


Environmental Indicator Profile Sheet

	<p>Indicator Profile No. 6</p> <p>Human Health Criteria</p> <p>Category: Water Quality</p>	<p>Tools Used to Measure Indicator:</p> <ul style="list-style-type: none"> • Bacteria concentrations • Shellfish Bed Closures • Fishing Restrictions • Beach Closures
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Description:

Bacteria (usually fecal coliform, *Escherichia coli*, or *enterococci*) are often used as indicators of human pathogens in the water column. Large bacterial concentrations are assumed to be indicative of harmful levels of pathogens. Pathogens are of special concern in shellfish harvesting and recreational contact waters. Water quality criteria for these uses are among the strictest of all water use classifications.

Contact recreation such as water-skiing and swimming potentially expose humans to harmful pathogens; when bacterial levels exceed established standards, beaches may be closed. Since shellfish are filter feeders, they tend to accumulate pathogens in their tissues. When bacteria concentrations exceed the acceptable standard, it is assumed that shellfish taken from the area are unfit for human consumption. Consequently, the shellfish beds are closed to recreational and commercial harvesting.

Because bacteria concentrations tend to sharply increase following storm events, it is strongly suspected that stormwater runoff contributes significantly to elevated bacteria levels. A change in the frequency of shellfish bed closures or beach restrictions, therefore, can provide an early indication of degradation and may be used to assess the effectiveness of stormwater management programs.

Increases in fishing restrictions may also indicate degradation due to urban runoff. Similar to shellfish, fish tend to accumulate pathogens in their tissue. It should be noted that not all fishing restrictions are due to elevated bacterial concentrations. Restrictions may also be implemented in response to high toxic metal, or other pollutant concentrations.

Utility of Indicator to Assess Stormwater Impacts:

- The tendency for many shellfish beds to be closed immediately following a storm event suggests that it can be used as an indicator of short term stormwater impacts.
- Consistent, long-term shellfish bed closures and beach restrictions can be used to detect early stages of water quality degradation.
- Can be used to assess the relative effectiveness of stormwater BMPs or watershed restoration efforts.
- Can be used as a motivational tool for initiating public support for stormwater management efforts.

Indicator Useful for Assessing:

- * Aquatic Integrity of:
 - Lakes
 - Streams
 - Estuaries
- * Land Use Impacts
- * Stormwater Mgmt Programs
- * Whole Watershed Quality
- * Industrial Sites
- * Municipal Programs

Key:

- Very Useful
- Mod. Useful
- Not Useful

Indicator Advantages

- * Geographic Range
- * Baseline Control
- * Reliable
- * Accuracy
- * Low cost
- * Repeatable
- * All Watershed Scale
- * Familiar to Practitioners
- * Easy to use & Low training

Key

- Very Advantageous
- Mod. Advantageous
- Not Advantageous

Cost

See Table 3.3A

Advantages of Method:

- Provides an early indication of water quality degradation and allows managers to address the problem before it becomes substantial.
- Since no shellfish may be harvested near areas with wastewater treatment plants, bed closures located away from such areas are more likely to indicate problems resulting from stormwater runoff.
- Long-term data is usually available for trend determination.
- The public is generally knowledgeable about this issue; consequently, this indicator may generate public pressure on officials to initiate cleanup efforts.
- Beach closures and shellfish bed closures impact the local economy which increases the likelihood that government officials and the business community will support pollution reduction efforts.

Disadvantages of Method:

- Many of the bacterial species used in human health criteria are common in soil, in other warm-blooded animals, and on the surface of plants, making it difficult to ascertain whether water quality problems are human-induced.
- There is some debate about which bacteria best correlates with presence of human pathogens.
- There are several anthropogenic sources of indicator bacteria (e.g. industrial wastewater, septic systems, agricultural and stormwater runoff), making it somewhat difficult to determine which specific source or sources require management measures.
- Application is limited only to areas where bacteria is regularly monitored, usually shellfish harvesting areas and recreational waters.
- Coliform dies off rapidly when introduced to surface waters and high concentrations can return to normal levels in a matter of days. This makes it difficult to determine whether stormwater runoff causes a chronic water quality problem.
- Relatively little is known about the capability of stormwater BMP's to actually remove bacteria from urban runoff.

Case Study: Barber, R.; Ohrel, R.; Fowler, P.; Gilbert, G.

Why We Are Convinced That Traditional Strategies for Wastewater Management Are Not Working
Symposium Proceedings: Integrated Coastal Wastewater Management in North Carolina. 1994.

In the North Carolina coastal region from Cedar Island to the South Carolina border, there have been increases and decreases in the acreage of shellfish beds closed to harvesting during the period 1980-1992. A large net annual decrease in prohibited area occurred once (1983/1984) in the Cape Fear River and the New River. This decrease in prohibited area resulted from both improvements in and elimination of point source discharges. When Cape Fear River and New River areas are excluded from the analysis, the remaining coastal region is shown to have increases in prohibited areas which have been steady and small, but numerous and widespread. The pattern of steady, widespread, and small annual increases in prohibited area does not match the pattern of agricultural or forestry activities; instead, the observed pattern suggests that expanding coastal development, with its associated increase in land disturbance, drainage, and urban runoff, is responsible for the observed pattern of degradation.

North Carolina's anti-degradation policy that protects existing uses of public trust waters. The evidence of shellfish bed closures indicates that State procedures for permitting development adjacent to shellfish waters do not protect the existing uses in those waters; that is, the permit process consistently violates North Carolina's anti-degradation policy.

Method References:

- Closure trends: North Carolina Division of Health Services, Shellfish Sanitation Program. 1988. *An Overview of Shellfish Growing Areas Since 1980.*
- Bacterial measurements: American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1989. *Standard Methods for the Examination of Water and Wastewater, 17th ed.* American Public Health Association, Washington, D.C.
- Bacterial measurements: Water Environment Federation. 1992. *The Detection of Pathogens in Storm-Generated Flows.* Alexandria, Virginia.