REMEDIAL ACTION PLAN UPDATE

for the

MILWAUKEE ESTUARY AREA OF CONCERN

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Wisconsin Department of Natural Resources
Office of the Great Lakes

2014 Remedial Action Plan Update
for the
Milwaukee Estuary Area of Concern

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Disclaimer: The Great Lakes Water Quality Agreement is a non-regulatory agreement between the U.S. and Canada, and criteria developed under its auspices are non-regulatory in nature. Any actions identified in this document as needed to remove the impaired beneficial uses are not subject to enforcement or regulatory actions.

Cover Photo: Lincoln Park Phase 1 riverbank restoration area, Gail Epping Overholt, UW-Extension

EXECUTIVE SUMMARY

The Milwaukee Estuary Area of Concern (AOC) encompasses portions of three large watersheds where many partners are working to improve conditions. Over the last couple of years, the Wisconsin Department of Natural Resources (WDNR) with its partners made substantial progress on many of the impaired beneficial uses for the Milwaukee Estuary AOC. Changes from the previous Remedial Action Plan (RAP) Update are summarized below to highlight activities that occurred between 2013 and 2014.

Summary of Changes for Restrictions on Fish and Wildlife Consumption

- Sampling of waterfowl to assess the consumption advisory is underway and preliminary results indicate some type of consumption advisory will remain in place. The assessment was funded by a Great Lakes Restoration Initiative (GLRI) grant to WDNR.
- The second phase of the Lincoln Park and Milwaukee River Channels planning is complete and dredging is scheduled to begin in late 2014 or early 2015.

Summary of Changes for Degradation of Fish and Wildlife Populations

- Milwaukee County, University of Wisconsin – Milwaukee (UWM) and U.S. Geological Survey (USGS) completed target refinement studies for both fish and wildlife populations. The fieldwork/assessment phase of this project is now underway with sampling occurring throughout 2014.

Summary of Changes for Fish Tumors or Other Deformities

- Results of the fish tumor rate assessment project confirmed that this impairment exists in the AOC. Neoplastic liver tumors were found in 15% of Milwaukee Estuary white suckers. This is greater than the expected background rate. This beneficial use impairment (BUI) will no longer be listed as suspected or potentially impaired.
- Sampling was conducted at the Root River reference site to determine the tumor rate for comparison.

Summary of Changes for Bird or Animal Deformities or Reproduction Problems (potentially impaired)

- USGS continued to collect data on tree swallow hatching effects in the Milwaukee Estuary and other sites across the Great Lakes. The sampling was expanded to four sites in the AOC.

Summary of Changes for Degradation of Benthos

- Preliminary results from the 2012 benthos assessment conducted by USGS indicate that the benthic community of the Milwaukee Estuary is impaired.
- USGS completed an additional year of sampling for benthos and plankton in 2014.

Summary of Changes for Restrictions on Dredging

- The second phase of the Lincoln Park and Milwaukee River Channels planning is complete and dredging is scheduled to begin in late 2014 or early 2015.
- Work on other cleanups and assessments is underway to continue to address this impairment.

Summary of Changes for Eutrophication or Undesirable Algae

- Results for the Milwaukee Basin Total Maximum Daily Load (TMDL) study for phosphorus have been delayed, and are expected in 2015. TMDL implementation planning will follow.

Summary of Changes for Beach Closings/Recreational Restrictions

- A concept plan was completed for improvements to South Shore Beach as part of an overall park planning project. Milwaukee County received a pledge for $500,000 from MillerCoors to implement the park improvements.
- Data collection began on a two year project that will identify and quantify unrecognized sanitary sewage contamination to the AOC. The work is being carried out by UWM's School of Freshwater Sciences.

Summary of Changes for Degraded Aesthetics

- In 2014 the citizen based aesthetics volunteer monitoring program was suspended in order to update the protocols. In 2015 there will be a renewed effort to engage citizen monitors, hopefully through local groups.

Summary of Changes for Degraded Phytoplankton and Zooplankton Populations

- Preliminary results from the 2012 benthos assessment conducted by USGS indicate that the planktonic community of the Milwaukee Estuary is impaired.
- USGS completed an additional year of sampling for benthos and plankton in 2014.

Summary of Changes for Loss of Fish and Wildlife Habitat

- The technical team continues to work on a list of projects to address the impairment.
- In 2014 progress was made on a number of habitat projects by AOC partners.

Next Steps

For 2015, the Milwaukee AOC Coordinator will be focused on the following:

- determining management actions for BUIs;
- engaging the fish and wildlife technical team to begin working on a final list of fish and wildlife projects to address the loss of fish and wildlife habitat impairment;
- working with the University of Wisconsin – Extension Natural Resources Educator on Community Advisory Committee development;
- developing target refinements and updates as needed;
- continuing to help partners seek funding for priority habitat projects in the AOC; and,
- reviewing final assessment data from the numerous completed and on-going assessments and working with partners to develop next actions based on the information.

Sediment cleanups are critically important for removing nearly all impairments. While several sediment cleanups have been completed and others are currently underway, additional assessment and cleanup work is needed. In the next year WDNR sediment staff will continue to work on priority projects in the AOC including the following:

- Cedar Creek Superfund Alternative Site;
- Phase 2 of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project;
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary;
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive; and,
- Solvay Coke Superfund Alternatives Site.

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DEFINITIONS

Area of Concern (AOC)
Defined by Annex 2 of the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement as "geographic areas that fail to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life." These areas are the "most contaminated" areas of the Great Lakes, and the goal of the AOC program is to bring these areas to a point at which they are not environmentally degraded more than other comparable areas of the Great Lakes. When that point has been reached, the AOC can be removed from the list of AOCs, or "delisted."

Beneficial Use Impairment (BUI)
A "beneficial use" is any way that a water body can improve the quality of life for humans or for fish and wildlife (for example, providing fish that are safe to eat). If the beneficial use is unavailable due to environmental problems (for example if it is unsafe to eat the fish because of contamination) then that use is impaired. The International Joint Commission provided a list of 14 possible beneficial use impairments in the 1987 Great Lakes Water Quality Agreement amendment.

Delisting Target
Specific goals and objectives established for beneficial use impairments, with measurable indicators to track progress and determine when delisting can occur. Targets should be locally derived.

Hotspot
An area where additional characterization is needed to determine if further remedial actions are necessary. Typically, potential hotspots are identified by information related to historic or adjacent land use.

Remedial Action Plan (RAP)
According to the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement, a RAP is a document that provides "a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in Areas of Concern…" RAPs were required to be submitted to the International Joint Commission at three stages:

- Stage 1: Problem definition
- Stage 2: When remedial and regulatory measures are selected
- Stage 3: When monitoring indicates that identified beneficial uses have been restored

In 2012, the U.S. and Canada signed a renegotiated Great Lakes Water Quality Agreement which removed the "stage" terminology from the AOC Annex, and simply requires Remedial Action Plans to be "developed, periodically updated, and implemented for each AOC."

Total Maximum Daily Load (TMDL)
A TMDL is the amount of a pollutant a waterbody can receive and still meet water quality standards. It can be thought of as a pollution "budget" for a water body or watershed that establishes the pollutant reduction needed from each pollutant source to meet water quality goals.

List of Acronyms

AOC	Area of Concern
BCOC	Bioaccumulative chemicals of concern
BUI	Beneficial Use Impairment
CAC	Citizen advisory committee
CDF	Confined disposal facility
CSO	Combined sewer overflow
GLRI	Great Lakes Restoration Initiative
IISG	Illinois-Indiana Sea Grant
KK	Kinnickinnic
km	Kilometers
LAMP	Lakewide Action and Management Plan
LOEL	Lowest observable effect level
mg/L	Milligrams per liter
MMSD	Milwaukee Metropolitan Sewerage District
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAP	Remedial Action Plan
SEWRPC	Southeastern Wisconsin Regional Planning Commission
SSO	Sanitary Sewer Overflow
TBD	To be determined
TMDL	Total Maximum Daily Load
TP	Total phosphorus
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW-Extension	University of Wisconsin Extension
UWM	University of Wisconsin-Milwaukee
WDNR	Wisconsin Department of Natural Resources
WisCALM	Wisconsin Consolidated Assessment and Listing Methodology
WSG	Wisconsin Sea Grant

PURPOSE STATEMENT

The purpose of this document is to serve as a Remedial Action Plan (RAP) update. Remedial Action Plans are required by Annex 1 of the Great Lakes Water Quality Protocol of 2012 (which replaced the 1987 Protocol amending the Revised Great Lakes Water Quality Agreement of 1978). The 2012 Protocol indicates that Remedial Action Plans must include the following elements:

1. Identification of beneficial use impairments (BUIs) and causes;
2. Criteria for the restoration of beneficial uses that take into account local conditions and established in consultation with the local community;
3. Remedial measures to be taken, including identification of entities responsible for implementing these measures;
4. A summary of the implementation of remedial measures taken and the status of the beneficial use; and
5. A description of surveillance and monitoring processes to track the effectiveness of remedial measures and confirm restoration of beneficial uses.

This RAP, which updates the 2013 document, is intended to be a concise summary of beneficial use impairment status and specific actions that will be important for reaching the delisting targets. “Actions” may include on-the-ground restoration projects, monitoring and assessment projects, and stakeholder engagement processes. It is also a tool for documenting and communicating progress to agency partners and technical stakeholders. Subsequent updates will be completed as needed to incorporate new information that may become available.

INTRODUCTION

Areas of Concern (AOCs) are severely degraded geographic areas within the Great Lakes. The areas – 43 within the Great Lakes region – were designated as AOCs primarily due to contamination of river and harbor sediments by toxic pollutants. Cleaning up these severely degraded areas is a first step toward restoring the chemical, physical, and biological integrity of the lakes as required by the Great Lakes Water Quality Agreement. When the areas have been cleaned up to the point where they are not more degraded than other, comparable non-AOC areas, they are "delisted" as AOCs; they are then managed in accordance with the Lakewide Action and Management Plan (LAMP) program, a "whole lake" program that is also set forth in the Agreement. The Agreement is the means for the U.S. and Canada to work together to jointly manage the lakes.

AOC Boundary

The Milwaukee Estuary AOC is one of five Areas of Concern in Wisconsin. The estuary and lower portions of the rivers were designated as an AOC in 1987 and the boundaries were subsequently expanded in 2008 (see Figure 1; note that the documentation associated with the boundary change was attached to the 2011 Milwaukee Estuary RAP Update as Appendix C). The boundaries of the AOC are as follows (with original 1987 boundaries italicized):

Milwaukee River

- *Lower 5 km of the Milwaukee River downstream of (former) North Avenue Dam.*
- Cedar Creek downstream from Bridge Road to confluence with Milwaukee River.
- Milwaukee River and Lincoln Creek from confluence with Cedar Creek to former North Avenue Dam.

Menomonee River

- *Lower 4.8 km of the Menomonee River downstream of 35th Street*.
- Little Menomonee River from Brown Deer Road to confluence with Menomonee River.
- Menomonee River downstream from confluence with Little Menomonee River to 35th Street.

Kinnickinnic River

- *Lower 4 km of the Kinnickinnic River downstream of Chase Avenue*

Estuary

- *Inner and outer harbors.*
- *Nearshore waters of Lake Michigan, bounded by a line extending north from Sheridan Park to the city of Milwaukee´s Linnwood water intake.*

Impairments & Causes

The Milwaukee Estuary was designated an AOC due to the presence of impairments to the beneficial uses of the waters included within its boundaries. Out of a total of fourteen possible beneficial use impairments (BUIs), eleven were designated within the original AOC boundary and four within the expanded boundary. There are several causes of the impairments present, with the most prevalent being legacy contamination. Sediments contaminated with toxic pollutants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals contributed to nearly all of the eleven BUIs within the original boundaries of the AOC and all four within the expanded boundary. While loading of toxic substances was one of the primary drivers behind the AOC program, impacts from urbanization and terrestrial and aquatic habitat fragmentation also contribute to the impairments. The waterways within the AOC were also historically modified (straightened and dredged) to accommodate large vessel commercial shipping. Combined sewer overflows from wastewater treatment plants and soil erosion and nutrient enrichment from throughout the estuary's watershed contributed to degraded water quality.

Figure 1. Map of the Milwaukee Estuary AOC. The original boundaries are shown in red and the expanded boundaries are shown in yellow.

Milwaukee Estuary AOC beneficial use impairments and sources are summarized in Table 1. Note that some impairments must be addressed broadly for the whole AOC, while others must be addressed on a geographic basis (i.e., tributaries are different from each other and are different than the estuary). While significant progress has been made since the first Remedial Action Plan (RAP) document in 1991, no impairments have been removed for this AOC to date. In the expanded AOC boundary, the four BUIs that are most closely tied to sediment contamination are identified as impaired (USEPA, 2009, pp. 1-3). The Lincoln Park/Milwaukee River Channels Legacy Act Sediment project is a prime example of why the AOC boundaries were expanded. That particular site contributes the greatest mass loading of PCBs to the Milwaukee River and Harbor.

Table 1. Causes of Beneficial Use Impairments in the Milwaukee Estuary Area of Concern.

	Sources of Pollution/Problem			
Impaired Beneficial Use (Original AOC boundaries)	Toxic Substances	Point Source and Runoff Pollution	Physical Habitat Alteration	Other
Degradation of fish and wildlife populations	**X**	**X**	**X**	**X**
Loss of fish and wildlife habitat	**X**	**X**	**X**	**X**
Degradation of benthos	***x***	**X**	***x***	**X**
Restrictions on dredging	**X**	**X**		
Restrictions on fish and wildlife consumption	**X**	**X**		
Bird/animal deformities or reproduction problems (suspected)	***x***	***x***		
Fish tumors or other deformities	***x***	***x***		
Beach closings/recreational restrictions	**X**	**X**		
Degraded phytoplankton and zooplankton populations	**X**	**X**	**X**	
Eutrophication or undesirable algae		**X**	**X**	**X**
Degradation of aesthetics	***x***	**X**	***x***	**X**
Impaired Beneficial Use (Expanded AOC boundaries)				
Degradation of fish and wildlife populations	***x***			
Degradation of benthos	***x***			
Restrictions on dredging	***x***			
Restrictions on fish and wildlife consumption	***x***			

A lower case x indicates that at the time of the original RAP, these sources were not understood to be part of the source contributing to a particular impaired beneficial use, but are now considered to be a component of the impairment.

Toxic Substances

Loading of toxic substances into AOCs was one of the primary drivers behind the AOC program. Sources of toxic substances include contaminated sediments, spills of such chemicals within the watershed, and atmospheric deposition.

Point Source and Runoff Pollution

This category includes loading of sediment, nutrients, and/or bacteria as a result of nonpoint, or diffuse, sources of pollution and includes urban stormwater runoff. Point sources, such as sewer overflows, are also a source of sediment, nutrients, and bacteria into the AOC and are included in this category. Additionally, noncontact cooling water is a significant source of phosphorus, a nutrient, into the waters of the AOC.

Physical Habitat Alteration

Dams, drop structures, concrete-lined channels, and poorly-sized culverts and stream crossings degrade aquatic habitat by impeding the fishes' ability to get to suitable spawning habitat further upstream. This category also includes shoreline alteration, such as sheet piling, that doesn't provide high-quality habitat the same way that more naturalized, meandering streambanks would. Alterations in riparian habitats ecologically connected to the stream have the ability to impair the life cycles of wildlife, such as the ability of fish to spawn in floodplain wetlands, and ducks to nest in riparian grasslands.

Other

In the time since the original RAP documents were written, there has been recognition of the importance of thermal discharges in affecting water quality, specifically dissolved oxygen levels. As water temperature increases, its ability to carry oxygen decreases. Therefore, discharges of water with elevated temperatures can have a significant negative impact on aquatic communities. “Other” for the Degradation of Aesthetics impairment is listed because litter was a primary source of pollution for that impairment.

Remedial Action Planning & Progress

The Wisconsin Department of Natural Resources (WDNR) worked with community stakeholders to develop a RAP in 1991, with updates in 1994 and 1999. In 2011, WDNR began working again with stakeholders to identify goals and actions necessary to address the impairments of the AOC. To do this, WDNR develops annual Remedial Action Plan Updates to summarize progress toward improving conditions in the AOC. Annual RAP updates were produced in 2011-2013.

The main priorities for the Milwaukee Estuary AOC include remediation of contaminated sediments in tributaries and nearshore waters of Lake Michigan, nonpoint source pollution control, improvement of water quality for recreational purposes, enhancement of fish and wildlife populations, and habitat rehabilitation.

Many projects have occurred in the AOC that have helped to address the impairments. Several formerly contaminated sites have been assessed and remediated through the Great Lakes Legacy Act, the Superfund program, or other efforts. Moreover, a total maximum daily load study for the Menomonee, Kinnickinnic, and Milwaukee Rivers and the Milwaukee Estuary are expected to be completed in 2015 for phosphorus, fecal coliform bacteria, and sediment loading. The Total Maximum Daily Load (TMDL) implementation plan, also expected in 2015, will identify the next steps needed to reduce pollution and meet water quality criteria in the AOC. Partners within the AOC have been pursuing and implementing habitat restoration projects for fish and wildlife.

This RAP Update concisely lists the current status of each BUI, the next actions needed, and potential issues. The AOC is dynamic, and this document captures progress made from the last update completed in 2013 through October 2014. Citizen engagement has been an integral component of the AOC program since the beginning and continues to be a priority as additional actions are identified and implemented. A summary of BUI status is included in Table 2.

Table 2. Milwaukee Estuary Beneficial Use Impairment Status Summary.

Beneficial Use Impairment	Beneficial Use Remains Impaired	Summary Status
Restrictions on fish and wildlife consumption	Yes	Preliminary results indicate waterfowl consumption advisories will remain in place. Fish consumption advisories also remain in place. Dredging for the Lincoln Park Phase 2 contaminated sediment removal is set to begin in late 2014/early 2015.
Degradation of fish and wildlife populations	Yes	Fish and wildlife population assessments developed by the fish and wildlife technical team are underway.
Fish tumors or other deformities	Yes	Fish tumor study conducted in 2013 determined that an impairment exists with a tumor rate of 15%. Reference sampling occurred in 2014 at the Root River.
Bird/animal deformities or reproduction problems	Suspected	USGS has conducted tree swallow monitoring since 2010. If found to be impaired, an assessment strategy will be needed for this impairment.
Degradation of benthos	Yes	Preliminary results from the USGS benthos study from 2012 indicate that the benthic community of the estuary is impaired. The USGS completed an additional year of sampling in 2014.
Restrictions on dredging activities	Yes	Several sediment cleanup projects have been completed; additional sediment assessments and cleanups are needed. Dredging for the Lincoln Park Phase 2 contaminated sediment removal is set to begin in late 2014/early 2015.
Eutrophication or undesirable algae	Yes	TMDLs will inform sources and phosphorus loading reductions needed. The TMDLs and TMDL implementation plan have been delayed and are expected to be completed by 2015.
Beach closings/recreational restrictions	Yes	Bacterial contamination source tracking by UWM, funded through a GLRI grant to WDNR, is underway. Milwaukee County is working on improvements to South Shore Beach.
Degradation of aesthetics	Yes	An on-going citizen-based monitoring project will characterize the impairment and may determine what or how it would need to be addressed.
Degraded phytoplankton and zooplankton populations	Yes	Preliminary results from the USGS plankton study from 2012 indicate that the planktonic community of the estuary is impaired. The USGS completed an additional year of sampling in 2014.
Loss of fish and wildlife habitat	Yes	The fish and wildlife technical team is developing a list of projects to address the BUI. Several of these projects are underway.

Stakeholder Engagement

The original RAP and RAP Update were the result of significant public consultation and involvement and included multiple technical advisory committees and a citizen advisory committee. In 2012 WDNR established a Fish and Wildlife technical team and a re-established a citizen advisory committee in the form of the "Stakeholder Delegation," a subset of the larger groups of interested stakeholders. The purpose of the delegation is to advise and support an education, information, and outreach strategy through direct involvement, consultation, and review of outputs.

This past year's efforts built upon previous efforts including collaboration between the University of Wisconsin Extension (UW-Extension) Natural Resources Educator and local historian John Gurda to produce a Milwaukee Public Television documentary and related classroom learning activities. The WisconsinEye Public Affairs Network is also a partner in producing the documentary, which is titled "A City Built on Water." UW-Extension (working in collaboration with Wehr Nature Center, the Milwaukee

Metropolitan Sewerage District, the Urban Ecology Center and the University of Wisconsin Arboretum) recruited teachers from Milwaukee and Shorewood Public Schools and Escuela Verde, a public charter school, in Milwaukee County. The teachers all attended one or more week-long trainings focused on the Great Lakes Literacy Principles and will use that training to develop middle and high school learning activities to correlate to the themes outlined in the documentary. This project received $11,500 in funding through the WDNR's AOC capacity grants and leveraged an additional $40,300 from other funding sources to cover project costs.

In 2014, due to WDNR staff turnover in all but one of the AOCs, and reduced funding to support UW-Extension, much time was spent preparing for the transition and working with partners on their many efforts to involve the public and gain their support for actions to improve environmental conditions in the Milwaukee Estuary Area of Concern. The UW-Extension Natural Resources Educator and WDNR worked with community partners to identify collaboration opportunities when their goals overlap with the AOC program goals. Existing venues for communicating with the public are utilized, for example incorporating AOC updates into quarterly RiversReport newsletters, using social media and partner outreach programs, events and publications. In addition, this coming year, UW-Extension will continue to lead hikes in the AOC as field trips through the Natural Resources Foundation of Wisconsin. The first Wisconsin Great Lakes Areas of Concern Restoration Reports were produced in Summer 2013. These illustrate the status of each AOC's progress towards removing the beneficial use impairments and the next steps for the coming year. The next Restoration Report updates are expected in spring of 2015.

The Stakeholder Delegation has been serving the AOC program in many ways, including support for outreach and educational efforts, developing a strategy for community engagement and providing review and evaluation for projects endorsed by the Delegation. The Delegation has unofficially served as the Citizen Advisory Committee (CAC) when it comes to endorsing on-the-ground projects that are seeking federal agency funding. As the Milwaukee Estuary AOC progresses and matures, it is critical to community engagement to have a fully-functioning, official CAC. In October 2014, UW-Extension identified members from the Stakeholder Delegation and the Fish & Wildlife Technical Team to serve on a CAC Transition Task Force. The task force is charged with providing recommendations to the agencies, partners and stakeholders on the roles and responsibilities of a Milwaukee CAC and how the CAC will function. UW-Extension is leading facilitated monthly meetings of the Transition Task Force to produce those recommendations by spring of 2015.

For a complete list of areas the Stakeholder Delegation identified for outreach and communication for 2014, see Appendix B.

BENEFICIAL USE IMPAIRMENT UPDATES

The following pages summarize the current status of each Beneficial Use Impairment using the format below. An explanation of each section is provided after the heading.

Target and Status

Updated Targets	Status
The updated target based on the 2011 Draft Stage 2 modifications to the 2008 targets for the Milwaukee Estuary AOC are listed here as separate components on each row to clearly show the status of each part of the target.	May be: – "Complete" – "In progress" – "Addressed by current projects" – -"Action needed" – "Unknown" – "Assessment in progress" (data collection occurring in years listed in parentheses) – "TBD" (to be determined)

Target Rationale

May list one or more of the following:

- Relevant background and explanation related to the target and any applicable modifications.
- If applicable, an explanation of why the updates or clarifications were necessary for the 2008 target updates.

Please note that the information referring to the 2008 delisting targets can be found in the document *Delisting Targets for the Milwaukee Estuary Area of Concern: Final Report.*

Rationale for Listing

The section briefly summarizes the reason the BUI was known or suspected at the time of listing. If sources contributing to the impairment have been identified since listing, those are included in this section as well. Typically, the information from this section is drawn from the existing RAPs for the Milwaukee Estuary that were developed in 1991 and 1994.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

"Key remedial actions" are those that directly contribute to the current status of the BUI. Note that any items listed here are not an exhaustive list of all the remedial actions completed that may have helped make progress toward removing the BUI. The items listed here are any key actions that were completed since the draft 2013 RAP. The narrative here explains and leads to the "Next action needed."

Next actions needed

This section is a narrative listing of assessments and on-the-ground projects that are clearly delineated and directly address the specific BUI. This is also not an exhaustive list of all actions needed to address the impairment, but rather a list of actions that we know must be implemented to make progress toward removing the impairment. Plans for verifying achievement of delisting targets are listed here, if known. Please also note that because of the urban nature of the AOC, contaminated sediment projects listed in this section are not necessarily the only cleanups that would need to occur before removal of a particular

impairment. Rather, the projects listed reflect the current knowledge of what must be addressed so that progress on an impairment can continue.

It is important to keep in mind that the primary goal of the AOC program is to address legacy contamination and issues related to severe water quality degradation. While there are some other important and necessary considerations for making progress toward removing impairments, areas with high concentrations of contaminated sediment that contribute to loading of toxic substances into the AOC may need to be addressed before additional work can occur, especially in the case of any physical habitat improvements. That said, it should be noted that more than contaminated sediment remediation will be required to remove all BUIs.

Issues (challenges, risks) affecting progress on this BUI

This section lists project contingency (i.e., one thing has to happen before another can occur), funding obstacles, and any other considerations that could affect the timeline for BUI removal.

RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION

Target and Status

Updated Target (2011)	Status
Fish Approach to be used with current level of monitoring for fish consumption advisories within the AOC (every five years):	
• All known man-made sources of BCOCs (including PCBs, mercury, dioxins, and furans) within the AOC and tributary watershed have been controlled or eliminated; and	In progress, *and* Action needed
• State fish tissue monitoring confirms that waterbody-specific fish consumption advisories are no longer needed for PCBs for waters in the AOC.	TBD
• Waters within the Milwaukee Estuary AOC are not listed as impaired due to fish consumption advisories in the most recent Clean Water Act 303(d) and 305(b) Wisconsin Water Quality Report to Congress (submitted to USEPA every two years).	Assessment in progress (on-going)
Approach to be used with funding to support additional monitoring: • All known man-made sources BCOCs (including PCBs, mercury, dioxins, and furans) within the AOC and tributary watershed have been controlled or eliminated; and	TBD
• A multi-year comparison study of fish tissue contaminant levels demonstrates that there is no statistically significant difference (with a 95% confidence interval) in fish tissue BCOC concentrations in the AOC compared to fish tissue BCOC concentrations in a representative non-impacted control site within the Lake Michigan Basin.	TBD
Wildlife There are no waterfowl consumption advisories for resident waterfowl due to contamination originating within the AOC.	Assessment in progress (2013-2016)

Target Rationale

Contaminated sediments are the primary contributor of PCBs to fish and wildlife within the AOC. An effective source control and remediation program is therefore necessary in order to meet delisting goals. Following remedial actions and taking appropriate source control measures, evaluation monitoring must be conducted to determine the state of recovery for this impairment. Please note that for this impairment, PCBs are the contaminant of concern; there are no additional fish consumption advisories pertaining to mercury in the AOC (i.e., beyond the state-wide fish consumption advice that applies for mercury). Please refer to WDNR's *Fish Consumption Advice for the Milwaukee Estuary Area of Concern* (WDNR, 2014a and *Choose wisely: A health guide for eating fish in Wisconsin* (WDNR, 2014b) documents for more information about fish consumption advisories.

It should be noted that unrestricted consumption, as proposed in the 2008 targets, is not a goal that can be supported by the AOC program. For this reason, the target was updated in 2011 to reflect that waters

in the AOC should be no worse than other unimpaired waters of the state. There is, however, statewide fish consumption advice because of other, more widespread sources of contamination.

Fish

WDNR monitors fish for contaminant burdens from rivers within the Milwaukee River basin (including the AOC) on a five-year schedule and from the open waters of Lake Michigan every other year. New data are reviewed in the context of the existing advisories and previous data. Fish consumption advisories are updated by the WDNR and Department of Health and Family Services as needed based on WDNR sampling results. The most current fish consumption advisories for the AOC are available at http://dnr.wi.gov/topic/fishing/consumption/ and http://dnr.wi.gov/topic/fishing/documents/consumption/MilwaukeeAreaFishConsumptionAdvisories2014.pdf. Because the state regularly monitors fish tissue concentrations for the waters of the state, a new monitoring program is not necessary to assess this impairment. Additionally, the state Impaired Waters List is updated every two years, which means that the state evaluates new data and analyzes trends over time. If tissue concentrations consistently improve to the point where fish consumption advisories can be lifted so that there are no waterbody-specific advisories, then the desired outcome has been met and there is no need to wait to remove the impairment (if the other parts of the target have been met, i.e., "All known man-made sources of BCOCs…within the AOC and tributary watershed have been controlled or eliminated").

Listing guidelines for the state Impaired Waters Program considers a waterbody impaired for fish consumption if a water body has special PCB-based fish consumption advice of one meal per month or less frequent for resident fish species (like walleye, carp, smallmouth bass and others) or one meal per week or less frequent for resident panfish (like yellow perch or bluegill). Special advice for PCBs currently applies to several of these more resident fish species. There are no special fish consumption advisories due to mercury for the Milwaukee AOC.

The fish consumption advice that applies to fish from the Milwaukee Estuary AOC depends on the type of fish. Fish consumption advice is also provided for the Milwaukee River from Estabrook Falls downstream to the estuary and includes the Menomonee and Kinnickinnic Rivers and Lincoln Creek. This advice is for species primarily resident within these rivers and the inner harbor. These advisories will be used to determine when the Restrictions on Fish and Wildlife Consumption BUI in the Milwaukee AOC can be considered for removal.

Fish species like trout and salmon are migratory and may at times be found or caught in the river. However, these species spend most of their time in Lake Michigan; therefore, removal of the fish consumption BUI will not be dependent on these migratory species or on the Lake Michigan fish consumption advisory.

The Milwaukee River downstream from Estabrook Falls, the Menomonee, and Kinnickinnic Rivers (which include the river portions of the AOC) contain special advice for PCBs for several species. Since these species tend to be resident within the AOC and have no barriers to migration, it is appropriate to base delisting targets on resident species. The resident species that exceed the AOC delisting targets include Yellow Perch, Bluegill, Rock Bass, Largemouth Bass, Channel Catfish, Smallmouth Bass, Walleye, Black Crappie, Northern Pike, Redhorse, White Suckers and Carp. There is a "do not eat" advisory for all fish species from Cedar Creek from Bridge Road in the Village of Cedarburg downstream to the Milwaukee River and Zeunert Pond (WDNR, 2014a; WDNR, 2014b).

Wildlife

In the 2008 target document, there were no targets proposed for wildlife. Unlike fish consumption advisories, for which all waters of the state are assessed in Wisconsin, waterfowl advisories are only assessed in areas with suspected contamination issues. Because of its legacy of contamination, the Milwaukee Estuary was assessed in the 1980s to determine if a waterfowl consumption advisory should exist for certain waterbodies or portions of waterbodies. According to the state guidelines for developing waterfowl consumption advice, portions of the Milwaukee Estuary AOC did exceed state waterfowl criteria, and thus, the state issued a waterfowl consumption advisory in 1987 for portions of the AOC. Since the advisory was issued, no additional data had been collected.

In the AOC, the following waterfowl consumption advisories apply (please note that in some cases a relevant structure or landmark may no longer be present. Assessing the waterfowl consumption advisory will be necessary to determine the exact locations of any waterfowl consumption advisory, should such advisories still be necessary after reassessment):

- Milwaukee River from Highway 167 (Thiensville) upstream to Lime Kiln Dam at Grafton and Cedar Creek from the Milwaukee River up to Bridge Road in the Village of Cedarburg—do not eat mallard ducks using this water.
- Milwaukee Harbor—do not eat black ducks, mallards, scaup, and ruddy ducks using this water
- Waters in the City of Cedarburg—do not eat Canada geese using these waters.

Rationale for Listing

Fish samples taken from the Milwaukee River system (which includes the Menomonee and Kinnickinnic Rivers) exceed standards established by the state of Wisconsin for the consumption of sport fish. The state issues consumption advisories for various population groups based on fish species and size classes. Advisories are collectively issued for the presence of mercury and PCBs. The Milwaukee River system has had waterbody-specific fish consumption advisories listed for PCBs for decades. As there is no waterbody-specific advice for mercury for waters of the AOC, waters within the AOC fall under the statewide consumption advisory for mercury.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

Because contaminated sediments are the primary contributor of contaminants to fish within the AOC, contaminated sediment cleanups (especially for PCBs) are necessary in making progress toward addressing this impairment. In 2014 designs were completed for Phase 2 of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project. Dredging is scheduled to start in late 2014 or early 2015. Mercury Marine is working in consultation with the U.S. Environmental Protection Agency (USEPA) and WDNR on a feasibility study for the Cedar Creek Superfund Alternative Site. This site is a source of PCBs to the AOC and needs to be remediated for BUI removal to occur. Ozaukee County and partners are conducting comprehensive monitoring of sediment contamination within the upper portion of the AOC in Ozaukee County, including the Mequon-Thiensville Dam impoundment on the Milwaukee River. Results of this assessment were received in late 2014 and are being reviewed.

WDNR received Great Lakes Restoration Initiative (GLRI) funding to collect data to reassess the status of the waterfowl consumption advisories, determine if any of the existing advisories can be removed or if any additional advisories are warranted. Sample collection began in 2013 and continued in 2014. Preliminary results indicate some type of consumption advisory will remain in place. However, as all data have not been received and analyzed as of late 2014, no change is currently proposed. Sampling will continue through spring of 2015. WDNR Fisheries Management samples waterbodies every 5 years in order to assess consumption advisories. The Milwaukee River and Cedar Creek are due for resampling in 2017 and 2018, respectively.

Next action(s) needed

Areas of the AOC contaminated with PCBs or other bioaccumulative chemicals of concern (BCOCs) need assessment and remediation. Consumption advisories for fish and wildlife need to be reassessed until it is determined the delisting targets are met.

At this time, the following specific actions are needed to address contaminated sediments:

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site (see Figure 2).
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to the former rail crossing south of Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.
- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

Issues (challenges, risks) affecting progress on this BUI

The main barrier to progress is ensuring enough funding through programs or responsible parties to complete all the contaminated sediment projects (both assessment and remediation) in a timely manner.

Figure 2. Map of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act site.

DEGRADATION OF FISH AND WILDLIFE POPULATIONS

Target and Status

Updated Target (2011)	Status
Fish This BUI will be considered to be eligible for removal when the following have occurred:	
• All contaminated sediment hotspots within the AOC have been identified, and implementation actions to remediate contaminated sites have been completed.	In progress, *and* Action needed
• A local fish and wildlife management and rehabilitation plan has been compiled for the estuary that: o Defines the causes of all population impairments within the AOC o Establishes site specific local population targets for native indicator fish and wildlife species within the AOC o Identifies all fish and wildlife population rehabilitation programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities, including identification of lead and coordinative agencies o Establishes a time table, funding mechanism, and lead agency or organization responsibility for all fish and wildlife population activities needed within the AOC. o The actions/projects necessary to accomplish the recommendations of the fish and wildlife management and restoration plan are implemented.	In progress
• Populations for native indicator fish species are statistically similar to populations in reference sites with similar habitat but little to no contamination.	Unknown
Wildlife Assess wildlife populations and the possible extent of any impairment within the AOC before setting specific wildlife population targets.	In progress, *and* Action needed

Target Rationale

Many partners in the AOC have developed plans that can be drawn from to determine the actions that are a priority to address this BUI. (Please see the References section for a list of resources related specifically to the fish- and wildlife-related impairments.) In 2012, WDNR assembled a team of fish and wildlife experts and began facilitating a process to determine measures of success, develop scopes of work for necessary assessments, and identify interim habitat projects that would help assess and address this impairment. Proposals for separate fish and wildlife assessments, as well as an outline of potential fish and wildlife goals and measures of success, can be found in Appendices A and B. The work of the fish and wildlife technical team will be assembled into a Habitat Plan for the AOC. Being able to define the causes of all population impairments is contingent upon completion of the assessments.

Rationale for Listing

The Stage 1 RAP (WDNR, 1991) and 1994 RAP update (WDNR, 1994) indicated that fish populations in the AOC were severely degraded and that the fish species resident in the AOC were mostly pollution tolerant species due to poor water quality. The lack of natural shoreline and channel features throughout the AOC, urban runoff, point sources, and sediment accumulation were the major factors noted for this impairment (WDNR, 1994, p. 2-17). In terms of the wildlife component of this goal, at the time that the RAP documents were written, there was essentially no data about wildlife populations. In the first RAP document written in 1991, the wildlife component was not considered to be part of the impairment for the Milwaukee Estuary AOC (WDNR, 1991, p. V-3). The RAP revision in 1994 stated that declines in wildlife populations were likely attributable to degraded water quality and loss of habitat, especially the loss of wetlands (WDNR, 1994, p. 2-17). The 1994 RAP also said that contaminants present in the AOC are known to affect wildlife reproduction and growth, and so the use should be considered impaired (WDNR, 1994, p. 2-18).

According to Waller and Rooney (2010), studies published in 2008 assessed ecological change in Milwaukee County and concluded there have been substantial losses of species richness with declines of 20-70% for bird, amphibian, and reptile groups, resulting mainly from habitat loss (2010).

Historically, there is a component of these impairments that has been viewed as being tied to contamination. While it is unclear from the scientific literature the degree to which contamination contributes to the decline of fish and wildlife populations, cleanup of contaminated sites in the AOC remains a key management action for this impairment. The lack of suitable physical habitat in order to support populations of desired fish and wildlife species is also a key feature that will need to be addressed to make progress on this impairment.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

Work on the GLRI-funded fish and wildlife population assessments began this year, completing the first year of these three-year projects. The wildlife population assessment is being carried out by Milwaukee County and UW-Milwaukee. The fisheries population assessment is being carried out by the U.S. Geological Survey (USGS) Wisconsin Science Center. The data collected will inform the identification of management actions needed to remove this BUI.

Next action(s) needed

The fish and wildlife assessment projects will continue in the next two years. Management actions will then be identified in consultation with the Fish and Wildlife Technical Team.

At this time, the following specific actions are needed to address contaminated sediments:

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.
- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

Issues (challenges, risks) affecting progress on this BUI

Answering the question of “when do we know we have created/enhanced enough habitat” will be challenging to determine, although the assessments’ results will help make the determination. We are aware of the difficulties with establishing population-related objectives for this BUI since attracting desired species can be more complicated than just providing them with suitable habitat. Just because habitat is created does not necessarily mean that the desired species can colonize those areas and persist as viable populations. The assessments will determine what species can still be viably sustained within the AOC, given the constraints imposed by the limited amount of habitat extent and diversity that can be restored in an urban environment.

FISH TUMORS OR OTHER DEFORMITIES

Target and Status

Updated Target (2011)	Status
Removal may occur if: • All known major sources of PAHs and chlorinated organic compounds within the AOC and tributary watershed have been controlled or eliminated	In progress *and* Action needed
• A fish health survey of resident benthic fish species, such as white suckers, finds incidences of tumors or other deformities at a statistically similar incidence rate of minimally impacted reference sites.	Assessment in progress (2012-2015)
OR, in cases where tumors have been reported: • A comparison study of resident benthic fish such as white suckers of comparable age and maturity, or of fish species found with tumors in previous fish health surveys in the AOC, with fish at minimally impacted reference sites indicate that there is no statistically significant difference (with 95% confidence) in the incidence of liver tumors or deformities.	TBD

Target Rationale

The 2008 document stated that the first step toward removing this impairment would be to determine if the use was impaired by sampling 50 fish to determine whether the tumor incidence rate was greater than 5%. WDNR's Office of the Great Lakes has used documented incidence rates and performed rigorous statistical analyses to help guide its approach to assessing the fish tumor impairment. The sampling design suggests a relatively large data collection effort in an attempt to achieve an acceptably high and known degree of confidence in the study results. For more detailed information about WDNR's sampling strategy for the 2012-2013 evaluation of this BUI, please see Appendix E in the 2012 RAP Update.

The updated target stipulates that the appropriate reference sites would be minimally impacted, as opposed to non-impacted, and that the tumors and deformities need to be contaminant-related since there can be other causes, like pathogens, of tumors and deformities in fish. A zero-percent incidence rate is not achievable, since tumors occur naturally in fish even in the absence of contaminants. The updated target also removed a previous provision stating that resident non-benthic fish should be sampled for this impairment. Given the nature of this particular impairment, and its close connection to contaminated sediments, there was no justifiable basis for this provision.

Rationale for Listing

The 1994 RAP included this BUI as suspected because the concentrations of certain PAHs and metals in AOC sediments were similar to concentrations in areas with verified fish tumors. As of 2008, no fish health surveys had been conducted within the AOC to determine the extent (or existence) of the impairment. This has since changed (see information in next two sections).

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

Sampling of 200 white suckers was conducted in 2013 in the Milwaukee Estuary to determine if this impairment existed (it was previously listed as suspected). The results of this assessment were received in 2014. Researchers found that 15% of the fish sampled in the Milwaukee Estuary had neoplastic liver tumors. This rate is higher than an expected background rate of fish tumors. This finding confirms that

an impairment exists. Henceforth, the "suspected" reference for this BUI is removed. The change is reflected in this RAP Update.

In 2014 the Root River (Racine, WI) was sampled to determine the tumor incidence rate at an appropriate minimally impacted reference site. The results of this assessment are expected in 2015.

Next action(s) needed

The results from the 2012-2013 sampling show that the tumor incidence rate in the Milwaukee Estuary is higher than background tumor rates. If the rate is found to be similar to a minimally-impacted reference site then the BUI may be considered for removal. However if the rate is higher than the reference site, it would indicate more needs to be done to control or eliminate the sources of contaminants contributing to the problem.

Sites that contain elevated amounts of PAHs, metals, and other substances that cause fish tumors and deformities must be addressed before removal of this impairment can occur. At this time, the following specific actions are needed to address contaminated sediments:

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.
- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

Issues (challenges, risks) affecting progress on this BUI

Although sampling is necessary to confirm whether the tumor incidence rate is similar to a reference river, there is a need to continue making progress on cleaning up PAH-contaminated sites in the AOC.

BIRD OR ANIMAL DEFORMITIES OR REPRODUCTION PROBLEMS (POTENTIALLY IMPAIRED)

Target and Status

Updated Target (2011)	Status
This BUI can be removed if: • Studies conducted in the AOC indicate that the beneficial use should not be considered impaired, or • If studies conducted in the AOC determine that this use is impaired, then two approaches can be considered for delisting: o Approach 1 – Observational Data and Direct Measurements of Birds and other Wildlife ▪ Evaluate observational data of bird or other animal deformities for a minimum of two successive monitoring cycles in indicator species identified in the initial studies as exhibiting deformities or reproductive problems. If deformity or reproductive problem rates are not statistically different than those at minimally impacted reference sites (at a 95% confidence interval), or no reproductive or deformity problems are identified during the two successive monitoring cycles, then the BUI can be removed. If the rates within the AOC are statistically higher than the reference site, it may indicate a source from either within or from outside the AOC. Therefore, if the rates are statistically higher or the data are insufficient for analysis to achieve agreed upon statistical power, then… ▪ Evaluate tissue contaminant levels in egg, young and/or adult wildlife. If contaminant levels are lower than the Lowest Observable Effect Level (LOEL) for that species for a particular contaminant that are not statistically different than those at minimally impacted reference sites (at a 95% confidence interval), then the BUI can be removed. ▪ Where direct observation of wildlife and wildlife tissue data are not available, the following approach should be used:	Assessment in progress TBD

o Approach 2 – Fish Tissue Contaminant Levels as an Indicator of Deformities or Reproductive Problems ▪ If fish tissue concentrations of contaminants known to cause deformities or reproductive suppression identified in the AOC are at or lower than the LOEL known to cause reproductive or developmental problems in fish-eating birds and mammals, the BUI can be delisted, or ▪ If fish tissue concentrations of contaminants known to cause deformities or reproductive suppression identified in the AOC are not statistically different than Lake Michigan (at 95% confidence interval with sufficient and agreed upon statistical power), then the BUI can be removed. Fish of a size and species considered prey for the wildlife species under consideration must be used for the tissue data.	

Target Rationale
Before targets can be developed with confidence for the AOC, sufficient studies must be conducted to determine if this beneficial use is impaired. The targets identified above should be reviewed following completion of the studies and modified in accordance with the findings of those studies.

Rationale for Listing
Insufficient data are available to show if these problems exist with birds or other animals within the AOC. The 1991 RAP considered this use unimpaired because of lack of information. Because contaminants like PCBs and heavy metals that are found in AOC sediments may have the potential to impair reproduction and development in wildlife, this use was considered impaired in the 1994 RAP.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status
USGS has been using tree swallows as indicators of environmental contamination in areas across the United States, and they previously sampled at least one site in the Milwaukee Estuary. USGS researchers expanded into four sites along the AOC in 2014; data were not yet available as of late 2014. Expanded sampling in Milwaukee will provide data robust enough to determine if this beneficial use is impaired.

Next action(s) needed
Additional data is needed to determine whether this is an impaired use in the AOC. Sampling by USGS at the expanded suite of sites in the AOC appears to be the best course of action to assess this impairment.

Issues (challenges, risks) affecting progress on this BUI
Until recently, limited data have been available to aid in the assessment of this impairment.

DEGRADATION OF BENTHOS

Target and Status

Updated Target (2011)	Status
Removal may occur if:	
• Known contaminant sources contributing to sediment contamination and degraded benthos have been identified and control measures implemented; and	In progress
• All remediation actions for contaminated sediments are completed and monitored according to an approved plan; or	In progress, *and* Action needed
• The benthic community within the site being evaluated is statistically similar to a reference site with similar habitat and minimal sediment contamination.	Assessment in progress (2012-2015)

Target Rationale

There are several considerations for this impairment. First, the harbor portion of the AOC will support different benthic communities than will the tributaries. Benthic communities in the harbor/estuary are subjected to regularly disturbed and altered physical conditions (like dredging and shoreline hardening from the installation of sheet piling). Second, benthic communities, either in the harbor or in the tributaries, are also impacted from pollution[1]. The rationale for this target is to clean up contaminants so that they aren't substantially impacting benthic communities, and then determine if the degradation of communities in the harbor is likely being caused by the poor physical conditions for which there is little feasible remedy. If there are degraded benthic communities in the tributaries, the main causes could be the presence of contamination or degraded physical habitat (e.g., substrates that don't provide adequate conditions for higher quality benthic communities). For both the harbor and the tributaries, contaminants and pollution must be assessed. Physical habitat should also be assessed to determine whether this could be contributing to the degraded communities, and, where feasible, habitat improvements should be made.

Measures such as sediment quality guidelines, equilibrium partitioning sediment benchmarks, and other sediment guidelines are part of the WDNR review to arrive at an approved remediation plan.

Rationale for Listing

According to earlier RAP documents, this beneficial use is considered impaired because of degraded physical habitat, low dissolved oxygen concentrations, and constituents in sediment toxic to macroinvertebrates, but the extent of the impairment is not well defined. The 1991 and 1994 RAP documents recognize that monitoring is required to better define this impairment. Furthermore, because physical conditions within the AOC are diverse, different final targets may be required for different habitat types within the AOC.

[1] The *Consensus-Based Sediment Quality Guidelines* for Wisconsin (see References) were developed through an assimilation of results from multiple published effects-based toxicity testing to freshwater benthos, so there is a clear and documented connection between contamination and deleterious benthic community impacts.

The RAPs also cite results of several benthic surveys in the AOC that showed benthos were lacking in diversity and were dominated by pollution-tolerant species. It was because of the lack of diversity and the prevalence of pollution-tolerant organisms that this impairment was listed.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status
Preliminary results from the benthos assessment in 2012 indicate that the Milwaukee Estuary benthos is impaired. A second year of sampling was completed in 2014, with results pending.

Next action(s) needed
Sources of contamination to the benthic community within the AOC need to be remediated. The next step will be to evaluate the findings of the USGS benthos study and then assess the need to supplement the study to adequately characterize the range of benthic conditions in the AOC.

Sources of contamination to the benthic community within the AOC need to be remediated.

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.
- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

Issues (challenges, risks) affecting progress on this BUI
Given the disturbance found in some of the AOC waterways, it is unlikely that high quality benthic communities can be established at all sites. For instance, the inner harbor has high degrees of sedimentation and low dissolved oxygen levels that tend to be dominated by very tolerant organisms. Changes in the habitat in this area are unlikely. Refinement of the target may be needed, taking into consideration the achievability of targets for BUI removal and the varied benthic conditions throughout the AOC.

RESTRICTIONS ON DREDGING ACTIVITIES

Target and Status

Updated Target (2011)	Status
Removal of this BUI can occur when: • Contaminated sediment hotspots within and upstream from the AOC have been identified.	In progress and Action needed
• Implementation actions to remediate contaminated sites have been completed. As a source control measure and for AOC remediation, known contaminated sites must be addressed before BUI removal is possible.	In progress
• There are no special handling requirements of material from routine navigational dredging due to contamination originating from controllable sources within the AOC.	In progress

Target Rationale

While many of the AOCs have defined this BUI to only federally maintained navigation channels, the Milwaukee Estuary RAP took a broader view of this issue. The Technical Advisory Committee for the 1994 RAP update recognized that contaminated sediments are linked to most of the BUIs in the AOC. Therefore, addressing contaminated sediments is central to removing this impaired beneficial use.

The intent is to eliminate special handling requirements that go beyond the normal handling requirements for dredged sediments. If sediments that are dredged for navigation, either by the U.S. Army Corps of Engineers or by private companies, contain moderate to high levels of contaminants, then there are additional costs incurred from the proper disposal of such sediments. We seek to eliminate those additional burdens imposed by the presence of contaminants so that parties can dredge and dispose of sediment by simply following required standard testing and disposal as mandated by state law.

Rationale for Listing

Contaminated sediments are recognized as one of the primary sources of pollution in the Milwaukee Estuary AOC. Historically, most of the AOC was modified, dredged, and maintained for large vessel navigation, making the estuary a settling basin for sediments. Over time, sections of the rivers that were previously maintained are no longer needed for deep draft navigation, but the sediments and their associated contaminants remain. This impairment was listed due to the presence of a number of contaminated sediment sites. Contaminants that are issues within the AOC include PAHs, heavy metals, and PCBs.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

Designs were completed for Phase 2 of the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project in 2014. Dredging is scheduled to start in late 2014 or early 2015. Mercury Marine is working in consultation with USEPA and WDNR on a feasibility study for the Cedar Creek Superfund Alternative Site. This site is in the AOC, has PCB-contaminated sediment and needs to be remediated for BUI removal to occur. Ozaukee County and partners are conducting comprehensive monitoring of sediment contamination within the upper portion of the AOC in Ozaukee County, including the Mequon-Thiensville Dam impoundment on the Milwaukee River. Results of this assessment were received in late 2014 and are being reviewed. Figure 3 shows the status of contaminated sediment projects in the AOC.

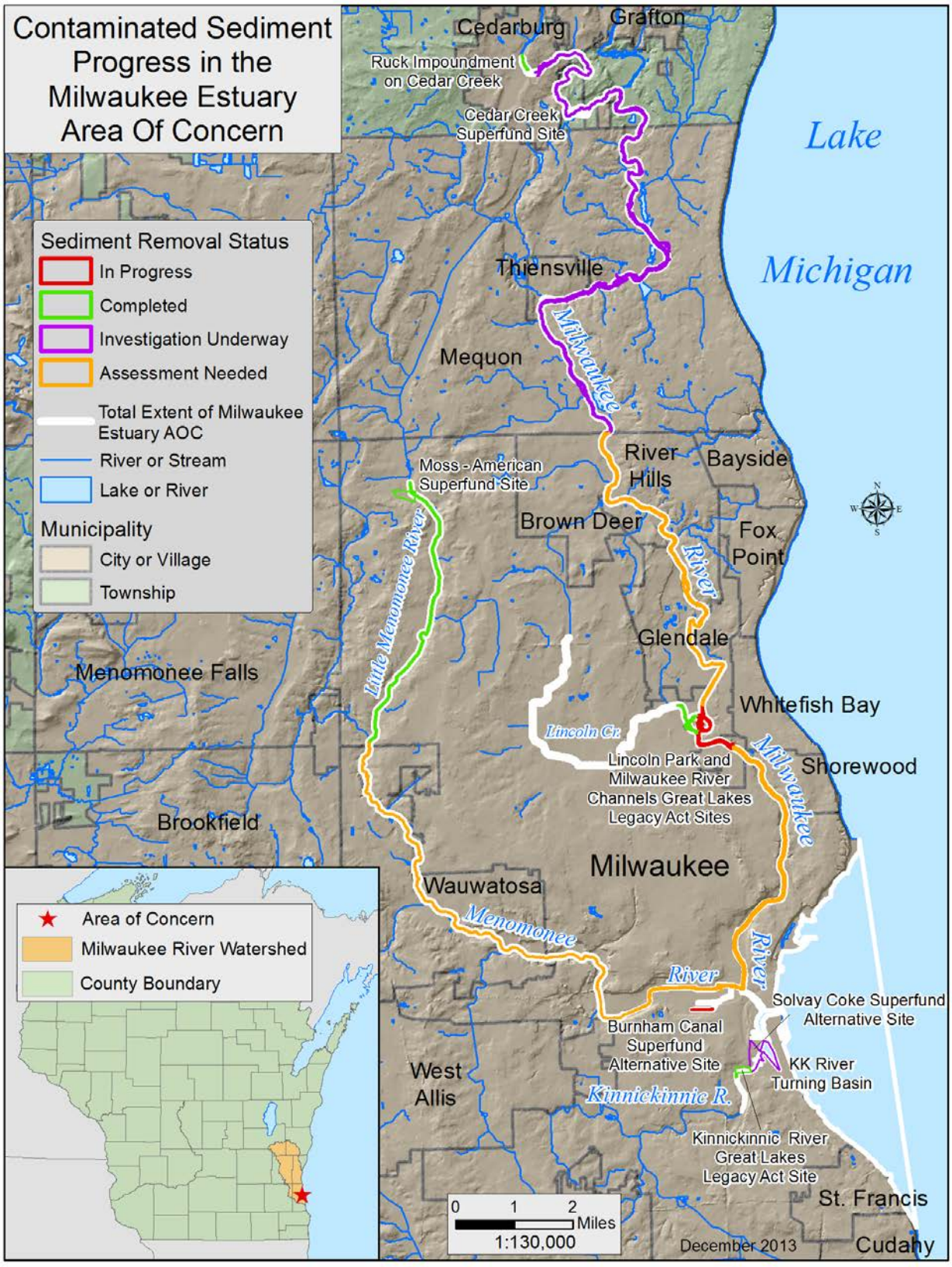

Figure 3. Sediment progress and sites needing action in the Milwaukee Estuary AOC.

Next action(s) needed

Remediation of contaminated sediment is necessary before this BUI can be removed. The next action needed is to investigate suspected areas of contaminated sediment in areas of the Milwaukee and Menomonee River portions of the AOC shown on Figure 3. This will assist in identifying the need, if any, for cleanup actions. At this time, the following specific actions are needed to address contaminated sediments:

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.
- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

For contaminated sediment cleanups, when possible upstream sources/sites should be addressed before addressing sites further downstream; however, anytime opportunities present themselves to address contamination, they should be taken, even if a downstream site is cleaned up ahead of a site further upstream.

Issues (challenges, risks) affecting progress on this BUI

The main barrier to progress is ensuring enough funding through programs or responsible parties to complete all the contaminated sediment projects (both assessment and remediation) in a timely manner.

EUTROPHICATION OR UNDESIRABLE ALGAE

Target and Status

Updated Target (2011)	Status
Removal of this BUI can occur when:	
• Total phosphorus (TP) concentrations within the AOC rivers, harbors, and nearshore waters meet the criteria recommended for the State of Wisconsin, as established by WDNR.	In progress *and* Action needed
• When the results from the total maximum daily load study for phosphorus, total suspended solids, and bacteria are completed for the Menomonee, Kinnickinnic, and Milwaukee Rivers.	In progress
• Measures to meet the Total Maximum Daily Loading Implementation Plan are being completed.	TBD
• No water bodies within the AOC are included on the list of impaired waters due to nutrients or excessive algal growths in the most recent WI Impaired Waters list.	Action needed
• Chlorophyll-*a* concentrations within the AOC lake and impoundment areas do not exceed 4.0 µg/L.	Unknown
• There are no beach closures in the AOC due to excessive nuisance algae growth.	Unknown

Target Rationale

The target revision was needed because at the time that the proposed targets were being developed in 2008, Wisconsin did not have any criteria for nutrients, but was in the process of developing them. Phosphorus criteria have since been established, and in the AOC, the Menomonee, Milwaukee, and Kinnickinnic Rivers (as well as many of their tributaries) are listed as impaired because of low dissolved oxygen concentrations caused by excessive phosphorus pollution (WDNR, Impaired Waters Program). The Milwaukee Metropolitan Sewerage District (MMSD) has received funding to determine where the sources of contamination are coming from (i.e., a total maximum daily load study, or TMDL), and the results of the study should inform future actions that will be necessary in order to reduce phosphorus pollution to the AOC.

The estuary rivers currently have variance criteria (see NR 104.06 of the Wisconsin Administrative Code) for dissolved oxygen concentrations (2 mg/L), indicating that the estuary is not capable of supporting full fish and aquatic life use designations that would require dissolved oxygen concentrations of at least 5 mg/L. Stakeholders have indicated that they would like waters of the AOC to meet the full fish and aquatic life standard of 5 mg/L, and significant strides have been made in improving water quality. We'd like to aim for attaining the full fish and aquatic life standard in cases where there are sometimes lower dissolved oxygen concentrations (e.g., on portions of the Kinnickinnic River).

Rationale for Listing

The 1994 RAP considered this use impaired because phosphorus, nitrogen, and chlorophyll *a* concentrations within the AOC indicated eutrophic conditions (WDNR, 1994, p. 2-19). Low dissolved oxygen concentrations were also common within the AOC rivers. The estuary acts as a settling basin for suspended materials. The organic portion is broken down through chemical and biological processes that demand oxygen from the water column, leading to lower concentrations. The Milwaukee Estuary, including the lower Menomonee, Milwaukee, and Kinnickinnic Rivers are regularly listed as impaired waters (as part of the state's Clean Water Act/303(d) program) for excess phosphorus and low dissolved oxygen concentrations. In the 1994 RAP, total phosphorus levels in the AOC exceeded 0.1 mg/L in 40 to 75 percent of the samples taken from the Inner Harbor, and 10 to 25 percent of the time from the Outer Harbor.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

MMSD received GLRI funding to complete third-party TMDL analyses on the Kinnickinnic, Menomonee, and Milwaukee Rivers and the Milwaukee Estuary. While the project was scheduled to be completed by the end of 2013, delays have pushed back the completion date to 2015, with implementation to follow.

Next action(s) needed

The results from the TMDL study should be helpful in determining what progress can be made with regard to the issue of phosphorus loading in the estuary, and improving water quality. Once the TMDL has been completed and the implementation plan has been prepared, we will have a better idea if we will need to do anything further in order to remove this BUI. Support for the TMDL implementation will also be critical, and specific actions will be identified in the TMDL implementation plan.

Nonpoint source pollution is a challenge to making progress on this impairment. Therefore, addressing nonpoint source pollution throughout the AOC watersheds is a priority issue for continuing to make progress in the estuary itself. Green infrastructure projects and implementation of other stormwater best management practice projects should be a priority to address this impairment.

Issues (challenges, risks) affecting progress on this BUI

The physical conditions within the estuary itself have not changed so despite the substantially decreased contributions of organic material from sewer overflows, meeting the designated fish and aquatic uses may still be difficult. Another challenge for addressing this impairment will be the contribution of orthophosphate to total phosphorus levels in waterbodies in the AOC. Some municipal water supplies in the AOC add orthophosphate as an anticorrosive agent. Under Wisconsin state statute and administrative code (Section 283.35, Wis. Stats. and Section NR 205.08, Wis. Adm. Code), this treated water is used in some non-process waters, (e.g., cooling systems) and directly discharged without having the orthophosphate removed. The orthophosphate increases the total phosphorus concentrations in waterbodies and can contribute to further algal growth.

BEACH CLOSINGS/RECREATIONAL RESTRICTIONS

Target and Status

Updated Target (2011 & 2012)	Status
This BUI will be considered removed when:	
• All known sources of bacterial contamination to the AOC and tributary watersheds have been identified and, if feasible, have been controlled or treated to reduce possible exposures; and	Assessment in progress, *and* Action needed
• No unpermitted overflows (either from sanitary sewers or combined sewers) have occurred within the AOC during the previous five year period.	Unknown
• All municipalities within the AOC have adopted and are implementing storm water reduction programs including an illicit discharge elimination program; and	Complete
• No water bodies within the AOC are included on the list of impaired waters due to contamination with pathogens or chemicals having a public health concern (i.e., carcinogenic, mutagenic) in the most recent Wisconsin Impaired Waters list that is submitted to USEPA every two years; and	In progress *and* Action needed
• No local or state contact advisories related to the presence of a chemical contaminant have been issued within the AOC during the previous five years.	Unknown
• No water bodies (including beaches) within the AOC are included on the list of impaired waters for recreational restrictions in the most recent Wisconsin Impaired Waters list.	In progress, *and* Action needed
• Implementation of the Milwaukee River Total Maximum Daily Load Study for bacteria is complete.	In progress, *and* Action needed

Target Rationale

At the time that the targets were being proposed, there were several beaches listed for pathogens, and there had been problems with pathogens at beaches. Bradford Beach was closed 28 days in 2006 and South Shore Beach was closed 43 days in 2006. Bradford, McKinley, and South Shore Beaches were listed on the Wisconsin Impaired Waters list because they were not meeting their full recreational uses due to bacterial contamination.

Since that time, conditions at several of the beaches have substantially improved, and for the 2010 impaired waters list, Wisconsin recommended delisting, or removing, Bradford and McKinley beaches from the impaired waters list for pathogens.

In 2012, WDNR modified the targets for this impairment (refer to WDNR, 2012, p. 37-38). The second bullet specifying that there should be no sanitary sewer overflows or unpermitted combined sewer

overflows for a less than 25-year rainfall event was revised, since this language is inconsistent with WDNR's wastewater permitting language. Additionally, two items of the target relating to no water bodies or beaches in the AOC being listed for recreational restrictions were combined into one target item. Additionally, a target item related to implementation of the TMDL for bacteria was necessary, since implementation of the TMDL should lead to removing the AOC waterbodies from the impaired waters list.

Since the Deep Tunnel system came online in 1994, the frequency of sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) has decreased dramatically. Complicating matters is that water quality models have shown that 60-75% of the fecal coliform loads cannot be explained by nonpoint source runoff from rooftops, parking lots, streets, and other impervious surfaces (SEWRPC, 2008), especially for the Menomonee and Kinnickinnic (KK) Rivers. The Great Lakes Water Institute's preliminary data demonstrates that exfiltration (leaking) from failing sanitary sewer infrastructure is a major source of fecal indicator bacteria and pathogens in urban stormwater that impacts the AOC. This means that stormwater systems are acting as conduits for conveying sewage from failing infrastructure into surface waters used for drinking water and recreation. This sanitary waste poses a more direct threat to human health, since it is more likely to contain pathogens than urban stormwater runoff. This problem is particularly difficult to address because thousands of localized breaches within the sanitary sewage system are much more difficult to address than combined and sanitary sewage overflows, where sources and system capacities are well understood. Pathogen loading from non-point sources is quite high and must be addressed before state water quality standards for recreation can be met. This is why we are proposing that the TMDL be implemented first before BUI removal occurs. In order to implement the TMDL, there is a need to understand where sewage is getting into the AOC waterways. To this end, a proposal was written to both help with TMDL implementation and BUI removal. This proposal can be found in Appendix G of the 2012 RAP Update.

Although the 2008 targets address some aspects of source control, actions that will address the problems caused by bacteria loading (e.g., excessive beach closures or recommended limits for body contact on AOC rivers attributed to high pathogen levels) need to be considered. This means that additional reductions through the abatement of non-point source loading of bacteria will be necessary in order to remove this impairment.

According to the current methodology in the Wisconsin Consolidated Assessment and Listing Methodology (WisCALM), waters can be listed as impaired for having contaminated sediments that would pose a risk to public welfare and safety (WDNR, 2013, p. 51). While contaminated sediments are a problem in the AOC, high counts of pathogens are a more widespread recreational hazard and are more directly associated with this impairment.

Rationale for Listing

The 1991 RAP indicates that although there are no beaches within the river system, there are several public beaches within the Lake Michigan portion of the AOC that consistently do not meet water quality standards for recreation. Data from the lower river system also exceeds the state recreation standards. The 1994 RAP Update indicates that there were essentially no changes in the status of this BUI between the initial RAP document and the update. Beach closings and recreational restrictions was still considered an impaired beneficial use in the AOC. Potential sources of contamination are indicated as CSO events and both urban and rural storm water. In the early 1990s, South Shore beach along Lake Michigan closed periodically, for 48 to 96 hours, when high bacteria counts occurred after CSO events (WDNR, 1994, p. 2-19). In summary, the waters of the AOC have frequently exceeded state water quality standards for recreation.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

There are six beaches within the AOC: Bradford Beach, McKinley Beach and Jet Ski Launch, South Shore Beach, South Shore Rocky Beach, and Bay View Beach (Figure 4). Conditions have improved greatly at McKinley and Bradford Beaches. Bradford Beach received Blue Wave Certification through the Clean Beach Council in 2009. While there have been successes with regard to beaches, South Shore Beach continues to be on the impaired waters list for high levels of bacteria. In 2013, the Natural Resources Defense Council listed South Shore Beach in its Annual Beach Report as a National "repeat offender" because of persistent contamination problems—water samples violated public health standards more than 25 percent of the time for each year from 2008 to 2012 (NRDC, 2013). Concept plans for improvements to South Shore Beach commissioned by Milwaukee County were completed as part of a larger Park planning effort in 2013. MillerCoors has pledged $500,000 over five years to implement improvements to the park.

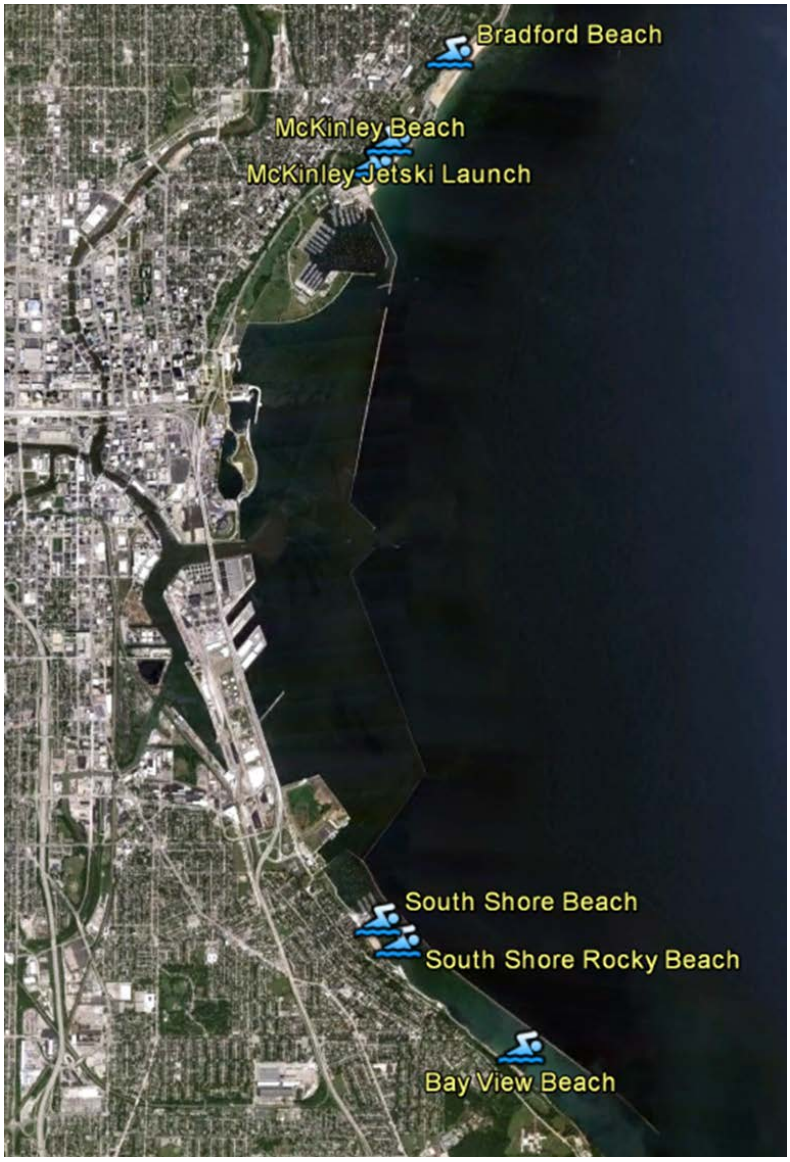

Figure 4. Beaches in the Milwaukee Estuary AOC.

In 2014 sampling began for the “Identification and Quantification of Sanitary Sewage Contamination in the Milwaukee Estuary AOC” or bacterial source tracking project. This effort will identify areas that pose the greatest risk to human health. Specifically, the project will address significant impediments to TMDL implementation by identifying the most critical infrastructure failures, and assisting decision-makers in determining their policy priorities for stormwater management and infrastructure investment. WDNR has established an agreement with the University of Wisconsin-Milwaukee (UWM) School of Freshwater Sciences to complete this two year project. The information collected will provide critical information needed to address this impairment.

Next action(s) needed

The bacterial source tracking project will continue in 2015. An output of this effort will be mapping and disseminating the locations of stormwater outfalls that are discharging sewage to the municipalities, so they can effectively direct their limited budgets toward projects that would make the greatest impact on improving water quality in the Milwaukee Estuary AOC, thus helping to bring the AOC into compliance with water quality standards.

Work to address high bacterial levels at South Shore beach is needed. Supporting Milwaukee County’s plans to improve the beach will be an important step in addressing this impairment. In addition, when and where it is feasible, actions should be taken to control sources of bacteria that cause recreational restrictions on AOC waters.

Issues (challenges, risks) affecting progress on this BUI

Bacterial levels will continue to increase as infrastructure ages and lateral sewer lines continue to fail, posing a significant obstacle toward making progress on the recreational restrictions portion of this impairment.

DEGRADATION OF AESTHETICS

Target and Status

Target (2008)	Status
This delisting target is consistent with Chapter NR 102, Water Quality Standards for Surface Waters. Delisting shall occur when monitoring data within the AOC and/or surveys for any five year period indicates that water bodies in the AOC do not exhibit unacceptable levels of the following properties in quantities which interfere with the Water Quality Standards for Surface Waters:	
a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water shall not be present in such amounts as to interfere with public rights in waters of the state.	Assessment in progress
b) Floating or submerged debris, oil, scum, or other material shall not be present in such amounts as to interfere with public rights in waters of the state.	Assessment in progress
c) Materials producing color, odor, taste, or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.	Assessment in progress
The following target will also be met to determine when restoration has occurred: Corrective action plans are in-place and being implemented for all known sources of materials contributing to the degradation of aesthetics within the AOC.	TBD

Target Rationale

The proposed target is consistent with existing state water quality standards, but because of its arbitrariness, we should evaluate with the Stakeholder Delegation whether a five year period is the appropriate amount of time necessary to determine when impairment removal can occur.

Rationale for Listing

This beneficial use is considered impaired because of the poor visual quality of the water resources and adjacent land. The 1994 Milwaukee RAP attributed the likely cause of the impairment to surface water debris, oil and grease, and overdevelopment along the estuary. The likely sources of these causes include point source pollution, nonpoint source pollution, and litter.

After storms, considerable debris can be seen near almost every combined sewer overflow and storm sewer outfall. Floating litter significantly degrades aesthetic value and recreational enjoyment of urban waterways. Floatable trash likely comes from many sources, including illegal dumping of trash into streams; littering into the drainage area of rivers; ill-maintained dumpsters; improper streambank modifications; sanitary sewer overflows and combined sewer overflows; marine sources and recreational users; and, most importantly, from stormwater runoff.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

The volunteer aesthetics monitoring program was suspended in 2014 in order to update the protocols. Previous monitoring data collected at 12 sites can still be used in conjunction with information collected under the updated protocol (see Figure 5). Efforts by partners, including river clean up events and operation of the river skimmer, continue within the AOC.

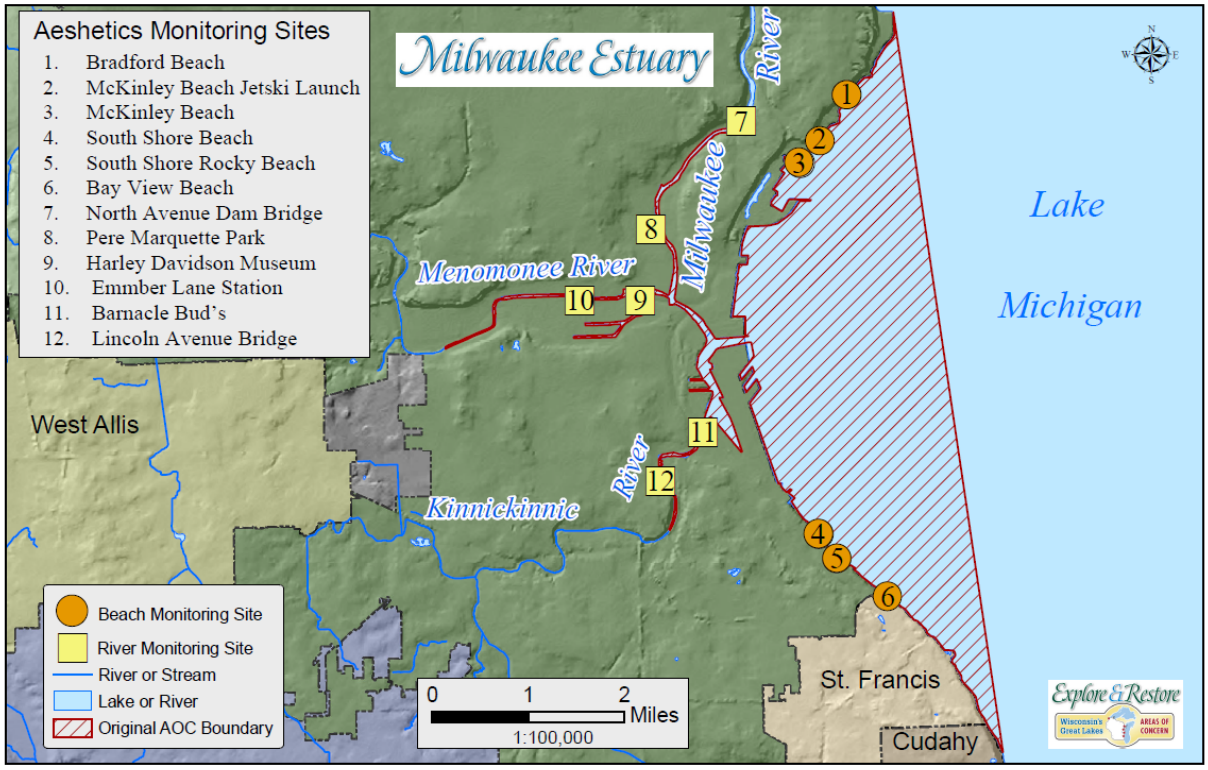

Figure 5. Aesthetics monitoring sites.

Next action(s) needed

Under the updated protocols, more data collection will be necessary. A renewed volunteer monitoring effort will be pursued in 2015 along with target updates that address a statistically valid monitoring protocol. The goal is to work with local organizations to carry out the volunteer aesthetics monitoring program to assess the status of the impairment and if necessary determine what additional actions would be needed for BUI removal.

Issues (challenges, risks) affecting progress on this BUI

The impairment was listed primarily for the AOC because of the water's poor visual appearance and "overdevelopment along the estuary." At the present time, it is unclear whether some of the potential contributing factors that degrade aesthetics may be able to be addressed through the AOC program.

DEGRADED PHYTOPLANKTON AND ZOOPLANKTON POPULATIONS

Target and Status

Updated Target (2012)	Status
A stepped approach is needed for delisting for this impairment:	
1. The first step toward delisting will be to establish a baseline condition for the estuary to evaluate the extent of this impairment. Phytoplankton and zooplankton community surveys should be conducted and compared to a non-impacted or minimally impacted reference site to set the baseline condition. If the community structure is statistically different than the reference conditions, this BUI should be considered impaired.	Assessment in progress (2012-2015)
2. Identify the factors leading to this impairment. a) Ambient water chemistry sampling should be conducted to determine if nutrient enrichment is the main contributor. If nutrients are the main contributor, sources causing nutrient enrichment to the outer harbor and nearshore waters are identified and controlled. b) If nutrient enrichment is not considered the cause of the impairment, conduct bioassays to determine if ambient water toxicity is causing impairment.	TBD

Target Rationale

Basic information regarding this impairment is lacking. Assessment is needed to verify the impairment before factors leading to the impairment can be identified. The 1994 RAP indicated that this beneficial use was impaired because of the poor diversity of plankton, attributed to the eutrophic conditions and the increased conductivity in the estuary and Outer Harbor (WDNR, 1994, p. 2-20).

WDNR removed a third item in the targets last year requiring the AOC not to be listed as impaired due to phytoplankton and/or zooplankton toxicity in the most recent Wisconsin Impaired Waters list. It was removed because there are no considerations for listing waterbodies as impaired due to plankton toxicity (WDNR, 2013). The results of the plankton assessment will be used to try to determine any causes of the impairment. Item two in the targets captures the necessity to look at both water chemistry and possible toxicity effects on plankton communities.

Rationale for Listing

This BUI is relevant to the Outer Harbor and nearshore Lake Michigan portions of the Milwaukee Estuary AOC. The 1994 RAP Update indicated that both phytoplankton and zooplankton populations within the Outer Harbor and near shore Lake Michigan are impaired. Like the eutrophication and undesirable algae BUI, these organisms are most affected by nutrient loading and dynamics in the estuary and lake.

According to the 1994 RAP, phytoplankton population data collected by MMSD in the Outer Harbor were representative of nutrient enriched (eutrophic) conditions. Nearshore phytoplankton assemblages had some tolerant organisms, but were more indicative of mesotrophic conditions. The data indicated that the three rivers draining to the Estuary have a significant influence on the phytoplankton community in the Outer Harbor. The nearshore waters in the AOC are also affected by the rivers, but to a lesser extent.

Phytoplankton populations were noted to be affected by high nutrient loads to the rivers and harbor. An increase in species tolerant of eutrophic conditions indicated degraded water quality conditions.

Zooplankton populations were also affected. Studies in the 1980s done by MMSD found declining species richness, and dominance of pollution tolerant species in the outer harbor compared with the community structure of the open lake. Species abundance was greater in the Outer Harbor compared to the lake, which indicates nutrient enrichment (WDNR, 1994).

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status
Preliminary results from the plankton assessment in 2012 indicate that the Milwaukee Estuary planktonic community is impaired. A second year of sampling was completed in 2014, with results pending.

Next action(s) needed
The next step will be to evaluate the findings of the USGS study from 2012 and 2014 and then investigate if nutrient enrichment and/or toxicity are causes of the plankton impairment.

Issues (challenges, risks) affecting progress on this BUI
A full assessment of the impairment cannot be made until the final data from 2012 and 2014 are received from USGS.

LOSS OF FISH AND WILDLIFE HABITAT

Target and Status

Updated Target (2011)	Status
This BUI will be considered to be eligible for removal when the following have occurred:	
• All contaminated sediment hotspots within the AOC have been identified, and implementation actions to remediate contaminated sites have been completed.	In progress
• A local fish and wildlife management and rehabilitation plan has been compiled for the estuary that: o Defines the causes of all habitat impairments within the AOC o Establishes site-specific habitat and population targets for native indicator fish and wildlife species within the AOC o Identifies all fish and wildlife habitat rehabilitation programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities, including identification of lead agencies o Establishes a time table, funding mechanism, and lead agency or organization responsibility for all fish and wildlife habitat rehabilitation activities needed within the AOC.	In progress
• The programs and actions necessary to accomplish the recommendations of the fish and wildlife habitat plan are implemented, and modified as need to ensure continual improvement.	In progress

Target Rationale

Contaminated sediments in the AOC must be addressed in order for this impairment to be removed. A plan also needs to be developed that will list measures of success, focal species, and projects that will help address the physical habitat issues in the AOC.

Rationale for Listing

This beneficial use is considered impaired by the 1994 Milwaukee AOC RAP. The 1994 RAP cites urban development in areas adjacent to the estuary as having greatly diminished aquatic and wildlife habitat. Natural stream banks did not, and still do not, exist below the former North Avenue Dam on the Milwaukee River. Almost no natural areas exist on adjacent streambanks in the harbor or along the rivers. The rivers within the estuary have been heavily engineered for shipping and commerce, producing unnatural shorelines and a virtual “ecological desert” for many aquatic and semi-aquatic wildlife species. The habitat in the lower reaches of each of the watersheds draining into the Milwaukee Harbor estuary is typical of that found in a highly urbanized environment, with extensive channelization and placement of sheet piling for bank stabilization. From a water quality perspective, fish and aquatic habitat is impaired by excessive sedimentation (including contaminated sediments) and poor ambient water quality. Nutrient loading and low dissolved oxygen concentrations further degrade habitat available for fish forage and spawning. There is little cover for resident fish species, and few trees, shrubs and other vegetation to provide shade that could temper high water temperatures in summer months. More natural habitat can be generally found in upstream areas of each of the major rivers and their tributaries.

Loss of wildlife habitat was not considered impaired in the 1991 RAP because it was not considered to be caused by contamination, but by lack of physical habitat (WDNR, 1991, p. V-12). The 1994 RAP expanded the scope to include lack of physical habitat as an impairment. There is very little loafing and resting habitat for migratory waterfowl—it is not uncommon to see mallards and other ducks resting on submerged logs, and other floating debris as well as boats due to general lack of natural resting areas in the AOC's urban waterways (WDNR, 1994, p. 2-21).

The 1994 RAP added that the confined disposal facility (CDF) near Jones Island may be a source of contaminants for waterfowl. The CDF within the outer harbor provides sheltered water habitat and is used for loafing and forage by many migratory and resident duck species and geese. A sentinel duck study was conducted in the summer of 1990 to determine if waterfowl were accumulating contaminants from the Milwaukee CDF. The study concluded that ducks released into the CDF did not accumulate significant concentrations of contaminants compared to field and background levels (WDNR, 1994, p. 2-16). This may be due to the fact that the most contaminated sediments within the CDF were originally deposited in the 1970s and are buried to the extent that they are no longer available to wildlife.

More recent studies documented substantial losses of species richness in Milwaukee County in other wildlife, with declines of 20-70% for bird, amphibian and reptile groups, resulting mainly from habitat loss (Waller and T. Rooney, 2010). Habitat restorations within the AOC will be important for addressing these more regional losses.

Summary of Key Remedial Actions since the 2013 RAP Update and Current Status

In 2014, work with the Fish and Wildlife Technical Team continued. The final list of habitat projects to address this BUI is a work in progress. Work on habitat projects by partners continued in 2014 including the following:

- Little Menomonee River Parkway Grassland Restoration implementation – Milwaukee County;
- Menomonee River Concrete Removal Phase 1 & 2 implementation and planning – MMSD & U.S. Army Corps of Engineers;
- Burnham Canal Wetland Restoration planning – MMSD;
- Bay View Wetland planning – City of Milwaukee; and,
- Milwaukee River Fish Habitat Enhancement & Expansion construction – WDNR Fisheries Management.

Next action(s) needed

In 2015, the Technical Team will continue to develop a final list of habitat projects that address this impairment.

Sources of contamination within the AOC need to be remediated.

- Complete the assessment and cleanup of PCBs at the Cedar Creek Superfund Alternative Site.
- Complete Phase 2 of the cleanup of PCBs and PAHs from the Lincoln Park/Milwaukee River Channels Great Lakes Legacy Act project site.
- Assess the sediment in the Menomonee River downstream of its confluence with the Little Menomonee River to the estuary.
- Assess areas on the Milwaukee River from confluence with Cedar Creek downstream to Silver Spring Drive, and from Estabrook Park dam, downstream to the estuary.
- Complete the cleanup of PAHs and metals from the Burnham Canal Superfund Alternative Site.
- Complete the assessment of contaminated sediment and evaluate clean up options related to the Solvay Coke Superfund Alternatives Site.

- Assess the potential impacts to sediments from other manufactured gas plants within the AOC.

Issues (challenges, risks) affecting progress on this BUI

Projects in and connected to the AOC can be expensive to complete due to many factors common in implementing projects in urban environments and along historically developed waterways. However, in order for aquatic projects to have an impact in the estuary, they need to be connected to the waterbody.

CONCLUSION

Working with the stakeholders and project partners will be critical to securing support for projects and continuing to make progress in the AOC. Although progress has been made in the AOC, there are still several key actions that need to continue or occur in order to address the impairments. First, the assessment and remediation of contaminated sites is necessary in order to address many of the impairments. Several sites to date have been addressed, but other parts of the AOC need to be characterized and addressed before contamination-related issues in the AOC no longer pose a substantial threat to fish and aquatic life in the AOC.

Work on identifying and implementing other management actions is an important next step in AOC progress. Supporting efforts already underway such as the TMDL, contaminated sediment dredging and habitat projects will be a priority in 2015. In some cases additional information is necessary to further refine our actions or in order to assess the status of a BUI. In 2015, continuing bacterial source tracking, fish and wildlife assessments aesthetics monitoring, assessment of consumption advisories and information from current USGS projects will be crucial to continuing to make headway on addressing impairments. The fish and wildlife technical team will continue to meet and make progress on identifying actions for the fish and wildlife impairments.

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APPENDICES

Appendix A Milwaukee Estuary AOC Tracking Matrix
Appendix B Outreach & Education - 2014

Appendix A

Milwaukee Estuary AOC Tracking Matrix

Note that projects listed in the table below are the next clearly delineated action steps that have been identified by WDNR in collaboration with AOC partners and stakeholders to make progress toward delisting the AOC. This list does not necessarily reflect all actions that will ultimately be needed to remove impairments.

Milwaukee Estuary AOC Tracking Matrix 2014

Project Name	BUI Addressed	Project Type	Action Type	Project Status	Project Start Date	Project End Date	Project Cost	Primary Funding Source	Project Lead Organization
Volunteer Aesthetics Monitoring Program	BUI 11	Aesthetics	Assessment	In Progress	March 2012	Unknown	50000 (e)	State GLRI non-competitive Grant	Wisconsin DNR
Assessment of Benthos and Plankton in Wisconsin's Lake Michigan Areas of Concern	BUI 6, BUI 13	Fish and Wildlife	Assessment	In Progress	Spring 2014	December 2015	$414,300	State GLRI non-competitive Grant	Wisconsin DNR
Burnham Canal Wetland Restoration	BUI 14	Fish and Wildlife	Restoration	In Development	Unknown	Unknown	$4,500,000	TBD	Milwaukee MSD
Estabrook Dam Fish Passage	BUI 14	Fish and Wildlife	Restoration	In Development	Unknown	Unknown	Unknown	TBD	Milwaukee County
Fish Population Assessment	BUI 3	Fish and Wildlife	Assessment	In Progress	April 2014	August 2016 (e)	$262,000	State GLRI non-competitive Grant	Wisconsin DNR
KK River Habitat Restoration from Becher St to Chase Ave	BUI 14	Fish and Wildlife	Restoration	In Development	Unknown	Unknown	$348,000	NOAA	Milwaukee MSD
Kletzsch Dam Fish Passage	BUI 14	Fish and Wildlife	Restoration	Not Started	Unknown	Unknown	Unknown	Unknown	Milwaukee County
Little Menomonee Grassland Restoration	BUI 14	Fish and Wildlife	Restoration	In Progress	2013	2014	$37,000	State GLRI non-competitive Grant	Milwaukee County
Menomonee River Concrete Removal Upstream of Soo Line RR Bridge to 1-94 (Phase 1)	BUI 14	Fish and Wildlife	Restoration	In Progress	July 2013	2014	$5,400,000	MMSD, EPA GLRI Competitive Grant	Milwaukee MSD
Menomonee River Concrete Removal Upstream of Soo Line RR Bridge to 1-94 (Phase 2)	BUI 14	Fish and Wildlife	Restoration	In Progress	2014	March 2016	$5,250,000	Great Lakes Restoration Intiative	Milwaukee MSD
Milwaukee Estuary Fish Tumor Evaluation	BUI 4	Fish and Wildlife	Assessment	In Progress	May 2013	April 2015	$168,400	State GLRI non-competitive Grant	Wisconsin DNR
Milwaukee EstuaryWildlife Consumption Advisory Evaluation	BUI 1, BUI 1	Fish and Wildlife	Assessment	In Progress	June 2013	June 2016	$185,436	State GLRI non-competitive Grant	Wisconsin DNR

Milwaukee Estuary AOC Tracking Matrix 2014

Project Name	BUI Addressed	Project Type	Action Type	Project Status	Project Start Date	Project End Date	Project Cost	Primary Funding Source	Project Lead Organization
Milwaukee River Fish Habitat Enhancement and Expansion	BUI 14	Fish and Wildlife	Restoration	In Progress	2014	2014	$80,000	Fund for Lake Michigan, State GLRI non-competitive grant	Wisconsin DNR
Removal of Five Low Flow Barriers on the Menomonee River	BUI 14	Fish and Wildlife	Restoration	In Progress	May 2014 (e)	Unknown	$973,527	Other GLRI Competitive Grant	Milwaukee MSD
USGS Tree Swallow Monitoring	BUI 5	Fish and Wildlife	Assessment	In Progress	2010	Unknown	Unknown	Great Lakes Restoration Intiative	USGS
Wheelhouse Gateway Riparian Restoration	BUI 14	Fish and Wildlife	Restoration	Completed	October 2013	October 2014	$971,000	EPA GLRI Competitive Grant	River Revitalization Foundation
Wildlife Population Assessment	BUI 3	Fish and Wildlife	Assessment	In Progress	May 2014 (e)	August 2017 (e)	$305,000	State GLRI non-competitive Grant	Wisconsin DNR
Identification and Quantification of Sanitary Sewage Contamination in the Milwaukee Estuary Area of Concern	BUI 10	Nonpoint	Assessment	In Progress	January 2014	December 2015	$502,226	State GLRI non-competitive Grant	UW-Milwaukee
Assess Menomonee River downstream of its confluence with the Little Menomonee River to the estuary	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA
Assess the Milwaukee River downstream of its confluence with Cedar Creek to the Milwaukee River Channels/Lincoln Park Great Lakes Legacy Act projects	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA
Burnham Canal Superfund Alternative Remediation	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	In Development	Unknown	Unknown	$1.6 million	Responsible Party	USEPA
Cedar Creek Superfund Alternative Remediation	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	In Development	May 2015 (e)	Unknown	Unknown	Responsible Party	USEPA
Lincoln Park/Milwaukee River Channels Remediation-Phase 1	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	Completed	May 2011	February 2012 (remediation)	approx $27.5 million	Great Lakes Legacy Act	USEPA
Lincoln Park/Milwaukee River Channels Remediation-Phase 2	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	In Progress	August 2014	September 2015 (remediation)	approx $15 million	Great Lakes Legacy Act	USEPA

Milwaukee Estuary AOC Tracking Matrix 2014

Project Name	BUI Addressed	Project Type	Action Type	Project Status	Project Start Date	Project End Date	Project Cost	Primary Funding Source	Project Lead Organization
Sediment characterization in KK River turning basin	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	Not Started	Unknown	Unknown	Unknown	Great Lakes Legacy Act	USEPA
Solvay Coke Superfund Alternative Remediation	BUI 1, BUI 3, BUI 4, BUI 6, BUI 7, BUI 14	Sediment	Remediation	In Development	Unknown	Unknown	Unknown	Responsible Party	TBD

BUI Number Key

BUI #	BUI Name	BUI#	BUI Name
BUI 1	Restrictions on Fish and Wildlife Consumption	BUI 8	Eutrophication or Undesirable Algae or Excessive Loading of Sediments and Nutrients
BUI 2	Tainting of Fish and Wildlife Flavor	BUI 9	Restrictions on Drinking Water Consumption or Taste and Odor Problems
BUI 3	Degraded Fish and Wildlife Populations	BUI 10	Beach Closings and Body Contact Restrictions
BUI 4	Fish Tumors and Other Deformities	BUI 11	Degradation of Aesthetics
BUI 5	Bird or Animal Deformities or Reproductive Problems	BUI 12	Added Costs to Agriculture or Industry
BUI 6	Degradation of Benthos	BUI 13	Degradation of Phytoplankton and Zooplankton Populations
BUI 7	Restrictions on Dredging Activities	BUI 14	Loss of Fish and Wildlife Habitat

Appendix B

Outreach & Education - 2014

Media	Target Audience	Messages	Implementer(s)	Collaborators	Funded by	Status
2014 AOC Annual Meeting in Chicago	1 - Stakeholder Delegation, 2 - Other Great Lakes AOC Staff and Stakeholders, Agency staff	1 – You attendance is important and essential in local AOC success, 2 – general information about Wisconsin GL-AOCs including current status and future projects	UW-Extension	Stakeholder Delegation Members	UW-Extension	New
Milw Public TV Documentary & Corresponding Learning Activities for the Classroom	Greater Milwaukee Region Viewership, Regional school districts, middle and high school students	Milwaukee's is "A City Built on Water". Since the city's beginning, the community's use of the land and the water has played a crucial role in the health of the waterways, and in turn, Lake Michigan.	John Gurda, WisconsinEYE, UW-Extension	MPS, Shorewood Public Schools, Escuela Verde Public Charter, UW-Arboretum, Wehr Nature Center, MMSD	WDNR CAC Capacity Grant 2014, The Water Council, Brookby Foundation, Fund for Lake Michigan, MMSD	New
Trainings	Teachers attending Great Lakes focused Teacher Academies, Master Naturalists	General AOC concepts, restoration efforts and potential application in the classroom, on field trips or in non-formal educational settings.	UW-Extension	UW-Arboretum, Wehr Nature Center, MMSD	The Water Council, Brookby Foundation, Fund for Lake Michigan, MMSD	New

Two Lincoln Park Focus Groups	Lincoln Park Community Members	1 – How has outreach been regarding the Lincoln Park Sediment Remediation Project? 2- Is there interest and capacity to form a “Friends of Lincoln Park” group.	UW-Extension, IISG	USEPA	UW-Extension-GLRI, IISG	New
Established a Friends of Lincoln Park citizen group	Lincoln Park Community Members	Established a Friend of Lincoln Park Group	UW-Extension, IISG, WSG, Milwaukee County Parks, The Park People	New Citizen Board will continue implementation	IISG, UW-Extension-GLRI	New
Lincoln Park Bird Hike	Lincoln Park Community Members	Clean up of the contaminated sediments is critical to re-establishing healthy habitat and restoring bird populations. Highlight Custer Swallow Study in LP	Wisconsin Bird City, Milwaukee Audubon, UW-Extension		UW-Extension-GLRI	New
Exhibits at Events	Event participants at local state and national conferences, local community meetings	Overview of the Milwaukee Estuary Sediment Cleanups and post-cleanup rehabilitation projects, Restoration report	UW-Extension	WDNR	GLRI	Continued

Stakeholder Delegation Meetings – In Person/Webinar	Delegation members	Review and act as a sounding board for UW-Extension NRE as key outreach mechanisms & audiences are identified and developed	UW-Extension	WDNR	UW- Extension - GLRI	Continued
Quarterly Rivers Report newsletters (July, Oct, Jan, Apr)	SIG, Tech Team, Sweet Water Partners, general public, residents, river businesses, tourists, project partners	1 page (or more) of Project updates and news, education opportunities, contact information.	UW- Extension	DNR, Sweet Water	UW-Extension	Continued
Milwaukee Estuary AOC web page & Facebook	SIG, Tech Team general public, residents, river businesses, project partners, other AOC staff	Milwaukee Estuary AOC info, status and events, grant/funding announcements, RAP updates	UW-Extension	WDNR	UW-Extension - GLRI	Continued
Natural Resources Info Blog	AOC stakeholders	highlights events, news, grant opportunities and project updates	UW-Extension	Multiple various partners	UW-Extension	Continued
Milwaukee River Clean-ups	General Public, residents & SIG	Importance of stakeholders to river health and upkeep; Tie to aesthetics problem/public perceptions	Milwaukee Riverkeeper	Urban Ecology Center, UW-Extension	Various	Continued
Explore & Restore Milw Estuary AOC Restoration Report	Key Stakeholders	Status and next steps of BUI removal process	UW-Extension, WDNR	AOC Staff	UW-Extension-GLRI	Spring 2015

Data Information System Refinement	Various: USEPA, WDNR, AOC Project Partners,	Tracking & reporting progress of AOC projects and movement towards BUI removal and AOC delisting	WDNR-OGL, UW-Extension	AOC Coordinators	WDNR, UW-Extension-GLRI	Continued
Lincoln Park Kiosk updates, 2014 Revision	Boaters, businesses, municipal officials, Park visitors	Project updates and logistics	Dredging and habitat contractors	City, County, WDNR, USEPA, UW-Extension, IISG	Dredging and habitat contractors, GLLA	C-focus on progress of Phase 2
River Ambassador Program Protocol Development	Varies depending on site location	We all have a role in river revitalization that will result in community improvements. Provide people with examples and opportunities for filling that role.	Groundwork Milwaukee	UW-Extension, UEC	WDNR CAC Capacity 2013 Grant Extension	Complete
Cedar Creek Hike	Local municipal officials, citizens	Highlight planning progress and possible post-remediation enhancements.	City of Cedarburg	Municipal partners, UW-Extension, citizens	City of Cedarburg	Continued
Aesthetics (River and Beach) Monitoring Training	Citizen Volunteers, DNR, Technical Team, Outreach Partners	Aesthetics Data collected that will guide remedial actions needed and BUI removal. This was temporarily put on hold due to need for protocol refinement.		WDNR, UW-Extension	WDNR CAC Capacity Grant	ON HOLD

Healthy Beach Brochure	General beach going public	What you can do to improve beach health while at or near the beach	Alliance for the Great Lakes, Volunteers, MKE Co. Park staff	UW Sea Grant, S. Shore Park Watch,	WI Energy Foundation	Aesthetics, Beach Closures
Healthy Beach signs in Spanish	General beach going public	What you can do to improve beach health while at or near the beach, and minimize bird loafing behavior	Alliance for the Great Lakes, MKE Co. Park staff,	UW Sea Grant	WCMP	Aesthetics, Beach Closures
Healthy Beach Interactive Tabling Display	General beach going public	What you can do to improve beach health while at or near the beach, and minimize bird loafing behavior	Alliance for the Great Lakes, Volunteers, MKE Co. Park staff	Keep Greater Milwaukee Beautiful, UW Sea Grant, S. Shore Park Watch, Milwaukee Water Commons, Bay View Neighborhood Association, Blue Jacket Bar	WCMP, WI Energy Foundation	Aesthetics, Beach Closures
51 Beach Cleanups (Bradford, McKinley, Watercraft, South Shore, Bay View)	General beach going public	What you can do to improve beach health while at or near the beach, and minimize bird loafing behavior	Alliance for the Great Lakes, MKE Community Leadership Corp, many individual groups working on cleanups	MKE County Park	WCMP, Alliance for the Great Lakes	Aesthetics, Beach Closures, Algae monitoring

Barefoot Wines Beach Cleanup and GL Tricia After Party	General beach going public		UW Sea Grant, S. Shore Park Watch,	UWM-SFS	Barefoot Wines	Aesthetics, Beach Closures, Algae monitoring