
5. GREAT LAKES

Last updated: 10-2007

The Great Lakes, including their bays and harbors, represent a water resource of major significance to Wisconsin's aquatic life, recreational uses, drinking water supply and economy. Monitoring of these vast water resources relates directly or indirectly to nearly every component of this monitoring strategy. As such, it is not possible to put all of the Great Lakes monitoring components in one section of this *Strategy*.

The Great Lakes section of *Tier 1: Statewide Baseline Monitoring* includes three primary activities: Lake Michigan Major Tributary Phosphorus Loading; Great Lakes Fishery Assessment; and Pathogen Indicator Monitoring on Great Lakes Beaches. These three activities are unique to the Great Lakes.

Great Lakes monitoring is also included in other sections of this *Strategy*, as follows:

- *Contaminants in Fish Tissue* included under the Tier 1: Cross-Resource Monitoring section has a major Great Lakes component.
- *Contaminated Sediment* included under Tier 2: Evaluation Monitoring also has significant Great Lakes components.
- Cladophora/Nutrient monitoring of near shore waters of Lake Michigan is included under *Special Projects and Research* under Tier 2: Evaluation Monitoring. However, this sampling is expected to be converted from a research-oriented activity to a more routine Tier 1 monitoring activity in the near future.
- Embayment monitoring, for the near-term, is included under Tier 2 *Special Projects and Research*.
- Lakes Superior and Michigan have 15 public water intakes that are monitored according to the Safe Drinking Water Act, using the same protocols as described in the Public Drinking Water Well Monitoring section in Tier 3. An expanded description of raw water intake monitoring may be included in a later draft of this *Strategy*.

The Great Lakes monitoring activities described in this *Strategy* generally represent activities conducted in conjunction with a variety of federal, state and local partners. And properly, they are not solely WDNR activities. These partners are identified in the individual activity description. For instance, the *Joint Strategic Plan for Management of Great Lakes Fisheries* provides the institutional framework for inter-jurisdictional cooperation in data collection related to fisheries management. Future versions of this *Strategy* may include an expanded description of Great Lakes monitoring activities conducted by federal partners.

National Monitoring Network Pilot for Lake Michigan

As of October 2007, Department staff are working with EPA, USGS, Illinois, Indiana, Michigan and others to develop a National Monitoring Network pilot project for Lake Michigan. This pilot project, which will be submitted in late-2007, focuses on six “locational” elements (areas of Lake Michigan):

- Open waters;
- Deeper nearshore waters;
- Shallower nearshore waters;
- Beaches;
- Embayments, including harbors, bays and Areas of Concern; and
- Wetlands.

In addition, the pilot project includes the following three “input” elements (sources of pollutants):

- Rivers;
- Groundwater; and
- Atmospheric.

The particular elements of the national pilot where the Department is already conducting related monitoring are primarily in deeper nearshore waters, shallower nearshore waters, beaches, embayments, rivers and atmospheric (air management program). Federal agencies, such as EPA-GLNPO, conduct monitoring in open waters. The ongoing monitoring of these federal partners is not described in this strategy.

LAKE MICHIGAN MAJOR TRIBUTARY PHOSPHORUS LOADING

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Status: Ongoing

The majority of the funds for this monitoring are from the state-funded Great Lakes Shore Monitoring segregated account. Most of the monitoring is conducted by Department staff, with substantial involvement of the Milwaukee Metropolitan Sewerage District and the Green Bay Metropolitan Sewerage District. Some of the sampling for this program is being conducted under the current Long Term Trend fixed sites to avoid duplication of monitoring.

Monitoring Objectives

Clean Water Act Objectives

- Determining water quality standards attainment
- Identifying causes and sources of water quality impairments
- Supporting the implementation of water management programs
- Supporting the evaluation of program effectiveness

Specific objectives

The primary objective for monitoring phosphorus loads in major Lake Michigan tributaries is to develop long term trends for phosphorus, nitrogen, and suspended solids loading to Lake Michigan, providing early warning of rising trends, and information for management issues that arise. This monitoring component is intended to be a supplement to the existing ongoing trend monitoring.

Monitoring Design

Monitoring focuses on selected tributaries representative of the largest drainage area, largest sources of phosphorus and streambed sediment type. Sampling locations coincide with permanent USGS stream gauging stations. Five tributaries addressing these criteria are: 1) Fox River, 2) Milwaukee River, 3) Manitowoc River, 4) Menominee River, and 5) Sheboygan River. These sites are sampled annually, using a combination of flow proportional sampling protocol and monthly sampling for a total of about 25 samples/year.

Sheboygan River Real-time Pilot Monitoring – In the fall of 2007, the Department and USGS initiated a pilot project on the Sheboygan River with the goal of providing real-time, continuous monitoring. The pilot study is investigating an alternative to the periodic grab sampling currently used. The pilot entails collecting continuous turbidity readings and using these readings along with phosphorus concentration information collected during runoff events and during baseflow conditions to develop a site-specific regression equation. The intent is to apply the regression equations to the real-time turbidity readings to calculate real-time phosphorus concentrations. The desire is to not only have the information on a continuous, real-time basis, but to produce better nutrient loading estimates to Lake Michigan. It is also anticipated that staff time and travel costs can be reduced.

Core and Supplemental Water Quality Indicators

The core indicator is total phosphorus, typically the limiting nutrient that affects aquatic plant growth and recreational water uses. Total suspended solids, total Kjeldahl nitrogen, and dissolved reactive phosphorus are also included as indicators.

Quality Assurance

Quality Assurance procedures should follow standard WDNR protocols.

Data Management

Water quality data from this monitoring component will be stored in the SWIMS system and will also flow to the USEPA STORET. These data are readily available internally through the intranet. All monitoring sites will be geolocated.

Data Analysis/Assessment

Critical to this monitoring is annual analysis of phosphorus loading to the Lake Michigan. Some of the data required for the assessment of the Milwaukee River and Fox River is already collected by other sources, Milwaukee Metropolitan Sewage District and Green Bay Metropolitan Sewage District, respectively. A key aspect of the monitoring program is for an annual load analysis to be conducted by WDNR Water Evaluation staff.

Reporting

Great Lakes nearshore data would be used for assessments required by Section 305(b) of the CWA. The Great Lakes Chronicles published by the Wisconsin Coastal Management Program is another possible opportunity for reporting. Additional reporting opportunities may arise as through other regular “State of the Great Lakes” publications.

Programmatic Evaluation

Sampling for this monitoring project began in 2006. The sampling schedule will be evaluated at the end of the calendar year. As the program progresses, modifications can be made as needed.

General Support and Infrastructure Planning

Laboratory analysis and supply costs are estimated at \$9,500. Load calculations will take the bulk of the WDNR staff time involved. Volunteers may be considered to conduct some of the monitoring for this program.

GREAT LAKES FISHERIES ASSESSMENTS

Contacts: Tim Simonson, Bill Horns

Last updated: 11-2007

Assessments of Great Lakes fisheries are used to guide management actions. The primary means of assessment are angler creel surveys; trawl and gill net surveys; statistical catch-at-age modeling of yellow perch in Green Bay and Lake Michigan, lake trout in Lake Superior, and lake whitefish in Lake Michigan; and monitoring of salmon and trout spawning runs. Lake-wide inter-jurisdictional data sharing is accomplished through the Lake Committees and Lake Technical Committees. The Lake Michigan program is described in the Lake Michigan Integrated Fisheries Management Plan, 2003-2013.

Status: Currently in Place

This program in its present form was established in approximately 1980 and has been consistently implemented using a variety of funding sources.

Monitoring Objectives**Clean Water Act Objectives**

- Identifying impaired waters
- Supporting the evaluation of program effectiveness

Specific Objectives

- Determine trends in the population status and health of major sport and commercial fisheries
- Evaluate program effectiveness
- Develop management plans

Monitoring Design

- Annual stratified random angler-contact creel surveys
- Statistical catch-at-age modeling of yellow perch in Green Bay and Lake Michigan, lake trout in Lake Superior, and lake whitefish in Lake Michigan using data collected by trawl, gillnet, seine, creel survey, commercial catch reports, and dockside monitoring of commercial catches
- Monitoring of salmon and trout spawning runs at three spawning weirs
- Lake-wide, multi-agency data sharing regarding species of common interest, including chinook salmon and lake trout
- Lake-wide surveys of forage species (primarily by USGS Great Lakes Science Center, but with cooperation by states)
- Estimates of trends in sea lamprey abundance by the Great Lakes Fisheries Commission (GLFC)
- Fish health inspections conducted at spawning weirs
- Local surveys to assess smallmouth bass and walleye
- Mandatory annual commercial harvest reporting
- Gill net assessments of bloater chubs
- Gill net assessments of lake trout
- Special, targeted studies

Core and Supplemental Water Quality Indicators

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|--|---|
| <ul style="list-style-type: none"> • Angler effort, catch, and harvest • Population abundance • Fish health and condition • Length frequency | <ul style="list-style-type: none"> • Age and growth • Diet • Recruitment |
|--|---|

Quality Assurance

Standardized protocols are used and training is provided. Data sharing and assessment coordination through the Lake Michigan and Lake Superior Committees provides a mechanism for inter-jurisdictional scrutiny of our data and analyses.

Data Management

Data are maintained in Great Lakes databases available on the internet at <http://dnr.wi.gov/org/water/fhp/fish/lakemich/>.

Data Analysis/Assessment

Data from Great Lakes surveys are used to guide the propagation and stocking of salmon and trout, establishment and revision of sport and commercial fishing regulations, and establishment of fishing harvest limits. Data are shared with other jurisdictions through the Lake Michigan Committee and Lake Superior Committee.

Reporting

Data are reported in the following manners:

- State Fish Restoration (SFR) or Fish-SEG Progress Report
- Annual Lake Michigan Management Report to the Lake Michigan Committee
- Annual Lake Superior Management Report to the Lake Superior Committee
- Biennial Great Lakes Salmon & Trout Stamp Revenue Expenditures Report
- Annual reports on returns of fish to spawning weirs
- Annual creel survey results
- Annual fish stocking reports

Programmatic Evaluation

Program review is accomplished with regular meeting of the Lake Michigan Fisheries Team, the Lake Michigan and Lake Superior Committees, and the Lake Michigan and Lake Superior Technical Committees.

General Support and Infrastructure Planning

Staff & Training – Several FTE staff participate in this monitoring activity. Volunteer participation in these activities is problematic in almost all cases because of the training and technical skills required.

Laboratory Resources - None.

Funding - Funding for this activity comes from the segregated account (Fish) and Great Lakes Trout and Salmon Stamp sales.

References

Schneeberger, P., M. Toneys, R. Elliott, J. Jonas, D. Clapp, R. Hess, and D. Passino-Reader. No Date. Lake-wide assessment plan for Lake Michigan Fish Community. Lake Michigan Technical Committee.

Lake Michigan Fisheries Team, WDNR. 2007. Lake Michigan Management Reports. Lake Michigan Committee.

Horns, W.H.J.. 2007. Great Lakes Salmon & Trout Stamp Revenue Expenditures Fiscal Years 2002-2005. Administrative Report 59. Bureau of Fisheries Management and Habitat Protection. Wisconsin Department of Natural Resources.

Lake Michigan Fisheries Team, WDNR. 2004. Lake Michigan Integrated Fisheries Management Plan, 2003-2013. Administrative Report No. 56. Bureau of Fisheries Management and Habitat Protection. 60 pp

Great Lakes Fishery Commission. 1997. A Joint Strategic Plan for Management of Great Lakes Fisheries (as revised in 1997).

PATHOGEN MONITORING ON GREAT LAKES BEACHES

Contact: Bob Masnado

Last updated: 7-2006

Status: Currently in Place; Temporarily Funded

This program was established in 2002 and is currently being funded under the Beaches Environmental Assessment and Coastal Health (BEACH) Act grant. The grant is guaranteed through the 2005 beach season.

Monitoring Objectives

The Beaches Environmental Assessment and Coastal Health (BEACH) Act, passed in October of 2000, authorized EPA to provide grants to States that have beaches bordering coastal or Great Lakes recreational waters for the purpose of developing a beach monitoring and public notification program. This effort is directed at Great Lakes coastal waters, namely Lake Michigan and Lake Superior. The purpose of this program is to monitor beaches along the Great Lakes in accordance with BEACH Act requirements, allow for prompt notification to the public whenever bacterial levels exceeds EPA's established standards, and investigate alternative methods for public notification. This information will be used to investigate long-term trends in water quality and to establish a beach monitoring and public notification plan that will assist communities along the lake shore to improve their ability to monitor and notify beach users of risks associated with high bacteria levels.

Clean Water Act objectives

- Monitoring and assessing coastal recreation waters to determine attainment of applicable water quality standards for pathogen indicators. (CWA section 304(a), Section 305(b))
- Prompt notification of the public of any exceedances or likelihood of exceedances of water quality standards for pathogen indicators. (CWA section 406)
- Establishing, reviewing, and revising water quality standards (CWA Section 303(c)).

Specific objectives

- Strengthening water quality standards for bathing beaches
- Improving state and local beach programs
- Providing better information regarding beach water quality to the public
- Promoting scientific research to better protect the health of beach users.

Monitoring Design

The Wisconsin Beach Monitoring Program was developed in accordance with EPA performance criteria. Adherence to the program performance criteria is required for all participants in the Wisconsin Beach Monitoring Program.

Lake Michigan and Lake Superior are coastal recreational waters designated in Wisconsin Administrative Code, Chapter NR 104 for swimming, recreational bathing and other contact water activities. Only beaches located along the Lake Michigan and Lake Superior shorelines were identified and evaluated. For the purpose of the BEACH Act, beach shall be defined as:

"A publicly owned shoreline or land area, not contained in a man-made structure, located on the shore of Lake Michigan or Lake Superior, that is used for swimming, recreational bathing or other water contact recreational activity."

173 public beaches along Lakes Michigan and Superior have been identified, and located via the use of global positioning system (GPS) and GIS technologies. A map identifying each beach was developed indicating the adjacent coastal recreation waters, beach location and any known potential sources of pollution. Each beach was evaluated to identify the potential risk of disease to swimmers and to classify the beaches accordingly. Beach waters that have a high potential for fecal contamination and/or have high usage are considered high priority. All beaches were evaluated using a standard evaluation form and classified as either High, Medium or Low priority based on the following factors:

- The nature and extent of the use
- The proximity to known point and non-point sources
- Any effects of storm events on the waters.

A tiered monitoring plan describing the monitoring requirements for *High*, *Medium* and *Low* priority beaches was developed. It addresses when basic sampling should be conducted, when additional samples should be collected and where and how to collect samples.

Table 4. Sampling design for high-priority Great Lakes beaches.

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<ul style="list-style-type: none"> • Begin sampling on or before Memorial Day Weekend and sample through Labor Day Weekend • Some contractors may sample 1 time per week until bather density increases with warmer temperatures • Sample at least 4 times per week during the swimming season 	<ul style="list-style-type: none"> • After heavy rainfall (generally ¼ to ½ inch depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of your beach</i></p> <ul style="list-style-type: none"> • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach 	<ul style="list-style-type: none"> • Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water • Other as you feel is necessary for your beach (<i>e.g., surface of water, waist depth, sediment</i>)

Table 5. Sampling design for medium-priority Great Lakes beaches.

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<ul style="list-style-type: none"> • Begin sampling on or before Memorial Day Weekend and sample through Labor Day Weekend • Some contractors may sample 1 time per week until bather density increases with warmer temperatures • Sample at least 2 times per week during the swimming season 	<ul style="list-style-type: none"> • After heavy rainfall (generally ¼ to ½ inch depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of your beach</i></p> <ul style="list-style-type: none"> • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach 	<ul style="list-style-type: none"> • Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water

Table 6. Sampling design for low-priority Great Lakes beaches.

Basic Sampling	Additional Sampling	Where to Sample	Depth to Sample
<ul style="list-style-type: none"> Begin sampling on or before Memorial Day Weekend and sample through Labor Day Weekend Sampling at low priority beaches should occur at least one time per week 	<ul style="list-style-type: none"> After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) Immediately following the exceedance of the water quality standards 	<p><i>Depends on characteristics of your beach</i></p> <ul style="list-style-type: none"> Middle of typical bathing area 	<ul style="list-style-type: none"> Knee depth Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water

Core and Supplemental Water Quality Indicators

The “Advisory” standard of 235 CFU/100mL (*E. coli* in water) was adopted for the beach program as a requirement of the BEACH Act and based upon data from three US EPA studies conducted in the late 1970s. These studies indicate that *E. coli* and/or Enterococci are the best bacterial indicators to assess the risk of acquiring a gastrointestinal illness as a result of using recreational waters. These levels are the original recommendation of US EPA and they were reaffirmed in a revisiting of the issue in 2002. Additional epidemiological studies are set to take place during the BEACH program and should be completed by 2008.

The epidemiological studies indicated that a level of 235 CFU of *E.coli*/100mL of recreational water is approximately equal to 8 cases of gastrointestinal illness per 1000 recreational water users. The “Closure” level of 1000 CFU *E.coli*/100mL was adopted by the WDNR based upon data from the studies mentioned above and represent a risk of approximately 14 cases of gastrointestinal illness per 1000 recreational water users.

EPA recommends the following criteria for *E. coli*:

- 235 cfu/100mL as a single sample maximum
- 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30-day period.

Quality Assurance

A number of quality control checks are required to ensure the quality of the data generated. All laboratory staff will adhere to current and generally accepted practices for safe handling, testing of samples, and chain of custody measures.

Precision

Precision of sampling methods will be estimated by taking two samples at the same sampling site at approximately 10 percent of the sites. The precision of laboratory analyses is estimated by analyzing two or more aliquots of the same water sample. This data quality indicator is obtained from two duplicate samples by calculating the relative percent difference (RPD) as follows:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

Where C_1 is the first of the two values and C_2 is the second value. Because of the heterogeneity of populations of bacteria in surface waters, an RPD of less than or equal to 50 percent between field duplicates for microbiological analyses might be considered acceptable. Analysts should be able to duplicate bacterial colony counts on the same membrane within 5 percent and the counts of other analysts within 10 percent; otherwise, procedures should be reviewed and corrective action implemented.

Accuracy

Because accuracy is the measurement of a parameter and comparison to a “truth” and the true values of environmental physicochemical and biological characteristic cannot be known, use of a surrogate is required. To estimate the densities of bacteria, use of samples prepared from known quantities of freeze-dried and cultured bacteria as a surrogate can result in 97.9 percent recovery of the bacteria from water samples. Based on the mTEC medium, bias was determined to be 2 percent of the true value. This information is helpful in establishing the most appropriate methods to be followed.

Representativeness

In the sample design, care is taken to determine if the area of sample collection is typical and representative of each area of concern. For lengthy beaches, if bathers are relatively evenly distributed along the beach area, samples will be spaced a maximum of 500 meters apart. For beaches where bathers are concentrated in one area, 1 sample will be taken where most of the swimmers congregate and then a sample shall be taken 15 meters on either side.

Data Management

The United States Geological Survey (USGS), in partnership with the City of Milwaukee Health Department, City of Racine Health Department, and the University of Wisconsin-Milwaukee Great Lakes WATER Institute developed the "Beach Health" website. This website is used as a tool to post real-time information about beach water quality at beaches in Milwaukee, Kenosha and Racine.

The Wisconsin Beach program expanded the current "Beach Health" website to include all the Great Lakes beaches that are monitored through this program. The website contains beach water quality data and real-time advisories for the general public as well as real-time environmental data for use by the scientific community. The site also contains links to pollution prevention information and project partners, as well as general pollution prevention information. Designed and maintained by the United States Geological Survey (USGS), the website delivers beach water quality and information from early May through September. All data collected from beaches along Lake Michigan and Lake Superior are stored in a database and can be queried by the public. The availability of the data and the website capabilities allow health professionals to share information used in assessing risk to the public and understanding trends in water quality, and enhancing regional pollution prevention efforts. The Beach Health website also includes links to local health department websites.

At all levels of government, the data will be collected by beach managers and/or designated "data stewards". Participating levels of government include municipalities, counties, and administrators of state properties such as the State Parks. The "data stewards" are responsible for coordinating the collection of monitoring data at all the beaches in their jurisdiction. The monitoring data are entered into an Oracle database housed at the U.S. Geological Survey in Middleton, Wisconsin. Data stewards or lab personnel enter results of monitoring data into password-protected online web forms.

Daily notification data comprised of the types of notification that are given for beaches on a daily basis (i.e., good or poor water quality conditions or open/closed beaches) is entered into the Oracle database using password-protected online webforms. The notification data are also stored in the Oracle database. Notification information is available to the general public on the website as soon as an advisory is posted (www.wibeaches.us). Reports of historical data are also available on the website.

BEACH data relevant to water quality standards work will be migrated to SWIMS in 2005-06.

Data Analysis/Assessment

To assure consistency in collecting samples for analysis, a standard sampling protocol was used for all Great Lakes beaches. Specific sites were designated for collecting samples during the bathing season. Samples were collected exclusively at these sites for the duration of the sampling period. Sample records, chain of custody records, and sample tracking records are reviewed to verify that all the samples collected were analyzed so the data set is complete. Data entries and analyses are also verified. Calculations are reviewed by rechecking the

computations, reviewing the assumptions used and checking the input data against the original sources to be sure transcription errors have not occurred.

Analytical tests are performed by state certified labs. Data are reviewed by WDNR staff to determine whether the established QC procedures are being used and how the program is operating. This Project identified specific assessment methods and procedures for collection, preservation, and storage of water samples.

Reporting

At the end of each beach season, notification data are submitted to USEPA in XML form. XML form is a file format that identifies each bit of data with "tags" like the tags HTML uses to make some text bold, make other text red, etc. The USEPA has defined tags for the beach notification data. Data must be submitted in XML format so USEPA can load the data into its PRAWN database.

CDX is the Central Data exchange, which is a USEPA office that provides a single point of entry for incoming data into USEPA. Each state has to first register at the CDX website and then can start submitting data. Users can use CDX or email files to USEPA.

A data report will be submitted to the US EPA at the end of the beach season, by the end of September. Local governments will submit status reports to the WDNR throughout the beach season on a monthly basis. The State Coordinator will be responsible for submitting a final report to EPA at the end of each beach season.

Programmatic Evaluation

The effectiveness of the monitoring program is assessed annually through the use of surveys, annual meetings with beach program participants and performance evaluations.

General Support and Infrastructure Planning

Currently, approximately \$350,000 is required to fully implement the Great Lakes beach monitoring program. BEACH Act funding made available for Great Lakes beaches averaged \$225,000 each year and is only guaranteed through 2005. Additional grants were made available for the 2006 season and may possibly continue. This amount falls short by \$125,000 each year. If the grant allocations from EPA remain the same for the 2005 beach season, money will not be available for a LTE to assist in the coordination of the program. Management and assessment of this program requires the work of, at a minimum, one full time employee. If the program continues beyond 2005, consideration must be given to employing a full-time staff or LTE to manage the beach program.

Some local groups are currently submitting beach pathogen data. For future monitoring, WDNR would like to develop a program for collection of data by local public health officials and volunteer groups, following WDNR methodologies.

References

USEPA, 2002. Implementation Guidance for Ambient Water Quality Criteria for Bacteria. U.S. Environmental Protection Agency. EPA-823-B-02-003. May 2002 Draft.

USEPA, 1986. Ambient Water Quality Criteria for Bacteria—1986. U.S. Environmental Protection Agency. EPA-440/5-84-002.

USEPA. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. Environmental Protection Agency. EPA-600/1-84-004.

Cabelli, V. J. 1983. Health effects criteria for marine recreational waters. U. S. Environmental Protection Agency, Cincinnati, OH. EPA-600/1-80-031.