

Swimming in the Great Lakes

The 5,500 miles of coastline along America's Great Lakes have begun to show signs of strain brought on by years of misuse and the gathering onslaught of climate change.¹ Historically, though residents of the region have embraced and loved the Great Lakes, we have not treated the lakes with the care that should be afforded to North America's most valuable freshwater resource. The world's largest freshwater ecosystem (representing one-fifth of the world's fresh surface water) provides drinking water for 30 million people as well as recreation and relief from the region's hot and humid summers. But the beaches of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin are perennial victims of overwhelmed and broken infrastructure that damages water quality. Exacerbating conditions even further are invasive species that have had devastating impacts on the Great Lakes food web.² These issues are not new. In 2010 and 2011, great strides have been made to address the problems that plague our inland seas, but we still find ourselves nibbling at the edges as challenges expand.

Gaps in knowledge about the various pollution sources hinder the creation of a comprehensive plan and public action agenda to improve beach and water quality in the Great Lakes Basin so as to fully protect public health and safety. Lake Erie, once the poster child for improved waters after the implementation of the Clean Water Act, is once again showing signs of utter collapse under a growing deluge of nutrient pollution that threatens to kill the lake, one of the continent's premier fisheries, once again.^{3,4} Today, increased runoff of dissolved phosphorus from farm fields and cities, continued dumping of pollution and hot water from wastewater treatment and power plants, and the invasion of quagga mussels and zebra mussels that concentrate nutrients in nearshore areas and at the lake bottom have conspired to cause thick carpets of toxic blue-green algae to cover portions of Lake Erie every summer.^{5,6,7,8}

While we do not know all the sources of contamination at Great Lakes beaches, we do know that aging and failing infrastructure throughout the region is probably the most prevalent factor. Gary, Indiana, for example, has discharged 6.8 billion gallons of raw and partially treated sewage into waterways flowing directly into Lake Michigan in the past three years, according to press accounts.⁹ This vexing issue is not a unique situation in the region and will require significant investment to fix.

The Chicago Climate Action Plan is instructive in setting forth what the region will be facing in the coming years and the actions necessary to prepare for it.¹⁰ For the report, researchers from the University of Illinois and Texas Tech University downscaled national climatic models to understand how changing climate patterns would affect Chicago. They concluded that the amount of annual precipitation would remain roughly the same but that storms would be shorter and more intense. Stormwater picks up contaminants—including fecal matter from all manner of sources—as it runs off hard surfaces. In areas with combined sewer systems, runoff is routed to sewage treatment plants, a practice intended to remove pollutants from stormwater before it is discharged. However, violent storms can outpace treatment plant capacity, resulting in the discharge of raw or partially treated sewage into rivers and lakes in what is called a CSO (combined sewer overflow). In Chicago, NRDC research has shown this to occur with as little as 1.5 inches of rain.¹¹ This limitation is not uncommon for the region—and that is bad for the Great Lakes, where much of that pollution can end up. A 2006 study estimated that 20 cities dump almost 25 billion gallons of untreated sewage into the Great Lakes each year through CSOs; this points to one obvious place to focus resources in order to reduce a significant pollution source impacting beach and water quality. The federal Clean Water Act not only requires communities to eliminate such sources but also provides federal funding to do so through the State Revolving Fund (SRF) program. Unfortunately, those federal dollars are highly competitive and will not adequately address the problem. The U.S. EPA estimates the eight states in the Great Lakes Basin will need to spend more than \$30 billion on drinking water and wastewater infrastructure upgrades, while the SRF is facing significant budget reductions. Funding gaps like this one have increased over time and go a long way toward explaining the grade of D consistently given by the American Society of Civil Engineers in its biannual *Report Card for America's Infrastructure* for both wastewater and drinking water infrastructure.¹²

A revolution in thinking about stormwater is slowly advancing in the nation and the Great Lakes region. Traditionally we have thought of stormwater as undesirable, something that had to be captured in sewer systems before being piped and pumped to wastewater treatment plants. Traditional, “gray” infrastructure—hard surfaces like rooftops, parking lots, and roads—causes stormwater to run into our limited sewer systems. Green infrastructure, on the other hand, embraces stormwater as a resource and uses natural systems to capture, hold, and even clean rainwater, limiting the negative impacts of storms. Vegetated green roofs and greenways use ecological principles and functions to promote environmentally and economically beneficial outcomes such as energy efficiency, clean water, and conservation. Specifically, the use of vegetation and restored open space helps reduce energy demand, break up heat islands, prevent water pollution and flooding from storm events, restore hydrological functions, and conserve and recharge water resources to better meet the challenges of droughts. It also prevents contaminated stormwater from fouling beaches. Green infrastructure offers a way to help relieve the burden on traditional infrastructure in an inexpensive and aesthetically pleasing way that also helps make our built infrastructure more resilient.

In Cleveland, regional water regulators recently inked a consent decree that will address the tangled mess of northwestern Ohio’s combined sewers, leaning heavily on green infrastructure tools to relieve the burden on the sewer system. The Milwaukee Metropolitan Sewerage District is attempting to eliminate its CSOs and sees green infrastructure as a critical part of the process. It has already taken significant action in buying and preserving land upstream to prevent stormwater runoff from even reaching Milwaukee, investing in green roofs and rain barrels, and educating residents. The City of Chicago has made significant investments in green infrastructure as well, taking the lead on green roofs and rolling out permeable paved alleyways. However, the regional wastewater utility, the Metropolitan Water Reclamation District, has fought this approach, instead relying on a 1972 plan to build a series of tunnels and reservoirs to protect the region from flooding and overflows. NRDC and its partners recently filed suit to force the district to clean up its infrastructure, and there are signs of a shift. For instance, the district’s board recently voted to begin disinfection of effluent discharged into the Chicago River. This is hugely important, since the river discharges billions of gallons of water into Lake Michigan during heavy storms when sluice gates and locks are opened to relieve pressure on the overburdened water system.

All of that pollution takes a toll on swimmers and recreators, and the issue has not gone unnoticed. In the past decade, increased attention to the health of swimmers in the region, along with the BEACH Act of 2000, has brought significant data to light on beach contamination. In 2010, 579 Great Lakes beaches were monitored on at least a weekly basis. But inconsistencies in data-gathering practices and timing continue to make beach warning data less than ideal for protecting public health. Some beaches are monitored daily, while others are monitored weekly or less frequently. In part, these inconsistencies appear to be the result of inadequate funding and staffing. Like monitoring, public notification of beach quality and safety is critical to protecting public health. Here too, practices in the Great Lakes region are inconsistent both within and across states. States differ not only in the information they use to make beach closing and advisory decisions, but also in how they convey this information to the public. While some states issue both advisories and closings, others issue only closings or only advisories.

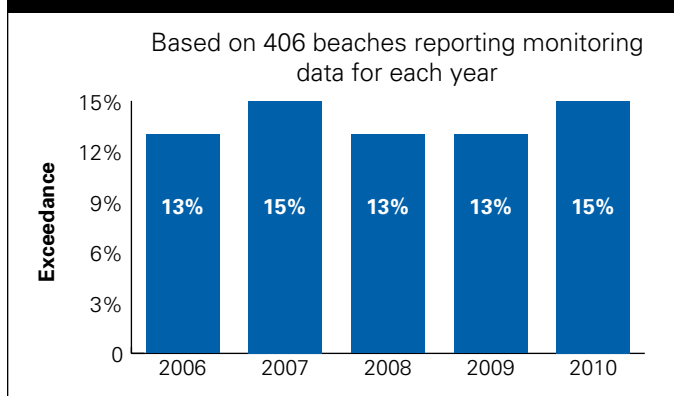
Beach officials in Great Lakes states are required to use traditional culture-based test methods to quantify bacterial indicator levels in beach water samples. These tests take about 24 hours, so when standards are exceeded and warnings issued, officials are essentially telling people a day late that they should not have used particular beaches. For some beaches, water quality can be fairly accurately assessed on the basis of physical measurements such as rainfall levels, wind speed and direction, tides, wave heights, and currents. These models allow beaches to be closed or placed under advisory the day that bacterial levels are expected to be high, rather than 24 hours later when sample results are available. Studies suggest that closings and advisories based on this predictive approach better protect public health than do those based on day-old monitoring results.¹³ Several Great Lakes states have created beach water quality computer models that rely on data from physical measurements. States using computer models to inform closing and advisory decisions for at least some of their Great Lakes beaches in 2010 included Illinois, Indiana, New York, Ohio, and Wisconsin. The only other state that uses a predictive model for closing and advisory decisions at some of its beaches is California. These models need to be tailored to the unique conditions at each beach and thus require significant research and development time.

Many of the Great Lakes states have also participated in pilot projects to research rapid test methods for quantifying indicator bacteria levels and the link between these levels and illness rates in swimmers. Michigan and Ohio participated in the EPA’s National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Studies, which the EPA conducted as part of its requirement to develop more protective health standards for recreational beachwater.

Beachgoers were interviewed and water samples collected and analyzed for bacteria using several methods including rapid tests. Ohio and Wisconsin have conducted studies of rapid test methods in addition to the NEEAR studies.

NEEAR studies were conducted in 2003 at two Great Lakes beaches. At Indiana Dunes National Lakeshore on Lake Michigan in Indiana, it was found that those who had any contact with beach water were twice as likely (10%) to have gastrointestinal illness as those who had no contact (5%). The risk of gastrointestinal illness was as high as 14% at a beach located on Lake Erie near Cleveland. The presence of the indicator organism enterococcus was associated with the increased risk. The study concluded that rapid measurement of enterococcus could predict gastrointestinal illness occurring as a result of swimming in fecally contaminated freshwater and that samples collected each morning could allow beach managers to assess the microbiological safety of the beach before most beachgoers were exposed.¹⁴

Figure 2-1: Percent of Samples Exceeding *E. coli* Standard for Great Lakes States Combined, 2006–2010



Bacteria in Great Lakes Beachwater

NRDC conducted a comparative analysis of water quality at beaches along the U.S. Great Lakes shoreline using publicly available monitoring data from all eight Great Lakes states. Fifteen percent of all beachwater samples collected in 2010 exceeded the BEACH Act's single-sample maximum *E. coli* standard for designated freshwater beaches (235 cfu/100 ml). Levels above the standard indicate the presence of human or animal waste in the water that could make swimmers sick. Over the five-year period during which NRDC has conducted this analysis of Great Lakes beaches, 13% to 15% of samples at the 406 beaches that reported monitoring data for each year had levels of *E. coli*

contamination exceeding the standard, a figure well above the national average (see Figure 2-1: Percent of Samples Exceeding *E. coli* Standard for Great Lakes States Combined, 2006–2010).

Table 2-1: Great Lakes Beaches with Frequent Exceedances of the National Standard

State	County	Beach	Tier	Monitoring Frequency	Total Samples	Exceedance Rate
MI	Muskegon	Meinert County Park	1	1/wk	21	81%
MI	Marquette	Marquette South Beach	1	3/wk	33	76%
IN	Lake	Jeorse Park Beach I	2	5/wk	75	75%
MI	Macomb	St. Clair Shores Blossom Heath Beach	1	2/wk	129	67%
IN	Lake	Jeorse Park Beach II	2	5/wk	75	67%
NY	Niagara	Krull Park	2	1/wk	25	64%
OH	Erie	Edson Creek	1	4/wk	55	64%
IL	Cook	Winnetka Elder Park Beach	1	daily	72	61%
WI	Milwaukee	South Shore Beach	1	4/wk	54	59%
MI	Alpena	Blair Street Park	1	1/wk	16	56%
NY	Wayne	Pultneyville Mariners Beach	3	1/wk	18	56%
WI	Douglas	Wisconsin Point Beach 2	3	1/wk	29	52%

Great Lakes Beach Closings/Advisories and Pollution Sources

- During 2010, U.S. Great Lakes beaches had 3,766 days of closings and advisories and 6 extended (361 days total) and 1 permanent (110 days total) closings and advisories. Extended events are those in effect more than six weeks but not more than 13 consecutive weeks; permanent events are in effect for more than 13 consecutive weeks. Including extended days, the total comes to 4,137 beach closing and advisory days.
- The number of beach closing and advisory days increased 14% from 3,300 in 2009.
- The continued high level of closings/advisories is an indication that serious water pollution persists at our nation's Great Lakes beaches. Eighty-four percent of the 2010 beach closing and advisory days (3,176 days, 165 more than in 2009) were issued because of bacteria levels that exceeded health and safety standards.

Besides high bacteria levels, other reasons for beach closings and advisories in 2010 included the following:

- 7% (276 days) were precautionary due to stormwater runoff, a known source of pollution in some swimming waters.
- 4% (135 days) were issued in response to known pollution events, such as sewage treatment plant failure or breaks in sewage pipes.
- 3% (106 days) were due to other, unspecified causes.
- 1% (33 days) were preemptive due to real-time computer modeling that uses readily measurable physical parameters such as wind speed and wave height to predict indicator bacterial levels.

Major pollution sources listed as responsible for 2010 beach closings and advisories included the following:

- Unknown sources of pollution caused 3,143 closing/advisory days (83% of this year's total), compared with 2,444 days in 2009, 3,015 days in 2008, and 1,994 days in 2007.
- Polluted runoff and stormwater caused or contributed to 351 closing/advisory days (9% of this year's total), compared with 588 days in 2009, 550 days in 2008, and 914 days in 2007.
- Sewage spills and overflows caused or contributed to 64 closing/advisory days (2% of this year's total), compared with 122 days in 2009, 16 days in 2008, and 44 days in 2007.
- Elevated bacteria levels from miscellaneous sources (wildlife, boat discharges, etc.) accounted for 208 closing/advisory days (6% of this year's total), compared with 156 days in 2009, 134 days in 2008, and 91 days in 2007.

Bacterial Standards

Seven of the eight Great Lakes states use the BEACH Act single-sample standard to inform beach closing/advisory decisions. This standard is 235 cfu/100 ml of *E. coli*. Michigan's single-sample standard is 300 cfu/100 ml of *E. coli*.

Two of the Great Lakes states use a geometric-mean standard based on at least five samples over a 30-day period to inform beach closing/advisory decisions. Minnesota applies the BEACH Act geometric-mean standard of 126 cfu/100 ml, and Michigan applies a geometric-mean standard of 130 cfu/100 ml. Illinois, Indiana, Ohio, Pennsylvania, and Wisconsin do not apply the geometric-mean standard when making closing and advisory decisions. In New York, local beach authorities decide whether to apply the geometric mean when making closing and advisory decisions.

Threats to the Health of Great Lakes Swimmers and the Ecosystem

Pathogens in beachwater contaminated with sewage and fecal matter can cause a wide range of diseases that threaten human health, including gastroenteritis, dysentery, hepatitis, respiratory illness, and ear, nose, and throat problems. The consequences of these swimming-associated illnesses can be greater for children, elderly people, pregnant women, cancer patients, and others with weakened immune systems. And these pathogens may be persisting longer in the Great Lakes region due to conditions being established by large populations of invasive species.¹⁵

There is growing evidence that broad changes in the freshwater environment of the Great Lakes brought about by invasive species are promoting conditions that nurture bacteria, including *E. coli*.¹⁶ Healthy lakes are often murky, but feeding by quagga mussels has eliminated as much as 20% of Lake Erie's phytoplankton in less than 15 years.¹⁷ The elimination of those and other microorganisms has literally cleared the waters. Although that sounds good, it has allowed sunlight to penetrate to the bottom of the lakes, encouraging aquatic plant growth on formerly barren lake beds. In Lake Michigan, that is increasingly coming in the form of cladophora, a green algae that accumulates near shorelines. A link between cladophora mats and exceedances of recreational water quality criteria has been suggested, and studies show increased *E. coli* concentrations under and near these mats.^{18,19} A growing number of beaches have been impacted by algae mucking, when the mats disengage from the lake bottom and wash up on shore in foul-smelling mounds.

Recent studies have shown continued rapid growth in the quagga mussel population in the Great Lakes; it is estimated that they now number nearly a quadrillion.^{20,21,22} As dire as the situation looks, it could be made worse if another infamous invader, Asian carp, gains access to the Great Lakes from waterways in and around Chicago. Like the mussels, silver and bighead carp are tireless filter feeders that would continue the process of clarifying lake water, hastening an ecosystem collapse. Recent studies suggest that the carp may also be able to take advantage of cladaophora, establishing themselves in Lake Michigan before colonizing the other lakes.²³

On the positive side, the well-publicized advance of Asian carp has helped to make the public more aware of invasive species threats to the region. Significant resources and energy are being directed to address the sources of invasive species, though NRDC and other Great Lakes advocates remain concerned that the battle against Asian carp is moving too slowly to head off their advance. Still, there is good news on this front too. NRDC helped to broker a legal settlement that will require the EPA to set new national limits on invasive species in ship ballast that should help to eliminate one of the biggest sources of invasive species: water dumped from freighters moving between the lakes and coming from ocean ports.²⁴ The settlement should prompt the EPA to treat this "living pollution" as aggressively as it would an oil spill or toxic release and set protective limits on biological discharges to help prevent future species invasions.

The Aquatic Nuisance Species (ANS) Task Force estimates that the 15 most recent introductions of these invaders could cost the United States \$134 billion by 2050.²⁵ The cost of damages caused by zebra mussels alone to the Great Lakes regional economy could be as much as \$4.9 billion per year.²⁶ Far more costly are the potential threats to the Great Lakes themselves.

Economic Effects

The Great Lakes are a massive tourism engine for the region. For example, Lake Erie is said to generate \$9 billion in tourism revenue annually and support jobs for nearly 150,000 workers in Ohio alone.^{27,28}

Beaches are the top vacation destination in the country. And coastal tourism, dependent in part on clean waters, generates substantial revenues for state and local governments. Studies on the impact of beach closures vary greatly. One study estimated that economic losses resulting from the closure of a Lake Michigan beach due to pollution could be as high as \$37,000 per day. The study also anticipated additional economic losses from polluted waters due to swimming-related illnesses and from beachgoers' lost use of the beach.²⁹ Another study, by researchers at the University of Chicago, estimated that swim bans at Chicago beaches cost the local economy more than \$2 million a year.³⁰ Yet another posited that the closure of all Lake Michigan beaches would result in a loss of nearly \$1 billion.³¹

Boating is a significant source of economic revenue for the Great Lakes. Nearly one-third of the nation's boats are registered in the Great Lakes region. In 2003, boating on the lakes generated direct revenue of \$16 billion and supported 107,000 jobs. Indirect revenue from boating-related industries such as manufacturing, marinas, charter operations, restaurants, lodging, and other businesses located near docking facilities increased the total number of jobs to 244,000 and

revenue to \$19 billion.³² Beach-related products, such as swimsuits, sunscreen, beach chairs, towels, boogie boards, and surfboards, generate hundreds of millions, if not billions, of dollars each year in sales. Sunscreens alone earn manufacturers revenues of about \$640 million a year.³³

Recommendations for Great Lakes Communities

- The EPA's recent municipal guidance emphasizing the value of using green infrastructure tools to augment and replace gray infrastructure should be heeded by governments throughout the Great Lakes basin.
- The EPA and the states must develop numeric nutrient standards for bodies of water, like Lake Erie, that are overwhelmed by nitrogen and phosphorus pollution that causes low-oxygen "dead zones" and toxic algal blooms. Creating these standards establishes an important baseline against which reductions in nutrient pollution from farm fertilizer runoff, urban stormwater, and wastewater dumping can be measured.
- The imminent invasion of Asian carp requires swift and coordinated action from an array of engaged authorities. NRDC has long advocated for a physical separation of the Great Lakes Basin and Mississippi River system in the Chicago-area waterways that connect the two great ecosystems. While further study may be necessary, the current decade-plus timeline set by the Army Corps of Engineers is inadequate to rebuff the invasion. Additionally, tools currently in use are focused on the carp and will not help prevent the next major species invasion. The influx in resources to address the carp invasion must also address the long-term threat of invasive species queued up to move between ecosystems on both sides of the Corps's current ineffective electric barrier. A more effective solution needs to be fast-tracked to end this vector for invasive species movement once and for all. The Stop Asian Carp Act of 2011, introduced by Sen. Debbie Stabenow and Rep. Dave Camp and sponsored by Sen. Dick Durbin, will help to jump-start the development of real long-term solutions.
- Full funding of Great Lakes restoration and collaboration initiatives will allow the EPA to continue to support research and habitat restoration in the region to help stem the impacts of invasive species. The Great Lakes Restoration Initiative funds programs that support beach monitoring, CSO improvements, and green infrastructure.
- Residents throughout the Great Lakes region have a critical role to play: adding water efficiency and green infrastructure features to their homes and workplaces. Installing rain gardens and rain barrels captures water where it falls, reducing the amount of flow to sewer systems. Planting trees and native plants, participating in beach cleanups, and practicing simple water conservation techniques—such as turning off the water while brushing one's teeth—all have significant impacts on the local water footprint and help avoid polluting our lakes and beaches.
- The EPA is expected to update the requirements that apply to long-term runoff from developed sites by proposing a rule in September 2011. The EPA should take full advantage of this once-in-a-generation opportunity by adopting new objective performance requirements to control runoff volume from new and redeveloped sites, which will create strong incentives for the deployment of green infrastructure approaches. The EPA should also require retrofits in already existing public and private developed areas and as part of infrastructure reconstruction projects. Likewise, the agency needs to ensure that significant runoff sources are covered.

NOTES

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