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Lake Erie Lakewide Management Plan (LaMP) Technical Report Series

Degradation of Aesthetics

Prepared for the Lake Erie LaMP
Preliminary Beneficial Use Impairment Assessment

Lauren Lambert
August 28, 1997

Lake Erie LaMP Technical Report No. 15

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NOTE TO THE READER:

This technical report was prepared as one component of Stage 1, or "Problem Definition," for the Lake Erie LaMP. This report provides detailed technical and background information that provides the basis for the impairment conclusions recorded in the Lake Erie LaMP *Status Report*.

This document has been extensively reviewed by the government agencies that are partnering to produce the LaMP, outside experts, and the Lake Erie LaMP Public Forum, a group of approximately of 80 citizen volunteers. This review was designed to answer two questions:

- Is the document technically sound and defensible?
- Do the reviewers agree with the document conclusions and format?

In its present form, this report has been revised to address the comments received during that review process, and there is consensus agreement with the impairment conclusions presented.

15.1 **Listing Criteria**

According to the International Joint Commission (IJC), an aesthetic impairment occurs when any **substance in water** produces a **persistent** objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum) (emphasis added, IJC, 1989).

As a result of the Lake Erie LaMP process the IJC listing criteria have been adopted for evaluating aesthetic impairments in Lake Erie, with the following additions:

> Whether an aesthetic problem is "naturally" occurring versus "man-made" does not affect its potential designation as an impairment.
>
> The fact that there is currently no known solution to an aesthetic problem does not affect its potential designation as an impairment.

15.2 **Scope of the Assessment**

The geographic scope of the Lake Erie LaMP beneficial use impairment assessment (BUIA) includes open lake waters, nearshore areas, river mouths and embayments, and the lake effect zone of Lake Erie tributaries. The lake effect zone is defined as that zone where the waters of the lake and the tributary river are mixed. When aesthetic impairments are mentioned in this summary in relation to Lake Erie Areas of Concern (AOCs), these impairments are occurring in the lake effect zone of the AOC.

The presence of native species (such as Canada Geese, Ring-billed Gulls, and Cormorants) can conflict with human use of the lake in certain situations. The issue of overabundant native wildlife species and the interference of large quantities of living aquatic plants with recreational boating are perceived by some as aesthetic problems. For the reasons listed below, they do not meet the listing criteria for an aesthetic impairment and are therefore outside the scope of the Beneficial Use Impairment Assessment.

> Over abundant native wildlife species are not "substances" in water. In addition, the perceived "nuisances" these species create to human use are not limited to aesthetic considerations.
>
> Similarly, large quantities of **rooted** aquatic plants are not "substances", and, in fact, provide valuable habitat for certain aquatic organisms. However, the **uprooting** of large quantities of aquatic plants can cause persistent, water-based, objectionable deposits by washing up on beaches and this problem has been included in the impairment assessment.

Although the issues of overabundant native wildlife species and rooted aquatic plants do

not meet the beneficial use impairment listing criteria, they are nevertheless viewed as problems that need to be addressed in Lake Erie. Therefore, these issues will be included in a list for consideration by the LaMP process, so that they are not lost, simply because they do not fit within the scope of the beneficial use impairment assessment.

15.3 **Status**

The purpose of this summary is to: a) outline all known instances of aesthetics problems in Lake Erie waters, b) evaluate the nature of these problems, where possible, and c) to distinguish between aesthetic impairments to use of Lake Erie, as defined by the IJC listing criteria, and other aesthetic issues of concern that do not meet the listing criteria. To date, the Lake Erie LaMP process has identified the following list of potential aesthetic problems.

A. High Turbidity
B. Obnoxious Odor
C. Excessive *Cladophora*
D. Excessive Blue-green Algae
E. Nuisance Conditions at Public Beaches/ Lake Shoreline
    1. Excessive aquatic plants washing up onto beaches and shorelines.
    2. Excessive algae fouling the shoreline (covered under excessive *Cladophora* and obnoxious odors, above)
    3. Large numbers of zebra mussel shells cutting people's feet/odors due to decay.
F. Floating garbage/debris
G. Dead Fish

With the exception of beneficial use impairment assessments already completed for Lake Erie AOCs, Lake Erie aesthetic problems have not previously been evaluated collectively. In most cases the locations, frequency, duration, and magnitude of any identified aesthetic problems or impairments have not been regularly tracked through any formal monitoring program. In addition, there is no precise/common definition for a "persistent objectionable deposit." Therefore, detailed information is largely anecdotal and inherently subjective. The information that does exist is outlined below.

15.3.1 **High Turbidity**

Turbidity, or muddy/cloudy water, has been identified as an impairment in the Maumee, Black, Cuyahoga (navigation channel), and Rouge River AOCs (Black River RAP, 1994; Cuyahoga River RAP, 1992; Rouge River RAP, 1994; Maumee River RAP, 1995). Turbidity is a persistent problem in the Black River mainstem and nearshore area and the navigation channel of the Cuyahoga River. In the Black River AOC, "the cloudy

appearance of [the] water column due to continual clay particle suspension [is] of special concern" (Black River RAP, 1994).

Turbidity is a periodic problem in the nearshore area of the Cuyahoga AOC and the river mouth/nearshore areas of all other major Ohio and New York Lake Erie tributaries. Increased turbidity is evident after high flows and wet weather conditions. Nearshore areas are particularly affected by storms stirring up bottom sediments, sediments carried by the tributary river, and storm sewer discharges (Cuyahoga River RAP, 1992; ODNR, 1995; Draper, 1995).

In summary, high turbidity is causing an impairment, due to its persistence, in the Maumee, Black, Cuyahoga and Rouge River AOCs. In other areas where turbidity has been noted, it is not persistent, and is therefore not considered an impairment using the IJC listing criteria.

15.3.2 **Obnoxious Odors**

Oil and grease, raw sewage from combined sewer overflows and/or failing septic systems, and excessive decaying algae and zebra mussels are known to cause objectionable odors in and around surface waters in the Lake Erie basin. In addition to potential odor problems, CSO discharges can also cause problems due to the resulting floating garbage and debris. This issue is discussed in more detail in the floating garbage and debris section of this assessment.

In areas where oil and grease and raw sewage odors have been noted, they are not persistent, and are therefore not considered impairments. Oil and grease are mentioned as an aesthetic problem in the Black, Rouge and Detroit River AOCs (Black River RAP, 1994; Rouge River RAP, 1994; Detroit River RAP, 1991). In the Black River AOC oil and grease loadings are of low concern because, problems are limited to very localized areas and are limited in magnitude. Problems are not persistent in the Detroit River AOC due to the high flow of the river. Combined sewer overflows are causing periodic odor problems in two central basin locations, Edgewater Beach in Cleveland and in the nearshore area between Geneva and Ashtabula (ODNR, 1995).

Persistent, seasonal, problems with obnoxious odors due to fish die-offs and decaying algae have been identified in Lake Erie waters. These odors have interfered with human recreational use of Lake Erie waters. Decaying algae odors are addressed below and in the "Eutrophication and Undesirable Algae" assessment report. Odor problems associated with decaying zebra mussels and fish die-offs are addressed below.

15.3.3 ***Cladophora***

Cladophora is a filamentous alga that requires both a hard substrate and at least periodic

submersion by water. *Cladophora* flourishes in areas of high nutrient concentrations and significant quantities are an indicator of eutrophication. The growth of *Cladophora* in the littoral zone does not necessarily indicate that there is a nuisance algal problem. It is the die-back and sloughing of *Cladophora* in early to mid- summer and the subsequent accumulation and rotting of *Cladophora* around the lake perimeter that is the primary factor associated with an aesthetic use impairment. Current and wave actions can dislodge and deposit large quantities of these attached algae onto the shoreline resulting in aesthetic nuisance accumulations and obnoxious odors from decay (Bolsenga and Herdendorf, 1993; L'Italien, 1996).

In 1995, the Ontario Ministry of Environment and Energy surveyed 16 areas between Fort Erie and Port Dover to determine *Cladophora* abundance. *Cladophora* fouling was observed in 4 of the 16 areas surveyed (west of the Grand River mouth, Featherstone Point, east of Sandusk Creek, and Peacock Point east of Nanticoke) (OMEE, 1995). Because this survey was only conducted once, it is not known whether the *Cladophora* fouling is persistent in these four areas (see Section 9.5.3, Shoreline *Cladophora* Surveys, of the Eutrophication or Undesirable Algae component of the Beneficial Use Impairment Report, for more details).

Specific details are summarized in Table 15.1 below.

Table 15.1: Median thickness and percentage cover of *Cladophora* over the 0.5 to 1.5 m depth on rocky substratum in eastern Ontario Waters of Lake Erie, July 1995 (OMEE, 1995).

Survey Area	Median Thickness (cm)	Percent Cover (%)
Bertie Bay (n=18)	5.4 (4-8)	89 (50-100)
Windmill Point (n=10)	7.7 (6-11)	98 (90-100)
Whiteman's Point (n=10)	4.4 (2-7)	92 (60-100)
Sugar Loaf Point (n=10)	6.5 (6-7)	98 (80-100)
Raton Point (n=10)	9.7 (7-11)	91 (70-100)
Morgan's Point (n=10)	8.0 (6-10)	96 (60-100)
Mohawk Point (n=9)	10.9 (6-15)	94 (80-100)
Rock Point (n=10)	5.4 (4-7)	60 (20-90)
Spatt's Bay (Grand R.) (n=6)	20 (10-28)	100
Grant Point (n=10)	13.4 (8-17)	94 (40-100)

Survey Area	Median Thickness (cm)	Percent Cover (%)
West of Low Point (n=10)	7.4 (4-12)	91 (40-100)
Featherstone Point (n=10)	18.0 (16-20)	100
Sandusk Creek Mouth (n=10)	10.8 (7-17)	98 (90-100)
Peacock Point (n=3)	10.3 (8-13)	100
Nanticoke (n=10)	7.6 (5-10)	76 (50-100)
Port Dover (n=10)	5.8 (4-7)	94 (60-100)

Median thickness = median height of the top of *Cladophora* lawn. N=number of 0.25 m^{-2} quadrants surveyed. The values in parentheses give the range of values.

In addition to the four eastern basin locations mentioned above, the Norfolk-Haldimand Public Health District in Ontario receives complaints from recreational users about *Cladophora* fouling all along the eastern basin shoreline in Ontario. The rotting Cladophora causes an obnoxious odor at public beaches and elsewhere along the shoreline and is a source of taste and odor problems in drinking water (Steen, 1996).

Another identified nuisance problem with *Cladophora* growth in Ontario eastern basin waters is the fouling of fishing nets. The *Cladophora* is very difficult to remove from the fishing gear (Ryan, 1995). The fishing net fouling is not related to the seasonal die-off and sloughing of *Cladophora*, but rather to abundant *Cladophora* growth in the littoral zone.

In the central basin, persistent problems (July through September) with excessive *Cladophora* and shoreline fouling are occurring in Rondeau Bay, Ontario (Shepley, 1996).

Cladophora is commonly found along break walls and other suitable habitats in Wheatley Harbor and in many areas of Ontario western basin waters of Lake Erie. To date, no complaints have been formulated from area residents about excessive *Cladophora* accumulations on the shoreline (Wheatley Harbour RAP, 1995).

Based on information provided to date, there are no excessive *Cladophora* problems in the western basin of Lake Erie. Excessive *Cladophora* is a problem and may be causing interference with human recreational use in at least 4 locations in the eastern basin and one location in the central basin along the shoreline. A key issue with *Cladophora* fouling is the obnoxious odor associated with its decay along the shoreline (Steen, 1996).

With the exception of Rondeau Bay in Ontario, sources of information documenting persistent *Cladophora* fouling in problem areas are not available. Therefore, for the remaining areas where *Cladophora* growth has been noted, it is not possible to determine impairment or lack of impairment at the present time.

15.3.4 **Blue-green Algae (Cyanobacteria)**

Blue-green algae are a component of the phytoplankton and have the ability to adjust their buoyancy, floating or sinking depending on circumstances of light and nutrient supply. Blue-green algae can be responsible for algal blooms, which are dense growths of algae that can cover large portions of a lake's surface (Bolsenga and Herdendorf, 1993). Cyanobacteria water blooms are defined as the visible coloration of a water body due to the presence of suspended cells, filaments and/or colonies and in some cases subsequent surface scums (surface accumulations of cells resembling clotted mats of paint-like slicks).

In northern latitudes like North America waters supporting cyanobacteria growth have a sequence of algal dominance, generally being diatoms in the spring, then green algae followed by cyanobacteria in the summer and often into the autumn. It is generally agreed among aquatic microbiologists and limnologists who study water bloom formation that: 1) nutrient loading, 2) retention time of water within the water body, 3) stratification, and 4) temperature, are the main factors influencing bloom formation and intensity. Stratification tends to induce rapid dominance by buoyant populations of cyanobacteria if conditions of nutrient availability also exist. Thus the low wind days of summer and fall lead to unhindered thermal stratification and buoyancy regulation (Carmichael, 1992).

From an aesthetics standpoint, *Microcystis* affects the color of the water. A *Microcystis* bloom was described by one source as a "thick slick of grass-green paint" (Henry, 1995). *Microcystis*, (tentatively identified as sp. *aeruginosa*) a genus of unicellular blue-green algae, was found in mid-August 1995 floating on water near Rattlesnake Island, two miles west of Put-in-Bay. The colony bloomed and by mid-September peaked, covering much of the western basin. The bloom has reoccurred in the western basin in 1996. Although *Microcystis* blooms appeared in Lake Erie annually in the 1970s and early 1980s, researchers were not expecting a bloom to be present in Lake Erie today due to lower phosphorus concentrations and the presence of zebra mussels.

It should be emphasized that toxin forming cyanobacteria are all naturally occurring members of freshwater phytoplankton (Carmichael, 1992). However, *Microcystis* outcompetes other algae, and as it is rather inedible, it diverts energy from the food chain that would normally support zooplankton (Johannsson, 1995). The production of toxins by cyanobacteria, to inhibit grazing pressures by zooplankton, may be one of the main ecological roles for these compounds. Studies have shown that cyanobacteria may be inhibitory or toxic to diatoms, zooplankton, and crustaceans (Carmichael, 1992).

Besides the aesthetic impact on Lake Erie, there is also concern about *Microcystis'* tendency, under certain conditions to produce microcystin. Microcystin is a potent hepatic (liver) toxin. At elevated concentrations, microcystin is suspected to cause bird and fish kills as well as severe gastrointestinal problems in humans (Ohio Lake Erie Office,

1995). Because the *Microcystis* blooms occurred so recently and were not expected, it is not yet known if any aquatic organism mortality due to microcystins occurred in the western basin in 1995 or 1996. A research project, currently underway, will evaluate whether waterfowl deaths due to ingestion of microcystin occurred in 1995 and/or 1996 (Culver, 1996). More details about microcystin toxicity research can be found in section 2.2.4.4, "Ohio Contaminants Studies", in Chapter 2, Restrictions on Fish and Wildlife Consumption, of the Beneficial Use Impairment Assessment.

The appearance of *Microcystis* in western Lake Erie is an emerging issue and it is not yet known what caused the bloom in 1995. As of July 22, 1996, *Microcystis* blooms were again occurring in the western basin of Lake Erie (Nichols, 1996). By mid-September 1996 much of the *Microcystis* bloom has dissipated due to a tropical storm.

There is some speculation that 1995 bloom may have been related to the presence of zebra mussels. Due to the lack of current information related to the cause and potential ramifications of the 1995 bloom, the Ohio Lake Erie Commission is funding a research project that will investigate the scope, impact, and potential toxicity of *Microcystis* blooms in the western basin of Lake Erie. Specifically this project will:

> Monitor the occurrence of future blooms of *Microcystis* and other toxic algae.
>
> Determine the risks of toxicity from microcystins released into Lake Erie to all trophic levels, including wildlife species and humans.
>
> Assess the potential ecological impacts of *Microcystis* blooms to the Lake Erie ecosystem.
>
> Educate and alert users of Lake Erie and its water to potential health risks associated with blooms of *Microcystis* (Ohio Lake Erie Office, 1995).

In summary, the 1995 *Microcystis* bloom in western Lake Erie caused aesthetic problems in western basin Lake Erie waters. However, because: a) this is the first bloom in many years, and b) there is little to no information about the ecological impacts of the 1995 and 1996 blooms, it is not yet known whether this problem is significant enough to be considered an impairment. The above-mentioned research, which is currently underway, should provide data needed to re-evaluate this aspect of the impairment assessment.

15.3.5 **Nuisance Conditions at Public Beaches/Lake Shoreline**

Perceived nuisance conditions at beaches or along the shoreline include: 1) excessive aquatic plants washing up onto beaches/shorelines; 2) excessive aquatic plants interfering with boat props and fishing gear; 3) Excessive algae fouling the shoreline (covered under excessive *Cladophora* and obnoxious odors, above); 4) large numbers of zebra mussel

shells cutting people's feet and/or odors due to zebra mussel decay; and 5) over abundant native species such as Canada Geese and Ring-billed Gulls. For the reasons outlined in Section 12.2, "Scope of the Assessment" of this report, shoreline nuisances created by conflicts between human use and overabundant species of native waterfowl and rooted aquatic plants will not be addressed in this assessment.

This assessment **will** address the nuisance conditions created when large quantities of aquatic plants are **uprooted** and wash up on beaches. This has been a periodic problem along the Michigan shoreline of Lake Erie, at Edgewater Beach in Cleveland (4 to 6 times per year), and at Put-in-Bay and Catawba Island beaches (Sweet, 1995; Letterhos, 1995; ODNR, 1995; Shieldcastle, 1995). This has been less of a problem along the Michigan shoreline and at Edgewater Beach in 1995 than in past years.

Considerable anecdotal information regarding locations where large shoreline accumulations of zebra mussels/shells have been noted has been provided to the BUIASC. However, much of this information is not detailed enough to determine whether these zebra mussel accumulations are persistent in nature. In addition, opinions differ regarding whether the accumulated zebra mussels are objectionable to the point where they interfere with human use of the Lake Erie shoreline. This has made it difficult to make a definitive impairment determination.

It is clear that zebra mussels and their shells accumulate in large quantities along certain portions of the shoreline, particularly in the western basin. What is not clear is whether these accumulations persist, without some type of shoreline clean-up, to the extent that people are not using the shoreline area affected, either due to odor problems or shells cutting their feet. What is known, is summarized below.

Zebra mussel shells are abundant in the western basin, particularly at the Maumee Bay and Crane Creek State Park, Catawba Island, South Bass Island, and Cedar Point beaches, along certain portions of the Michigan Lake Erie shoreline, and in the central basin at Presque Isle Bay State Park Beach (Letterhos, 1995; ODNR, 1995; Rutkowski, 1995; Day, 1996). Large numbers of zebra mussel shells wash up onto the sand. In the case of Cedar Point, zebra mussels wash up onto the shoreline and accumulate in windrows. This is a problem not only in the beach area, but also along the private shoreline of the nearby residential area. In addition, large piles of decaying zebra mussels cause an odor nuisance (ODNR, 1995). Abundant zebra mussel shells on the beach are less of a problem at Maumee Bay where an influx of sand from the lake tends to bury the shells fairly quickly. According to park managers at both Crane Creek and Maumee Bay, routine beach cleaning is generally an effective remedy during the bathing season, removing many of the shells (ODNR, 1995).

Zebra mussel colonies on the bottom nearshore areas of both Crane Creek and Maumee Bay State Park beaches are also a growing problem, again because people step on the

shells. The problem has not yet become severe enough to require physical removal of the colonies. Periodic northeastern storms cover these colonies with sand, smothering the colonies. The dead zebra mussels then wash up onto shore where they can be removed by beach cleaning.

In the case of South Bass Island, one journalist states, "not far from the Perry Monument....[we] walked out onto a northeast-facing beach to look at what had to be the most remarkable dune in the world. Built by days of winds, perhaps 200 feet long and several feet high, the dune was made of millions upon millions of tiny brown-striped mollusk shells. I bent and dug down, a foot, then two feet, astonished at the number of shells, each about the size of a dried bean" (Luoma, 1996). At Presque Isle Bay State Park, Beach # 11 was closed for two days in June of 1994 due to abundant zebra mussels. The beach was cleaned and the problem has not reoccurred as of March 1996 (Bernoski, 1996).

For the Michigan shoreline, the BUIASC has received a few reports of large accumulations of zebra mussels, up to 2 feet deep, in certain areas. On the days these zebra mussels were observed, it did not appear that any clean-up was occurring or was planned (Day, 1996). However, the Michigan Health Department has not received any public complaints about zebra mussel accumulations along the Michigan shoreline (Sweet, 1996).

In summary, nuisance conditions related to aquatic plant deposits and zebra mussel shells are occurring. In the case of aquatic plants washing up on the beach, because no current problems have been reported, this issue is not considered an impairment. However, because zebra mussels are relatively new to Lake Erie and their filter feeding habitats have created conditions that are ideal for increased growth of aquatic plants, the significance of this problem may increase in the future. As a result, it is recommended that this problem be re-evaluated periodically.

As outlined above, zebra mussels and shells are accumulating in large numbers along certain stretches of the Lake Erie shoreline. Because detailed data is not available on persistence and impact on human use, it is not possible to say with certainty that impairment is occurring. However, based on anecdotal reports, it appears that impairment is likely occurring in certain locations because there is no entity officially responsible for removing the zebra mussels when they reach "objectionable" levels.

15.3.6 **Floating Garbage and Debris**

Lake Erie Shoreline

Floating debris and garbage is a problem for most beaches and river mouth areas along the Ohio Lake Erie shoreline. In many cases the debris is natural in origin (wood, cattails,

grass, etc.) and is deposited on beaches/shoreline areas in the early spring as a result of high flows from tributary river mouths. In some cases, large pieces of erosion control structures are washed into the lake and sink in the nearshore areas along the Ohio shoreline. These become hazards for waders, particularly in private residential areas on the lake shore (ODNR, 1995). In other locations, floating debris from CSOs is deposited in areas that are managed for public recreational use (Hudson, 1996).

Routine beach cleaning is usually an effective remedy for floating garbage and debris deposited on public beaches just prior to or during the bathing season. In addition, an International Coastal Cleanup has been conducted annually since 1989. The mission of the International Coastal Cleanup is to: 1) remove debris from the shorelines, waterways, and beaches of the world's lakes, rivers, and bordering oceans; 2) collect valuable information on the amount and types of debris; 3) educate the public to the issue of marine debris; and 4) use the information collected from the cleanup to effect policy changes and other measures needed to reduce marine debris and enhance marine conservation (Center for Marine Conservation, 1994).

Ohio participates in the International Coastal Cleanup by sponsoring a Lake Erie shoreline clean up as part of the annual Coastweeks celebration. The Coastweeks clean up addresses a much greater portion of the shoreline than routine public beach cleaning annually. In 1995, approximately 450 volunteers removed almost 30 tons of debris/litter at 10 sites along 22.5 miles of the Ohio Lake Erie shoreline and river mouth areas. This effort included underwater cleanups at Gordon Park, Put-In-Bay, and Arcola Creek Beach. The trash was inventoried and classified into the following categories: plastic, glass, rubber, metal, paper, wood, cloth/clothing, and other (Ohio Lake Erie Office, 1995).

1,062 New York volunteers removed 18,000 pounds of debris from 95 miles of the Lake Erie shoreline in 1995 (Cohen, 1996). In Pennsylvania, volunteers clean 7 miles of Lake Erie shoreline at Presque Isle Bay State Park twice annually in the spring and fall. Daily use of State Park beach cleaning equipment removes much of the debris during the period of highest beach use. Volunteer cleaning in the spring is focused on removing debris washed down from the tributary areas and fall cleaning focuses on debris that is not addressed by beach cleaning equipment (Guerrein, 1996).

Canada and Michigan do not participate in the International Coastal Cleanup along Lake Erie (George, 1996; England, 1996). However, local clean ups do occur along Canada's Lake Erie shoreline sponsored by municipalities or local organizations. Therefore, no readily accessible information is available on the results of Lake Erie shoreline clean ups in Canada.

In addition to the annual International Coastal Cleanups around Lake Erie, since April of 1989, a group of student naturalists from the Cleveland Museum of Natural History have

conducted an annual one day trash clean-up and inventory/characterization at Headlands Dunes State Nature Preserve in Ohio. Since 1989, approximately 21,700 pieces of trash has been collected at Headlands Dunes State Nature Preserve. The trash was categorized as plastic, styrofoam, paper, cigarette butts, glass, metal, rubber, wood, cloth or food/masonry, and distinctions were made between beach trash (more representative of floating garbage) and dunes/paths/woods trash (more representative of trash carried into the site). Most of the trash was plastic or styrofoam and the approximately 50% of it was found on the beach (Bartolotta, 1996).

Despite the above-mentioned efforts to remediate floating garbage and debris at Headlands Dunes State Nature Preserve, problems persist. Specifically, CSOs along the Chagrin River discharge during wet weather and deposit floating plastic debris on the Preserve shoreline on a regular basis. Visitors to the Preserve register frequent complaints with the manager (Hudson, 1996). Anecdotal reports to the BUIASC suggest that similar CSO-related floating garbage and debris problems are occurring along other areas of the Lake Erie shoreline. However, with the exception of the AOCs (where a portion of the debris is CSO-related) mentioned below, no specific information to confirm locations where problems occur and/or their persistence has been provided to date.

Areas of Concern

Persistent problems with debris occur in the navigation channel of the Cuyahoga River and periodic problems occur in the nearshore area of the Cuyahoga AOC. This issue has been studied by many interested groups and agencies over the past 40 years and has been addressed by a number of different periodic clean up efforts. Specifically, floating debris presents a navigational hazard to recreational boaters and commercial boaters who travel through the lower 5.6 miles of the Cuyahoga River - the dredged navigation channel. An estimated $460,00-$500,000 was spent on debris-related damage to recreational watercraft in 1994. Commercial vessels also incur damage from floating debris. In addition, industries dependent on the river must build enclosures to keep debris away from their water intake pipes.

The increase in floating debris on the Cuyahoga River is a result of the extensive development in the watershed. If left untouched, trapped floating debris will accumulate in piles several feet thick in backwaters, around bends, underneath docks, and against bridge abutments. Here the logjams will remain until a heavy rain or flood waters wash the debris to Lake Erie. Once in the lake, the debris will move east by prevailing westerly winds and longshore currents. Although small debris is scattered by wind and currents, many large logs collect inside the breakwall between the river mouth and North Coast Harbor. Because of its location, North Coast Harbor becomes a catch basin for some of the debris caught inside the breakwall.

Presently there are no programs to regularly remove floating debris from the navigation

channel of the Cuyahoga River. A cooperative effort between the U.S. Army Corps of Engineers and U.S. Coast Guard eliminates some of the larger logs in the spring, but for the rest of the year, the majority of big logs and the smaller scattered debris continue to float down river. These problems are significant enough that the Cleveland Waterfront Coalition commissioned a study to assess the feasibility of using a trash skimmer boat for removing floating debris on the Cuyahoga River, North Coast Harbor, and inside the breakwall between these two points.

Field biologists noted the types of debris floating on the surface of the Cuyahoga River in the 5.6 mile navigation channel between July, 1994 and January, 1995. On August 22, 1994, 257 cubic yards of floating debris was measured between river mile 5.6 and the mouth of the river. This measurement included a large log jam under the Conrail bridge at LTV steel, but did not include the shoreline debris at the mouth of the river. The composition of the measured debris was 71.5% wood material (less than 10 feet in length), 27.5% large logs (greater than 10 feet in length), and 1% litter. The 1995 report recommended the acquisition of a debris harvester to be used for more regular debris removal. Planning is currently underway to develop the financing package needed to purchase, store, operate and maintain the needed equipment. The estimated capital cost for the debris harvester is $250,000 (Rogers, 1995; Cleveland Waterfront Coalition, 1995).

Problems with debris, particularly log jams, is also a problem in the Rouge River AOC. An annual cleanup, "the Rouge River Rescue" is conducted to remove Rouge River debris (Rouge River RAP, 1994).

In more urbanized areas, storm sewer and combined sewer overflow discharges often contain manmade debris such as litter and human waste. This is a particular problem in the Black, Detroit, and Rouge River AOCs (Black River RAP, 1994; Detroit River RAP, 1991; Rouge River RAP, 1994). Persistent problems occur in both the nearshore and mainstem areas of the Black River and debris persists until it can be removed manually. The annual Rouge Rescue is conducted to manually remove man-made debris from this AOC. Due to the high flow in the Detroit River, these problems are not persistent within the AOC.

15.3.7 **Dead Fish**

Public concern is often expressed about seasonal die-offs of alewife (eastern basin), smelt (all basins) and gizzard shad (central and western basin). It is generally unclear how closely public concern about these die-offs is linked to a perceived aesthetic problem versus curiosity regarding the cause of the fish die-off. Documentation of situations where fish die-offs have caused an objectionable deposit is scarce.

Alewife die-offs do apparently cause nuisance deposits during the winter in the eastern basin for commercial fishermen. When trawling in February they have to avoid certain areas when they encounter dead alewives on the bottom (Ryan and MacGregor, 1995).

Seasonal die-offs of alewife, smelt and gizzard shad are considered routine according to fishery biologists, unless they are associated with a system too heavily balanced toward planktivores (Ryan, 1995; ODNR, 1995; Johannsson, 1995). The two key reasons for die-offs are water temperature and a weakened immune system during a certain stage of the fish life cycle (usually post-spawning).

The temperature or range of temperatures provided by the environment controls and limits the survival of individual fish and populations (Fry, 1947). Particular fish species have evolved and adapted to live in particular thermal environments. The alewife is an exotic species and is therefore not well adapted to the Lake Erie environment (Ryan and MacGregor, 1995). The phenomenon of spring mortality of alewives is most likely due to rapid seasonal decreases in water temperatures after the fish have acclimated to warm nearshore waters (Ryan, 1995).

Although gizzard shad may be an exotic species it has inhabited Lake Erie long enough to become naturalized. Gizzard shad, particularly in the 120 mm or smaller size range, are also susceptible to the cold. If the Lake Erie water temperature remains between 1 and 3 C for 10 days or more, many of the fish in the smaller size range will die. According to the Floating Debris Removal Feasibility Study for the Cuyahoga River AOC, in the lower 5.6 miles of Cuyahoga River, billions of dead gizzard shad carcasses collect beneath docks and in marinas where their stench creates "unforgettable" aesthetic impacts (Cleveland Waterfront Coalition, 1995).

Smelt is also an exotic species. Both smelt and alewife have a lower immunity to bacterial and fungal diseases during a certain portion of their spawning cycle. Specifically, smelt die-offs have largely occurred during or post-spawning. The mortality likely occurs because poor physical conditions and warming waters leave the fish vulnerable to fungal and bacterial disease (Ryan, 1995). These diseases are present in Lake Erie due to the great numbers of smelt and alewife populating the lake. Widespread seasonal alewife and smelt mortality is often attributed to these diseases (ODNR, 1995).

Isolated instances of dead fish occur in the vicinity of power plants during changes in power production or near industrial water use facilities. Specifically, fish kills occur when fish are: 1) drawn in at intakes (trapped on traveling screens), 2) they become acclimated to the warm-water environment of discharges and are unable to survive at ambient lake temperatures when the heat source is lost, or 3) where warm-water discharges reach lethal temperatures. These situations appear to be short-lived, of low magnitude, and consequently are not an aesthetic impairment. However, these effects are difficult to

observe due to timing and the fate of the dead fish (sinking, predation by gulls, etc.). Therefore, the ecological significance, particularly locally, of the fish kills is not known (Ryan, 1995).

15.4 Summary of Lake Erie Aesthetic Impairment Conclusions

A summary of conclusions related to aesthetic impairments is presented in Table 15.2.

Table 15.2 Summary of Lake Erie Aesthetic Impairment Conclusions

Type of Impairment	Determination of Impairment	Location/Extent of Impairment	Known Causes of Impairment	Notes
High Turbidity	**Impaired**	Maumee and Rouge River AOCs, western basin; Black and Cuyahoga (navigation channel) AOCs, central basin.	Agricultural and urban point and non-point source runoff and storms stirring up bottom sediments.	
Obnoxious Odors	**Impaired** for fish and *Cladophora*; Inconclusive decaying zebra mussels.	Cuyahoga AOC, central basin (fish); *Cladophora* fouling has occurred at Rondeau Bay, Ontario.	Decaying algae and fish.	Although decaying zebra mussels and CSO discharges of raw sewage are known to cause obnoxious odors, it appears from information to date that these problems are not persistent in Lake Erie.
Excessive *Cladophora*	**Impaired.**	Central basin-Rondeau Bay, Ontario.	Nutrient enrichment, availability of substrate.	It is not known if fouling problems are persistent in Ontario waters of the eastern basin. Only 1 year of monitoring data.
Blue-green Algae	Inconclusive.	Western basin.	Emerging issue. Research is underway to pinpoint cause of *Microcystis* bloom. Hypothesis that zebra mussels may be contributing to the problem.	It is not known whether *extensive Microcystis* blooms will continue to persist. Therefore a definitive impairment determination has not been made.
Aquatic Plant Deposits at Public Beaches	Not Impaired/No documentation to date showing a persistent problem.	N/A	N/A	

Type of Impairment	Determination of Impairment	Location/Extent of Impairment	Known Causes of Impairment	Notes
Zebra Mussel Shells at Public Beaches	Inconclusive.	Large deposits of shells have been reported at many western basin beaches and at Presque Isle Bay State Park, central basin.	Deposits of zebra mussels/shells.	It is not known whether reported problems are persistent, and if so, if they are interfering with human use of shoreline areas.
Floating Garbage and Debris	**Impaired.**	Geographic extent of impairment is localized, Cuyahoga AOC, Headlands Dune State Nature Preserve, central basin.	Large quantities of floating debris (primarily natural), Cuyahoga AOC; interfering with navigational, recreational, and industrial use of affected area in Cuyahoga AOC. Large quantities of floating garbage (primarily CSO-related) have led to citizen complaints at Headlands Dunes State Nature Preserve.	This issue is significant enough for the Cuyahoga AOC, that a proposal to purchase a debris harvester is being pursued.
Dead Fish	**Impaired**	Geographic extent of impairment is seasonal and localized. Cuyahoga AOC, central basin, Ontario eastern basin waters are only documented impairments to date.	Post-spawning die-offs; Alewife not acclimated to colder water temperatures.	
N/A = Not Applicable				

15.5 **Emerging Issues**

There are two current Lake Erie phenomena that have aesthetic ramifications, but are also indicators of much broader ecosystem changes in Lake Erie -- *Microcystis* blooms and the reappearance of the burrowing mayfly, *Hexagenia limbata* in the western basin.

Research is currently underway to determine the cause and potential implications of the 1995 and 1996 *Microcystis* blooms in the western basin. The significance of this issue, both aesthetically and ecologically, will be directly linked to whether the blooms continue to be annual events. The LaMP will use the research findings, when available, to reevaluate the status of *Microcystis* blooms as an aesthetic impairment to the western basin of Lake Erie.

Another emerging issue is the conflict between traditional indicators of improving ecosystem quality and perceived aesthetic problems. For example, during a certain stage of their life cycle, burrowing mayflies emerge from western basin Lake Erie sediments and swarm in large numbers. Swarms of mayflies made roads slippery and caused a temporary brown-out in much of the [Toledo] region in June of 1995. It was the thickest infestation since the mayfly disappeared in the mid 1960s (Henry, 1996). These swarms of mayflies are regarded as a signal of improving Lake Erie water quality, but during the swarming stage create a temporary nuisance to humans.

Some have suggested that mayfly swarms be classified as an aesthetic impairment. Because the mayfly is widely regarded as a signal of improving water quality, any aesthetic problems created by swarming have not been classified as an impairment in this assessment. However, it is acknowledged that there can be temporary conflicts between the improving Lake Erie ecosystem and certain desired human uses of the Lake region during the mayfly swarming period.

15.6 **Conclusions**

Reaching definitive impairment conclusions was difficult for many of the aesthetic issues. This was due to lack of information or because the information provided was not detailed enough to determine the persistence of the problem or whether the problem was perceived as "objectionable" by the general public to the point where it was inhibiting the use of the Lake Erie shoreline. Nevertheless, based on available information, it appears that there are not widespread aesthetic impairments to Lake Erie. Impairments that have been documented are localized and, in most cases, some sort of remediation is being attempted, with varying frequency.

The most frustrating problems to remediate are reported to be zebra mussel shells and CSO discharges of garbage and debris, because clean-up only results in temporary remediation before the accumulation of shells or garbage and debris occurs again.

As additional public input on aesthetic problems is received, it will be used to update the information included in this assessment with the hope that "inconclusive" determinations will eventually be revised to state "impaired" or "not impaired". This input is needed to insure that the data contained in this summary accurately reflects the extent of the impairments in Lake Erie.

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