and shellfish growing areas. The extent of the survey is not always easily determined, especially in areas impacted by large river systems. Collecting water samples upriver to pinpoint potential sources can help answer this question, but often the availability of resources is the determining

MAPS AND SPATIAL INFORMATION

Maps are excellent tools for determining the general outline and characteristics of the drainage area(s), as well as for estimating the potential number of pollution sources. Maps and aerial photographs may suggest properties with the greatest likelihood of affecting water quality, and therefore they can be used to prioritize areas for survey work. These are generally areas in close proximity to the shoreline, banks of rivers/streams, storm drains, land with steep sloping topography, impervious surfaces, etc. A list of potential sources may be coded and documented on a good map of the area with a useful scale.

Aerial photographs, US Geological Survey topographic maps, tax maps, and zoning maps can be gathered from the municipality and/or regional planning commission. Maps may be available in digital format using online mapping software such as Google Maps or Google Earth, Bing Maps, or Geographical Information Systems (GIS); see Appendix I for details on GIS and access to mapping data.

Communities without GIS or other mapping capabilities at the local level have several options. The watershed can be determined fairly easily using topographic maps and aerial photographs,[20] though some field work is needed to verify drainage divides that have either changed or were not accurately mapped. Town tax maps are valuable tools for identifying potential pollution sources. Finally, other entities within the state and region may have current or existing watershed-level data. The DEP or the Maine Geological Survey may have watershed maps of particular areas along the coast. Depending on the watershed, it may be delineated in an existing digital data set. Regional planning commissions, land trusts, libraries, and research institutions (e.g., Wells National Estuarine Research Reserve) may have watershed data available for certain areas in Maine.

factor. While all sources of fecal contamination may not be identified, targeting human sources first should result in a measurable improvement in water quality.

What information about the watershed already exists?

Depending on the location of the area of concern, information and maps needed to design a survey likely already exist. State and federal agencies, universities and research institutions, and nonprofit environmental organizations all conduct watershed investigations and assessments. Before heading to the field, find out what information is available for the area, and identify related activities. Researching any prior survey work also can identify potential partners who may contribute resources or expertise. This information will help inform the survey design, prioritize survey areas, and improve organization, all key elements to a successful and efficient survey.

The following entities should be consulted before beginning a survey. The most current survey and water quality data should be requested directly from the appropriate contact.

Maine Healthy Beaches (MHB) Program:

Beach water quality data (e.g., bacteria, temperature, salinity, tidal stage, rainfall, observations) for areas participating in the MHB Program can be accessed via www.mainehealthybeaches.org. Additional monitoring data for rivers, streams, and storm drains impacting beach areas with chronic bacteria issues may be available from the local “beach manager” and/or MHB Program coordinator.

Maine Department of Environmental Protection (DEP):

Depending on the area, the DEP may have relevant watershed information and/or water quality data. The DEP is responsible for permitting discharges related to stormwater, wastewater, etc. DEP sanitary surveys, performed in response to citizen complaints or requests for assistance from state agency partners, the MHB Program, or municipalities, entail house-to-house septic system checks and may include dye testing and water monitoring. I f a septic system problem is brought to the attention of the municipality, the municipality is statutorily required to issue an abatement order. Most property owners do correct their problems voluntarily; however, additional enforcement from the DEP may be necessary to correct the problem. DEP professionals have the expertise and experience working with malfunctioning subsurface wastewater disposal systems and may be able to pr ovide support to municipalities.

Under the Clean Water Act, DEP produces Integrated Water Quality Monitoring and Assessment Reports (305b reports) summarizing water quality data from various sources. Water bodies that do not meet standards for one or more designated uses are considered impaired and are placed on the 303(d) list. DEP classifies water bodies according to their designated uses and pollutant levels. DEP has developed a list of priority watersheds based on the degree of impairment, the value of the water body, the likelihood of successful protection, and the extent of local support for management. The purpose of the list is to provide guidance to watershed managers in determining where additional resources (e.g., grant money) may be most beneficial.

In some cases, a watershed survey may have been conducted by a local lake or watershed association or other non-governmental organization, and DEP may have information about previous watershed surveys.[21]

Maine Department of Marine Resources (DMR) Public Health Division:

DMR divides Maine's coast into 45 Shellfish Growing Areas, classified as Approved, Conditionally Approved, Restricted, Conditionally Restricted, or Prohibited.[16] Classification is based on a sanitary survey of the *shoreline*, routine fecal coliform bacteria monitoring, and analysis of environmental conditions and distribution of pollutants.

DMR SHELLFISH GROWING AREA CLOSURE INFORMATION

http://www.maine.gov/dmr/rm/public_health/closures/closedarea.htm

The DMR's shoreline survey is a periodic inspection of all possible sources of pollution within 500 feet of the shoreline. If pollution sources are identified, the DMR notifies the municipality and the appropriate agencies. Surveys are renewed a minimum of every 12 years with problematic areas reviewed every three years. Municipal staff may assist DMR upon request to complete sanitary shoreline survey work. For more information see DMR's 2010 Growing Area Standard Operating Procedures.[16]

To assist in shellfish growing area classification, fecal coliform bacteria samples are collected at least six times per year per station, and some areas are monitored more intensely. Bacteria data collected by the DMR can help identify contaminated areas and provide information for beach-related sanitary survey work. If the beach area(s) overlap with a shellfish classification area, efforts can be combined to address pollution sources affecting both resources. Contact the DMR to find information about the status of the shoreline survey for a particular shellfish growing area.

Maine Department of Health and Human Services:

DHHS can provide information on standards, types, operation, and maintenance of wastewater disposal systems and technical support regarding malfunctioning septic systems. The Maine Center for Disease Control Subsurface Wastewater Disposal Program established rules for creating a reliable method of subsurface wastewater system design and installation, requiring that a Maine Licensed Site Evaluator perform a site evaluation and complete an HHE-200 form. The local plumbing inspector issues a permit, and inspects construction. DHHS also has the authority to enforce an abatement order and to fine a municipality for inaction if necessary. The Drinking Water Program may have inspected the watershed of concern as part of the Source Water Assessment Program. States are required to identify the land areas which provide water to each public drinking water source and to assess the existing and potential sources of contamination in those areas.

Maine Department of Agriculture:

The Animal Health & Industry, Natural & Rural Resources Division's Agricultural Compliance Program addresses complaints concerning agricultural activities including livestock access to waterways, manure runoff, etc. Inspections are required for livestock operation permits and Concentrated Animal Feeding Operations (CAFOs). Investigations through this program determine whether or not Best Management Practices (BMPs)[22] are being used. This program also works with farmers to take corrective action and develop site-specific BMPs, and, when necessary, take enforcement action. The Nutrient Management Program works to increase public awareness of non-point source pollution such as nutrients and sediments. A major goal of the program is to implement BMPs to reduce nutrient loading, and to target agricultural operations contributing bacteria to water resources.

Maine Geological Survey (MGS):

Hydrographic, meteorological, circulation, and other studies can be completed to understand how pollutants affect the surrounding areas. For some areas along the coast, MGS has completed circulation studies to determine the fate and transport of bacteria leaving river mouths, storm drains, sewage treatment plant outfalls, and other point sources. Scientific research may provide useful information and possibly support for special studies and data analysis (e.g., University of Maine School of Marine Sciences).

Maine Geological Survey

Paul Demers

The initial risk assessment: how well do you know your beach or bay?

A sanitary survey begins with an initial risk assessment. A suggested format is the Maine Healthy Beaches Program Risk Assessment Matrix, located in Appendix II. Depending on the results of the initial assessment, a more thorough sanitary survey or studies of potential pollution sources, as described in Parts II and III of this guide, may be necessary. An initial risk assessment of the designated drainage area(s) beyond the immediate shoreline area will also help prioritize areas to focus the sanitary survey.

Consider all the possible ways fecal bacteria are being introduced into the area, including land-based and offshore activities. The amount and quality of information gathered via maps, town records, and phone interviews is limited. Spending time in the field studying the area will help determine the feasibility of the survey and priority areas for further investigation. **Do your homework first, stay organized, and have a plan in place before physically surveying properties.**

Shoreline features, such as a river outlet or storm drain, will help determine the scope of the sanitary survey and priority areas for investigation. For example, high bacteria levels documented at the mouth of a river or stream emptying to the beach/shellfish growing area requires expanding the survey beyond the shoreline to include the watershed (or portion of the drainage area) of that river or stream. Completing an initial risk assessment of the shoreline will also help determine the actual/potential sources of bacteria.

Once the watershed or sub-watershed boundaries have been determined, drive around and conduct a "windshield survey" of the area. Walk around and take notes. Evaluate the shoreline/watershed characteristics that may pose a risk to coastal water quality (again, refer to the Risk Assessment Matrix in Appendix II). The types of things to keep an eye out for include but are not limited to:

- Freshwater inputs (river mouth, stream, storm drain)
- Properties with subsurface wastewater disposal systems (i.e., septic systems)
- Significant wildlife habitat/wetlands
- Agricultural operations
- Impervious surfaces
- Marinas/moorings/anchorages
- Recreational uses and availability of facilities (restrooms, trash cans, doggie bag stations)

Then, based on the initial risk assessment findings as well as background research and discussions with towns and state agencies, compile a list of properties that are potentially contributing pollution in the watershed or sub-watershed of concern. The town assessor's commitment list is needed to determine the owner(s) of each property.

While no property should be excluded from consideration until it is assessed in the field, in-depth surveys of all properties within the watershed may not be feasible or necessary due to the size of the watershed and the number and location of potential pollution sources. An effective strategy is to narrow down the list of factors to investigate according to documented issues and proximity to water resources (i.e., the most direct or greatest impact on coastal water quality).

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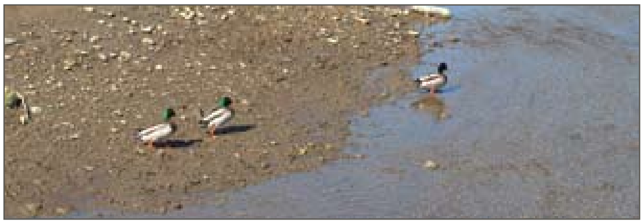

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Field Datasheets and Creating a Survey Database

Sanitary survey information collected as part of the background research and initial risk assessment can be organized in an Excel spreadsheet or Access database or similar software, and information can be transferred to the field datasheets in preparation for physically surveying properties. The database is a dynamic resource to be updated throughout the survey process, and to help produce the final Sanitary Survey Report. A database will allow properties to be sorted by map number, actual or potential source of contamination, septic vs. sewered areas, location/distance to water, etc. Properties that are not likely sources of bacterial pollution (e.g., undeveloped lots, cemeteries) will not be part of the in-depth property survey.

For shellfish growing areas, potential pollution sources must be labeled using the DMR codes. These codes are also useful for sanitary surveys of beaches and other water resources.

A field data sheet and associated codes and definitions can be found in Appendix IV.

Preparing the Sanitary Survey Report

The sanitary survey and related activities should be summarized in a final report that includes all supporting documents and information. Creating a report is made simpler if data collected during the sanitary survey have been appropriately coded and entered into an Excel file and/or Access database. Mapping software such as Geographical Information Systems (GIS) can overlay multiple data sets and act as a powerful organizational, analytical, and communications tool (see Appendix I).

A final report will improve organization, facilitate information sharing, and allow updates to be integrated in a more timely and efficient manner. The final report and supporting documents (digital and hard copies) should be easily accessible locally through multiple outlets including Web sites, presentations, and workshops. Survey information should be shared with key participants and decision-makers, including but not limited to: local water resource committees, shellfish commissions, board of selectmen, residents and visitors, and municipal, state, and federal agency partners. For shellfish growing areas, sanitary

NOTIFICATION

If someone other than the municipality is conducting the sanitary survey, the municipality should be notified in advance about where and how the survey will be conducted (DMR notifies the municipality at least two weeks in advance of shoreline survey activities).

Sanitary survey work is an opportunity to educate property owners. It may be appropriate to notify property owners within the drainage area of concern and inform them of the purpose and scope of the sanitary survey. Consider sending a mailed letter indicating that the property will be visited by local/state officials, that questions will be asked regarding their subsurface wastewater disposal system (if they are home), and that the property will be surveyed for potential sources of fecal contamination (including evidence of a subsurface wastewater disposal malfunction).

When conducting special studies or intensive monitoring in a river or stream, a letter may be sent to property owners informing them of the purpose of the study and asking permission to cross their property in order to locate monitoring stations.

Sample letters are included in Appendix III.

Note that because unlicensed discharges from malfunctioning subsurface wastewater disposal systems are in violation of Maine law, and in order to prevent individuals from attempting to conceal malfunctions, state and/or local officials who have statutory authority to investigate possible pollution sources on private property often will *not* notify property owners in advance of the survey. Property owners who refuse access may be served with an administrative search warrant should one be needed. See Part IV for more information.

survey work must be reported correctly and in a timely manner to the DMR.

Sanitary survey reports written by municipalities for areas that may impact shellfish harvesting areas should be submitted to DMR. This information may be used by DMR staff as supplementary materials; however, sanitary survey reports written by non-DMR staff do not fulfill the requirements of the National Shellfish Sanitation Program (NSSP) for Growing Area Sanitary Survey Reports.

The final report is intended to be a "living" document with continuous updates and improvements over time. Periodic updates are essential to make the sanitary survey a useful tool and a continuous method for achieving improved water quality. Create an action plan based on the survey findings and recommendations for next steps. Components of the action plan include but are not limited to:

- Identify specific actions to be taken.
- Identify the people responsible for completing the actions.
- Identify funding sources if necessary.
- Set a timeline for completing the actions.
- Develop of a system for evaluating and measuring your success (e.g., database, GIS, water quality monitoring, surveys, etc.)

Why generate a final report?

A final report will help transform survey findings and recommendations into local level action. Make the report available to the public, town officials, board of selectmen, nonprofits, etc. to attract attention and generate support for addressing the issues. Give life to the final report—bring together local plumbing inspectors, planners, watershed groups, and concerned citizens from within the shared watershed to communicate relevant sanitary survey findings, delegate tasks, and to generate a timeline for completion.

Sanitary Survey Final Report: Suggested Format

I. Abstract

II. Introduction

III. Scope of the Survey

  A. Beach and watershed area characteristics (e.g., beaches and/or shellfish growing area of concern, watershed boundaries, population, land use, environmental factors, etc.)

  B. Need for the survey (summarize water quality history, local level value, etc.)

IV. Special studies, survey work, and initial risk assessment (data analysis, circulation studies, dye testing, fluorometry work, watershed surveys, mapping projects, initial risk assessment, etc.)

V. Potential sources of bacteria

  A. Land-based sources

  B. Offshore sources and activities

VI. Known sources of bacteria (documented sources)

  A. Land-based sources

  B. Offshore sources and activities

VII. Accomplishments and strategies (e.g., work completed, remediation efforts in progress, education campaigns, etc.)

VIII. Recommendations and next steps. Make recommendations based on survey findings. Prioritize the list of items to address. Outline necessary improvements and best management practices.

IX. Missing information

X. Appendices (e.g., field datasheets, compliance records, tax maps, etc.)

Part II. Special Studies: Finding Bacteria Hotspots[17, 23]

REMEMBER

The sections of this guide are not linear. Special studies may help pinpoint problem areas and verify pollution sources, but nothing can replace careful scrutiny of land use practices, especially properties with subsurface wastewater disposal (septic) systems. Depending on the watershed characteristics, it may be most useful to start with the wastewater disposal section in Part III. Reviewing the methods of wastewater disposal and types of land use for all properties within the drainage area of concern, as described in Part III, will help narrow down the list of possible contributing sources and prioritize areas needing future action and remediation. As always, target human sources first! Think bang for the buck!

A special study refers to any monitoring, analysis and/or research studies beyond routine monitoring of the shoreline area. There is no single, perfect method or indicator for tracking down sources of bacteria. Verifying the status of a potential source may require a combination of strategies. The goal of special studies is to find bacteria "hotspots" within the watershed that require further investigation.

Typically, sources of bacteria are not obvious and verifying the actual status of a potential pollution source requires a tool-box approach that integrates multiple resources. Methods of source tracking beyond initial property surveys may need to be employed. For example, intensive monitoring upstream will help identify areas needing further investigation, followed by property surveys to identify potentially malfunctioning septic systems, and possibly dye tests to verify the malfunctioning status of the systems.

Note that verification of a problem is not always possible. For example, effluent from a malfunctioning septic system may percolate quietly through soil into groundwater and adjacent water bodies. Similarly, dye testing of a malfunctioning system may never show visible dye in surface waters.

Sanitary survey work is a continuous process. While all sources of fecal contamination may not be identified, the elimination of most human sources should result in a measurable improvement in water quality. The goal is to identify and remediate as many of those sources as possible. Also, over time, systems that are currently working may malfunction in the future due to aging, changes in use (e.g., from seasonal to permanent residence), or inadequate maintenance.

For purposes of the guide, the same source tracking principles can be applied to relatively undeveloped areas and urban areas, to rivers and storm drainage networks. The following information is a brief overview of source tracking methods.

Visual field screening

High bacteria levels documented in freshwater outlets (e.g., river mouth, storm drain) along the shoreline warrant moving inland to investigate contributing sources of bacteria. Field observation can spot obvious problems and will help identify additional "special study" monitoring locations. Potential problem areas should be identified first and prioritized using drainage area and property maps in conjunction with a field screening by vehicle and on foot.

- Conduct field screening during dry and wet weather. Bring a GPS unit to document the location of potential pollution sources and/or monitoring stations. For a storm drainage network, start by looking for discharge during dry weather, and gradually move up the network until the flow is no longer present. The goal is to isolate discharge areas within the larger storm drainage system. Changes in


Michelle Warneke

vegetation or unusual flow, odor, or color; turbidity; deposits/stains; floating debris; or damage to storm drainage structures (e.g., cracking, corrosion) can indicate grossly contaminated areas.[17]

Fecal indicator bacteria monitoring

Preliminary screening for high bacteria scores should be conducted throughout the watershed to identify general pollution trends. Sample collection should be conducted using quality-assured protocols available via the MHB Program and/or state agencies such as the DEP and DMR.

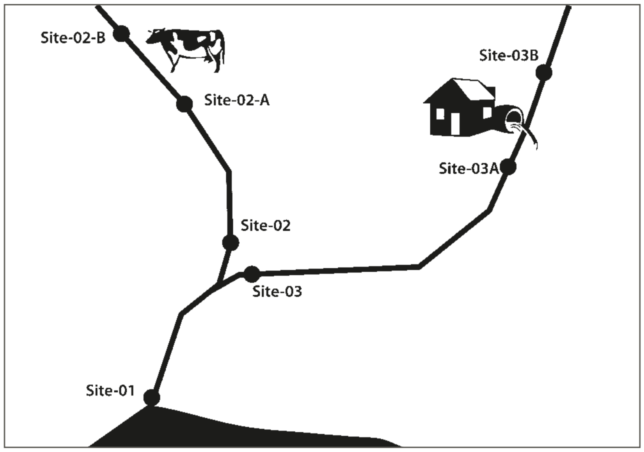
- Monitoring stations should be safely accessible. Obtain permission from property owners when appropriate. Use caution when collecting samples that you suspect may have high bacteria levels. Consider wearing gloves and wash your hands before and after sample collection.

After gathering generalized water quality data, specific streams, drainage pipes, etc. can be monitored to identify pollution sources. Try to bracket (i.e., monitor above and below) potential pollution sources. For example, if a monitoring station located below a suspect property has recorded bacteria levels that are higher compared to an upriver location, this provides sufficient evidence to take a closer look. Additionally, a sample can be collected from any type of questionable flow, seepage, standing water, etc. within the survey area to determine bacteria levels.

- Document monitoring locations via maps and/or GPS coordinates.

Monitoring should focus on human activities and disturbance in the watershed. Depending on the size and characteristics of the watershed, start at the mouth of the river and/or storm drain on the shoreline and progressively move inland to bracket potential sources. Monitoring sites should be strategically placed to capture the impact of suspect areas such as properties with subsurface wastewater disposal (i.e., septic) systems in close proximity to the water body, agricultural operations, OBDs, POTW outfalls, CSOs, tributaries, etc.

- Conduct bacteria monitoring during dry and wet weather. Trends in concentrations should be examined for "hotspots" within the drainage network and the monitoring locations should be adjusted based on the results. For example, if a monitoring station has high bacteria levels and the next station upriver is clean, continue to adjust the location of the upriver site to further narrow the problem area.



Sarah Mosley

Similar to the challenge of determining how far inland the sanitary survey should extend, how far upriver a special monitoring study should extend depends on the characteristics of the watershed, recorded bacteria levels, and the resources available. In some cases, the monitoring data will continue to exhibit high bacteria levels as the stations move farther upstream. In other words, the sources of contamination may be extensive and there may not be a "clean" sample to determine the upper limit of the focus area. This is especially true in large watersheds, where the first tier of the special study and corresponding property survey may encompass the shoreline extending upstream to the head of tide region (i.e., the farthest point upstream where a river is affected by tidal fluctuations).

Testing for optical brighteners[24]

Optical brighteners are commonly used in commercial or retail products such as clothing detergents, dishwashing, personal care products, etc. to increase the whiteness of materials. After use, these products are typically flushed down the drain; therefore, the presence of optical brighteners in water likely indicates human sources of contamination (i.e., from an illicit discharge/straight pipe or graywater, or malfunctioning septic system).

- Anchor absorbent pads via traps (i.e., metal cages) at sample locations. Retrieve after 48 hours and examine under a UV light to detect the presence/

absence of fluorescence. Additionally, a fluorometer can be used to quantify optical brightener levels in water samples.

The usefulness of optical brightener monitoring depends on several factors including the characteristics of the water body and bacteria source(s). In some cases, naturally occurring organic materials in the water can create background interference. The episodic nature of laundry activities and the short time optical brighteners spend in wastewater disposal units require multiple monitoring events. Additionally, brightener levels are not always linked to high bacteria levels, but instead may indicate gray water discharges, which typically have lower bacteria levels compared to black water or sewage discharges. Fecal indicator bacteria and optical brighteners have different residence times in wastewater disposal systems, and bacteria may be diluted below detection levels while optical brighteners remain at high levels, further limiting their usefulness in tracing illicit discharges.[26]

Table 3. Potential sources of fecal indicator bacteria based on bacteria and optical brightener levels.[25]

	High Bacteria	Low Bacteria
High Optical Brightener	Black water (malfunctioning septic system, sanitary sewer cross-connection)	Gray water (laundry, wash water)
Low Optical Brightener	Human or non-human sources	Potentially low or no fecal contamination

Testing for other parameters

Tracking less obvious sources of contamination may require monitoring for other parameters, including nutrients, turbidity, ammonia, potassium, caffeine, pharmaceuticals, changes in temperature, etc. As with bacteria, ammonia[27] concentrations can help determine "hotspots" within the drainage network.

Table 4. Indicators used to detect illicit discharges in stormwater.[17]

Parameter	Type of Discharge: Black Water (Sewage)	Type of Discharge: Gray Water (wash water)	Laboratory/Analytical Challenges
Ammonia	●	◓	Can change into other nitrogen forms as the flow travels to the outfall.
Boron	◓	◓	
Color	◓	◓	
Conductivity	◓	◓	Ineffective in saline waters, generally highly variable.
Detergents – Surfactants	●	●	Reagent is a hazardous waste.
E. coli **Enterococci** **Total Coliform**	◓	○	24- to 48-hour wait for results. Lab will need to modify dilution ratio for high bacteria concentrations.
Hardness	◓	◓	
pH	○	◓	
Potassium	◓	○	May need to use two separate analytical techniques, depending on the concentration.
Turbidity	◓	◓	

● Can almost always (>80% of samples) distinguish this discharge from clean flow types (e.g., tap water or natural water). For tap water, can distinguish from natural water.

◓ Can sometimes (>50% of samples) distinguish this discharge from clean flow types depending on regional characteristics, or can be helpful in combination with another parameter.

○ Poor indicator. Cannot reliably detect illicit discharges.

Other source tracking techniques

Other techniques may need to be employed to identify sources of pollution and are typically conducted by trained professionals, municipal and state agency staff.

Dye testing/plumbing inspections

Conducting indoor inspections and dye tests are relatively simple. However, some property owners may be uncomfortable and consider them to be an invasion of their privacy. For this reason, they should be done only when necessary. Dye testing is described on page 26.

Smoke testing

Smoke testing can be used to identify stormwater cross-connections within the sanitary sewer, and to locate damaged areas of the stormwater infrastructure. Smoke is introduced by igniting specialized smoke containers and forcing the smoke into the storm drain system via a blower while field staff observe where the smoke surfaces. This approach can be used when accessing multiple properties to conduct dye testing is not feasible, or when the diameter of the pipe is too small for video testing (see below).

- Before testing occurs, notify the public of the testing date, reason for testing, precautions to take to prevent smoke from entering homes/businesses, and what to do if smoke does enter a building. Smoke testing should not be used in sewers serving sensitive populations such as hospitals or people with asthma. A local contact number should be provided for questions and/or reporting health concerns.

Video surveillance

Video is a useful method for investigating continuous discharges, but will not detect illicit connections to the storm drainage network that are not flowing at the time of the video survey. Video testing uses a mobile camera to locate the illicit discharge within the pipe. The video camera can detect cracks and other pipe damage, flows, and leaks within the pipe. This method can be expensive, unless the community already owns the equipment for sewer inspections. The video camera equipment should be selected according to the diameter and the condition of the storm sewer under investigation.[17]

Infrared imagery

Infrared thermography uses differences in temperature to identify sewage discharges. In general, sewage discharges have a higher temperature compared to soils in the surrounding area. This is a fairly sophisticated technique that requires special infrared cameras and trained analysts. Color infrared aerial photographs also can be used to detect changes in vegetation and standing water to help locate malfunctioning subsurface wastewater disposal systems.[17, 28]

Microbial Source Tracking (MST)

This advanced approach uses molecular-based methods and genetic fingerprinting to identify sources of contamination. Typically, MST methods are expensive, require specialized equipment and the expertise of trained microbiologists, and are time consuming in both the field and laboratory. However, MST technology is changing quickly, with new and refined methods on the horizon. One MST method compares the ribotype profile or "fingerprint" of bacteria strains in a water sample to a genetic library of fecal bacteria sources compiled for the region. The usefulness of such data may be watershed-specific and library matches are not 100 percent reliable.[29]

Part III. Conducting the Sanitary Survey

Once potential pollution sources have been compiled through background research, the initial risk assessment, and special monitoring studies, the next step is to conduct on-site investigations. Several areas may need to be re-surveyed, especially seasonal properties. It may be impossible to prove that every factor is an "actual" pollution source; therefore, document all potential and confirmed sources. Every property within the watershed area of concern should be considered. This does not mean that there must be a thorough search of every property within a drainage area. Those properties that are far enough from any surface water drainage may not warrant an on-site investigation.

State agency partners, such as the DEP and DMR, may be able to provide sanitary survey technical support and expertise to the local code enforcement officer or plumbing inspector. **It is especially important to coordinate with DMR if the area(s) surveyed affects a shellfish growing area.** Municipalities may want to consider a regional approach to identifying illicit discharges within shared watersheds.

What to look for: 1. Environmental characteristics of the shoreline area

The dynamic nature of the coastal zone makes assessment of bacteria levels in the water column difficult. Bacteria concentrations vary depending on sunlight, rainfall, tidal stage, currents/waves/wind direction, temperature, and other features such as beach sand, seaweed wrack, and wildlife. While assessing the shoreline, consider all the potential bacteria sources during dry and wet weather conditions.

Where are the freshwater inputs to the beach or shoreline?

Freshwater inputs can carry contaminants from various sources in the watershed, especially during and following rainfall. Rain and resulting stormwater runoff transport non-point source pollutants (pet waste, manure, waste from malfunctioning septic systems, etc.) to rivers and storm drains, which eventually drain into coastal waters. Rainfall is associated with increased bacteria concentrations on both seasonal and daily time scales. Concentrations higher than regulatory standards are generally greater within 24 hours after rainfall and decline over time.[8] Excess rainfall can exceed the capacity of sewage treatment plants, leading to combined sewer/sanitary sewer overflows delivering untreated waste into receiving waters.[7, 30] Freshwater inputs to the shoreline can be a pathway of bacterial contamination. Studies of coastal watersheds have demonstrated a negative correlation between salinity and fecal bacteria; in other

Keri Lindberg

Keri Lindberg

words, low salinity levels (larger influence of freshwater) have been linked to high bacteria levels.[31, 32, 33, 34, 35, 36, 37]

- Note the presence and location (including GPS coordinates where possible) of the freshwater inputs including rivers, streams, and storm drain outfalls. In general, there are three types of streams: perennial (steady flow), intermittent (seasonal flow, typically active six to nine months of the year), and ephemeral (short duration following extreme storms). The latter two types of streams will need to be documented during or following wet weather.

Collect water samples at all discharges to the shoreline including storm drains, pipes, river mouths, etc. to determine the level of fecal indicator bacteria. If analysis indicates high bacteria levels, additional monitoring sites should be added upstream or within the storm drainage network to locate potential pollution sources (see Special Studies, Part II). The sanitary survey should be expanded to include the land draining to these freshwater inputs.

What is the relationship between tidal stage and bacteria levels?

The impact of freshwater (and resulting bacteria levels) in the coastal zone can vary according to the tidal stage. In general, freshwater inputs transfer a larger amount of water to coastal areas during an outgoing (ebb) tide compared to an incoming tide. Ebbing tides can drain pollutants and materials from the land, transporting watershed contaminants to the beach. Additionally, bacteria concentrations have been found to be significantly higher during spring (monthly high) tide conditions when coastal waters reach the upper intertidal zone.[36, 38] Incoming flood (tidal) conditions can dilute bacteria concentrations[39] or bring contaminants entrained offshore back to the shoreline.[40, 51]

What are the natural features of the beach?

There is growing evidence that biological factors such as beach sand and tidal wrack can increase concentrations of bacteria in recreational waters. Beach sand may act as a reservoir, protecting bacteria from the sun's radiation. Bacteria also adhere to sand grains, and can persist longer

Sarah Mosley

in sand compared to water.[8, 41, 42] Similarly, algal mats that accumulate on beaches have been shown to harbor elevated levels of *Enterococci* bacteria, especially if waterfowl, dogs, or deer have defecated in the vicinity. Resuspension of bacteria-laden beach sands and algal mats can contribute to degraded water quality in coastal areas.[43, 44]

- Note the amount of sand and the presence of seaweed and other debris washed ashore, and if and how often the beach is cleaned.

- Note the presence of tide pools in the upper area of the beach. Sometimes stagnant tide pools develop over time and do not flush on a regular basis. These areas are prone to high bacteria levels due the lack of water flow and increased water temperatures, especially where they attract small children and waterfowl.

Gary Curtis

While forests help protect water quality, other areas of wildlife habitat like game reserves and marshes often harbor large animal and bird populations whose fecal matter can contribute to high bacteria levels in the watershed. Coastal areas with marsh outlets will likely experience elevated bacteria levels, because marshes are ideal locations to promote bacterial growth due to their soft sediments, bacteria-laden sand, nutrients, decaying seaweed wrack, wildlife populations, etc. The impact of these areas on coastal water quality generally increases during spring tidal conditions when the flooding tide picks up contaminants from the upper reaches of the high water line.

Studies have demonstrated that spring tide conditions mobilize pollutants, enhance flushing, and create conditions which increase bacteria levels in coastal waters.[36]

- Note the presence of significant wildlife habitat, salt marshes, and other wetlands that drain to the shoreline area. Habitat areas may be designated by the Natural Resources Protection Act or the Maine Natural Areas Program.

Keri Lindberg

Is the area used by waterfowl or pets?

Animal waste from beavers, deer, waterfowl, cats, dogs, horses, etc. can contaminate surface waters and beach sand (see Table 1). The contribution of animal sources to elevated bacteria levels is not well known, and more studies are needed to further explore this relationship.[8, 37, 45] However, fecal contamination of recreational and drinking water by non-human sources can lead to water-related illnesses.

- Note the type and number of animal(s) present, and the presence of droppings. Note whether dogs are allowed to access the shoreline (are there signs prohibiting them?) and record the presence/absence of dog waste stations and trash receptacles. Many communities ban dogs on the beach or restrict access to certain hours or months of the year.[46]

Keri Lindberg

- Note any factors that attract (or could attract) waterfowl to the area. Feeding seagulls and ducks may cause them to become a nuisance and increase their vulnerability to predators. It can also lead to overcrowding, increased concentrations of droppings, poor nutrition, increased spread of disease, and disruption of natural waterfowl migration patterns. Trash can attract waterfowl and other animals.

Is groundwater discharging to the beach?

Nicholas R. de Sieyes, Stanford University

Ground and surface waters are connected, and contaminated groundwater can contribute bacteria to coastal waters. Nutrient- and bacteria-enriched groundwater in septic effluent-affected watersheds can lead to high bacteria levels and the "freshening" of water quality, especially during low tides.[47] Compared to surface water, groundwater is more difficult to see and monitor; however, seepages resulting from pressure relief of an outgoing tide sometimes can be visible.

- Note any groundwater seepages visible on the shoreline. An unusual amount of green algae, slime, or discolored sand (usually black or gray) around the seepage face can indicate an upgradient discharge of wastewater.[48] Collect a water sample at the seepage for bacteria analysis.

Groundwater pollution can come from a variety of sources. For example, beach sand can release bacteria into groundwater that comes in contact with it. Groundwater can be contaminated by inland sources (e.g., malfunctioning septic systems) and also can contain dissolved organic matter and nutrients that stimulate the growth of bacteria in coastal waters.[49, 50]

What are the current, wind, and wave conditions?

Nearshore currents affect the fate and transport of pollutants and are driven by wind, tides, and remote (offshore) forcing. The surf zone is the area between the shoreline and where the waves begin to break. It is the region where most recreational water contact occurs. If sources of contamination are land-based, the surf zone generally has higher concentrations of bacteria compared to offshore waters. Waves primarily control mixing and transport in the surf zone, and prevailing winds influence movement of water outside of this zone. Depending on the area, cross-shelf exchange may carry contaminants from a distant source to the surf zone.[51]

- Note the water flow in the areas of the sanitary survey. Typically, areas with little water flow have higher concentrations of bacteria compared to areas with more water movement. Document the typical speed and direction of alongshore currents. This can help to assess the impact of a storm drain or river outlet located a short distance from the beach area. The volume of the "plume" of freshwater should also be considered. A flow meter can be used to determine the flow/velocity. An easy method of determining the speed and direction of water flow is to place a marked orange (or other "drifter") in the water and record the travel time and distance.

The physical characteristics and oceanography of the shoreline can influence the temperature of the water and the amount of sunlight that penetrates the water.

Water temperature and sunlight play a key role in the activity, distribution, and persistence of marine organisms, and affect the rate of biological and chemical reactions. Each type of bacteria has an optimal temperature for growth; fecal indicator bacteria generally survive longer in colder waters compared to warmer waters.[7, 52] However, warmer water may act as an indicator of polluted waters entering coastal waters via streams, rivers, and storm drains.[31]

Many studies have documented the effects of sunlight on bacteria levels in polluted estuaries and beaches. Bacteria can survive longer in turbid waters and in bottom sediments that are not as susceptible to UV radiation. Sunlight breaks down bacteria concentrations with a distinct diurnal pattern whereby levels are generally lower in the afternoon than in the early morning.[31, 53]

What to look for: 2. Wastewater disposal

Target human sources first! Human sewage can cause disease through indirect or direct body contact or ingestion of contaminated water or shellfish, and is potentially more dangerous compared to non-human sources of fecal contamination. Studies have shown a strong link between contact with water polluted by human "point" sources of contamination and gastrointestinal (GI) illness.[8, 9] Generally, human sources are easier to control compared to non-human sources of pollution.[18] For these reasons, identifying sources of human sewage and wastewater is the priority target for a sanitary survey.

What properties are serviced by a publicly owned treatment works (POTW)? Are they properly connected?

- Contact the town office or engineering department or DEP Wastewater Division to determine which properties along the shoreline and within the larger watershed are serviced by public utilities (municipal wastewater or sanitary sewer collection and treatment system).

Sometimes, structures that are supposed to be connected to the sanitary sewer have been wrongly connected to a storm sewer, or were never connected. Connections or sewer mains may also leak. Methods to check for leaks and cross-connections include on-site plumbing inspections, introducing smoke or dye into the system, or using television cameras; these are discussed in detail in Part II. In some cases, the sewer lines have been mapped and transferred to digital files that can be used in GIS and other mapping software.

Are there publicly owned treatment works (POTW) outfalls and pump stations in the vicinity?

- Note the presence of POTW outfalls that may impact coastal waters.

The outfalls of POTWs are usually located far enough upstream to provide dilution to within legal pollutant levels. However, POTW malfunctions have the potential to impair coastal water quality, in particular when high flows in the collection system during wet weather result in combined sewer overflows and sanitary sewer overflows. All POTWs have permit requirements to verbally report unauthorized discharges and other permit violations to the DEP upon knowledge of the incident(s).

DMR also conducts periodic evaluations of POTWs in areas where shellfish growing areas are conditionally managed based on POTW performance. A Memorandum of Agreement requires that POTWs report sewage overflows or disinfection problems to DMR.

Are there any overboard discharge systems?

An overboard discharge system (OBD) is a discharge of treated (via sand filter or mechanical aeration) wastewater from a residential, commercial, or public facility to a stream, river, or the ocean. OBDs have been regulated by the Maine DEP since the 1970s, when the Clean Water Act banned direct discharges of untreated waste (straight pipes). OBD treatment systems were installed for those facilities that were unable to connect to POTWs or unable to install a septic system because of poor soil conditions or small lot sizes. Approximately 1,390 licensed OBDs remain throughout the state today, less than half the number of OBDs documented to be in existence in 1987. Use of an OBD requires a license from the Maine DEP. A site evaluation is required for a license to be renewed or when a property is transferred. If there is a practical non-discharging alternative, the OBD may have to be eliminated. OBD systems are periodically inspected by DEP staff to determine if they are being properly maintained and operated. Failure to meet the conditions of a waste discharge license subjects the violator to possible enforcement action.

When OBDs are improperly maintained or malfunction, they can discharge harmful bacteria into surface waters. Several shellfish growing areas in Maine are closed due to the actual or potential threat of contamination by OBDs.

- Determine the location and status of OBD systems along the shoreline and within the watershed of concern. Record properties with OBDs and the corresponding OBD waste discharge license number on the field datasheets for transfer into the sanitary survey database. Specific information on each system can be obtained from the DEP, including inspection/compliance history reports, maps indicating the location of each OBD system and, when available, plans for removal. The DEP maintains a GIS layer that includes the geographic coordinates and links to descriptive information about all of the licensed OBD systems. OBDs may require additional follow-up depending on documented issues and/or bacteria sample results indicating a problem with the system. This may require additional DEP inspections and working with the owner(s) to take corrective actions.

The presence of an OBD mandates a shellfish harvesting closure of an area within 300 feet from the outfall pipe. However, to facilitate administration of closed areas, obvious landmarks and straight lines are used to delineate closed areas so that harvesters and wardens will be able to easily determine whether they are within or outside of a closed area, which means the actual closure may be much larger than the potentially polluted area. Stretches of shoreline with multiple OBDs will create larger closed areas.

DEP provides grants to remove some OBDs. To qualify, the OBD must be legally licensed by the DEP, and OBDs affecting shellfish growing areas are given higher funding priority.[54]

Which properties are served by subsurface wastewater disposal (septic) systems?

Improperly maintained or poorly sited subsurface wastewater disposal systems will likely malfunction and create conditions that can threaten human health and the environment. Often, little thought is given to septic system inspection and maintenance until the system malfunctions. Untreated effluent or “breakout” from a malfunctioning system can be obvious by sight or smell or by the backing up of sewage into the structure. However, malfunctions can also be difficult to detect. Effluent can percolate through soil and ledge into ground and surface waters, and be carried by stormwater runoff to adjacent water bodies.

In Maine, depending upon the capacity of the system, subsurface wastewater disposal systems are designed by either a licensed site evaluator or engineer, with a permit and construction inspection completed by the local plumbing inspector (LPI). If problems with a system are suspected, an inspection may be appropriate to ensure that the system is properly functioning and that it was constructed in accordance with the Maine Subsurface

Wastewater Disposal Rules. Routine inspection and maintenance will help to ensure that subsurface wastewater disposal systems function properly.[55]

Conduct research before surveying properties for waste disposal.

The background or known information can be documented in the sanitary survey database and transferred to field datasheets before physically surveying properties. The municipality may have an HHE-200 form showing the design of systems installed after 1974. The DHHS Subsurface Wastewater Program may also have HHE-200 forms on file.

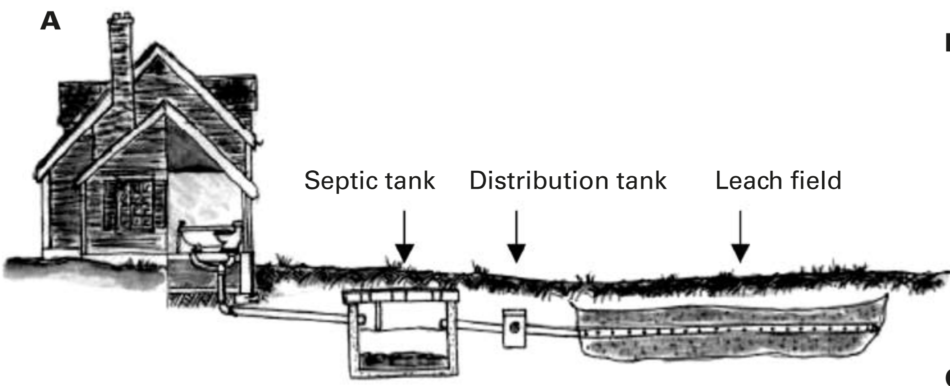
TYPES OF SUBSURFACE DISPOSAL SYSTEMS[56, 57]

A large percentage of domestic wastewater is comprised of "gray" water generated from laundry, dishwashing, bathing, etc. The rest is "black" water, human sewage from toilets. Unlicensed discharges of domestic wastewater via straight pipes, drains, etc. to surface waters are illegal and are not "grandfathered" methods of waste disposal in Maine. They must be replaced by an approved subsurface disposal system or connected to a sanitary sewer system.

Subsurface waste disposal systems take many forms and the technology is constantly changing. In general, they can be grouped into cesspools, conventional septic systems, proprietary systems, and alternative toilets such as outhouses and pits. A cesspool is any buried chamber (usually a covered hole surrounded by a rock wall) that allows wastewater to drain into the soil. Some cesspools have one or more overflow pipes or outlets that flow into a secondary soil absorption system (leach field). Cesspools that overflow to water bodies or onto the surface of the ground are illegal and must be replaced with an approved wastewater disposal system. Well-maintained and properly constructed cesspools can provide adequate wastewater disposal and those that are not obviously malfunctioning or causing a public nuisance are not illegal until they do malfunction.

Conventional septic systems include three basic components: building sewer, septic tank, and a soil absorption system. The building sewer is a pipe that delivers wastewater to the septic tank. Typical septic tanks are rectangular concrete boxes or fiberglass tanks with sizes ranging from 750

A



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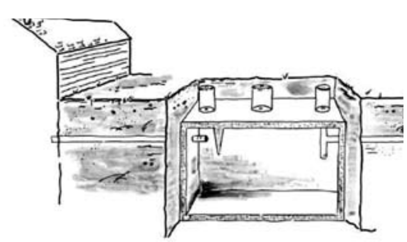

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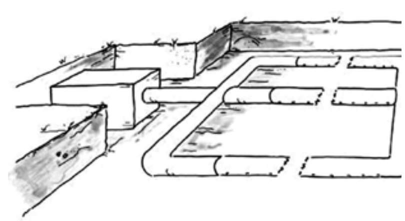

A. A conventional septic system. Wastewater flows from the building sewer to the septic tank, then to the distribution box and then to the soil absorption system. B. A conventional 1,000-gallon septic tank. C. A soil absorption bed system. Other types of soil absorption bed systems include trench systems and seepage pits.[57]

Septic System Checkup: The Rhode Island Handbook for Inspection

Written records may be out of date or contain inaccuracies, and new developments may not be recorded on municipal tax maps. Interviews with property owners are a useful way of gathering information such as known problems, age of system, system location, usage, and the last time the septic tank was serviced. Maintain a courteous and professional demeanor while interviewing property owners in person or on the telephone. Sanitary surveys are a good opportunity to educate owners about how to properly maintain their system.[58]

to 1,500 gallons, depending on the number of bedrooms served. Older tanks may be round and made of substandard material such as metal, where rusting can compromise the structural integrity. Tanks hold wastewater while the solids (sludge) sink to the bottom to decompose. Grease, oil, and other lightweight material (scum) float to the surface and become trapped in devices (usually baffles or sanitary tees) at the tank's inlet and outlet. Effluent leaving the tank enters the soil absorption system.

Raw wastewater is treated in septic tanks through anaerobic decomposition, a process where microorganisms in the tank digest much of the organic matter. Some newer septic systems aerate the raw wastewater and utilize aerobic decomposition, which generally produces a cleaner effluent and may allow the size of the leach field to be decreased. This can be important in locations where the area for a leach field is limited.[57]

The area (clear zone) within the septic tank between the scum and sludge zones has relatively "clean" seepage, which passes out of the tank to the soil absorption system. It is typical for solids to build up in the tank before they decompose, reducing the clear zone in the tank. When this area becomes too narrow, unsettled solids will bypass the effluent tee or baffles and clog the soil absorption system and eventually result in a wastewater breakout and/or a plumbing back-up. A significant amount of excess water may be added to the septic system by outdated or faulty plumbing. Home plumbing inspections should include carefully checking all plumbing, water fixtures, and water-using devices for malfunctions.[55]

Tanks must be pumped regularly to maintain the clear zone and the integrity of the soil absorption system. The frequency of pumping depends on the water usage, the size of the tank, and the volume and type of waste. On average, a three- to five-year pump-out schedule for a year-round single-family home is sufficient. One way to assess whether or not the tank still has working capacity is to remove the cover, shovel a hole in the floating sludge and measure its thickness, then use a "Sludge Judge" to assess the thickness of the sludge on the bottom.[57]

It is illegal and a violation of the Maine Subsurface Wastewater Disposal Rules to operate a "malfunctioning" subsurface wastewater disposal system. A malfunctioning system is one that is neither treating wastewater, nor functioning properly.[55] Reasons for a malfunction can include:

- The system may be improperly sited, constructed, or designed (e.g., systems built in a high water table, located in poorly suited soils, improper fill).
- Tree and/or shrub roots break pipes and interfere with the distribution system.
- Heavy machinery or cars may crush pipes and/or crack the septic tank.
- The system may be compromised by disposal of hazardous chemicals, oil, and other substances which interfere with biological digestion.
- Heavy water use and flushing of non-toilet paper items (diapers, paper towels, tampons, etc.) exceed the system capacity.
- The tank is not pumped out regularly. The "clear" zone of the tank is not maintained and the system is clogged by sludge and scum.

The following are basic guidelines to follow while surveying properties:[59]

Property inspections can only be conducted by authorized municipal and/or state agency staff.

- Be prepared for the field and have available the necessary information including field datasheets, town tax maps, list of property owners, photos to help locate properties and drainage ways, etc. A list of suggested equipment for the field is included in Appendix V. Record the information clearly and legibly on the field datasheets. Have copies of the relevant laws to give to the property owner.

- Field work should be conducted by physically capable, trained teams of at least two people for safety and efficiency. One person can talk with the property owner while the other looks for a problem. Two noses and two pairs of eyes can be more effective than one.

- Many Maine homes are seasonal. It is generally easier to determine if there is a malfunctioning septic system or other discharge if the house has been occupied for some time (usually weeks or months); therefore, limit the time spent looking at seasonal homes during the winter or early spring, when the septic system has had little or no use for several months.

- Always knock on the door immediately upon entering the property, even if it appears that no one is home. Most residents grant permission; immediately leave the property if permission is denied. Property owners who refuse access may be served with an administrative search warrant. Only authorized town or state officials are able to request and be granted search warrants by District Court; see Part IV for more information on legal rights.

- Never enter a home if an adult is not present.

- When you meet the occupant, introduce yourself and show proper identification. Briefly explain the purpose of the survey and why you are there. Be polite. The owners may have received a letter (see Appendix III) from the municipality indicating that survey work is being conducted and requesting permission to enter their property. It may also be worth explaining the scope of the survey to avoid property owners thinking they are being singled out.

- Ask the location of the septic system and ask to look around the property for any evidence of a problem. Ask if all wastewater is disposed of in the septic system. Many homes have a separate discharge point for the washing machine, sometimes a dry well, roadside ditch, or stream. This can best be determined by looking in the basement for more than one wastewater discharge pipe. Do not take the homeowner's word for the location of the septic system or that it is functioning properly. Those systems that "have never had a problem" are often the ones that are malfunctioning. Note any evidence of a malfunctioning system, including seepage into the building, and back-up of wastewater in toilets/drains that is not caused by the blockage of internal plumbing. Ask the owner if bacteria or nitrates have ever been detected in the home's well water, as these may indicate a septic leak.

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Maine DEP

- Establishments such as apartment buildings, campgrounds/RV parks, restaurants, businesses, etc. generally have a larger number of system users compared to single-family units. Examine the amount of usage of the system to ensure that it is not overloaded and that it is appropriate for the location, size, and type of establishment.

- When searching the property, be thorough so that you only have to search once!

- Locating the subsurface system can be tricky. If necessary, ask the property owner and/or locate the HHE-200 form (available through the municipality) indicating the system design and location. A septic tank can sometimes be located by the presence of a rectangular outline on the lawn, and cesspools are easily located by their cover. Look for indirect evidence of the building sewer pipe by locating the sewer vent pipe on the roof. Typically, the building sewer runs a straight line to the cesspool or septic tank, but can also bend or corner from the basement outlet.

- Much can be accomplished simply by using your eyes and nose! Look for low wet spots and areas of lush plant growth. The presence of lush vegetation, such as unusually large jewelweed can indicate a problem. Look for seepage from rock walls or at the base of slopes. Smell the air. Use a stick or metal probe to smell the mud and/or sediment. If necessary, collect a sample of liquid for bacterial analysis. The point of discharge may not always have an odor, especially if it is dilute or if it is subject to tidal fluctuation.

- If a discharge is found during the inspection and if the occupant is home, talk with them immediately to communicate the problem and potential solutions.

- Record all findings on the field datasheet (see Appendix IV). This includes tax map and lot number, distance of pollution source to water, etc. If a violation is found, it needs to be thoroughly documented.

- Dye tests/plumbing inspections for a prioritized list of properties may need to be scheduled following the initial sanitary survey if property owners are not home during the initial visit.

- Sanitary surveys are not limited to malfunctioning septic systems. Any potential source of bacterial contamination from farming and other land uses should be noted. Record the presence of questionable pipes and drains (e.g., cellar drain, sink drain) on the property. Look for evidence of gray water discharge, including detergent or soap residue, hair or lint, food particles, etc. Record the presence of pet waste and evidence of lawn care practices such as fertilizer application. Estimate the potential runoff. Record storm drains and/or culverts adjacent to the property.

Photos this page—Maine DEP

A dye test of a subsurface wastewater disposal (septic) system may be appropriate when:

- The discharge of pollutants is observed but its source unknown.
- High bacteria levels and/or optical brighteners are documented in surface waters.
- Liquid is seen but it is not obvious whether or not it contains pollutants.
- The malfunctioning status of the system is being questioned by the property owner.
- The septic system is located in a very confined area (such as behind a retaining wall located adjacent to surface water).
- The septic system is not found but there is surface water very close to the house.

Before beginning the dye test, verify the presence of all drains exiting the building. Introduce non-toxic dye to sinks, toilets, shop drains, and other plumbing fixtures and monitor the area near the septic leach field, nearby ditches, manholes, streams, etc. for the presence of dye. Depending on the situation, dye may be visible immediately or may never appear on the surface.

DYE-TESTING TIPS

- Two people are best: one person to introduce the dye while the other watches for it in the field.
- Use waterproof disposable gloves while conducting the dye test and when handling dye.
- Green dye is often the easiest to see, depending on site conditions. Green dye is also the best for systems where the wastewater is likely to migrate through soil before discharging, because green dye binds less to soil particles than other colors. Red dye may be more visible especially when the water already has a greenish tint.
- Use dye tablets for toilets and other household plumbing fixtures. They are easy to handle and quickly dissolve. Liquid concentrate also works well for any volume of flow but care must be taken not to spill it on carpets and furniture.

Keri Lindbergr

- Use enough dye to detect a problem if there is one, and to avoid repeat testing. For the typical septic system, 50-100 tablets should be adequate. For a straight pipe, 5-10 should be adequate.
- Test a representative fixture (e.g., kitchen sink, bathroom toilet). Multiple drains may require multiple colors and/or testing several fixtures over a period of days.
- Run the water for several minutes or flush the toilet several times to ensure that the dye moves through the system. Running too much water might overload or damage the system.
- Dye may not be visible right away. Check the surrounding area within one to two days and continue to check for up to a week if necessary.

Determine how many wastewater pipes exit the basement and that all are properly connected to an approved wastewater disposal system such as a sewer line, septic system, or overboard discharge unit. Check that the washing machine is also connected to the wastewater system and not illegally routed to the lawn or storm drain network, and that sump-pumps and foundation drains are not routed to the wastewater disposal system. These devices can overload the system causing back-ups and/or hydraulic problems; therefore, they should be routed to a dry well, or to the ground surface,[57] or if they contain only clean water they can legally be discharged to surface waters.

For storm drainage networks, dye testing is most useful when the drainage area is small and communication with local agencies is necessary to avoid the dye being mistaken for a spill or another contaminant.

Every identified problem is a violation that should be eliminated. The DEP has overlapping jurisdiction and authority with the municipality where wastewater disposal systems discharge to surface and ground waters. All problems should be brought to the attention of the municipality and the DEP and need to be eliminated if water quality and public health are to be protected (see Part IV).

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What to look for: 3. Land use

Land use is directly linked to water quality. Studies have demonstrated that as the watershed population increases, so does the abundance of fecal indicator bacteria in coastal watersheds. The land-water interface is not restricted to shoreline areas, but is connected and influenced by land use and activities throughout the watershed, some of which are described below.[33, 60, 61]

- Record the types of land use and activities on the field datasheet and in the sanitary survey database. Some areas may require follow-up investigation to verify (when possible) their impact on water quality.
- Depending on the type of land use, record whether or not vegetative buffers are present to trap and filter runoff.

Are there recreational uses of the shoreline?


Gary Curtis

Keri Lindberg

Large numbers of people in the water ("bather loads") and unhealthy beach habits, such as young children without swim diapers and people using the beach/water as their toilet, can contribute bacteria to coastal waters. Additionally, studies have shown that bathers can shed significant amounts of *Enterococci* and *S. aureus* into the water column.[62]

- Note the average number of bathers and the presence/absence of restroom facilities. Collecting bacteria samples during peak usage may help illustrate the relationship between the number of beach users and high bacteria levels. Statistical analysis can be conducted to further determine this relationship.[63]

How developed is the shoreline and watershed?

Studies of coastal areas have demonstrated a strong relationship between increased bacterial counts and watershed population, and an even stronger relationship between fecal bacteria abundance and developed land within a watershed. Increased population increases the amount of human sources capable of impairing coastal water quality.[33, 34, 60]


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- Note the approximate percentage of developed shoreline and estimate the percentage of impervious surface. Impervious surfaces (parking lots, roads, roofs) associated with human population and development inhibit the land's filtration ability, permitting a larger volume of pollutants to accumulate on the land surface, which are then more rapidly conveyed to waterways.[64]
- Note the presence or absence of vegetative buffers (areas of natural or planted vegetation) located between developed areas and the beach/water body. Vegetative buffers filter pollutants and reduce the flow and volume of runoff reaching the shoreline. Buffers trap polluted runoff, allowing the water to percolate into the ground. Manicured lawns are *not* buffers.[65]


LaMarr Cannon, Maine NEMO

What agricultural land use occurs in the watershed?

The types of agricultural activities and facilities to identify and investigate include, but are not limited to, livestock farms (e.g., dairy, beef, chicken, deer, buffalo, horse, fowl), Concentrated Animal Feeding Operations (CAFOs), composting facilities, fruit and vegetable horticulture, manure spreading, horse farms, zoos, and kennels.

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- Record details such as whether there is a direct or indirect pathway to a water body, the type and number of animals, setback distance of fencing to a water body, manure management, runoff potential (including pollution source distance to water body, slope of the land), and any other observations relevant to water quality.

Livestock can be a major source of ground and surface water contamination by pathogenic bacteria. Additionally, the spread and application of animal manure can be a major bacterial transport pathway.[66] Certain types of activities, such as CAFOs, may pose environmental and public health risks by increasing the amount of waste and contaminants produced.[67]

Pollutants from agricultural operations may reach surface waters through animal contact with water, improper manure management, runoff during wet weather events, etc. Studies have demonstrated that manure application can contribute significant amounts of bacteria to downstream waters, especially following rainfall events that occur soon after the manure is applied.[68] Manure can harbor and release bacteria for weeks after it is produced.[69]

Discharges of manure from any type of livestock are initially under the jurisdiction of the Maine Department of Agriculture and must be reported to that agency. They should also be reported to the DEP to ensure that any water quality impacts from the manure are eliminated. Additional bacterial samples can be collected to determine the impact of runoff from agricultural and other commercial operations.

The potential for agricultural activities to cause or contribute to impaired water quality reinforces the need to implement Best Management Practices (BMPs) such as the use of vegetative buffer filters, fencing to restrict animal access to water, rotational grazing, animal waste control facilities, pasture management, etc.[22, 70]

THINGS AREN'T ALWAYS AS THEY SEEM

The bacterial pathway may not be obvious. As a case in point: a small brook adjacent to a popular beach area had consistently elevated bacteria levels. Several attempts to identify the source(s) led to the discovery of a small discharge behind a pile of rocks on the bank of the brook. This discharge came from the neighboring restaurant's lobster pound tank. The discharge was tested for fecal indicator bacteria to verify that it was indeed contributing high bacteria levels into the brook. The local code enforcement officer worked with the restaurant owner to improve the condition of the tank and to filter the water entering and leaving this commercial operation. This less-than-obvious pollution source was addressed and water quality on the beach improved.

Other types of activities and facilities to identify and record include but are not limited to:

- Landfills/dumps
- Golf courses
- Campgrounds/RV parks
- Lobster pound tanks, aquaculture, and other fisheries infrastructure

STORMWATER[30,71]

Laura Wilson

Wet weather and storms typically result in the "worse-case scenario" for water quality, leading to advisories/closures of valued coastal beaches and shellfish growing areas due to increased fecal bacteria concentrations.[34, 52] Studies have demonstrated that swimmers have a higher risk of contracting a waterborne illness if they swim in coastal waters receiving stormwater runoff, especially swimming next to storm drain outfalls.[7]

Where does the water go when it rains?

Urban and suburban development changes the path of rain water through structures such as impervious surfaces (parking lots, roofs, etc.), catch basins, culverts, storm sewers, ditches, etc. Impervious surfaces do not allow water to percolate into the ground; instead, water flows across the land surface and is conveyed directly to streams and rivers at a more rapid rate and at higher volumes. The volume of runoff and the amount of pollution reaching receiving waters increases as human development and the amount of impervious surfaces increase in the watershed.[7, 33, 60] In Maine, stormwater collection systems are generally separated from sanitary wastewater collection systems, allowing untreated runoff to enter receiving waters.

- Determine the general size, age, and condition of the stormwater infrastructure; some municipalities have mapped their stormwater systems, although many areas in Maine rely on ditches and swales rather than enclosed storm sewer pipes. If the path of stormwater is not well documented, spend time in the field during wet weather to observe the flow of water, and record it using a marker, map, and GPS unit. Collecting bacteria samples from storm drains, ditches, catch basins, etc. during wet weather can help determine whether stormwater is negatively impacting the area of concern.

What is the relationship between rainfall and bacteria levels?

Local climate influences the frequency and duration of wet weather events, which in turn influences rainfall's impact on receiving waters. Rapid influx (i.e., pulse effects) of stormwater can create highly contaminated "plumes" leaving storm drains and river mouths. The extent of wet weather influence on bacteria concentrations is linked to transport dynamics such as mixing, dispersion, and bacteria die-off, and can vary from several hours in well-flushed areas to several days in areas with limited circulation.[72] Studies have shown that bacteria levels are greatest within 24 hours following rainfall and decline steadily over the next three days.[8] Runoff can re-suspend sediments and further impact surface waters by flooding beach sand and sediments collected in storm sewers during dry periods, which can contain large quantities of fecal indicator bacteria.

- Statistical analysis can help determine whether rainfall events are linked to high bacteria levels. Compile rainfall statistics for the area. A simple rain gauge can be used to measure local rainfall data. Alternatively, rainfall information may be obtained from a local weather station managed by the National Weather Service. It is important that rainfall data be measured in close proximity to the beach and/or shellfish growing area.

For example, analyses of data from Ogunquit Beach determined that rainfall levels exceeding one inch resulted in the highest recorded levels of fecal indicator bacteria, especially at the beach monitoring site closest to the mouth of the Ogunquit River, and that a potential lag time (up to five days) exists between rain events and elevated bacteria levels recorded on the beach. Findings from this study also showed that the Ogunquit River is the primary source of bacterial pollution impacting the nearby beach area.[73]

Stormwater pollution is not just a rainy-day issue. Dry weather flows from storm sewers can be a symptom of systematic problems, including sanitary sewer cross-connections and groundwater infiltration. Standing water remaining in storm drains between wet weather events can be rich with nutrients, causing substantial regrowth of bacteria.[72] Transient, illegal dumping of sewage and other materials into storm drains (e.g., dog waste, cat litter, and sewage from recreational vehicles) also can cause problems during dry weather.

Table 5. **Stormwater pollutants can impair habitat, human health, local economies, and the quality of surface waters.**[30, 74]

Pollutant	Sources	Impacts
Sediment	Construction sites; eroding stream banks and lake shores; winter sand and salt application; vehicle/boat washing; agricultural sites; dirt roads; logging activities.	Destruction of plant and fish habitat; transportation of attached oils, nutrients, and other pollutants; increased maintenance costs.
Nutrients (phosphorus, nitrogen)	Fertilizers; malfunctioning septic systems; bird, pet, and livestock waste; vehicle/boat washing; gray water; decaying grass and leaves; sewer overflows; leaking trash containers; erosion; lawns.	Increased potential for nuisance or toxic algal blooms; increased potential for hypoxia/anoxia (low levels of dissolved oxygen which can kill aquatic organisms).
Hydrocarbons (petroleum)	Vehicle and equipment leaks; emissions; recent paving projects; fuel spills; equipment cleaning; improper fuel storage and disposal; industrial sites.	Toxic at low levels.
Heavy metals	Vehicle brake and tire wear; vehicle/equipment exhaust; batteries; galvanized metal; paint and wood preservatives; fuels; pesticides; cleaners; industrial processes.	Toxic to aquatic life at low levels; drinking water contamination; persistent and bioaccumulating.
Pathogens	Livestock; bird and pet waste; malfunctioning septic systems; sewer overflows; overboard discharge units.	Risk to human health leading to closure of shellfish areas and swimming areas; drinking water contamination.
Toxic chemicals (pesticides, dioxins, PCBs, etc.)	Spills; illegal discharges and leaks; industrial processes.	Toxic at low levels. Some are persistent, bioaccumulating.
Debris/litter	Improper waste disposal and storage; fishing gear; leaking rubbish containers; cigarette butts; littering.	Potential risk to human and aquatic life.

According to the EPA, stormwater is now the dominant source of water quality impairment in the US, and so it is regulated as a pollution source. Some urban storm drain outfalls contain combined sewer overflows (CSOs) and are considered to be "point" sources of contamination that require a discharge permit. Several Maine communities ("MS4 Communities") are subject to EPA's Stormwater Phase II regulations, and must obtain a general stormwater permit every five years. Requirements include CSO abatement and making improvements to stormwater systems.[30]

However, most of the time stormwater enters streams and rivers untreated. The preferred treatment method is to discharge stormwater to upland vegetated buffers to allow infiltration. Other stormwater treatment techniques include: sand filtration, soil filtration, and transferring stormwater to the local sewage treatment plant. A long-term approach is to minimize the amount of impervious surface in the watershed.

What to look for: 4. Offshore activities

Up to this point, this guide has focused on land-based sources of bacteria pollution, looking inland from the shoreline into the watershed. But activities occurring *offshore* can also influence water quality. The extent of the impact typically depends on the type of activity, proximity to shoreline, tidal stage, prevailing winds, local circulation patterns, and other factors.

Is the area used by recreational and commercial boats?

Poor waste disposal practices among boaters can lead to unacceptably high bacteria concentrations. **It is illegal to dump untreated sewage overboard within three miles of the shoreline.** It is also illegal to dump any sewage, treated or not, into areas classified as a "No Discharge Zone." Fecal matter and other solid waste must be disposed of with a properly functioning, Coast Guard-approved marine sanitation device (MSD). Marinas and other high-use areas should have easily accessible pump-out facilities; however, illicit dumping can still occur in areas with adequate facilities.

- Note the location of marinas, mooring fields, anchorages, boat ramps, etc. and the presence of pump-out facilities and other waste disposal options.

The DMR conducts evaluations (typically every one to three years) of marinas impacting shellfish growing areas and defines a "marina" as an area with 10 or more boats containing MSDs. Contact DMR for evaluations of marinas having an effect on shellfish harvesting. Additionally, the DEP requires adequate pump-out facilities at harbors with 18 or more slips/moorings for boats greater than 24 feet in length.

- Determine the distance of the marina or mooring field from the beach. Monitor bacteria levels in and around marinas and other high-use areas to determine if high bacteria levels are linked to the "peak" boating season. For example, if boats are moored or anchored offshore of a beach area, are surf zone bacteria levels higher during the peak season and/or during an incoming or flooding tide stage? Consider local circulation patterns and the potential for boating waste to be transported to the shoreline.

Pam Parker, Maine DEP

Characteristics to record during the "peak" season include:

- Name of marina.
- GPS coordinates.
- Date of evaluation.
- Operating dates.
- Peak season.
- Name of marina operator/harbormaster.
- Distance of marina to beach and/or shellfish growing area.
- Total number of slips; total number and type (i.e., powerboat, sailboat) of boats occupying slips.

Pam Parker, Maine DEP

- Total number of moorings; total number and type of boats occupying moorings.
- Total number of boats with toilets/marine sanitation devices (MSDs).[75]
- Is there an operational pump-out facility or boat?
- Is this facility accessible? Describe cost and distance.
- Is this facility regularly checked for leaks or hazards?
- Are there onshore facilities? Describe type of sewage disposal (municipal sewer, holding tank, septic system, OBD).
- How often is the holding tank or septic system pumped? Is it alarmed?
- Is there any evidence of a malfunction?
- Describe the distance of the subsurface wastewater disposal system to the waterbody, runoff potential, slope of land, etc.

Other useful, but less essential characteristics to record include, but are not limited to:

- Total number of boats lived on. Describe length (weekends, summers, year-round).
- Is the marina a member of the Clean Marinas Program?
- Is the pump-out facility advertised? Is it clean and attractive for use?
- Are facility staff adequately trained to perform pump-outs?
- Include records of pump-out use.
- Educational efforts for boat owners?
- Is the marina located in a designated No Discharge Zone?
- Describe local currents/circulation patterns.

Not all mooring fields and anchorages are associated with marinas, but these areas also should be evaluated along with other activities occurring "offshore" at town landings, fish piers, islands, etc., that can adversely impact water quality. For example, trash and bait dumped overboard can contribute bacteria directly or attract waterfowl. Subsurface wastewater disposal systems, or lack thereof, on nearby offshore islands should be noted in the sanitary survey.

Part IV. Eliminating Identified Problems

Fixing problems requires an integrated, persistent approach, a combination of "carrots and sticks," and a system to track progress. This information should be included in the survey database and/or the final sanitary survey report, and shared with DEP and DMR for areas impacting shellfish growing areas.

Maine DEP

What constitutes a violation?

Discharging pollutants to Maine waters without a license is a violation of Title 38 MRSA § 413, which subjects the polluter to possible enforcement action including the imposition of monetary penalties. "Discharge" means any spilling, leaking, pumping, pouring, emptying, dumping, disposing, or other addition of any pollutant to state waters (Title 38 MRSA § 361). Section 413(1-A) prohibits operation of a subsurface wastewater disposal system without a license, and 413(1-B) prohibits subsurface discharges without a license, unless the system is designed and installed in conformance with the plumbing code. Each property owner found to be discharging illegally may be the subject of DEP enforcement action; however, the DEP usually does not pursue enforcement action for a discharge if it is promptly eliminated.

To report complaints for systems that discharge to water, contact the Maine Department of Environmental Protection Enforcement Section, 207-287-3901 or 800-452-1942, and the Maine Department of Health and Human Services Subsurface Wastewater Program 207-287-5689; http://www.maine.gov/dhhs/eng/plumb/

Who has legal authority to inspect properties and respond to violations?

Municipalities are responsible for administering the Maine State Plumbing Code (Title 30-A MRSA § 4211). The state code, however, is only a baseline. Municipalities have the authority to enact more stringent rules governing plumbing or subsurface wastewater disposal systems than those adopted by the state.

The local plumbing inspector (LPI) is responsible for administering and enforcing Maine's Subsurface Wastewater Disposal Rules (144 CMR 241). In many cases, the LPI is also the local code enforcement officer. The LPI and/or designated official have Right of Entry on Inspection (Title 30-A MRSA § 4213), and with the owner's permission may enter the property or structure to determine if it is in compliance. If entry is denied, an administrative search warrant is necessary.

The Maine DEP has overlapping jurisdiction and authority with the municipality's LPI over malfunctioning subsurface wastewater disposal system discharges to surface waters or the surface of the ground (Title 38 MSRA § 347-C). DEP staff have the authority to enter any property to ensure compliance with laws administered by the department, and enter any building with the consent of the property owner. If permission is denied, an administrative search warrant is necessary.

For areas impacting shellfish growing areas, the DMR Commissioner (or authorized staff acting on behalf of the Commissioner) has the right of entry on private property with the owner's permission and the right to seek an administrative warrant if necessary (Title 12 MRSA § 6172 [5]).

Maine LD 2160, An Act To Protect Shellfish Waters and Shellfish Resources from Coastal Pollution (Title 38 MRSA § 424-A), includes statutes outlining the abatement procedure for malfunctioning domestic wastewater disposal units and the coordination between the DMR and municipalities in addressing illicit discharges in shellfish harvesting areas. An additional provision requires an inspection for any area where high bacteria scores are believed to be caused by malfunctioning systems.

The law also contains provisions for when shoreland property is bought or sold (Title 30-A MRSA § 4216): A person purchasing property with a subsurface wastewater disposal system in a coastal shoreland area must have the system inspected by a person certified by the DHHS prior to purchase, unless the system is less than three years old, has been inspected by a certified inspector within three years, or will be replaced within one year of purchase. Municipalities may want to expand this requirement to other systems within the beach watershed, or require that older systems are inspected at least once to ensure compliance with Maine's Subsurface Wastewater Disposal Rules.

Other local, state, and/or federal departments may have authority over certain aspects of illicit discharges; therefore, coordination and communication are helpful. Municipalities may want to consider a regional approach to addressing illicit discharges within shared watersheds.

What happens after a violation is identified?

According to Maine law, a malfunctioning subsurface wastewater disposal system is considered to be a nuisance that threatens public welfare. If a malfunction is documented, it is the responsibility of municipal officers (i.e., LPI) to order an abatement of the nuisance (Title 30-A MRSA § 3428).

The local LPI, code enforcement officer, or building inspector is responsible for enforcing laws and ordinances, and also can issue penalties and represent the municipality in District Court (Title 30-A MRSA § 4452).

In addition to the LPI, the local public health officer may issue an abatement order based on a complaint of pollution. A malfunctioning subsurface wastewater disposal system falls under the broad scope of situations that adversely affect public health and safety (i.e., miscellaneous nuisance). DEP and DHHS also have jurisdiction to enforce abatement orders (Title 38 MRSA § 424-A).

Once the responsible party has been identified, a letter with a notice of violation is issued. Local jurisdictions have primary responsibility for enforcement (Title 30-A MRSA § 4214). The letter should specify all documented issues and the expected timeframe for remediating the problem. The notice of violation should describe the violation and the law or ordinance provision violated, describe required corrective actions, and impose deadlines.

In situations where voluntary compliance is not realized in a timely manner, more aggressive enforcement measures including abatement orders, penalties, and court cases may be necessary to resolve the problem. The choice of enforcement tools depends on the type and volume of discharge, the nature of the pollution, the responsiveness of the property owner, etc. Resource managers should use judgment in using the right mix of compliance assistance and enforcement.

What resources and funding are available to help fix problems?

Limited funding and resources exist to assist municipalities, individuals, or nonprofit organizations in addressing sources of fecal contamination. Support is available from the following programs for a range of activities. Keep in mind that grants and available funding change from year to year, and new opportunities emerge.

Maine State Housing Authority Home Repair Program offers low- or no-interest loans to qualified homeowners for home repair, including septic system repair and replacement.

Maine DEP Small Community Grants Program may help replace malfunctioning septic systems that are polluting water bodies or causing a public nuisance. Depending upon the income of the property owners and the property's use, this program may fund from 25% to 100% of design and construction costs. The Overboard Discharge (OBD) Removal Grant Program provides funding to remove licensed discharges. To qualify, the OBD must be legally licensed by the DEP, and OBDs affecting shellfish growing areas are given higher funding priority.

The Combined Sewer Overflow (CSO) Grant Program provides funding and assistance for CSO planning and abatement projects. Non-point Source Water Pollution Control (319) Grants provide funding for comprehensive watershed projects that prevent or reduce non-point source pollutants entering water resources. The Watershed Protection Grant Program is available for service learning projects designed to protect the water quality of a lake or stream and to educate the public about the relationship between land use and water quality.

Maine DEP Pump-Out Grant Program, which is funded by the federal Clean Vessel Act, provides funds to help pay for the installation and maintenance of holding tank pump-out stations in coastal areas. In addition, the voluntary Maine Marine Trades Association Clean Boatyards and Marinas Program promotes best management practices in boatyards and marinas.

Maine State Revolving Loan Fund provides low-interest loans to municipalities and quasi-municipal corporations such as sanitary districts for construction and upgrades of wastewater facilities.

Maine Department of Agriculture, Food & Rural Resources Maine Nutrient Management Loan Program (FAME) is a low-interest loan program for qualified businesses and individuals to assist in the construction and improvement of livestock manure waste containment/handling facilities.

The Conservation Technology Support Program awards grants of equipment plus software to tax-exempt conservation organizations to build their Geographic Information Systems (GIS) capacity.

Preventing bacterial pollution

As Benjamin Franklin stated, "an ounce of prevention is worth a pound of cure." Maintaining clean water takes work. It requires routine water quality monitoring, vigilant watch on potential pollution sources on land and offshore, local level comprehensive planning, and communication between land use boards, commissions, municipal departments, and surrounding towns. A regional approach to preventing bacterial pollution should be considered as several towns may share land within the watershed of concern.

- Maintain an up-to-date "tool box" of resources to identify, fix, and prevent sources of bacterial pollution.

Municipal staff should take advantage of professional development opportunities (e.g., trainings, workshops) and invest in resources (e.g., manuals, listservs, GIS software, etc.) to improve their skills and confidence in conducting sanitary survey work and implementing best management practices (BMPs). BMPs are the most effective, practical means of preventing or reducing non-point source pollution, followed by region-wide educational efforts linking land use practices to water quality, and targeted education programs tailored to specific problem types or areas. Towns should actively pursue funding opportunities to investigate potential problems, fix documented problems, and prevent new problems. Adaptive management is important as communities realize the scope and nature of their bacterial pollution problems.[76, 77]

Sarah Mosley

What happens to the sanitary survey report?

The completed sanitary survey report should not sit on a shelf and collect dust. Maintaining clean water requires frequently updating this resource through a tracking and reporting system. Properties should be routinely surveyed and potential sources assessed and reassessed. A survey should be updated typically every one to three years and as new information is gathered. A database, as described in Part I of this guide, allows the greatest flexibility and ease in updating changes (e.g., new development, the status of a subsurface wastewater disposal system, etc.) and tracking progress within the watershed of concern. This can also help evaluate which corrective actions had the greatest impact on water quality.

How does preventing bacterial pollution fit in with other planning efforts?

Water quality is linked to land use practices, and therefore fits within the scope of local comprehensive plans. Conservation and development planning lays the groundwork for regulations and policies. According to Maine NEMO (Non-point Education for Municipal Officials), key components of a natural resource-based comprehensive plan include:

- Inventory of natural resources
- Priority areas for conservation
- Targeting development to the most appropriate locations
- Development of an action plan at the local and regional (watershed) level
- Creation of and/or revising ordinances to support plans

Regional or local level zoning ordinances can work to protect water quality by implementing BMPs. Municipalities cannot make ordinances less strict than the state and federal requirements. Ordinances should give municipalities the authority to identify and correct pollution sources, and should clearly outline enforcement actions. They should provide incentives to protect water quality and provide disincentives for development and practices causing bacterial pollution.[78]

For example, local ordinances can require new development to demonstrate that water quality will not be degraded. Offshore activities can also be regulated. Examples include but are not limited to ordinances that:

- Require routine maintenance of subsurface wastewater disposal systems.
- Require routine property surveys including a point of sale inspection and verification process.
- Require routine assessment, maintenance, and repair of the sewer system and of the storm drain network.
- Require greater (than state or federal regulations) setback requirements from water.
- Prohibit livestock access to waterways.
- Prohibit diverting stream flows.
- Retain and/or restore natural landscape and drainage patterns.
- Protect wetlands.
- Limit the amount of shoreline development and land covered by impervious materials.
- Require new developments to have effective stormwater management plans (e.g., road swales).[79]
- Require vegetative zones and buffers along waterways.
- Require pump-out logs for recreational and commercial boats.
- Prohibit illicit discharges to the storm drainage network and/or sanitary sewer system.[80]
- Restrict access of (or prohibit) dogs and horses on the beach.
- Prohibit feeding of waterfowl and other wildlife.
- Provide tax incentives to limit shoreline development and to implement low-impact development practices (i.e., reduce impervious materials, promote use of porous pavement, vegetative swales for stormwater infiltration, etc.). Low-impact development practices are site-specific development strategies designed to reduce stormwater runoff by mimicking natural hydrological function, recharging groundwater, and treating pollution. [81]

Education

Maine Healthy Beaches Program

Targeted education programs include outreach materials that link land use practices and offshore activities to water quality, promote best practices, and clearly outline local and/or state regulations. The tool (e.g., brochure, TV commercial, radio spot, poster, flyer, forum, article, etc.) or combination of tools should be tailored to the particular area of concern. Examples include but are not limited to materials or activities that promote septic system care and maintenance, healthy beach habits, responsible boating, no dumping in storm drains, planting buffers, reducing impervious surfaces, and responsible pet ownership. Other types of activities include beach clean-ups, adopt-a-stream programs, water quality symposiums, resource protection events, citizen beach or harbor patrols, planting of buffer vegetation along waterways, etc.[82]

Maine Healthy Beaches Program

Pollution hotline

A hotline or Web site dedicated to reporting complaints can be a useful tool in identifying pollution sources, especially intermittent discharges that may be missed during inspections and source tracking efforts. Citizens can report illicit discharges and/or pollution concerns. The success of the hotline depends on advertising and it must be supported by the LPI and/or municipal staff who will follow through on complaints. Complaints should also be tracked in a database. The cost to create and maintain a hotline varies, but benefits include detection and removal of illicit discharges (also increases the likelihood of detecting intermittent discharges), increased accountability, public stewardship, and educational opportunities.[17] The hotline may be combined with another community hotline and the cost shared by towns within a shared watershed or region.

Monitoring, maintenance, and upgrades to wastewater infrastructure

Publicly-owned treatment works should practice year-round disinfection and tertiary (advanced) treatment. Tertiary treatment is typically nutrient and fine particle removal, including advanced filtration methods, constructed wetlands, etc.[83] A routine inflow and infiltration plan to detect groundwater and/or stormwater entering sewer lines includes a schedule for repairing and replacing sewer lines and manholes that have infiltration problems. Similar plans for checking for and fixing illicit connections to the stormwater system are important. Both the sewer and stormwater networks can be divided into districts and prioritized based on their illicit discharge potential (i.e., age and material of the infrastructure such as clay).[17]

Frequent cleaning of the storm drain system will prevent buildup of trash, sediment, and other debris. Stormwater should be diverted and allowed to percolate into the ground. Vegetative swales can be designed to trap particulate pollutants, promote infiltration, and reduce the flow velocity of stormwater runoff. New technologies are under development to control urban stormwater pollution, such as advanced infiltration systems to recharge groundwater and ultraviolet disinfection of stormwater (end of pipe). Local jurisdictions and commercial establishments should decide the best methods for their needs.

No Discharge Areas or Zones

Pollution prevention, through education and promotion of sanitary practices, is important because monitoring and enforcement against illegal dumping of boat waste are difficult.[84]

- Inform boat owners of the location of pump-out facilities and educate them about the importance of keeping harmful sewage out of the water. Advertise and promote pump-out facilities. Be sure that the facility is clean and readily accessible.

If a pump-out facility does not exist, work with the DEP and Maine's Clean Boatyards and Marinas Program to explore the possibility of developing such a facility. To ensure compliance with facility rules, customers can sign off on an agreement to disclose their sewage management practices. Additionally, a log of pump-out activity can be kept by the facility operator and/or harbormaster. Local and state level cooperation is necessary to ensure compliance.

A No Discharge Area (or Zone) covers all or part of a water body where any discharge of treated and untreated sewage is prohibited from all vessels. The US EPA designates No Discharge Areas, and communities work with the DEP to complete the petition and designation process.

FOLLOW THE SIGNS

In addition to signage posting the status of the beach and/or shellfish growing area, consider posting educational signage at locations with the greatest risk of pollution, including freshwater inputs to the shoreline (e.g., river mouth, stream, storm drains, seepages, etc.). Typically, these locations have high bacteria counts during and following rainfall. This may also include stagnant tidal pools that do not flush with the changing tide. The signage can simply state: "Unsuitable for Water Contact" or "No Swimming or Wading in Storm Drain." Signage can also be posted to promote healthy beach habits such as: "Do Not Feed Waterfowl" and "Dispose of Trash and Pet Waste Properly." There are many ways to approach educational signage and the language should be modified for the particular area.

New York State Department of Conservation

NOTICE

Avoid water contact at this location

High bacteria levels may result from rainfall and stormwater runoff, malfunctioning septic systems, livestock and wildlife contamination, and/or poor sanitary beach practices. Exposure to high bacteria levels may cause nausea, diarrhea, stomach cramps, chills, and fever. Skin rashes and infections of the eyes, ears, nose, and throat may also occur.

If you are sick, notify your physician or seek treatment. If you have reason to believe your symptoms were due to water contact at this location, CONTACT INFORMATION. Please refer to this area as BEACH OR AREA NAME.

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Center for Watershed Protection, Controlling Runoff and Discharges.
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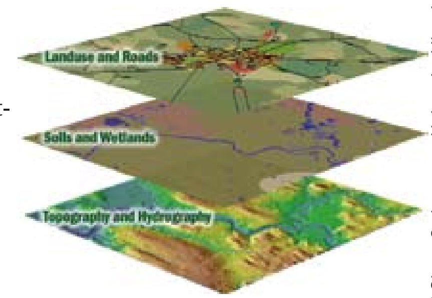
Appendix I. Geographic Information Systems (GIS)

Geographic information system (GIS) technology integrates, stores, analyzes, and displays both non-spatial and spatial geographic data. The capabilities and applications of this technology are vast and beyond the scope of this resource guide; however, this technology can be useful in the sanitary survey process.

GIS is a powerful communication and analytical tool. Maps or images created using GIS are easily shared and understood. GIS can be used to identify properties with subsurface wastewater disposal systems with the highest potential risk of contaminating neighboring water bodies (e.g., structures which sit on marginal soils for septic systems, are adjacent to surface water, and do not have sewer access). GIS is like a "data sandwich" where multiple sets of data are layered to illustrate patterns or pollution risk "hotspots" in the watershed. It can also help organize survey information and track the progress of remediation efforts.



Bill Olsen, St. Lawrence University Libraries

GIS technology is used to investigate relationships or patterns in space. For purposes of the sanitary survey, the types of GIS layers of interest include, but are not limited to:

- Watershed and sub-watershed boundaries (hydrography networks including rivers, streams, ponds, lakes)
- Coastline features
- River and stream features
- Municipal/township boundaries
- Municipal parcels
- Aerial photographs
- Habitat (wildlife, wetlands, flood plains, forest, grasslands, shellfish)
- Impervious areas
- Digital elevation models (i.e., slope)
- Soils
- Census data
- Sewer lines
- Overboard Discharge Units
- Storm sewer/drain network
- Outfalls- publicly owned treatment works
- Marinas and other high-use areas
- Water quality monitoring sites
- Land Use

What resources and data are available?

The standard GIS software is ArcGIS, available through ESRI (see also http://www.gis.com). Alternatives include other commercial packages, shareware, freeware, and beta software. Municipalities without GIS capacity may need to contract with environmental consultants, nonprofit organizations (e.g., regional planning commissions), educational institutions, etc. Depending on the watershed, the Maine Healthy Beaches Program may be able to provide GIS assistance.

Many spatial datasets ("layers") are available from the Maine Office of GIS (MEGIS). The MEGIS coverage files include Level 6 sub-watershed boundaries (from 10,000 acres to 200,000 acres of land, or up to 300 square miles) with 12-digit USGS Hydrologic Unit Codes (HUCs) and Level 7 drainage boundaries (from 3,000 acres to 10,000 acres of land or 5 square miles to 15 square miles) with 14 digit HUCs. The most useful scale for evaluation will depend on the particular area, and often the sub-watershed is sufficient.

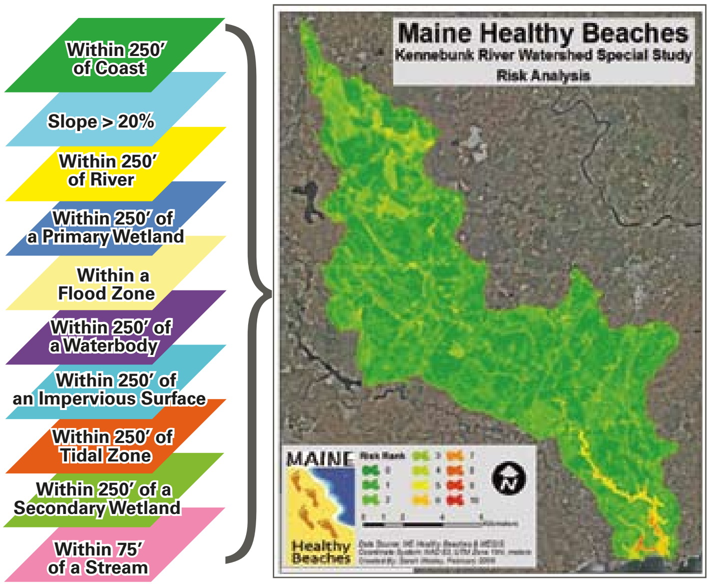
Other useful GIS layers can be obtained through state and federal agencies, or at the regional and local level. The same list of contacts in Part I should be consulted for available data. In many cases, new layers can be created as part of the sanitary survey process, such as parcels with septic systems that have the highest risk of contaminating nearby water bodies, known problem areas, agricultural operations on land with sloping topography, monitoring sites with consistently high bacteria levels, intermittent stream flows, etc.

The Conservation Technology Support Program awards grants of equipment and software to tax-exempt conservation organizations to build their GIS capacity.

US Geological Survey (USGS) and Natural Resource Conservation Service (NRCS) Watershed Numbering System

Level	Name	HUC Number
1	Region	2 digit
2	Sub -region	4 digit
3	Basin	6 digit
4	Sub-basin	8 digit
5	Watershed	10 digit
6	Subwatershed	12 digit
7	Drainage	14 digit
8	Site	16 digit

How is GIS used to identify potential pollution sources?



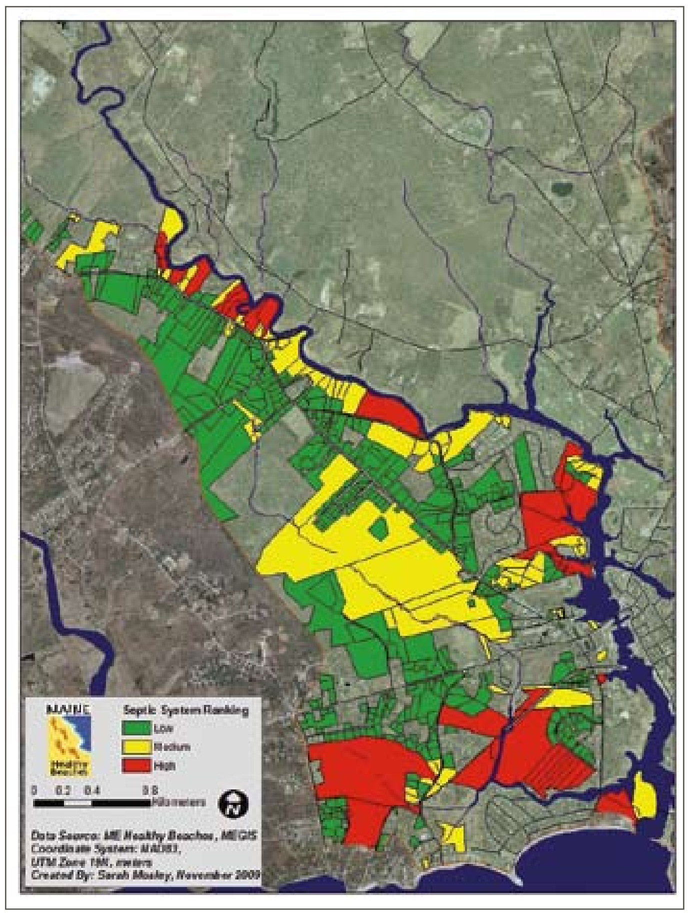
Sarah Mosley

Overlaying multiple data sets can highlight patterns or potential and actual hotspots within the watershed. The examples presented here focus on watershed areas and on subsurface wastewater disposal systems, but this model can be applied to agriculture and other land uses as well as potential offshore sources to investigate relationships between land use and river monitoring sites, or between shoreline monitoring data and offshore activities.

This figure illustrates how GIS technology was used to identify preliminary hotspot areas within the watershed. Watershed characteristics were integrated to highlight areas needing further investigation.

Similar to the example above, GIS can be used to specifically target subsurface wastewater disposal systems (septic systems) within the watershed and their potential pollution risk. The visual representation of this information can be useful and the selected parcels can be downloaded into a table format to be shared with local plumbing inspectors, etc.

Note that the same criteria used to rank the watershed areas can be applied to parcels with subsurface wastewater disposal systems. Additional files/criteria that would be useful and were not used in this example include potential problem parcels (parcels with corrective action required, agricultural parcels, campgrounds). The more detailed information (i.e., age of system, last time it was pumped out), the more useful the septic system ranking effort will be in prioritizing the first "tier" of properties to survey.



Sarah Mosley

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Biddeford Maine GIS Web site:
http://www.biddefordmaine.org/index.asp?Type=B_BASIC&SEC=%7BC26FCDEE-AC34-41B1-9B9D-C9B3893CEC07%7D

York Maine GIS Web site:
http://www.yorkmaine.org/Default.aspx?tabid=59

ME DEP GIS Data and Maps:
http://www.maine.gov/dep/gis/datamaps/index.htm#Google-Earth-Maps

Appendix II. Maine Healthy Beaches Program Risk Assessment Matrix (Draft)

Scope and Application

A *Risk Assessment Matrix* (RAM) is a preliminary assessment of beach characteristics, activities, and water quality. The Maine Healthy Beaches (MHB) Program uses this risk-based ranking system to assess and classify coastal beaches and their management areas. This assessment helps beach managers gain a better understanding of the actual and potential pollution sources impacting the beach. The RAM will help define the typical "worst-case scenario" (i.e., when the risk of pollution is the greatest) resulting in unsafe bacteria levels at coastal swim beaches. Each beach or beach management area (BMA) is ranked based on a points grading system. A higher point score indicates a beach management area with a greater risk of bacterial pollution compared to areas with a lower point score. The number of points and associated ranking will help determine the beach's "tier"[1] classification, and provide guidance on the best management course of action (monitoring frequency, posting a precautionary advisory following rainfall, the need to implement a more thorough sanitary survey, etc.).

The purpose of the RAM is to:

- Provide a preliminary assessment of potential and actual sources of bacterial pollution.
- Assist beach managers in making well-informed beach management decisions related to monitoring, assessment, and public notification of beach water quality conditions.
- Work in conjunction with routine monitoring, special studies, and sanitary survey work to build a profile of each BMA.
- Determine the need for an in-depth sanitary survey of the shoreline, adjacent watershed area(s), and offshore.

Beach Management Areas

A beach management area (BMA) is an entire beach or segment of a beach that is managed independently from other segments or area beaches. Implementing separate BMAs for large or heterogeneous beaches allows management decisions to be made for a specific region of the beach, rather than treating the whole beach as one unit. Each beach management area has its own beach sign(s) and is listed separately on the MHB Web site.

An initial RAM of the entire beach will help managers determine if separation of the larger beach area is warranted. Possible reasons to implement separate BMAs include, but are not limited to:

- The beach is heterogeneous and conditions vary considerably (e.g., a river mouth or storm drain on the north end of the beach increases the likelihood of bacterial pollution compared to the southern end, or an area where water quality results are not consistent throughout the entire length of beach).
- Monitoring and public notification of conditions are not practical or feasible for the entire beach.
- Sections of the beach not promoted for public use, including areas that are privately owned, not serviced by lifeguards, lack public access, or deemed unsafe for recreational purposes.
- A section of the beach is heavily used by the public compared to other areas.
- The beach has historically informal names or sections known to the public.

1. The MHB Program ranks coastal beaches into separate tiers or categories based on criteria for program participation, water quality history, beach usage, risk of pollution, etc. See MHB Tiered Monitoring Plan.

Equipment List

- Pencils/pens
- Clipboard
- Risk Assessment Matrix
- Definitions

Before heading to the field, read through the RAM and become familiarized with the process and the resources necessary to successfully complete the exercise. Obtain copies of data and reports specific to the beach management area(s) as described in Part I of this guide.

Completing the RAM

A RAM should be completed for each BMA.[2] The matrix should be updated frequently, typically every one to three years, depending on conditions and new information available. The frequency of updates depends on new development, increase in activities posing a risk to water quality, designated use of the waterbody, etc. The coastal surf zone is a dynamic environment where conditions can change very rapidly. Each beach management area has its own set of factors or characteristics impacting water quality, and the RAM helps to determine what those factors are.

If bacteria levels are consistently above the US EPA safety limit,[3] simply examining the areas/properties directly on or adjacent to the beach may not be sufficient to thoroughly investigate all of the actual and potential sources of fecal contamination affecting the beach. Further sanitary survey work includes additional monitoring of freshwater inputs, property and septic system inspections within the watershed, and documenting offshore activities (unsanitary boating practices, dumping) contributing to poor water quality. Removing sources of bacterial pollution can lead to measurable improvements in water quality.

While completing the RAM be sure to:

✓ Complete all sections of the RAM as thoroughly as possible.

✓ Integrate the expertise and knowledge of local officials (code enforcement officers, local plumbing inspectors, planners, conservation commission members).

✓ Refer to the Definitions for terms used in the RAM.

Complete the Following Sections of the RAM:

I. Beach History

✓ Access previous years' monitoring, notification (beach posting), and environmental data to determine each criterion's point value. This information can be found from MHB Program data, sanitary surveys, special studies, and local weather monitoring stations (e.g., sewage treatment plant).

✓ Total the number of points and enter the sum in the **Section I. Total Points Box.**

II. Potential and Actual Sources of Contamination

✓ Access the appropriate data/reports and conduct on-site evaluation to obtain the information for this section.

✓ Fill out each segment and record individual totals. Transfer the sums to the associated boxes at the end of this section.

✓ Total the number of points from each segment and enter the sum in the **Section II. Total Points Box.**

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2. Initially, a RAM may be completed for the entire beach which is then separated into BMAs.

3. The US EPA has deemed Enterococci bacteria as the most appropriate indicator organism for marine recreational waters. The single sample safety limit for marine waters is 104 MPN or cfus per 100 ml, 35 geometric mean value (five records within a 30-day period). For fresh water (zero salinity), the single sample limit is 61 MPN or cfus per 100 mls, and a geometric mean of 33.

III. Beach Activities and Environmental Conditions

✓ Access the appropriate data/reports and conduct on-site evaluation to obtain the information for this section.

✓ Total the number of points and enter the sum in the **Section III. Total Points Box.**

IV. Subtract Points for the Following

✓ Access the appropriate data/reports and conduct on-site evaluation to obtain the information for this section.

✓ Total the number of points and enter the sum in the **Section IV. Total Points Box.**

V. RAM Final Score

✓ Enter the section totals in their corresponding boxes.

✓ Total all of the section points and enter the final score in the **Section VI. Final Total Box**. This final RAM score will correspond with the RAM Ranking system.

RAM Ranking System

The final RAM score corresponds to a ranking or grade with associated recommendations. The beach rankings are meant as *guidelines* to help communities and resource managers assess the recreational water quality and safety of their beaches. Conditions can change very rapidly in the coastal surf zone and the RAM is simply one piece of the beach management "tool-box."

The exercise of completing the RAM will allow beach managers to gain a better understanding of the beach area and to assist in making informed management decisions such as when to post a beach advisory or closure, or to determine whether a more thorough sanitary survey is warranted.[4] It is a *get to know your beach* exercise.

Two examples of using the RAM in making beach management decisions:

- Bacteria results are slightly above the safety limit, there is no known safety hazard (e.g., malfunctioning septic, sewage treatment plant overflow), the conditions are not the typical "worst-case scenario" and the **Beach Ranking = A**. The beach manager may choose to wait for the resample results before posting an advisory.
- The same conditions as above, but the **Beach Ranking = D**. The beach manager may choose a more cautious approach and post an advisory or closure immediately, prior to the availability of resample results.

Beach Scores & Rankings

A. (0-50 points) Suggested Action: Conduct routine monitoring once per week or less during the monitoring season. Resample if Enterococci results exceed the single sample safely level of 104 mpn/100 ml of sample water. Routinely update the RAM and take precautionary actions to maintain healthy conditions including routine septic system inspections, reduce runoff by planting buffers and minimizing impervious surfaces within the watershed, ensure adequate pump-out facilities for boats, etc.

B. (51-100 points) Suggested Action: Continue to monitor at least once per week depending on the recorded bacteria levels. Additional monitoring of freshwater inputs (river mouths, streams, storm drains) during wet weather events may be warranted. Examine the relationship between bacteria levels and other parameters (e.g., rainfall, tidal stage, bather load). Education and outreach efforts should promote healthy sanitary practices at the beach and throughout the watershed.

4. Beaches with low scores may also require sanitary surveys.

C. (101-150 points) Suggested Action: Continue to monitor at least once per week depending on the recorded bacteria levels. Additional monitoring within the watershed including storm drains, rivers, and streams may be warranted. If there is a relationship between rainfall and bacteria exceedences, precautionary wet weather advisories should be posted. Education and outreach efforts should promote healthy sanitary practices at the beach and throughout the watershed.

D. (151+ points) Suggested Action: Increase the monitoring effort in response to recorded bacteria levels. This may require monitoring at least twice per week. Ensure that an advisory or closure is posted until monitoring results are consistently below the safety level. Consider posting additional educational signage at the beach (e.g., high bacteria levels during wet weather, do not feed waterfowl, pick up after pets, etc.). Examine all bacterial pathways to the beach. Special studies, additional data analysis, assessment of offshore activities, and sanitary surveys of properties within watershed is warranted. Identify and remediate pollution sources. Education and outreach efforts should promote healthy sanitary practices at the beach and throughout the watershed.

Maine Healthy Beaches Risk Assessment Matrix

Town or State Park:____

Beach or Beach Management Area (BMA) Name: ______________________________

____

Date of Evaluation:____

Beach or BMA Boundaries: ______________________________________

____

____

Evaluator Name(s):____

____

Title(s): ____

____

Address:____

____

Phone:_________________________ Fax: _________________________

Email: ____

I. Beach History

1. The geometric mean for beach monitoring sites (past season):
   _____ > 35 col/100mls (# sites ___ x 10 points) _____ < 35 col/100mls (0 points for each site) _________

2. Was an "advisory" or "closure" posted during previous season due to fecal contamination?
   _____Yes (10 pts) _____ No (0 pts) _________

3. How long was the beach posted during the previous season due to elevated levels of bacteria?
   _____ 0 days (0 points) _____ 1-5 days (5 points) _____ 6-10 days (8 points)
   _____ 11-15 days (15 points) _____ >16 days (20 points) _________

4. Was an "advisory" or "closure" posted during the bathing season 2 years ago?
   _____Yes (5 points) _____ No (0 points) _________

5. Was an "advisory" or "closure" posted during the bathing season 3 years ago?
   _____Yes (5 points) _____ No (0 points) _________

6. Any confirmed recreational water illnesses directly related to beach water quality reported in the past 4 years?
   _____ > 3 reports/year (20 points) _____ < 2 reports/year (10 points) _____ 0 reports (0 points) _________

7. Has dry weather monitoring resulted in *Enterococci* scores greater than 104?
   _____Yes (10 points) _____ No (0 points) _________

8. Has wet weather or rain event monitoring resulted in Enterococci scores greater than 104? (>1" rain in 48 hours)
   _____Yes (5 points) _____ No (0 points) _________

Section I. Total Points: [ ]

II. Potential and Actual Sources of Contamination

Impact Guidelines

- Adjacent to the beach
- Adjacent to a stream/river that empties within a mile of the beach
- Drains directly to the beach

1. Score 1 point for each of the following that impacts the beach based on impact guidelines (see above):

i. Number of Land Drains	(# of drains ______ x 1 point)	__________
ii. Number of Animal Farms or Kennels	(# of farms/kennels ______ x 1 point)	__________
iii. Number of Roof Gutter Drains	(# of drains ______ x 1 point)	__________
iv. Number of Gray Water Drains	(# of drains ______ x 1 point)	__________
Segment 1 Total		__________

2. Subsurface Waste Water Disposal (i.e. septic, cesspool) Systems that have not been inspected in over 3 years

(# uninspected systems ______ x 3 points) __________

3. Score 5 points for each intermittent stream flow

(# stream flows ____ x 5 points) __________

4. Score 10 points for each of the following that impacts the beach based on impact guidelines:

i. Waterbody on the 303d list with bacteria as a pollutant	(# waterbodies____ x 10 points)	__________
ii. Waterbody with a TMDL study for bacteria	(# waterbodies____ x 10 points)	__________
Segment 4 Total		__________

5. Score 15 points for each of the following that impacts the beach based on impact guidelines:

i. Stream flows, not related to rain event (may flow intermittently)	(# stream flows ___ x 15 points)	__________
ii. Malfunctioning Subsurface Wastewater Disposal (i.e. septic) Systems	(# malfunctioning systems ____ x 15 points)	__________
iii. Overboard Discharge Unit (OBD)	(# units ___ x 15 points)	__________
iv. Marina	(# marinas ___ x 15 points)	__________
v. Mooring Field	(# fields ___ x 15 points)	__________
vii. Stormwater Pipe or Drain	(# pipes ___ x 15 points)	__________
Segment 5 Total		__________

6. Score 25 points for each of the following that impacts the beach based on the impact guidelines:

i. Illegal straight pipe	(# of pipes ______ x 25 points)	__________
ii. Combined Sewer Overflow (CSO)	(# of CSOs ______ x 25 points)	__________
iii. Waste Water Treatment Plant Outfall (within 1 mile of beach)	(# of outfalls ______ x 25 points)	__________
Segment 6 Total		__________

Section II Segment Totals

Segment 1 Total	__________
Segment 2 Total	__________
Segment 3 Total	__________
Segment 4 Total	__________
Segment 5 Total	__________
Segment 6 Total	__________

Section II. Total Points:

III. Beach Activities and Conditions

1. The number of people visiting the beach throughout the season:

_______ < 50,000 visitors (1 point) _______ 50,000 - 150,000 visitors (5 points)

_______ > 150,000 visitors (10 points) __________

2. The number of people that visit any one mile stretch of beach during the time of maximum use:

_______ < 25,000 visitors (1 point) _______25,000 - 50,000 visitors (5 points)

_______ > 50,000 visitors (10 points) __________

3. Are there public restrooms located with 400’ (feet) of the beach?

_______Yes (0 points) _______ No (25 points) __________

3a. If yes, what type of public restrooms are they?

_______ Sewered (0 points) _______ Septic (5 points)

_______ Port-a-potty (10 points) _______ Outhouse (15 points) __________

4. Are domestic animals allowed on the beach during the months of May - September?

_______Yes (5 points) _______ No (0 points) __________

5. Are there large numbers of waterfowl regularly present on or near the beach? (e.g. flocks of birds)

_______Yes (10 points) _______ No (0 points) __________

6. Are there wildlife areas near or adjacent (based on Section II. guidelines) to the beach watershed?

_______Yes (15 points) _______ No (0 points) __________

7. Impervious surface scoring:

Each paved parking lot located within 100 feet (# lots _____ x 5 points) __________

Each building roof located within 200 feet (# roofs _____ x 1 point) __________

Each paved road within 500 ft of the beach (# roads _____ x 2 points) __________

Section III. Total Points:

IV. Subtract Points for the Following:

i. 5 points for each active marine vessel pump-out station within 3 miles of the beach
(# stations___ x 5 points) ________

ii. 3 points for each property located within 200 feet of the beach that is tied to a municipal sewer system (# properties___ x 3 points) ________

iv. 10 points if a significant portion of the beach has a 200 foot vegetative buffer ________

v. 5 points if beach management has posted educational signs about pollution resulting from soiled diapers, dog feces, gull feeding, and/or advertising public restroom locations ________

vi. 10 points if a sanitary shoreline survey has been conducted ________

viii. 3 points if trash cans are located at the beach ________

ix. 3 points if doggie waste bags are provided at entry points: ________

x. 15 points for a public bathroom facility at the beach tied into a municipal sewer system ________

Section IV. Total Points:

V. RAM Final Score

Section Total Points

I. Beach History (+) ________

II. Sources of Contamination (+) ________

III. Beach Uses and Conditions (+) ________

Subtotal Sections I-III ________

IV. Subtract Points (–) ________

Final Score

Note: See beach scores and rankings, page 47.

Definitions

303d List The 303d list identifies water quality limited waters within the state, causes and sources of nonattainment of standards, and a timetable for the development of TMDLs (Total Maximum Daily Loads) or other management processes to address attainment.

Actual v. potential pollution sources An "actual" source is one that has been documented or proven to impact water quality compared to a "potential" source which is likely impacting water quality but documentation is lacking.

Adjacent Nearby, neighboring, close.

Advisory An advisory posted on an MHB Program sign at the beach or on the Web site is a recommendation to the public to avoid water contact activities in those areas. Advisories are posted where bacteria results exceed the water quality standards for recreational water contact established by the US Environmental Protection Agency.

Analysis An examination of parts or elements and their interrelationships in making up a whole (i.e., examining patterns in rainfall and bacteria levels to determine overall beach health).

Assessment Appraisal, measure: evaluate or estimate the nature, quality, ability, extent, or significance of.

Bacteria Unicellular organisms lacking a nucleus and chlorophyll; used in MHB Program to indicate the possible presence of disease-causing organisms in recreational waters.

Beach A geological landform along the shoreline of a body of water usually consisting of unconsolidated material such as sand, gravel, cobbles, or pebbles. A marine beach is the zone of unconsolidated sand or gravel that extends landward from the mean low water line to the seaward toe of a dune. The definition of beach includes the beach face and berm. See also coastal sand dune systems.

Beach Berm Depending on the tide, this is the area mostly above water and is subject to wave activity.

Beach Management Area An entire beach or a segment of a beach that is managed independently from other beaches or segments due to potential pollution impacts or capacity of management to provide notification of water quality monitoring results.

Coastal Sand Dune System Sand and gravel deposits within a marine beach system, including, but not limited to, beach berms, frontal dunes, dune ridges, back dunes, and other sand and gravel areas deposited by wave or wind action. Coastal sand dune systems may extend into coastal wetlands. See Maine DEP Chapter 355, Coastal Sand Dune Rules.

Closure A closure, more severe than an advisory, can be based on chronic high bacteria results or when conditions greatly increase pollution levels. While it is rare in Maine to have closures, they are generally linked to known safety hazards. For example, a beach may be closed as a result of sewage treatment plant malfunctions, severe flooding, rip currents, sharks, hazardous surf conditions, and other safety hazards. A municipality must have a specific ordinance in place to close a beach.

Combined Sewer Overflows (CSO) Consist of mixtures of domestic sewage, industrial and commercial wastewaters, and stormwater runoff. Overflow may occur when the flow capacity of combined storm drains and sewer systems are exceeded during rainstorms.

Contamination General term referring to the introduction of undesirable materials (chemical, microorganisms, wastes, etc.).

Correlation Mutual relation; systematically connected.

Criteria Measurable physical, chemical, or biological characteristics commonly used as a basis for setting standards.

Elevated Raised, increased, high.

Enterococci The established bacterial indicator for designated coastal recreational waters in Maine. Indicates fecal contamination and the possible presence of pathogens.

Fecal contamination Introduction of fecal matter by contact or association into the environment.

Geometric mean Reduces the influence of outlying (i.e., the very low and very high) numbers on the data set. The data are transformed to the logarithmic values of each datum and then averaged (summed and divided by the number of terms).

Guideline A statement or other indication of policy or procedure by which to determine a course of action; standards.

Illegal Straight Pipe A man-made conduit through which liquid can flow, including pipes actively discharging untreated or partially treated sewage or "black" water, laundry or "gray" water, etc. This does not include road culverts.

Impact To have an effect.

Impervious surface Incapable of being penetrated by moisture. Impervious surfaces are mainly constructed surfaces—rooftops, sidewalks, roads, and parking lots—covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, repel water, and prevent precipitation and meltwater from infiltrating soils. These surfaces cause rapid run-off of storm water and contribute to non-point source pollution.

Inactive straight pipe A conduit not in use. Signs of non-use might include: the pipe is visibly disconnected from the ground and is lying on the shore; large amounts of corrosion and rotten spots; no flow or moistness in pipe; no noticeable variation in vegetation directly under the pipe versus vegetation to either side of the pipe; no pieces of tissue in various stage of decomposition. If you are uncertain whether a pipe is active or inactive, please note this on field sheet and give explanation as to why you think it is active or inactive so that this may be followed up.

Indicator organism Indicator bacteria are used to determine water quality conditions. An indicator organism is one used to determine the presence of pathogenic (disease causing) organisms that might be present in the same environment as the indicator. The actual pathogenic organisms are too many, too difficult, and too costly to measure.

Intermittent streams Streams that may only flow at certain times of the year (usually related to spring runoff) or after large rainfall events. Generally, intermittent streams will be narrow and shallow, with varying flow rates.

Malfunctioning subsurface wastewater disposal systems (i.e., septic, cesspool) Are of primary concern due to public health issues. You can usually tell a malfunctioning system by: odor; presence of wetland plant species such as cattails in an otherwise normal vegetation area; seepage from the tank or leach field area; mushy areas above the system; indents in the ground or other signs that the cover or tank might have collapsed.

Marine vessel pump-out station Provides a safe and legal method for disposing of human sanitary waste from vessel marine sanitation devices (i.e., storage tanks).

Monitor To check, keep records of.

Monitoring Season Period of time swim beach samples are collected to correspond with public use of recreational water; varies from one beach to another as weather and water temperature vary greatly from region to region; for most beaches in Maine, this is Memorial Day through Labor Day.

Non-point source pollution Indirect contamination (i.e., urban/agricultural runoff); many diffuse sources as compared to point source (i.e., straight pipe).

Overboard Discharge (OBD) A discharge of sanitary wastewater from residential, commercial, and publicly-owned facilities to streams, rivers, and the ocean. Since these are point discharges, they are required to be licensed by the state, and are currently being phased out by the Department of Environmental Protection.

Pathogen Any disease-causing agent, especially a bacterium or other microorganism.

Point-source pollution Direct contamination (i.e., via effluent pipe/smoke stack) as compared to non-point source (i.e., storm runoff).

Pollution The presence of harmful contaminants in the environment.

Posting Placement of a sign(s) at beach access points; making information available to the public through Web site, hotline, or other means.

Recreational waterborne illness Illness spread by swallowing, breathing, or having contact with contaminated water from swimming pools, spas, lakes, rivers, or oceans. Recreational water illnesses can cause a wide variety of symptoms, including gastrointestinal, skin, ear, respiratory, eye, neurologic, and wound infections. Diarrhea is the illness most commonly reported to the Maine CDC.

Risk assessment matrix (RAM) A preliminary assessment of potential and/or actual pollution sources on or directly adjacent to the beach. The RAM will assist beach managers in making well-informed beach management decisions, in conjunction with routine monitoring to build a "profile" of each BMA and to determine the need for an in-depth sanitary survey of the shoreline and adjacent watershed area(s).

Risk Exposure to possible danger, loss, or injury.

Sanitary survey The goal of a sanitary survey is to identify, document, and eliminate sources of fecal contamination affecting water resources (e.g., coastal beaches, shellfish growing areas, and freshwater inputs to these areas).

Sewage Potential source of microbiological contamination of recreational waters. May be associated with system failures in human sewage treatment facilities, leaking sewer lines, septic systems, or with rainfall and resulting surface water runoff.

Special Study Any monitoring, research, and data analysis conducted beyond the routine Enterococci monitoring of beaches. Typically, special studies are conducted in areas with chronic bacteria issues.

Standard operating procedure (SOP) Officially approved document describing prescribed techniques. Accepted method of performance.

TMDL (total maximum daily load) study Identifies the amount of a pollutant the receiving water can assimilate without violating water quality criteria or impairing the designated use. It is the loading capacity of a waterbody including a margin of safety to account for uncertainty in targ et-setting.

Vegetative buffer Undeveloped area directly adjacent to a body of water. Reduces runoff, stabilizes soils, provides habitat, etc.

Wastewater treatment plant Also referred to as a publicly-owned treatment works (POTW), a sanitary sewer collection and treatment system.

Watershed The upland land mass which drains to a particular waterbody.

Water quality criteria Specific levels of pollutants, which, if reached or exceeded, are expected to render a body of water unsuitable for its designated use; may adversely affect human health or aquatic life. Unenforceable guidelines issued by a governmental institution or other agency.

Appendix III. Notification letters

A. Request access to water

DATE

PROPERTY OWNER

ADDRESS

Dear PROPERTY OWNER:

Water quality monitoring in the BEACH/WATERBODY has detected elevated levels of bacteria which negatively impacts water resources and poses a threat to human health. In an effort to identify and ultimately eliminate sources of bacterial contamination, TOWN, in partnership with LIST PARTNERS will conduct additional water quality monitoring at various locations in the WATERBODY. This work will lead to a more thorough investigation and a sanitary survey of the larger drainage area. The start date of this work will be START DATE and it will be conducted through END DATE.

You are receiving this letter because your property is adjacent to one of the areas believed to have safe access to an identified water quality monitoring site. We would like your permission to access the WATERBODY from your property. We will be calling you to seek your approval.

Information collected will help inform future survey work and will be compiled in a report available for review. We request your cooperation in this important effort to protect and preserve valued water resources, public health, and ultimately maintain a clean and thriving BEACH/WATERBODY area.

If you have any questions, comments or concerns call or email:

LOCAL CONTACT INFORMATION

B. Property will be surveyed

DATE

PROPERTY OWNER

ADDRESS

Dear PROPERTY OWNER

The Town of TOWN will be conducting a sanitary survey of the BEACH/WATERBODY watershed (the area that drains to this water body). This important work will help the town identify sources of bacterial pollution impacting the water quality of BEACH/WATERBODY. The projected start day for the survey will be START DATE and will run until END DATE.

You are receiving this letter because your property is located within the drainage area of concern, which includes LIST TAX MAP #s. Information such as land-use practices and subsurface waste water disposal will be compiled in a sanitary survey report and will be available for review. We request your cooperation in this important effort to protect and preserve valued water resources, public health, and ultimately maintain a clean BEACH/WATERBODY area.

Most of the information will be gathered outside of the building. If you are home, the local/state officials will ask questions and on occasion will need to see the building drain. If you have any concerns or questions, or would like to request a specific day for your inspection, please contact: LOCAL CONTACT INFORMATION

The persons conducting the survey will be:

NAME, Local Plumbing Inspector/Code Enforcement Officer

NAME, STATE AGENCY

Appendix IV. Field data sheets, codes, etc.

Actual (A): Something that is a known source of pollution, and causes, or is capable of causing, a violation of NSSP bacteriological standards for approved shellfish growing waters during the time of observation. For beaches and other areas these are sources that contribute to bacteria levels above the EPA-approved standards for recreational water. A source can only be described as 'Actual' if: (1) It has been found to have consistently high bacteria levels; and/or (2) It is determined, beyond a reasonable doubt, that the source is polluting, or capable of polluting, the surrounding area (e.g., a sewage treatment plant outfall, straight pipe, malfunctioning septic system). Additional source tracking and identification tools may be necessary to verify "Actual" status. For DMR Sanitary Shoreline Surveys of shellfish growing areas, actual pollution sources must be re-sampled and re-evaluated at least once every three years.

Potential (P): Any source that has the potential to infrequently and/or unpredictably release contaminants to the surrounding shellfish growing waters at levels which are in violation of NSSP bacteriological standards. For beaches and other areas these are sources that contribute to bacteria levels above the EPA-approved standards for recreational water. During an initial shoreline survey all sources found will be classified as potential until further bacterial investigations and verification can be conducted. For DMR Sanitary Shoreline Surveys of shellfish growing areas, potential pollution sources must be re-evaluated, through sampling or other means, at least once every three years.

Direct (D): proceeding in a straight line or by the shortest course; straight; undeviating.

Indirect (I): not in a direct course or path; deviating from a straight line; roundabout.

Potential – Low Priority: Any pollution source found which meets the definition of 'Potential' and for which there is no likely means of abatement. Low priority sources will not be followed up in as much detail or as quickly as 'Potential' sources. These are sources that, due to distance or dilution, may not significantly impact coastal water quality. For DMR Sanitary Shoreline Surveys of shellfish growing areas, Potential – Low Priority pollution sources must be re-evaluated, through sampling or other means, at least once every three years.

Animal Farm Runoff (AF): Water originating from an area where animals are raised and/or housed and flows untreated into streams or other surface waters.

In-ground septic field (IG): The specific type of system and further details should be documented in the Pollution Source Description box.

Intermittent Stream (IS): A freshwater stream that flows only during periods of precipitation or snow melt. Stream is dry during certain periods of the year.

Malfunctioning Septic System (MS): A septic system that is not performing according to its design specifications. Can cause/be detected by overland flow or groundwater seeps near a leach field, ponding or breakout of wastewater, seepage into building, discharge into nearby surface waters.

Outhouse (OH): An outdoor toilet not connected to any type of septic system or wastewater treatment plant.

Perennial Stream (Steady Stream) (SS): A freshwater stream that flows continually during the entire year with the exception of periods of extreme drought or when frozen.

Town system (TS): Municipal, public or otherwise communal system that moves sewage to a central treatment plant.

Pipe: a man-made conduit through which liquid can flow. This does not include road culverts. Types of pipes include:

AP Active straight pipe	**IP** Inactive straight pipe	**PD** Pool drain	**SO** Septic overflow pipe
CD Cellar drain	**LD** Land drain	**SD** Sink drain	**WO** Well overflow
GD Gutter drain	**OD** Licensed overboard discharge		

Groundwater Seep: Percolation of water through the soil from a source under the ground (does not include the drainage of water from the surface of a tidal marsh at low tide).

Marina: A basin containing docks, slips, and boating supplies (fuel, repair equipment, waste pump-out capabilities) used for docking or storing vessels. Constructed to provide temporary or permanent docking space for more than 10 boats.

Mooring Field: An area of water (usually outside of the marina proper) containing buoys or floating docks anchored to the seabed for boats to tie up to. Constructed to provide temporary or permanent docking space for more than 10 boats.

Pump Station: A facility installed in a sewer or water collection system to pump sewage through a forced main to a higher elevation and/or treatment facility.

NPDES Outfall: The place where effluent is discharged into receiving waters from a facility with a National Pollutant Discharge Elimination System permit, e.g., wastewater treatment facility outfall pipe.

NPDES Facility: The actual building(s) where waste, to be released through the NPDES outfall pipes, is generated and stored.

Road Swale: A low, wet piece of land used to channel stormwater runoff from a road surface. Typically runs parallel to the road.

Road Culvert: A human-made conduit (box-shaped or round), used to convey water under a road.

Salt Marsh Ditch: A long, human-made, narrow channel in a salt marsh designed to facilitate draining. Typically three feet wide or less and 1-2 feet deep.

Sewer Line: A human-made conduit used to transport sewage and refuse. Consists of either gravity lines or forced mains.

Tidal Creek: A small stream influenced primarily by tidal waters. Typically found in salt marshes, concentrating the drainage of the marsh during low tide. Typically 4-10 ft in width and 3-6 ft in depth.

Tidal River: A moderate to large river influenced primarily by tidal waters. Typically greater than 10 ft in width and greater than 6 ft in depth.

Holding Tank (HT): Holding tanks are designed to receive and hold the wastewater leaving a domestic structure. This wastewater, in turn, is pumped out and transported to a municipal treatment plant or to an approved land-spreading site. Every holding tank shall be pumped at least once a year, providing the system has been used [Title 22 M.R.S.A. §22 Chapter 20 (2000.3.1). The owner, or agent for the owner, of a holding tank shall retain for a period of three years the copies of the pumping records, water-use records (if required) and the current agreement between the owner and tank pumper. A copy of these records shall be made available to the plumbing inspector upon his/her request. [Title 22 M.R.S.A. §22 Chapter 20 (2000.3.4). The holding tank shall have visual and audible alarm devices to assure the tank is always pumped before it is full [Title 22 M.R.S.A. §22 Chapter 20 (2000.3.8)].

Pit Privy or Outhouse: Pit privies are intended to receive and store human wastes in excavations below toilets. A pit privy is considered a “disposal field” for the purpose of setback distances, except for the distance requirements from a building. Pit privies may be part of a larger building [Title 22 M.R.S.A. §22 Chapter 20 (706.1).

Investigated/Clean: Any pollution source, actual or potential, that has been investigated, by means of bacterial sampling, and found to be at levels which are below NSSP bacteriological standards. For beaches and other areas these are sources that contribute to bacteria levels below the EPA-approved standards for recreational water contact.

Surveyor(s)________________________ **Date**__________ **Page**_____ **of** ______

Shoreline Survey ID	Town	Tax Map	Lot Number	Area Name	OBD #
Owner Last Name	Owner First Name	Street Address			
Pollution Type/Code	Problem: Y or N Year Round or Seasonal	Pollution Distance to water: Ft.	PS Latitude: ° ' " N	PS Longitude: ° ' " W	
Pollution Source: Actual or Potential	Pollution Path: Direct or Indirect	Pollution Source Description:			
Property Description:					

Shoreline Survey ID	Town	Tax Map	Lot Number	Area Name	OBD #
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Pollution Source: Actual or Potential	Pollution Path: Direct or Indirect	Pollution Source Description:			
Property Description:					

Appendix V. Field Equipment List

Useful equipment to bring into the field includes, but is not limited to the following. Some of the listed items may not be available or applicable.

- Field Data Sheets
- Pollution Source Codes and Survey Definitions
- Municipal Tax Maps
- 7.5 minute USGS Topographic Maps (1:24,000 scale)
- GIS Maps
- Nautical Charts
- Aerial Photographs
- List of Property Owners
- Clipboard
- Field Notebook
- Pen/pencil
- Stick or Thin Metal Rod
- Digital Camera
- GPS Unit
- Bacteria Monitoring Kit[1]
- Range finder
- Fluorescent Color Tape
- Flow Measurement Equipment
- Dye tablets
- First Aid Kit
- Foul Weather Gear
- Bug Repellant
- Sunscreen
- Drinking Water
- Cell Phone
- Identification

1. Water quality monitoring equipment and training may be provided by MHB Program staff.