STAGE 2 REMEDIAL ACTION PLAN

for the

SHEBOYGAN RIVER AREA OF CONCERN

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Wisconsin Department of Natural Resources
Office of the Great Lakes

Stage 2 Remedial Action Plan
for the
Sheboygan River Area of Concern

Compiled by:
Stacy Hron, Sheboygan River AOC Coordinator

With input and assistance from:
Kendra Axness, WDNR AOC and LAMP Coordinator
Deb Beyer, UW-Extension Natural Resources Educator
Donalea Dinsmore, WDNR Great Lakes Quality Assurance Coordinator
Andrew Fayram, WDNR Great Lakes Monitoring Coordinator
Steve Galarneau, Director, WDNR Office of the Great Lakes
Victor Pappas, WDNR Lake Michigan Field Supervisor
Candy Schrank, WDNR Fisheries Toxicologist
Sean Strom, WNDR Wildlife Toxicologist
Sheboygan River Fish and Wildlife Technical Advisory Committee
- Deb Beyer, UW-Extension, TAC facilitator
- Tim Beyer, WDNR Forester
- Paula Bizot, NOAA
- Owen Boyle, WDNR Regional Ecologist
- Brad Eggold, WDNR Lake Michigan Fisheries Biologist
- Patrick Forsythe, UW-Green Bay
- Betsy Galbraith, USFWS, Natural Resources Trust Coordinator
- Jon Gumtow, Sheboygan River Basin Partnership
- Stacy Hron, Sheboygan River AOC Coordinator, TAC leader
- Scott Isaacs, City of Sheboygan
- Christina Isenring, WDNR NHI Coordinator
- Dale Katsma, WDNR Wildlife Supervisor
- Laurel Last, WDNR
- John Masterson, WDNR Aquatic Biologist
- Pat Miles, Sheboygan County Conservationist
- Travis Motl, WDNR Fisheries Biologist
- Vic Pappas, WDNR Lake Michigan Field Supervisor
- Peter Pittner, Sheboygan River Basin Partnership
- Derek Strohl, BLM

EXECUTIVE SUMMARY

In 2012, agencies and local project partners will be implementing many management actions in the Sheboygan River Area of Concern (AOC) to achieve AOC goals. The actions include the following:

- Completing four sediment remediation projects;
- Initiating seven habitat restoration projects;
- Initiating studies to assess the status of the wildlife consumption, fish tumors, benthos, and plankton impairments;
- Writing fish & wildlife habitat restoration and management and dredge alternative plans; and,
- Compiling status change documentation for the eutrophication beneficial use impairment.

AOC partners built momentum throughout 2011 by planning multiple dredging and habitat restoration projects. The City of Sheboygan, Sheboygan County, Wisconsin Department of Natural Resources (WDNR), U.S. Army Corps of Engineers and U.S. Environmental Protection Agency worked closely together to plan both Great Lakes Legacy Act Dredging and Strategic Navigational Dredging projects. The WDNR, City, County and members of the Fish and Wildlife Technical Advisory Committee (TAC) worked on the "Pathway to Delisting Beneficial Use Impairments" project, which set the stage for the seven habitat restoration projects to occur while also providing for characterization of multiple impairments. Also in 2011, the members of the Sheboygan Dredging Workgroup met regularly to coordinate the details of the ongoing sediment dredging projects.

As actions are implemented in 2012, public engagement will continue to be a priority. UW-Extension will build upon efforts begun in 2011 to start a Community Advisory Committee (CAC) while continuing to assist with TAC facilitation. UW-Extension will also coordinate AOC-related education and outreach programs, such as the "Explore and Restore" programs that were conducted in partnership with Camp Y-Koda in 2011.

The AOC Coordinator's priorities in the next year will be to oversee implementation of the "Pathway to Delisting" and other AOC-related projects, to collaborate with UW-Extension for CAC & TAC engagement, and to write – with stakeholder input as appropriate - the fish and wildlife habitat restoration and management plan and the dredge alternatives plan. The Coordinator will also be the point of contact for any AOC-related grant proposals that may be developed by AOC partners.

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List of Acronyms

AOC	Area of Concern
BLM	Bureau of Land Management of the U.S. Department of the Interior
BUI	Beneficial use impairment
CAC	Community Advisory Committee
CHL-a	Chlorophyll-a
DO	Dissolved oxygen
GLRI	Great Lakes Restoration Initiative
LOEL	Lowest observed effect level
MGP	Manufactured Gas Plant
NOAA	National Oceanic and Atmospheric Administration
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAP	Remedial Action Plan
ROD	Record of Decision
TAC	Technical Advisory Committee
TP	Total phosphorus
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDHS	Wisconsin Department of Health Services
WDNR	Wisconsin Department of Natural Resources
WPSC	Wisconsin Public Service Corporation

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 in the Annex, 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.

Bioaccumulative
An adjective that describes a substance that builds up within the tissues of organisms.

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.

Goal
Goals are broad ideas that may take a long time to achieve. They usually don't change significantly over the life of a project. An example goal statement is, "*Nesting populations of a diverse array of wetland-dependent and riparian-associated birds are consistently present within the AOC."* The delisting targets for the impairments may also be considered the goal statements (in some cases they may be objectives).

Objective
Objectives are the detailed activities that are needed in order to meet goals. Objectives are normally accomplished in less time than goals. They are important because they provide a means of measuring progress toward plan implementation. Objectives should be SMART: Specific, Measurable, Achievable, Realistic, Time-Constrained.

Project
As defined for this document, a project is a specific activity that has been defined with enough detail to understand who will do the work, how it will be done, and where it will be done. The end result of the activity should be visible and concrete. One or more projects may be defined to meet the goals and objectives for the impairments, if the AOC is not yet eligible for delisting. With this definition, "Coordinating with partners to make sure data is consistently collected and used" would not be a project. However, "XY Agency will Host a data 'slam' and write a set of standards for data collection and analysis for the Example AOC." would be a project.

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 are 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

Remedial Action Plan (RAP) Update
A RAP Update fulfills the requirement for biennial progress reporting described in Annex 2 of the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement. Some RAP updates are more comprehensive than others, and contain some of the elements of an AOC delisting strategy (e.g., remedial measures). Most RAP Updates for Wisconsin's AOCs have not included project-specific information regarding who will do each project and how much each will cost.

PURPOSE STATEMENT

The purpose of this document is to serve as a Stage 2 Remedial Action Plan (RAP), which is described in the 1987 Protocol amending the *Revised Great Lakes Water Quality Agreement of 1978* as a plan that evaluates and describes remedial measures needed to restore the beneficial uses. The Protocol indicates that the Stage 2 RAP should also contain a schedule and identify the organization responsible for implementation.

This Stage 2 RAP 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. The Stage 2 RAP will be updated as needed to incorporate new information that may become available.

The Stage 2 RAP was prepared by the Wisconsin Department of Natural Resources in consultation with its partners. Wisconsin's AOC Program is guided by a set of core values, including strong citizen and stakeholder engagement, scientific defensibility, environmental stewardship, achieving timely progress, and documenting results. These values are reflected in the Stage 2 RAPs.

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 (sometimes referred to as "legacy" pollutants due to the historical industrial development that often was the source of the pollution). 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 considered to be part of the Lakewide Management Plan (LaMP) program, a "whole lake" program that is also set forth in the Agreement. The Agreement provides the framework for the U.S. and Canada to work together to restore the chemical, physical, and biological integrity of the lakes.

The Sheboygan River AOC is one of five Areas of Concern in Wisconsin (Figure 1). It was designated as an AOC primarily due to polychlorinated biphenyl (PCB) and polycyclic aromatic hydrocarbon (PAH) contamination in Sheboygan River sediments. One primary source of PCBs was an industrial facility operated by Tecumseh Products Company; a primary source of PAHs was a manufactured gas plant (MGP) operated by Wisconsin Public Service Corporation (WPSC). The Kohler Landfill was historically a source of various pollutants, including volatile organic compounds and heavy metals. The Sheboygan River Remedial Action Plan (RAP; WDNR, 1989) and Remedial Action Plan Update (RAP Update; WDNR, 1995) also identified nutrients and solids as significant pollutants for the AOC.

These sources of impairment led to designation of nine of the possible fourteen beneficial use impairments (BUIs) as applicable to the AOC. Sheboygan River AOC impairments and sources are summarized in Table 1. Impairment status is summarized in Table 2.

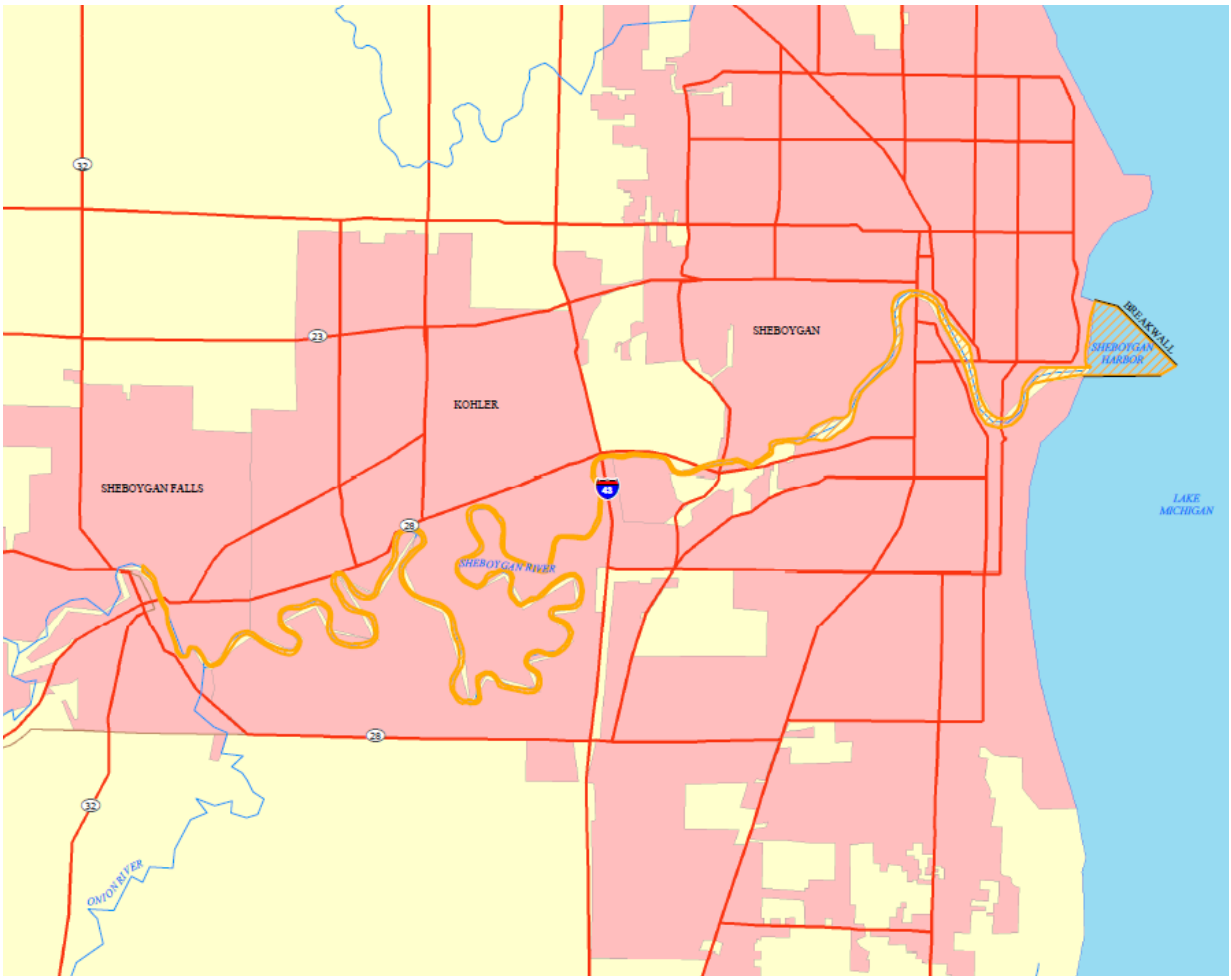
Since designation as an AOC, much progress has occurred to address pollutant sources. The Kohler Landfill was remediated in the late 1990s through the Superfund program. The Sheboygan River Priority Watershed Project (which ran from 1993 to 2003) resulted in installation of agricultural best management practices throughout the watershed to reduce nonpoint source pollution to the river. Sheboygan River stakeholders pursued Great Lakes Legacy Act funds to address contaminated sediments that fell outside of the Superfund program and Strategic Navigational Dredging to address minimally impacted sediments in priority navigational areas.

Efforts to improve the Sheboygan River accelerated in 2010 when the United States Environmental Protection Agency (USEPA) selected the Sheboygan River AOC as a focus for BUI removal. Because of the dedicated resources made available through the Great Lakes Restoration Initiative (GLRI), AOC staff and partners are addressing the BUIs more aggressively than what the AOC delisting targets call for (e.g., not tracking complaints for fish tumors, instead actually sampling them; more sediment remediation than just the Superfund projects, etc.). Implementation is also moving at a faster pace than was anticipated when the targets were written.

Sheboygan River AOC stakeholder engagement has been a top priority for the Wisconsin Department of Natural Resources (WDNR) throughout the history of the AOC program. The first Sheboygan AOC RAPs were written with the input of a variety of technical and community advisors. More recently, the University of Wisconsin-Extension (UW-Extension) has been contracted for stakeholder outreach and education to develop public awareness of AOC projects and issues. UW-Extension led the development in 2011 of a Community Advisory Committee (CAC) to provide an opportunity for general community engagement. A

wide spectrum of stakeholders from the community has been invited to participate. The CAC is still taking shape, and its roles will evolve and may be variable depending upon the individual BUIs.

Another important avenue for stakeholder engagement is the Fish and Wildlife Technical Advisory Committee (TAC). With leadership and facilitation from WDNR and UW-Extension, the group has met regularly since 2009 to provide technical input on the fish and wildlife related BUIs. The TAC contributed greatly, both in time and expertise, to the development of the "Pathway to Delisting" project and to the assessment projects which laid the foundation for it.



Map Courtesy by USEPA-Great Lakes National Program Office

Figure 1. Boundaries of the Sheboygan River Area of Concern

Table 1. Sheboygan River Area of Concern Beneficial Use Impairments Summary

Impaired Beneficial Use	Contaminated Sediments	Non-point Source Pollution (sedimentation, excessive nutrients)	Physical Alteration (dams, urbanization, agriculture)	Invasive or Exotic Species
Restrictions on Dredging Activities	X			
Restrictions on Fish and Wildlife Consumption	X			
Degradation of Benthos	X			
Degradation of Fish and Wildlife Populations	X	X	X	X
Loss of Fish and Wildlife Habitat	X	X	X	
Bird or Animal Deformities or Reproduction Problems	X			
Fish Tumors or Other Deformities	X			
Degradation of Phytoplankton and Zooplankton Populations	X	X		
Eutrophication or Undesirable Algae		X	X	

Table 2. Sheboygan River BUI Status Summary (refer to Appendix A for more detail)

Beneficial Use Impairment	Beneficial Use Remains Impaired	Summary of Status and Next Steps
Restrictions on dredging	Yes	Complete the two Superfund dredging projects, Great Lakes Legacy Act Dredging project, Army Corps of Engineers Strategic Navigational Dredging project and Dredging Alternatives Plan.
Restrictions on fish and wildlife consumption	Yes	Complete the four contamination/sediment remediation projects and monitor fish and wildlife for recovery and consumption advisory evaluation.
Degradation of benthos	Yes	Complete the four contamination/sediment remediation projects and complete the Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern project.
Degradation of fish and wildlife populations	Yes	Complete the four contamination/sediment remediation projects, the habitat restoration and conservation projects, the Fish and Wildlife Habitat Restoration Plan and monitor to evaluate projects meet their goals.
Loss of fish and wildlife habitat	Yes	Complete the four contamination/sediment remediation projects, the habitat restoration and conservation projects and the Fish and Wildlife Habitat Restoration Plan, monitor to evaluate projects meet their goals and work with Impaired Waters Program to assure that the Sheboygan River does not need to be listed on the 303 (d) list for aquatic toxicity.
Bird/animal deformities or reproduction problems	Yes	Complete the four contamination/sediment remediation projects and then complete a study to determine if BUI is no longer impaired. The study design will be scoped out as part of the fish and wildlife planning effort in Spring 2012.
Fish tumors or other deformities	Yes	Complete the four contamination/sediment remediation projects and complete the Fish Tumor BUI Evaluation study.
Degradation of phytoplankton and zooplankton populations	Yes	Complete the four contamination/sediment remediation projects, complete the Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern project and determine if bioassays to confirm that no aquatic toxicity is present in the river are necessary based on results of current assessment project.
Eutrophication or undesirable algae	No	AOC waters are not currently on the list of Impaired Waters based on WisCALM methods. A BUI status change package will be compiled.

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.

2008 Target and Status

Beneficial Use Impairment Name	Status
The 2008 Sheboygan River AOC delisting targets (WDNR, 2008) are listed here as separate target components on each row to clearly show status of each part of the target.	May be: - "Complete" - "Addressed by Current Projects" - "Not Complete" - "Unknown"

Note: may list one or more of the following:
- potential concerns about the target, particularly if the target is not specific enough to define a measurable endpoint for the BUI
- if revisions are anticipated and how such changes might be approached including responsible party and timeline
- if the 2008 target was modified and details of any changes

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.

Summary of key remedial actions since the last RAP and current status
"Key remedial actions" are those that directly contributed to the current status of the BUI. A table may be included as an appendix to capture a detailed list of past projects. The narrative here explains and leads to the "Next action needed."

Next action(s) needed
This section is a narrative listing of assessments, on-the-ground projects, and stakeholder engagement processes that are clearly delineated and directly address the specific BUI. Plans for verifying achievement of delisting targets are listed here if known.

Issues (challenges, risks) affecting progress on this BUI
This section lists project contingencies (i.e., one thing has to happen before another can occur), funding obstacles and any other considerations that could affect the timeline for delisting.

Stakeholder Engagement
The role of Technical and Citizen Advisory Committees are listed here. Key outreach activities or needs related to the specific BUI are listed and connected to overall timelines for implementing actions.

RESTRICTIONS ON DREDGING ACTIVITIES

2008 Target and Status

Restrictions on Dredging Activities	Status
All remediation actions for contaminated sediments are completed and monitored according to the approved remediation plans.	Addressed by Current Projects
A dredging alternatives plan is developed that includes an evaluation of the following: ▪ Restrictions that must remain in place to protect human health and the environment ▪ Restrictions that must remain in place due to Superfund or RCRA requirements that are based upon state and federal law ▪ Priority areas for navigational use ▪ Priority areas where dredging is needed for other purposes (i.e., utilities) ▪ Costs associated with removing dredging restrictions in priority areas ▪ Funding available to address removing dredging restrictions in priority areas	Not Complete

Due to the current Superfund and Legacy projects, some items in the dredging alternatives plan will be altered. This target was completed not anticipating that dredging projects were imminent. Therefore, there is no need to identify funding available to remove dredging restrictions as the current projects will address these restrictions. The dredging alternatives plan will now include a summary of actions and the process through which the restrictions were addressed and document the condition of the river after these projects are complete.

Rationale for Listing

Contaminated sediments are known to be present throughout the Sheboygan River AOC, which shares the same boundaries with the Sheboygan River and Harbor Superfund site. PCBs are the contaminants of concern throughout the Superfund site. (Note that although heavy metals are present, they are not the contaminant that is driving sediment remediation plans or work. It is anticipated that metals will be evaluated and addressed as part of the remediation work in addition to PCBs and PAHs.) Two additional Superfund sites are present within the AOC: Kohler Landfill and Camp Marina (a former Manufactured Gas Plant). While contaminated sediments were not associated with the Kohler Landfill site, there are issues with sediment contamination around the Camp Marina site. The major contaminant of concern in this area is coal tar by-products known as PAHs.

Due to the presence of contaminated sediments, dredging in the lower Sheboygan River and Harbor were restricted. Although the Harbor was a U.S. Army Corps of Engineers (USACE) federally authorized navigational channel, it has not been dredged for navigation purposes since 1969 because of contaminated sediment disposal concerns.

Summary of Key Remedial Actions since the Last RAP & Current Status

In recent years, progress has been made in both the Sheboygan River & Harbor and Camp Marina Superfund site cleanups. There has been additional progress in contaminated sediment removal through more recent Great Lakes Legacy Act and USACE Strategic Navigational Dredging projects.

In 2000, a Record of Decision (ROD) was completed for the Sheboygan River & Harbor Superfund projects. In 2006, contaminated sediment cleanup work began in the upper river segment of the site (Figure 2), which was completed in 2007. No sediment cleanup was necessary under the ROD for the middle river segment of the site. In spring 2011, dredging began in the lower river and inner harbor sections of the site. This work is slated to be completed in 2012. When complete, approximately 53,000

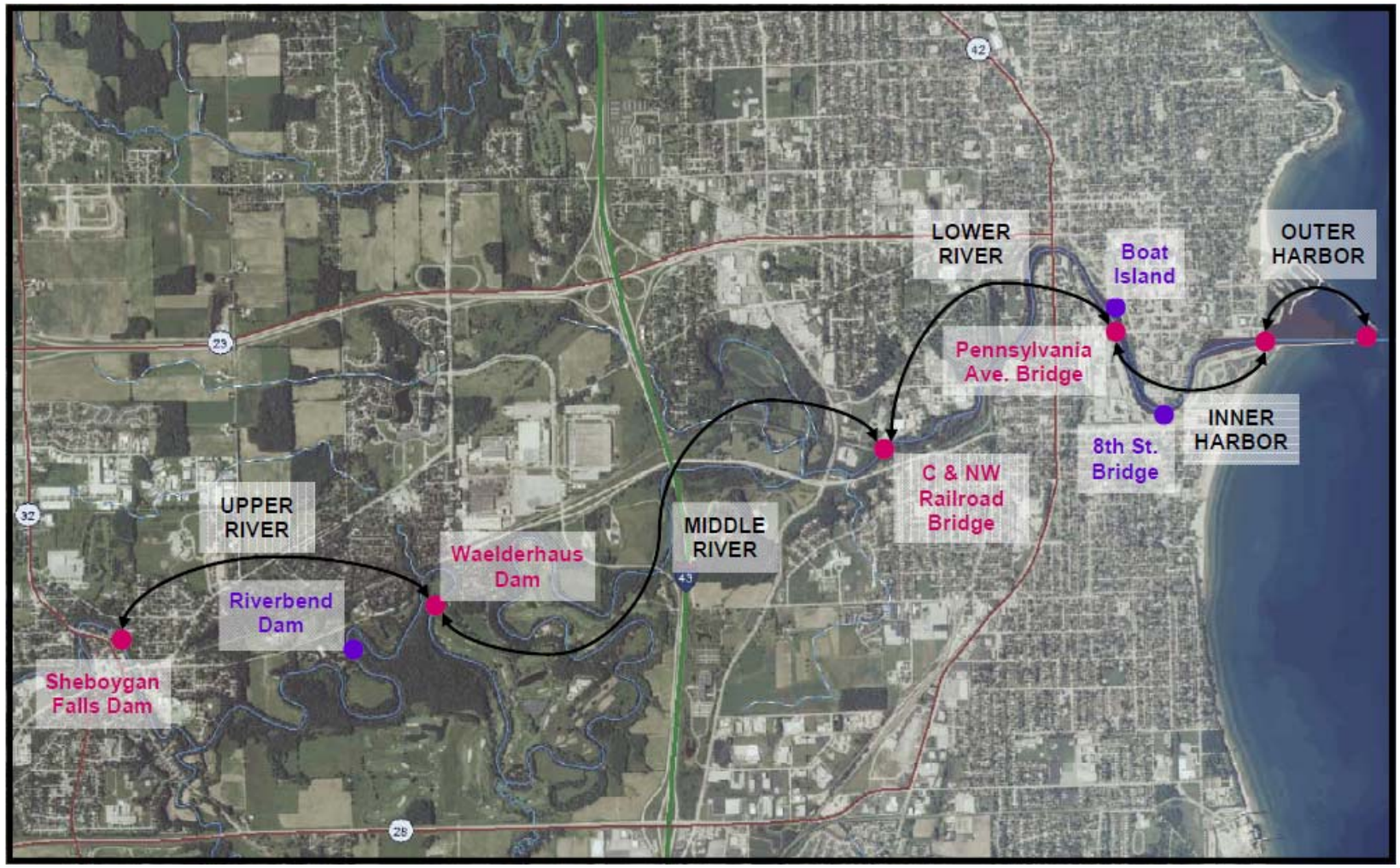


Figure 2. Sheboygan River Area of Concern Segments and Landmarks

cubic yards of contaminated sediments will be removed from the river at a cost of approximately $12.5 to $15 million. In a separate portion of the project, contaminated sediments will be removed from the floodplains of the river. The plans for this portion of the project have not yet been finalized.

The Camp Marina former MGP site remediation has been split into two separate actions, the upland portion and river portion. The site is located near "Boat Island" in the City of Sheboygan. The upland portion of the site was cleaned up in 2002. The river section is being dredged in 2011 as a Superfund Alternative or emergency action. This is due to the other Superfund Clean up taking place in 2011 which would have exposed PAH contamination during operations to clean up PCB contamination. The PAH and PCB contaminated sediment removal projects were coordinated in order to address these areas at the same time. Work at the Camp Marina site will be completed by the end of 2011. When complete approximately 28,500 cubic yards of PAH contaminated sediments will be removed from the river at a cost of approximately $9 million to $10.5 million.

River stakeholders pursued a Great Lakes Legacy Act project as a betterment to the two Superfund projects. There was a desire to remove contaminated sediment left behind after the Superfund actions were complete. The Legacy Act dredging project is being planned in 2011 for implementation in 2012. The majority of this work will occur in the lower river between Kiwanis Park and the 8th Street Bridge. This work is funded by the Great Lakes Legacy Act with cost share from the Department of Natural Resources, Sheboygan County, the City of Sheboygan, WPSC and the Superfund dredging projects. When complete, approximately 190,000 cubic yards of PAH and PCB contaminated sediments will be removed from the river at a cost of approximately 25 million dollars.

During the investigation stage of the Legacy Act project, sediments below the 8th Street Bridge were found to have much lower levels of contamination than were previously thought to exist in this area. Due to the now-documented low levels of contamination, USACE is able to pursue a navigational dredging project, something they were previously unable to do. Sediments in the lower portion of the river between the 8th Street Bridge and the outer harbor will be dredged in 2012. This project will improve the navigation of this area of the river. This work is funded through USACE and the GLRI. When complete, approximately 170,000 cubic yards minimally contaminated sediments will be removed from the river at a cost of approximately $10 to $15 million.

Next Actions Needed

1) Complete the sediment remediation projects.
Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river.

2) Complete the Dredging Alternatives Plan.
Completion of a Dredging Alternatives Plan is called for in the delisting targets to document any restrictions that may need to remain in place due to the Superfund projects and to identify priority areas for navigation. There are other items that the delisting targets call for to be included in the plan that have already been completed. In these cases, the Plan will document the recent work that has taken place and the process which future dredging may need to follow. The plan will be written by the AOC Coordinator with input from project partners and stakeholders. The goal is to complete the plan by September 2012, with updates occurring as needed.

Issues Affecting Progress on this BUI

There are currently no issues affecting progress on this BUI.

Stakeholder Engagement

In 2009 a Dredging Workgroup was formed to coordinate the contaminated sediment removal projects. This Workgroup is made up of local, state and federal officials, local stakeholders and the Superfund project Responsible Parties. This forum has provided excellent opportunities for stakeholder engagement and input into the projects. Several public meetings for general community input have been held associated with the Superfund dredging projects and more are planned in the near future for the Legacy Act and USACE projects.

RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION

2008 Target and Status

Restrictions on Fish and Wildlife Consumption	Status
Fish Consumption	
The Superfund PCB cleanup and Manufactured Gas Plant cleanup have been implemented.	Addressed by Current Projects
All other known sources of bioaccumulative contaminants of concern (PCBs, mercury, pesticides, and PAHs) have been identified and controlled or eliminated.	Complete
Waters within the Sheboygan River AOC are no longer listed as impaired due to PCB fish consumption advisories in the most recent Impaired Waters (303(d)) list.	Not Complete
Wildlife Consumption	
The floodplain cleanup action that is part of the Superfund Cleanup is implemented.	Not Complete
All other known sources of bioaccumulative contaminants of concern (PCBs, mercury, pesticides, and PAHs) have been identified and controlled or eliminated.	Complete
Waters within the Sheboygan River AOC are no longer listed as impaired due to wildlife consumption advisories listed in the annual Wisconsin Migratory Bird Regulations.	Not Complete

Rationale for Listing

The Sheboygan River has fish and waterfowl consumption advisories due to PCB contamination. Fish consumption advisories were issued for the Sheboygan River due to PCBs in 1979 and waterfowl consumption advisories were issued due to PCBs in 1987. Currently there is a “do not eat” advisory for all resident fish, mallards and lesser scaup from the river. It is not known whether the Sheboygan River is the only source of the PCBs in the waterfowl.

Summary of Key Remedial Actions since the Last RAP & Current Status

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Sport fish have been monitored for contaminants for the Sport Fish Contaminant Monitoring Program and the Superfund Program, so evidence supports the current advice. The WDNR has sampled fish each year from 1976-1997 and in 1999, 2000, 2004 and 2011. These fish have been tested for PCBs and a subset for other contaminants. However, waterfowl have not been monitored since 1989, so it is unknown whether the current advice is still appropriate. The goal of WDNR’s monitoring program is to resample fish from PCB advisory waters every five years.

Due to lack of information on the waterfowl in the AOC, WDNR recently pursued and received grant funding from GLRI for a three year study of contaminants in waterfowl in the Sheboygan River AOC for the purposes of assessing the status of this BUI. The project was initiated in fall 2011 and will continue through fall 2014. Mallard, Scaup and Canada Geese will be collected. Samples will be analyzed for legacy contaminants (PCBs, lead, mercury, DDT/DDE, organochlorine pesticides) as well as emerging contaminants such as polybrominated diphenylethers (PBDEs), perfluorooctane sulfonate (PFOS), and perfluorooctanoic acid (PFOA). Analysis of this suite of contaminants will provide information on known contaminants as well as others that may be causing problems for fish and wildlife in the AOC.

Next Actions Needed

1) Complete the sediment remediation projects.
Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river. The floodplain cleanup portion of the Sheboygan River & Harbor Superfund project must also be implemented.

2) Monitor contaminants in fish and wildlife populations for recovery to assess consumption advisories.
Monitoring of contamination in fish and assessment of the consumption advisories will continue through the existing WDNR program. Sampling was last conducted in 2011. The WDNR goal for PCB advisory sites is to resample fish every five years so that fish consumption advice remains up to date. The schedule may be adjusted considering workload, avoiding active dredging periods, and completion of sediment remediation projects. After new data is obtained, consumption advice will be re-evaluated using the "*Protocol for Uniform Great Lakes Sportfish Consumption Advisory*" for PCBs.

Waterfowl will be monitored for the next three years under the GLRI funded grant project. At the conclusion of this project, the consumption advisory will be evaluated. If the data does not support lifting the consumption advisory, additional sampling should be repeated at an interval determined by the trends in the data collected.

Issues Affecting Progress on this BUI
While the WDNR goal for PCB advisory sites is to resample fish every five years, the schedule may be adjusted considering workload, avoiding active dredging periods, and completion of sediment remediation projects.

Stakeholder Engagement
WDNR and UW-Extension will work with the Wisconsin Department of Health Services (WDHS) to provide information and education to the community regarding any changes in consumption advisories that may occur.

WDNR and WDHS initiated a project funded by the GLRI to examine fish consumption by male anglers over 50 and to assess their contaminant levels. The survey will take place over the next 3 years and responses will help WDNR and WDHS better understand fishing and fish consumption, and improve effectiveness of our outreach on healthy fish eating practices.

DEGRADATION OF BENTHOS

2008 Target and Status

Degradation of Benthos	Status
Known contaminant sources contributing to sediment contamination and degraded benthos have been identified and control measures implemented.	Complete
All remediation actions for contaminated sediments are completed and monitored according to the approved plan with consideration to using consensus based sediment quality guidelines and equilibrium partitioning sediment benchmarks.	Addressed by Current Projects
The benthic community within the site being evaluated is statistically similar to a reference site with similar habitat and minimal sediment contamination.	Addressed by Current Projects

Rationale for Listing

Due to the known contaminated sediments present in the river, there was concern that benthos populations might be negatively impacted, but little evidence existed to show that they were actually degraded. A subsequent study, the Aquatic Ecological Risk Assessment (EVS and NOAA, 1998), found that macroinvertebrate populations in sediment depositional areas of the AOC are degraded due to chemical contamination.

Summary of Key Remedial Actions since the Last RAP & Current Status

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for cleanup of the contaminated floodplain soils have not yet been finalized.

Due to lack of information on the benthic and planktonic communities in the Sheboygan River compared to reference sites, WDNR pursued and received grant funding from GLRI for a comparison study. This study, *Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern*, will be carried out by the United States Geological Survey (USGS) for WDNR and will include all four of the Lake Michigan AOCs and six reference sites. Benthos, phytoplankton and zooplankton communities will be sampled and assessed in each of the AOCs and in the reference rivers. This study will be used to evaluate the status of this BUI in the Sheboygan River AOC. The project was initiated in fall 2011 and sampling will occur in 2012.

Next Actions Needed

1) Complete the sediment remediation projects.

Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational Dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river.

2) Complete current Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern project and repeat if necessary.

This project will assess the benthic, phytoplankton and zooplankton communities of the river. Sampling will occur in the spring, summer, and fall of 2012. The data gathered as part of this project will be used to assess this BUI. If data indicate that the benthic community in the Sheboygan River is similar to non-impacted reference sites, the BUI can be considered for removal. If the data indicate that the benthic community is not similar, then the study should be repeated in the future when more time has been allowed for recovery after contaminated sediment removal.

Issues Affecting Progress on this BUI
Sampling locations will account for ongoing dredging work as well as comparability with other AOCs.

Stakeholder Engagement
WDNR and USGS will provide interested stakeholders and the general public with information about the benthos and plankton studies to describe what the results say about the river and how they can be used to define next steps.

DEGRADATION OF FISH AND WILDLIFE POPULATIONS

2008 Target and Status

Degradation of Fish and Wildlife Populations	Status
Approved remedial actions (Superfund and RCRA) for contaminated sediment and floodplains have been fully implemented; and	Addressed by Current Projects/ Not Complete (floodplain)
A local fish and wildlife management and restoration plan has been developed for the entire AOC that • Defines the causes of all population impairments within the AOC. • Establishes site specific local population targets for native indicator fish and wildlife species within the AOC. • Identifies all fish and wildlife population restoration programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities including identification of lead and coordinative agencies. • Establishes a time table, funding mechanism, and lead agency responsibility for all fish and wildlife population restoration activities needed within the AOC.	Not Complete
The programs necessary to accomplish the recommendations of the fish and wildlife management and restoration plan are implemented.	Addressed by Current Projects
Populations of native indicator fish/wildlife species are statistically similar to populations in reference sites with similar habitat but little to no contamination.	Unknown

Rationale for Listing

The reasons for listing this BUI that were identified in the 1989 RAP include concern that fish populations might be negatively impacted by exotic species, sedimentation, and dams. The 1995 RAP update also raises the possibility that contaminants may impact fish populations and their forage base. Although fish populations appeared to be good, all of these issues were present in the AOC and it was thought that they could be having a negative effect. There was concern that some wildlife species, such as mink, kingfishers and swallows were at lower-than-normal population levels in the AOC for the habitat available. Contaminants in the food chain were suspected as the cause of the low population levels.

Summary of Key Remedial Actions since the Last RAP & Current Status

Since the last RAP update in 1995, several actions have occurred that addressed impairments in the Sheboygan River AOC. These included sediment load reduction and erosion control as well as contaminated sediment cleanup.

A number of actions have been taken to decrease sediment loads to the AOC. The Sheboygan River Priority Watershed Project, which ran from 1993 to 2003, resulted in significant reductions in sediment contributed by agricultural areas from both upland soil loss and streambank erosion. Sheboygan County continues to implement its own buffer program. The Cities of Sheboygan Falls and Sheboygan have adopted construction site erosion control ordinances. The City of Sheboygan Storm Water Management Plan was completed in 1998. The City also adopted a Storm Water Management Ordinance and Erosion Control Ordinance in 2006. In addition, numerous wetland restorations and enhancements have been completed in the Sheboygan River watershed.

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Currently, very little information is available regarding fish and wildlife populations in the AOC. The WDNR received FY2010 GLRI funding for a project to survey and assess a broad range of the fish and wildlife communities and habitats, and to provide baseline information necessary for assessing the fish and wildlife related BUIs. This survey and assessment is underway and scheduled to be completed by the end of 2011. This project will deepen the Fish and Wildlife TAC's understanding of the species assemblages and relative abundance within these habitat and plant community types. This information is intended to be used in completing the Fish and Wildlife Habitat Restoration and Management Plan.

In fall 2010, USEPA approached the TAC and requested that it develop projects that address the fish and wildlife related BUIs, specifically Degradation of Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat. As contaminant-related dredging is expected to be completed by the end of 2012 and the Sheboygan River is a priority AOC for USEPA, they wanted other non-contamination related management actions to be addressed at the same time as the contaminated sediment dredging. The opportunity to use this funding spurred the TAC to develop a set of fish and wildlife habitat restoration and conservation projects that would encompass these necessary management actions to move toward removing the two fish and wildlife related BUIs.

In September 2010, TAC members qualitatively assessed the entire AOC as a preliminary reconnaissance survey of habitat related projects. During subsequent planning meetings, the TAC prioritized the projects identified during the reconnaissance survey, based on land available, project location within the AOC, feasibility, partnerships and need for habitat work, and produced a list of seven Tier I projects. Additional habitat projects (Tier 2 and 3) were also identified that will further restore the Sheboygan River after the contaminated sediment is removed. These are important habitat restoration projects that will build upon those needed to meet the delisting threshold. Only the Tier 1 projects are necessary to implement before the habitat and population BUIs can be removed.

The TAC has been guided by the Fish & Wildlife Population and Habitat goals and objectives stated in The Sheboygan River RAP (1989):

> Ecosystem Goals and Objectives for Restoration of Impaired Uses [Excerpt]
>
> > II. Maintain and enhance a diverse community of terrestrial and aquatic life and their necessary habitat
>
> In order to achieve these goals and restore beneficial uses (see Chapter IV), the following objectives must be met through the RAP process:
>
> > 1. Maintain a diverse resident fishery… (Goal II)
> >
> > 2. Protect natural areas (green space) along the waterway and enhance habitat for aquatic and terrestrial communities (Goals II, III, and IV)

These goals and objectives were reiterated in the RAP Update (1995), which also included recommendations for population and habitat related "assessment & monitoring" projects and "specific actions." The RAP implementation recommendations included watershed-wide projects and initiatives. This proposal focuses the recommendations further, identifying projects and actions that fall within the AOC boundary. The AOC boundary for the purposes of this proposal is defined as the Sheboygan River downstream of the Sheboygan Falls Dam, and the harbor and near-shore waters of Lake Michigan.

With the goals from the RAP in mind, the TAC identified the seven fish and wildlife habitat restoration and conservation projects. Fish and wildlife restoration efforts within the AOC will focus on restoring, enhancing, or protecting the connectivity, quality and quantity of habitat. Habitat in the AOC was found to be threatened by erosion (and resultant sedimentation), fragmentation, urban development, invasion by non-native plants, storm water runoff, and vegetation loss/removal. The fundamental strategies for

addressing these threats are restoring and enhancing connectivity, protecting high quality habitats, restoring habitat along riverbanks and riparian areas, reducing erosion and sedimentation, creating and restoring in-river habitat, controlling invasive plant species and enhancing native vegetation. The seven projects selected to implement these strategies include Kiwanis Park Shoreline Restoration, Wildwood Island Area Restoration, Taylor Drive and Indiana Avenue Wetland Restoration, Shoreline Stabilization in Problem Areas, In-Stream Habitat Improvements, Targeted Invasive Species Control and Schuchardt Property Conservation Planning (see Appendix A for additional details about these projects).

Next Actions Needed

1) Complete the sediment remediation projects.
Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river. The floodplain clean up portion of the Sheboygan River & Harbor Superfund project must also be implemented.

2) Complete the Fish and Wildlife Habitat Restoration and Management Plan.
In order to fulfill the delisting targets developed in 2008, a Fish and Wildlife Habitat Restoration and Management Plan needs to be developed that contains the following information for the Degradation of Fish and Wildlife Populations BUI:

- Defines the causes of all population impairments within the AOC.
- Establishes site specific local population targets for native indicator fish and wildlife species within the AOC.
- Identifies all fish and wildlife population restoration programs/activities within the AOC and establishes a mechanism to assure coordination among all these programs/activities including identification of lead and coordinative agencies.
- Establishes a time table, funding mechanism, and lead agency responsibility for all fish and wildlife population restoration activities needed within the AOC.

According to the next steps developed along with the targets, the extent of improvement that can be achieved within areas of the AOC that were historically or are currently modified and those dredged for commercial navigation should be determined along with trends in native fish and wildlife species in the AOC. During the project planning stages, the TAC deliberated on the extent of improvement achievable and decided to focus the habitat restoration efforts upstream of the 14th Street Bridge. Since there is so much contaminated sediment remediation work going on below this point and due to the very developed shoreline, it was not practical to attempt habitat restoration in this area. The fish and wildlife survey and assessment project developed in conjunction with the TAC and implemented in 2011 should provide information on trends in fish and wildlife in the AOC. Both the information captured in the project planning and the data from the fish and wildlife assessments will be included in the plan.

3) Projects and activities identified in the Fish and Wildlife Habitat Restoration and Management Plan are implemented and monitored to evaluate habitat goals.
The primary projects and activities necessary to restore and remediate fish and wildlife habitat have already been identified by the TAC. These projects will be included in the Fish and Wildlife Habitat Restoration and Management Plan. Funding for these projects has been obtained by WDNR through the

GLRI. All seven of the projects are currently underway, but at different stages of completion. It is expected that the projects will be complete by September 2012.

The TAC has begun the process of identifying measures of success that will be used to monitor and evaluate the habitat projects and goals. The focus of these measures has been measuring restored habitat area, habitat potential or suitability, improved habitat quality, or the presence of indicator species. These will be included in the Fish and Wildlife Habitat Restoration and Management Plan. Some of the measures already identified include:

- Acres of suitable migratory bird stopover habitat restored or improved. This may include a comparison study with other models, surveys or studies.
- Acres of potential suitable restored terrestrial habitat.
- Miles of warmwater fish community habitat restored or improved.
- Index of Biotic Integrity (IBI) scores or catch per effort in AOC are comparable to a non-impacted reference site. Smallmouth bass would be the preferred indicator species.
- Acres of riparian corridor and wetland restored and enhanced.
- Acres of riparian emergent wetland improved, enhanced or restored.
- Invasive species in riparian floodplain forest are inventoried and mapped. Pioneer colonies are treated and target populations are contained to prevent spread to "clean" stands.

Issues Affecting Progress on this BUI

Several issues have been identified in making progress on this BUI:

- Working on project development before the Fish and Wildlife Habitat Restoration and Management Plan could be completed is not ideal. Without the groundwork that this plan provides, the project development and planning is more difficult.
- The aggressive timeline for project implementation creates issues for logistics as well as limiting options for available projects.
- The lack of historical data also makes planning difficult.
- Access to private land for projects may be an issue and limits the projects that can be implemented.

Stakeholder Engagement

The TAC, which has been involved since the beginning of project planning, is made up of local technical stakeholders including WDNR, United States Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), Bureau of Land Management (BLM), the City of Sheboygan, Sheboygan County and the Sheboygan River Basin Partnership. This group works on fish and wildlife related BUIs and provides valuable input on projects and planning.

In 2011, UW-Extension and Camp Y-Koda scheduled several "Explore and Restore" events aimed at educating Sheboygan residents about fish and wildlife in the AOC (e.g., "Bats of the Sheboygan River," "Salmon Safari"). Additional wildlife-focused "Explore and Restore" events are expected to occur in 2012.

LOSS OF FISH AND WILDLIFE HABITAT

2008 Target and Status

Loss of Fish and Wildlife Habitat	Status
A local fish and wildlife habitat management and restoration/rehabilitation plan has been developed for the entire AOC that accomplishes the following: • Defines the causes of all habitat impairments within the AOC. • Establishes site-specific habitat and population targets for fish and wildlife species within the AOC. • Identifies primary and secondary habitat restoration goals, management activities, and projects that would adequately restore or rehabilitate fish and wildlife habitat within the Sheboygan River AOC.	Not Complete
All primary habitat restoration goals, management activities, and projects identified in the fish and wildlife management and restoration plan are implemented, and modified as needed to ensure continual improvement.	Addressed by Current Projects
Waters within the Sheboygan River AOC are not listed as impaired due to aquatic toxicity in the most recent Clean Water Act 303(d) and 305(b) Wisconsin Water Quality Report to Congress (submitted to USEPA every two years).	Not Complete

Rationale for Listing

The reasons for listing this BUI that were identified in the 1989 RAP included concern that fish habitat was being degraded by sedimentation, dams, and contaminants. There was also concern that agricultural and urban development had resulted in the loss of wildlife habitat, placing a greater importance on the remaining habitat.

Summary of Key Remedial Actions since the Last RAP & Current Status

Since the last RAP update in 1995, there have been several actions to address impairments in the Sheboygan River AOC. These include sediment reduction and erosion control as well as contaminated sediment clean up.

A number of actions have been taken to decrease sediment loads to the AOC. The Sheboygan River Priority Watershed Project, which ended in 2003, resulted in significant reductions in sediment contributed by agricultural areas from both upland soil loss and streambank erosion. Sheboygan County continues to implement its own buffer program. The Cities of Sheboygan Falls and Sheboygan have adopted construction site erosion control ordinances. The City of Sheboygan Storm Water Management Plan was completed in 1998. Also, a Storm Water Management Ordinance and Erosion Control Ordinance were adopted in 2006. In addition, numerous wetland restorations and enhancements have been completed in the Sheboygan River watershed.

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Currently, there is very little information available regarding fish and wildlife populations in the AOC. To provide baseline information necessary to assess fish and wildlife related BUIs, the WDNR applied for and received funding from the FY2010 GLRI for a project to survey and assess a variety of fish and wildlife communities and habitats. This survey and assessment is underway and scheduled to be complete by the end of 2011. This project will deepen the Fish and Wildlife TAC's understanding of the species assemblages and relative abundance within these habitat and plant community types. This

information is intended to be used in completing the Fish and Wildlife Habitat Restoration and Management Plan.

In fall 2010, USEPA approached the TAC and requested that it develop projects to address the fish and wildlife related BUIs, specifically Degradation of Fish and Wildlife Populations and Loss of Fish and Wildlife Habitat. As dredging work to address contamination in the river is expected to be completed by the end of 2012 and Sheboygan River is a priority AOC for USEPA, they wanted other non-contamination related management actions to be addressed at the same time as the contaminated sediment dredging. This funding opportunity spurred the TAC to develop a set of fish and wildlife habitat restoration and conservation projects that would encompass these necessary management actions to move toward removing the two fish and wildlife related BUIs.

In September 2010, TAC members qualitatively surveyed the entire AOC as a preliminary reconnaissance survey of habitat related projects. During subsequent planning meetings, the TAC prioritized the projects identified during the reconnaissance survey based on land available, project location within the AOC, feasibility, partnerships, and need for habitat work, and produced a list of seven Tier I projects. Additional habitat projects (Tier 2 and 3) were also identified that will further restore the Sheboygan River after the contaminated sediment is removed. These are important habitat restoration projects that will build upon those needed to meet the delisting threshold. Only the Tier 1 projects are necessary to implement before the BUIs can be removed.

The TAC has been guided by the Fish & Wildlife Population and Habitat goals and objectives stated in The Sheboygan River RAP (1989):

> Ecosystem Goals and Objectives for Restoration of Impaired Uses [Excerpt]
>
> II. Maintain and enhance a diverse community of terrestrial and aquatic life and their necessary habitat
>
> In order to achieve these goals and restore beneficial uses (see Chapter IV), the following objectives must be met through the RAP process:
>
> 1. Maintain a diverse resident fishery… (Goal II)
> 2. Protect natural areas (green space) along the waterway and enhance habitat for aquatic and terrestrial communities (Goals II, III, and IV)

These goals and objectives were reiterated in the RAP Update (1995), which also included recommendations for population and habitat related “assessment & monitoring” projects and “specific actions.” Earlier RAP implementation recommendations included watershed-wide projects and initiatives. For the purposes of this RAP, the actions identified as necessary for BUI removal are those that can be implemented within the AOC boundary. .

With the goals from the previous RAPs in mind, the TAC identified the seven fish and wildlife habitat restoration and conservation projects. Fish and wildlife restoration efforts within the AOC will focus on restoring, enhancing, or protecting the connectivity, quality and quantity of habitat. Habitat in the AOC was found to be threatened by erosion (and resultant sedimentation), fragmentation, urban development, invasion by non-native plants, storm water runoff, and vegetation loss/removal. The fundamental strategies for addressing these threats are restoring and enhancing connectivity, protecting high quality habitats, restoring habitat along riverbanks and riparian areas, reducing erosion and sedimentation, creating and restoring in-river habitat, controlling invasive plant species and enhancing native vegetation. The seven projects selected to implement these strategies include Kiwanis Park Shoreline Restoration, Wildwood Island Area Restoration, Taylor Drive and Indiana Avenue Wetland Restoration, Shoreline Stabilization in Problem Areas, In-Stream Habitat Improvements, Targeted Invasive Species Control and

the Schuchardt Property Conservation Planning (see Appendix A for additional details about these projects).

Next Actions Needed

1) Complete the sediment remediation projects.
Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river.

2) Complete the Fish and Wildlife Habitat Restoration and Management Plan.
In order to fulfill the delisting targets developed in 2008, a Fish and Wildlife Habitat Restoration and Management Plan needs to be developed that contains the following information for the Loss of Fish and Wildlife Habitat BUI:

- Defines the causes of all habitat impairments within the AOC.
- Establishes site-specific habitat and population targets for fish and wildlife species within the AOC.
- Identifies primary and secondary habitat restoration goals, management activities, and projects that would adequately restore or rehabilitate fish and wildlife habitat within the Sheboygan River AOC.

According to the next steps developed along with the 2008 targets, a technical advisory committee comprised of local stakeholders needs to be formed. That committee needs to work on and adopt the plan and then the projects identified in the plan need to be implemented. The TAC group has already been formed and has been working on AOC project development including the Fish and Wildlife Survey and Assessments and primary projects necessary to restore fish and wildlife habitat. The opportunity for project funding arose before the TAC was able to complete the plan required by the target; however, the fish and wildlife goals and objectives stated in prior RAPs provided a foundation for selecting projects. The TAC worked on the primary habitat project planning and development with the understanding that the process would be captured in the plan later. The TAC will soon begin the process of scoping out the entire plan. The goal is to complete the plan by late spring/early summer 2012.

3) Projects and activities identified in the Fish and Wildlife Habitat Restoration and Management Plan are implemented and monitored to evaluate habitat goals.
The primary projects and activities necessary to restore and remediate fish and wildlife habitat have already been identified by the TAC. These projects will be included in the Fish and Wildlife Habitat Restoration and Management Plan. Funding for these projects has been obtained by WDNR through the GLRI. All seven of the projects are currently underway, but are at different stages of completion. The projects are expected to be complete by September 2012.

The TAC has begun the process of identifying measures of success that will be used to monitor and evaluate the habitat projects and goals. The focus of these measures has been measuring restored habitat area, habitat potential or suitability, improved habitat quality, or the presence of indicator species. These will be included in the Fish and Wildlife Habitat Restoration and Management Plan. Some of the measures already identified include:

- Acres of suitable migratory bird stopover habitat restored or improved. This may include a comparison study with other models, surveys or studies.
- Acres of potential suitable restored terrestrial habitat.
- Miles of warmwater fish community habitat restored or improved.
- IBI scores or catch per effort in AOC are comparable to a non-impacted reference site. Smallmouth bass would be the preferred indicator species.
- Acres of riparian corridor and wetland restored and enhanced.
- Acres of riparian emergent wetland improved, enhanced or restored.
- Invasive species in riparian floodplain forest are inventoried and mapped. Pioneer colonies are treated and target populations are contained to prevent spread to "clean" stands.

4) Waters of the Sheboygan River AOC are not listed as impaired due to aquatic toxicity in the most recent 303(d) or 305(b) lists.

The waters of the Sheboygan River AOC are not currently listed on the 303(d) list for aquatic toxicity. The river is listed for contaminated sediments. Working in conjunction with the WDNR Impaired Waters Program, the Sheboygan River AOC will be assessed to ensure that it does not meet the criteria for aquatic toxicity listing.

Issues Affecting Progress on this BUI

Several issues have been identified in making progress on this BUI:

- Working on project development before the Fish and Wildlife Habitat Restoration and Management Plan could be completed is not ideal. Without the groundwork that this plan provides, the project development and planning is more difficult.
- The aggressive timeline for project implementation creates issues for logistics as well as limiting options for available projects.
- The lack of historical data also makes planning difficult.
- Access to private land for projects may be an issue and limits the projects that can be implemented.

Stakeholder Engagement

The TAC, which has been involved since the beginning of project planning, is made up of local technical stakeholders including WDNR, USFWS, NOAA, BLM, the City of Sheboygan, Sheboygan County and the Sheboygan River Basin Partnership. This group works on fish and wildlife related BUIs and provides valuable input on projects and planning.

In 2011, UW-Extension and Camp Y-Koda scheduled several "Explore and Restore" events aimed at educating Sheboygan residents about fish and wildlife in the AOC (e.g., "Bats of the Sheboygan River," "Salmon Safari"). Additional wildlife-focused "Explore and Restore" events are expected to occur in 2012.

BIRD OR ANIMAL DEFORMITIES OR REPRODUCTION PROBLEMS

2008 Target and Status

Bird or Animal Deformities or Reproduction Problems	Status
Superfund and RCRA sediment and floodplain remedial actions have been implemented.	Addressed by Current Projects/ Not Complete (floodplains)
Studies conducted in the AOC indicate that the beneficial use should not be considered impaired; or	Complete
If studies conducted in the AOC determine that this use is impaired, then two approaches can be considered for delisting:	Not Complete
Approach 1 – Observational Data and Direct Measurements of Birds and other Wildlife • Evaluate observational data of bird and 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 from 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 delisted. If the rates are statistically different from the reference site, it may indicate a source from either within or outside the AOC. Therefore, if the rates are statistically different or the data are insufficient for analysis, 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 and are not statistically different from those at minimally impacted reference sites (at a 95% confidence interval).	Not Complete
Where data from direct observation of wildlife and wildlife tissue data are not available, the following approach should be used:	Not Complete
Approach 2 – Fish Tissue Contaminant Levels as an Indicator of Deformities or Reproductive Problems • If fish tissue concentrations of contaminants of concern 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 of concern identified in the AOC are not statistically different from those found in Lake Michigan (at 95% confidence interval), then the BUI can be delisted. Fish of a size and species considered prey for the wildlife species under consideration must be used for the tissue data.	Not Complete

Note that LOELs (cited in Approach 1 of the target) may not exist for all species and/or all contaminants.

Rationale for Listing

Bird and animal deformities or reproductive problems were listed as a BUI because the levels of contamination present in the AOC were known to be high enough to cause these types of impairments in wildlife. While no deformities had been reported, reproductive problems were suspected. One example is mink populations in the AOC whose populations were low or non-existent despite available habitat. PCBs are known to impact mink reproduction (Aulerich and Ringer, 1977; Leonards et al., 1995).

Since the 1995 RAP Update was completed, several studies have been completed that documented contaminant levels in the food chain high enough to cause reproductive problems. Tree swallow (Patnode et al., 1998a) and snapping turtle (Patnode et al., 1998b) reproduction studies documented

impaired hatching success. The Aquatic Ecological Risk Assessment (EVS and NOAA, 1998) determined that mink and great blue heron were likely to suffer adverse reproductive effects from eating Sheboygan River small mammals, fish, and crayfish. The Terrestrial Ecological Risk Assessment (Chapman, 1999) determined that robins were likely to suffer adverse reproductive effects from foraging in contaminated sections of the floodplain.

Summary of Key Remedial Actions since the Last RAP & Current Status

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Next Actions Needed

1) Complete the sediment remediation projects.

Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river. The floodplain clean up portion of the Sheboygan River & Harbor Superfund project must also be implemented.

2) Complete study to determine if BUI is no longer impaired.

Once the contamination remediation projects are finished, a study should be completed to indicate if this BUI is no longer impaired. The study should follow general guidelines from the delisting target approaches listed above. Based on past or ongoing studies, preferred study species are tree swallows, mink, or kingfishers.

Issues Affecting Progress on this BUI

There are currently no issues affecting progress on this BUI.

Stakeholder Engagement

The TAC for the fish and wildlife related BUIs will be engaged in scoping out a study design for this BUI as part of the fish and wildlife planning process.

FISH TUMORS OR OTHER DEFORMITIES

2008 Target and Status

Fish Tumors or Other Deformities	Status
All known sources of PAHs and chlorinated organic compounds within the AOC and tributary watershed have been controlled through issuance of the appropriate regulatory control document or eliminated.	Complete
The Superfund PCB cleanup and Manufactured Gas Plant cleanup have been implemented.	Addressed by Current Projects
There have been no reports of external Deformities, Lesions, and Tumors (DLTs) or internal organ/system impacts that have been verified by qualified WDNR personnel to have been caused by chemical contaminants for a period of five years.	Addressed by Current Projects
A fish health survey of resident benthic fish species such as white suckers finds incidences of tumors or other deformities at an incidence rate of less than 5 percent.	Addressed by Current Projects
OR, in cases where any tumors have been reported a comparison study of resident benthic fish (e.g., brown bullhead or white suckers) of comparable age and at maturity (3 years), or of fish species which have historically been associated with this BUI, in the AOC and a non-impacted control site indicates that there is no statistically significant difference (with a 95% confidence interval) in the incidence of liver tumors or deformities.	Addressed by Current Projects

Rationale for Listing

Due to the high levels of contamination that were known to be present in the AOC when it was listed, it was assumed that these levels were high enough to cause fish tumors or deformities, although none had been observed. A study of white suckers in the Sheboygan River conducted since the last RAP (Schrank et al., 1997) found hepatic (liver) lesions in the white suckers, and at least some were preneoplastic. In addition, the Aquatic Ecological Risk Assessment (EVS and NOAA, 1998) evaluated health effects based on chemical concentrations and a review of the literature for reproductive effects. Potential reproductive effects from PCBs exist, especially for smallmouth bass. Reproductive effects from PAHs are less certain.

Summary of Key Remedial Actions since the Last RAP & Current Status

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Due to lack of information on the fish tumor incidence rate in the AOC, WDNR recently pursued and received grant funding from GLRI for a study to assess this BUI. The study, Evaluation of Fish Tumors or Other Deformities, will be initiated in spring 2012 and be carried out by UW-Madison and University of West Virginia/USGS Cooperative Science Center. In accordance with the delisting target guidance, 200 white suckers from the Sheboygan River AOC will be collected and tumor incidence rate verified. If the rate is found to be above the 5% target, a second year of reference site sampling in 2013 will determine if the tumor incidence rate is significantly different in the Sheboygan River than a non-impacted site. Stable isotope analysis will also be conducted to assist in determining residence of fish. Refer to Appendix C, *Sheboygan River Fish Tumor Evaluation*, for additional information about the study design.

Next Actions Needed

1) Complete the sediment remediation projects.
Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river.

2) Complete the Evaluation of Fish Tumors or Other Deformities study and repeat if necessary.
This project will determine the tumor incidence rate in fish in the Sheboygan River AOC and be used to evaluate if this BUI can be considered for removal. White suckers will be used as the indicator species. The second phase (reference site sampling) should only be completed if the tumor incidence rate is determined to be above 5% in the AOC. If this second phase indicates that the rate is significantly different from a non-impacted site, the study should be repeated in 5 years, allowing for more recovery after the contaminated sediment remediation is complete.

Issues Affecting Progress on this BUI
There are currently no issues affecting progress on this BUI.

Stakeholder Engagement
Stakeholders will be kept informed of study progress and results. Data and methods will be shared with the AOC community to facilitate tumor assessment elsewhere in Wisconsin and the Great Lakes region.

DEGRADATION OF PHYTOPLANKTON AND ZOOPLANKTON POPULATIONS

2008 Target and Status

Degradation of Phytoplankton and Zooplankton Populations	Status
Sources causing nutrient enrichment to the outer harbor and near shore waters are identified and controlled if nutrients are the main contributor; OR Sources resulting in ambient water toxicity in the outer harbor and near shore waters are identified and controlled if toxicity is the main contributor.	Addressed by Current Projects
Phytoplankton or zooplankton bioassays confirm no toxicity in ambient waters and the community structure is diverse and contains species indicative of clean water.	Addressed by Current Projects
The phytoplankton and zooplankton communities within the site being evaluated are statistically similar to a reference site with similar habitat and minimal sediment contamination.	Addressed by Current Projects

Rationale for Listing

Due to the known contaminated sediments present in the river and associated toxicity, there was concern that plankton populations might be negatively impacted. Also, there was a concern that excess nutrients might be affecting these populations. However, there was little or no evidence that the populations were actually degraded. To date, there have been no phytoplankton or zooplankton studies within the AOC to assess this BUI, so it is not known whether their populations are degraded or, if they are, what the cause might be.

Summary of Key Remedial Actions since the Last RAP & Current Status

As described in Section 2, significant progress has been made in the Superfund and contaminated sediment remediation projects. Dredging of contaminated sediments in the river is expected to be completed by the end of 2012. Plans for clean up of the contaminated floodplain soils have not yet been finalized.

Due to lack of information on the benthic and planktonic communities in the Sheboygan River compared to reference sites, WDNR recently pursued and received grant funding from GLRI for comparison study. This study, Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern, will be carried out by USGS for WDNR and will include all four of the Lake Michigan AOCs and six reference sites. Benthos, phytoplankton and zooplankton communities will be sampled and assessed in each of the AOCs and in the reference rivers. This study will be used to evaluate the status of this BUI in the Sheboygan River AOC. The project was initiated in fall 2011 and sampling will occur in 2012.

Next Actions Needed

1) Complete the sediment remediation projects.

Four separate sediment remediation projects are underway to address contaminated sediments in the Sheboygan River AOC. These projects include the Sheboygan River & Harbor Superfund project, Camp Marina Former MGP Superfund Project, the Great Lakes Legacy Act betterment project and the USACE Strategic Navigational dredging. Completion of these projects will address both the PCB and PAH contaminated sediments in the river.

2) *Complete current Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern project and repeat if necessary.*

This project will assess the benthic, phytoplankton and zooplankton communities of the river. The data gathered as part of this project will be used to assess this BUI. If data indicates that the planktonic communities in the Sheboygan River are similar to non-impacted reference sites, the BUI can be considered for removal. If the data indicates that the planktonic communities are not similar, then the study should be repeated in the future after more time has been allowed for recovery after contaminated sediment removal.

3) *Determine if bioassays to confirm that no aquatic toxicity is present in the river are necessary based on results of current assessment project.*

Data gathered by the current Benthos & Plankton BUIs Evaluation project will be used to determine if plankton communities are degraded. If these communities are not found to be degraded, no bioassays will be necessary to determine if aquatic toxicity is an issue or cause of population degradation. If they are found to be degraded, bioassays will need to be performed to determine if aquatic toxicity is the cause of this impairment.

Issues Affecting Progress on this BUI

There are currently no issues affecting progress on this BUI.

Stakeholder Engagement

WDNR and USGS will provide interested stakeholders and the general public with information about the benthos and plankton studies to describe what the results say about the river and how they can be used to define next steps.

EUTROPHICATION OR UNDESIRABLE ALGAE

2008 Target and Status

Eutrophication or Undesirable Algae	Status
In-river total phosphorous concentrations meet Wisconsin criteria when promulgated; and	Complete
There are no violations of the minimum dissolved oxygen concentrations established in NR 102 within the AOC due to excessive sediment deposition or algae growth; and	Complete
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 Wisconsin Impaired Waters list submitted to USEPA every two years.	Complete

Rationale for Listing

When the AOC was listed both phosphorus and nitrogen concentrations in the river were elevated due to excessive nutrient loads and undesirable algal blooms were occasionally seen. The source of the nutrients was assumed to be nonpoint source pollution from upstream sources and developing urban areas.

Summary of Key Remedial Actions since the Last RAP & Current Status

A number of actions have been taken to decrease nutrient loads to the AOC. The Sheboygan River Priority Watershed Project, which ended in 2003, resulted in significant reductions in phosphorus contributed by agricultural areas. Sheboygan County continues to run its own buffer strip program. The Cities of Sheboygan Falls and Sheboygan have adopted construction site erosion control ordinances. The City of Sheboygan Storm Water Management Plan was completed in 1998. The City also adopted a Storm Water Management Ordinance and Erosion Control Ordinance in 2006. In addition, numerous wetland restorations and enhancements have been completed in the Sheboygan River watershed.

Since the last RAP update, WDNR has monitored total phosphorus concentrations as well as dissolved oxygen and chlorophyll-a in the Sheboygan River. This data has been used to assess if this BUI should still be considered impaired. This assessment is included in Appendix B.

Next Actions Needed

1) Compile BUI Status Change Documentation for the Eutrophication or Undesirable Algae BUI.
The results of WDNR's *Sheboygan River Area of Concern Eutrophication or Undesirable Algae Beneficial Use Impairment Assessment* (Appendix B) generally suggest that the "eutrophication or undesirable algae" BUI is not supported by current total phosphorus (TP), dissolved oxygen (DO), or chlorophyll-a (CHL-a) data. Our comparisons were made with reference to the 303(d) listing criteria which indicate a level of impairment.

Our results are not meant to indicate that further improvements with regard to TP, DO, CHL-a or eutrophication in general cannot or should not be made or that other analyses may suggest results that do not support our conclusions here. Broader habitat alterations currently underway to address other BUIs in the Sheboygan River AOC will most likely improve the status of this AOC relative to the eutrophication BUI as well.

Issues Affecting Progress on this BUI

There are currently no issues affecting progress on this BUI.

Stakeholder Engagement

During 2012, stakeholders will be engaged in the process to request a status change for the eutrophication BUI. The nature of stakeholder engagement for BUI status change requests will need to be determined by WDNR, USEPA, UW-Extension, and other agency partners and stakeholder groups in the first half of 2012. At a minimum, a BUI status change document will be prepared and released for public comment, accompanied by a public informational meeting and 30-day (or longer) comment period.

CONCLUSION

This AOC will be very active in 2012 and much progress will be made toward achieving AOC goals. In the next year, it is expected that four dredging projects will be completed and seven habitat projects will be implemented. Assessments of the fish tumors, wildlife consumption, bird/animal deformities, benthos, and plankton BUIs will occur to provide information about their status. Two plans – the *Fish and Wildlife Restoration and Management Plan* and *Dredge Alternatives Plan* – will be written. BUI status change requests will be initiated for eutrophication and other impairments as appropriate. Stakeholder engagement will strengthen as UW-Extension continues to facilitate the TAC and CAC and implement community outreach and education programs.

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APPENDICES

Appendix A Sheboygan River AOC BUI Tracking Matrix

Appendix B Sheboygan River Area of Concern Eutrophication or Undesirable Algae Beneficial Use Impairment Assessment

Appendix C Appendix C Sheboygan River Fish Tumor Evaluation

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Appendix A

Sheboygan AOC BUI 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, and will be updated as more information is collected and as actions are completed.

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Sheboygan River AOC BUI Tracking Matrix – December 2011

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Restrictions on Dredging Activities	Yes, following dredging projects completion in 2012	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Restrictions on Dredging Activities	Yes, following dredging projects completion in 2012	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	
Restrictions on Dredging Activities	Yes, following dredging projects completion in 2012	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $27,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Restrictions on Dredging Activities	Yes, following dredging projects completion in 2012	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Restrictions on Dredging Activities	Yes, following dredging projects completion in 2012	Dredging Alternatives Plan	No Funding	In Progress	2	WDNR	September 30, 2012	
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	WDNR Fish Contaminant Monitoring and Advisory Program	WDNR Funding Level Unknown	In Progress	1	WDNR	Post-2012	
Restrictions on Fish and Wildlife Consumption	Yes, following remediation and monitoring projects	Evaluation of Waterfowl Consumption Advisories within the Sheboygan River AOC	GLRI $136,000	In Progress	1	WDNR	2011-2014	
Degradation of Benthos	Yes, following remediation and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Degradation of Benthos	Yes, following remediation and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Degradation of Benthos	Yes, following remediation and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Degradation of Benthos	Yes, following remediation and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Degradation of Benthos	Yes, following remediation and evaluation projects	Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern	GLRI $451,500	In Progress	1	WDNR and USGS	2011-2013	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Sheboygan AOC Pathway to Delisting Habitat BUI's–Survey and Assessment	GLRI $202,181	In Progress	1	WDNR	Spring 2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Small Mammal Contaminant Monitoring in the Sheboygan River AOC	GLRI Capacity Funding $16,767	In Progress	1	WDNR	2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	UWEX Education and Outreach	GLRI $83,000	In Progress	4	WDNR and UWEX	2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Building the Sheboygan River AOC CAC's knowledge and capacity to engage the broader community and assist in AOC restoration.	GLRI Capacity Funding $ 28,655	In Progress	4	Sheboygan River Basin Partnership	2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Kiwanis Park Shoreline Restoration	GLRI $2,115,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the City of Sheboygan and Sheboygan County.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Taylor Dr. & Indiana Ave. Riparian Area & Wetland Restoration	GLRI $795,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the City of Sheboygan and Sheboygan County.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Wildwood Island Area Restoration	GLRI $790,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the Bureau of Land Management, City of Sheboygan and Sheboygan County.

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Shoreline Stabilization in Problem Areas	GLRI $292,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with Sheboygan County.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	In-Stream Habitat Improvements	GLRI $141,000	In Progress	3	WDNR	2011-2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Targeted Invasive Species Control	GLRI $132,500	In Progress	3	WDNR	2011-2012, follow up 2013-2015	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Schuchardt Property Conservation Planning	GLRI $40,000	Completed	3	WDNR	2011	This project was completed in partnership with the City of Sheboygan. Army Corps ERDC contractors will complete additional invasive species planning work in 2012 on the Schuchardt property, building on this plan.
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Fish and Wildlife Habitat Restoration and Management Plan	No Funding	In Progress	4	WDNR	September 30, 2012	
Degradation of Fish and Wildlife Populations	Yes, following remediation, restoration and evaluation projects	Monitor to evaluate projects meet their goals.	Funding Source or Level Unknown	No Started	5	WDNR	Post - 2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Sheboygan AOC Pathway to Delisting Habitat BUI's–Survey and Assessment	GLRI $202,181	In Progress	1	WDNR	Spring 2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Small Mammal Contaminant Monitoring in the Sheboygan River AOC	GLRI Capacity Funding $16,767	In Progress	1	WDNR	2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	UWEX Education and Outreach	GLRI $83,000	In Progress	4	WDNR and UWEX	2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Building the Sheboygan River AOC CAC's knowledge and capacity to engage the broader community and assist in AOC restoration.	GLRI Capacity Funding $ 28,655	In Progress	4	Sheboygan River Basin Partnership	2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Kiwanis Park Shoreline Restoration	GLRI $2,115,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the City of Sheboygan and Sheboygan County.

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Taylor Dr. & Indiana Ave. Riparian Area & Wetland Restoration	GLRI $795,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the City of Sheboygan and Sheboygan County.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Wildwood Island Area Restoration	GLRI $790,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with the Bureau of Land Management, City of Sheboygan and Sheboygan County.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Shoreline Stabilization in Problem Areas	GLRI $292,000	In Progress	3	WDNR	2011-2012, follow up 2013-2015	This project is being completed in partnership with Sheboygan County.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	In-Stream Habitat Improvements	GLRI $141,000	In Progress	3	WDNR	2011-2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Targeted Invasive Species Control	GLRI $132,500	In Progress	3	WDNR	2011-2012, follow up 2013-2015	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Schuchardt Property Conservation Planning	GLRI $40,000	Completed	3	WDNR	2011	This project was completed in partnership with the City of Sheboygan. Army Corps ERDC contractors will complete additional invasive species planning work in 2012 on the Schuchardt property, building on this plan.
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Fish and Wildlife Habitat Restoration and Management Plan	No Funding	In Progress	4	WDNR	September 30, 2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Monitor to evaluate projects meet their goals.	Funding Source or Level Unknown	Not Started	5	WDNR	Post - 2012	
Loss of Fish and Wildlife Habitat	Yes, following remediation, restoration and evaluation projects	Consult with Impaired Waters Program to assure that the Sheboygan River is not listed on the 303 (d) list for aquatic toxicity.	No Funding	Not Started	5	WDNR	Post - 2012	

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Bird or Animal Deformities or Reproduction Problems	Yes, following remediation and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Bird or Animal Deformities or Reproduction Problems	Yes, following remediation and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	
Bird or Animal Deformities or Reproduction Problems	Yes, following remediation and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Bird or Animal Deformities or Reproduction Problems	Yes, following remediation and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Bird or Animal Deformities or Reproduction Problems	Yes, following remediation and evaluation projects	Complete a study to determine if BUI is no longer impaired.	Funding Source or Level Unknown	Not Started	5	WDNR	Post – 2012	
Fish Tumors or Other Deformities	Yes, following remediation and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Fish Tumors or Other Deformities	Yes, following remediation and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Fish Tumors or Other Deformities	Yes, following remediation and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).
Fish Tumors or Other Deformities	Yes, following remediation and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Fish Tumors or Other Deformities	Yes, following remediation and evaluation projects	Evaluation of Fish Tumors or Other Deformities	GLRI $168,500	In Progress	1	WDNR	2012-2013	
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	Sheboygan River & Harbor Superfund Site Remediation	Responsible Party Approx. $12,500,000	In Progress	3	USEPA	September 30, 2012	Implementation of floodplain contamination clean up still not started.
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	WPSC Camp Marina MGP Superfund Site Remediation	Responsible Party Approx. $10,000,000	In Progress	3	USEPA	September 30, 2012	
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	Great Lakes Legacy Act Dredging project	Cost Share – See Comments Approx. $25,000,000	In Progress	3	USEPA	September 30, 2012	Site characterization was paid for by Great Lakes Legacy program at approx. $700,000. Cost share for feasibility and design phases was provided by GLRI (65%) and the City of Sheboygan, Sheboygan County, WDNR and WPS (35%) at approx. $1,420,000. Cost share for the dredging will be provided by GLRI (65%) at approx. $28,000,000 and Superfund RPs (PRS and WPS) clean up costs (35%).

Beneficial Use Impairment Name	Status assessment needed? (If yes, provide dates if scheduled.)	Actions/Tasks Needed	Funding Source (Estimated Cost if Known)	Action Status (In progress, Completed, Not Started)	Project Type*	Project Lead	Timeframe for Project Completion	Comments
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	Army Corps of Engineers Strategic Navigational Dredging	GLRI Approx. $10,000,000 WDNR & Sheboygan City/County Approx. $800,000	In Progress	3	Army Corps of Engineers	September 30, 2012	Additional funding for disposal site will be provided by WDNR and Sheboygan County.
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	Benthos & Plankton BUIs Evaluation in Wisconsin's Lake Michigan Areas of Concern	GLRI $451,500	In Progress	1	WDNR and USGS	2011-2013	
Degradation of Phytoplankton and Zooplankton populations	Yes, following remediation and evaluation projects	Determine if bioassays to confirm that no aquatic toxicity is present in the river are necessary.	Funding Source or Level Unknown	No Started	1	WDNR	Post - 2012	
Eutrophication or Undesirable Algae	Yes, in 2012	Removal of the Eutrophication or Undesirable Algae BUI.	No Funding	In Progress	5	WDNR	2012	

*Project types:
1. Baseline assessment through data gathering
2. Compile & analyze existing data
3. On-the-ground remediation or restoration project
4. Stakeholder engagement and/or community education & outreach
5. Verification of target achievement through monitoring or other documentation

Appendix B

Sheboygan River Area of Concern Eutrophication or Undesirable Algae Beneficial Use Impairment Assessment

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Sheboygan River Area of Concern Eutrophication or Undesirable Algae Beneficial Use Impairment Assessment

Andrew H. Fayram
Wisconsin Department of Natural Resources
Office of the Great Lakes
101 South Webster St.
Madison, WI 53707

James Bauman
Wisconsin Department of Natural Resources
Watershed Bureau
101 South Webster St.
Madison, WI 53707

Kristi Minahan
Wisconsin Department of Natural Resources
Watershed Bureau
101 South Webster St.
Madison, WI 53707

Stacy Hron
Wisconsin Department of Natural Resources
Southeast Region
1155 Pilgrim Rd.
Plymouth, WI 53703

Vic Pappas
Wisconsin Department of Natural Resources
Southeast Region
1155 Pilgrim Rd.
Plymouth, WI 53703

Introduction

The Sheboygan River and Harbor Area of Concern (AOC) has been listed by the International Joint Commission as having nine of the possible 14 beneficial use impairments (BUI). Here, we are centrally concerned with the current status of the BUI "eutrophication or undesirable algae". The current WDNR delisting target for this BUI within the Sheboygan River AOC is as follows:

Delisting of this BUI can occur when

- o In-river total phosphorous concentrations meet Wisconsin criteria when promulgated; and
- o There are no violations of the minimum dissolved oxygen concentrations established in NR 102 within the AOC due to excessive sediment deposition or algae growth; and
- o 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 Wisconsin Impaired Waters list submitted to U.S. EPA every two years (SEH and ECT 2008)

With regard to this BUI we examine likelihood that the Sheboygan River and Harbor AOC remains impaired with regard to total phosphorus (TP), dissolved oxygen (DO), and chlorophyll-a (CHL-a) concentrations which are strongly associated with eutrophication. High levels of TP and CHL-a, and low levels of DO are indicators of eutrophic conditions. Certainly there are improvements above and beyond "impairment" can and should be made with regard to TP, DO, CHL-a, and other water quality parameters but our focus is on the AOC BUI designation. Our objectives were to determine whether TP and DO were substantially impaired in the Sheboygan AOC relative to the levels considered as impaired by the Wisconsin Department of Natural Resources (WDNR) relative to proposed 303(d) listing criteria (WDNR, WisCALM unpublished data). Although there is currently no 303 (d) listing criteria for CHL-a impairment in rivers, it is an indication of eutrophic conditions and we felt that examination of levels and trends would be helpful to assess the degree of impairment.

Methods

The proposed limits for 303(d) listing for TP and DO by the WDNR in river systems such as the Sheboygan River are as follows: TP $\geq$ 0.100 mg/L (at least 6 monthly samples May-October, lower 95% confidence interval of the population median exceeds threshold), DO < 5.0 mg/L (3 continuous days of measurement in July or August 10% or more of all values). There is no WDNR 303(d) listing criterion for CHL-a levels for river systems, however we examined levels with reference to 303(d) listing criteria for unstratified lakes "fish and aquatic life use" impairment (annual average >60 mg/L for at least 3 years, samples from July 15-September 15).

Phosphorus

We examined TP data obtained from within the Sheboygan River Harbor AOC in two manners. First, we calculated the mean and 95% confidence intervals of samples collected from the Esslingen Park location between May 2005 and August 2011 (69 samples, SWIMS station 603095, Figure 1) and from the 14th Street location between

October 2008 and September 2009 (7 samples, SWIMS station 10010954, Figure 1). In addition, we examined these data for evidence of a temporal trend using simple linear regression, $\alpha = 0.05$. Only samples collected from May through October were included in the analysis. Second, we used the Wisconsin Department of Natural Resources (WDNR) accepted TP Assessment Tool to determine if the Sheboygan River met maximum TP standards to be considered as impaired for the 303(d) impaired waters list for phosphorus. A full description of the WDNR TP Assessment Tool can be found at the end of this document.

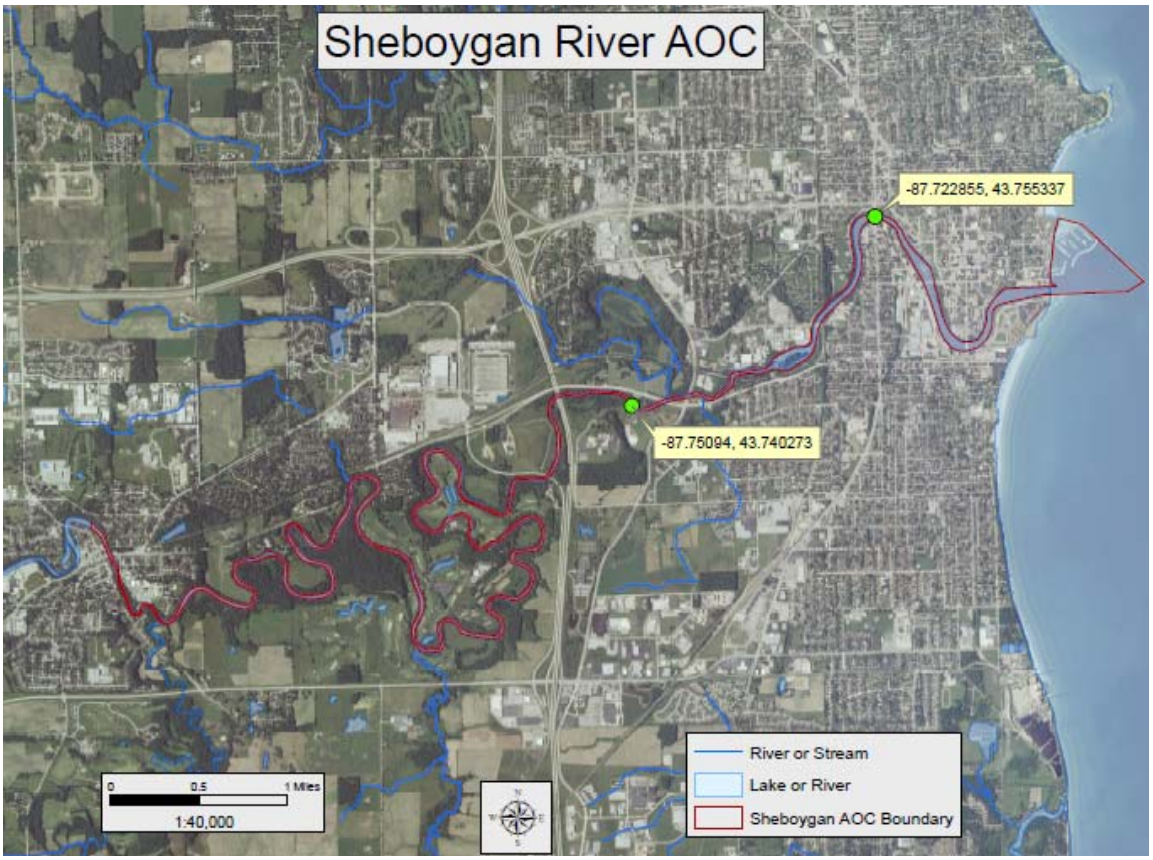


Figure 1. Sampling locations within the Sheboygan River AOC for TP and DO.

Dissolved Oxygen

We examined available DO measures in a similar fashion to TP measurements. Dissolved oxygen levels were sampled at the same two stations where historic TP data were collected. We considered levels of DO <5 mg/L as an indication of impairment. This level is considered marginal for some fish species and values lower than 5 mg/L can result in stress and potential mortality for some fish species and is the level associated with 303(d) consideration (WDNR, WisCALM unpublished data). First, we calculated the mean and 95% confidence intervals of samples collected from the Esslingen Park location between July 2001 and September 2011 (36 samples, SWIMS station 603095, Figure 1) and from the 14th Street location between October 2008 and September 2009 (2 samples, SWIMS station 10010954, Figure 1). Then, we examined these data for evidence of a temporal trend using simple linear regression, $\alpha = 0.05$. Only samples collected in July and August were included in the analysis.

Chlorophyll-a

We examined available CHL-a data collected between 2002 and 2010 at the Esslingen Park location. There is currently have codified criterion for an impairment threshold for CHL-a. However, CHL-a data may be used as guidance for WDNR impairment listing. There are no guidance thresholds for rivers but we examined Sheboygan River CHL-a values with regard to "deep lake" and "shallow lake" thresholds for 303 (d) listing. Exceedance thresholds are an annual average (for at least three years) of $\geq$ 60 ug/L for shallow lakes and $\geq$ 27 ug/L for deep lakes. Deep lakes and shallow lakes are differentiated by their likelihood to stratify as defined by Lathrop and Lillie (1980). Samples included in this analysis were collected between July 15 and September 15 as outlined in WDNR 303(d) listing documentations. We compared annual values to guidance exceedance thresholds with one-tailed t-tests. We also examined data for significant decreases or increases over time using linear regression analysis ($\alpha = 0.05$)

Results

Phosphorus

Phosphorus levels within the Sheboygan River AOC seem to be marginal. Total phosphorus levels from the Esslingen Park location ranged from 0.061 to 0.712 mg/L with a mean value of 0.195 $\pm$ 0.025 mg/L while levels at the 14th Street location ranged from 0.055 to 0.224 mg/L with a mean value of 0.125 $\pm$ 0.053 including all samples taken between May and October between 2005 and 2010. There was no significant temporal trend in TP values for either the Esslingen Park samples (Figure 2) (d.f. = 68, t = 0.11, P = 0.91) or the 14th Street samples (Figure 3) (d.f. = 6, t = 0.77, P = 0.47). Based on these very course results, the Sheboygan River AOC seems to be marginally impaired with regard to the 0.100 mg/L impairment criterion.

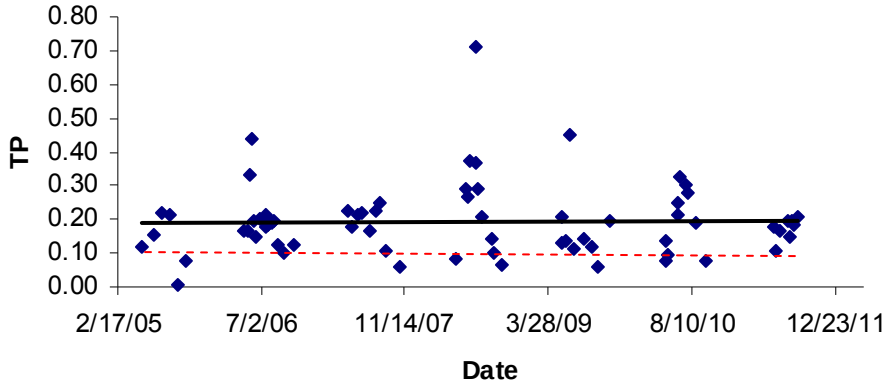


Figure 2. Total phosphorus values (mg/L) for the Esslingen Park location of the Sheboygan River May 2005-August 2011 and regression line. Total phosphorus threshold criterion shown as dashed line.

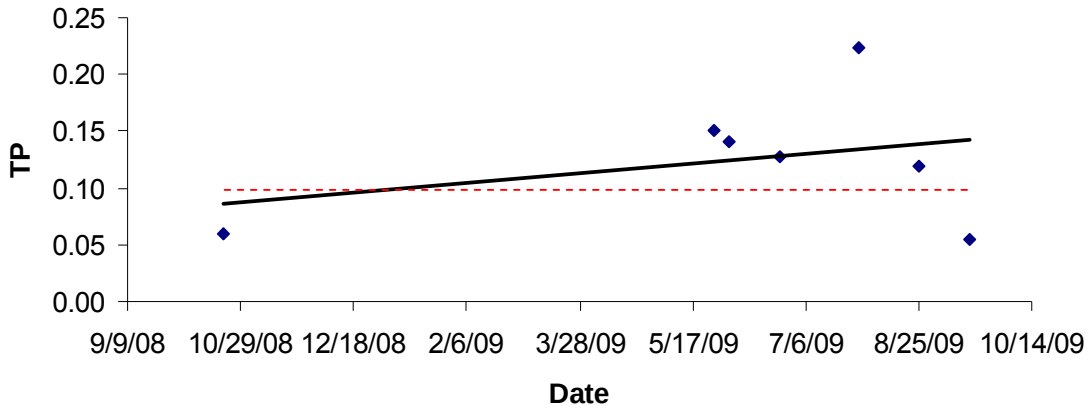


Figure 3. Total phosphorus (mg/L) values for the 14th Street location of the Sheboygan River October 2008-October 2009 and regression line. Total phosphorus threshold criterion shown as dashed line.

When we employed the more rigorous and standardized TP Assessment Tool (WDNR, WisCALM unpublished data), it appears that the TP levels are not particularly excessive since the lower 95% confidence interval is below the TP 303(d) impairment criterion for both sites within the Sheboygan AOC (Table 1).

Table 1. Wisconsin DNR TP Assessment Tool results for stations within the Sheboygan River AOC.

WBIC: 50700 **Official Name:** Sheboygan River **Segment #:** 1
Local Name: Sheboygan River **TP Threshhold (ug/L):** 100
County: Sheboygan **Watershed:** Sheboygan River

Station ID	Name	# Results	Median	Min	Max	95% CI Lower Level	95% CI Upper Level	Relation to Standard
603095	Sheboygan River at Sth 28 Sheboygan-Esslingen Park	18	165.0	61.0	712.0	84.0	216.0	May Exceed
10010954	Sheboygan River - 14th St	6	123.5	55.0	224.0	55.0	224.0	May Exceed

Dissolved Oxygen

There is little evidence that DO levels are impaired in the Sheboygan River AOC. Of the July and August samples available, none were below the impairment criterion of 5.0 mg/L. The Esslingen Park DO level ranged between 5.7 and 14.3 mg/L with a mean value of 8.6 $\pm$ 0.45 mg/L. There was no evidence of a temporal trend in DO at the Esslingen Park station (Figure 4) (df = 35, t = 1.43, P = 0.16). The 14th Street DO level ranged between 13.8 and 14.6 mg/L with a mean value of 14.2 $\pm$ 5.1 mg/L. Limited data from July and August at the 14th Street station prevented an evaluation of temporal trend.

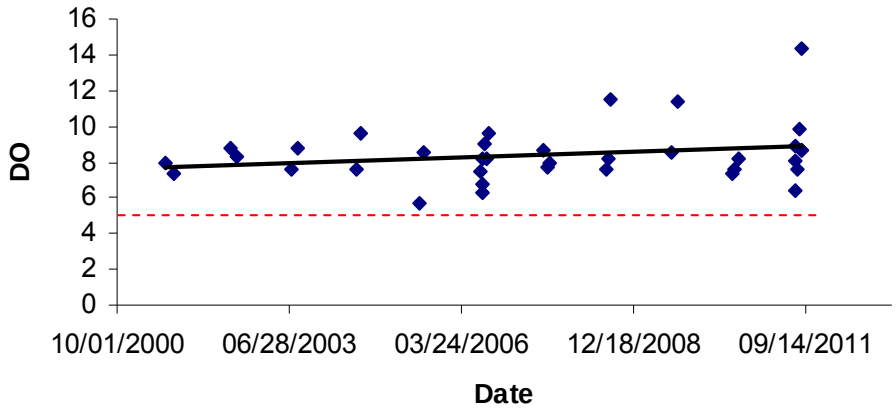


Figure 4. Dissolved oxygen values (mg/L) for the Esslingen Park location of the Sheboygan River July 2001-August 2010 and regression line. Dissolved oxygen threshold criterion shown as dashed line.

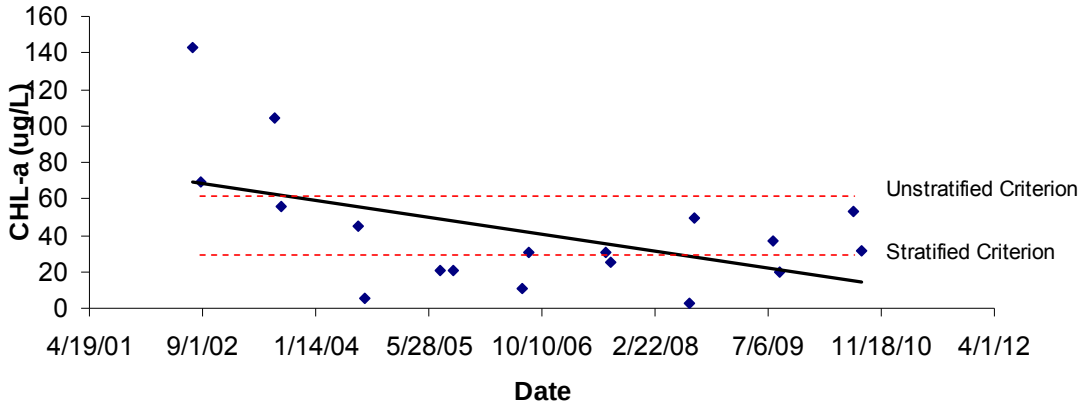
Chlorophyll-a

Our results suggest that the threshold criterion for 303(d) listing criteria for unstratified lakes "fish and aquatic life use" impairment was not met in the Sheboygan AOC although mean values of earlier samples taken in 2002 and 2003 did exceed >60 ug/L threshold criterion for unstratified lakes and samples taken in 2002, 2003, 2007, 2009, and 2010 exceeded the >27 ug/L for stratified lakes (Table 2). Similarly, the mean value of samples taken from 2002 to 2010 was 41.9 $\pm$ 23.1 ug/L but was not significantly higher than either 27 ug/L ($t = 1.47$, $p = 0.09$, d.f. = 8) or 60 ug/L ($t = -1.79$, $p = 0.94$, d.f. = 8). There was a significant decline in CHL-a values utilizing all data collected between July 15 and September 15 2002-2010 ($t = -2.37$, $p = 0.03$, d.f. = 17) (Figure 5).

Table 2. Mean values for CHL-a samples (ug/L) taken from the Sheboygan River Esslingen Park location sampled between July 15 and September 15, 2002- 2010.

Year	CHL-a	N
2002	106.25	2
2003	79.7	2
2004	25.295	2
2005	20.85	2
2006	20.45	2
2007	27.8	2
2008	26.09	2
2009	28.35	2
2010	42.15	2

Figure 5. Figure 4. Chlorophyll-a values for the Esslingen Park location of the Sheboygan River July 2002-September 2010 and regression line. 303 (d) lake threshold criterion shown as dashed lines.



Discussion

Our results generally suggest that the "eutrophication or undesirable algae" BUI is not supported by current TP, DO, or CHL-a data. Our comparisons were made with reference to the 303 (d) listing criteria which indicate a level of impairment.

Dissolved oxygen levels appear to be consistently above 303(d) impairment levels. However, the samples were generally not obtained during the time period when DO levels reach their daily minimum (i.e. just prior to dawn) (Goldman and Horne 1983). Therefore, it is possible that additional samples taken during this time period might indicate an occasional measurement below the threshold criterion. However, given the large number of samples which indicate that the DO level is generally considerably above the threshold criterion.

Our results are not meant to indicate that further improvements with regard to TP, DO, CHL-a or eutrophication in general cannot or should not be made or that other analyses may suggest results that do not support our conclusions here. Broader habitat alterations currently underway to address other BUI in the Sheboygan River AOC will most likely improve the status of this AOC relative to the eutrophication BUI as well.

Acknowledgements

Thanks to Tom Simmons for providing GIS assistance and to Aaron Larson for providing guidance related to the 303(d) listing process and criteria.

References

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WDNR, Unpublished Data. Wisconsin 2012 Consolidated Assessment and Listing Methodology (WisCALM). Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting

WDNR Total Phosphorus – Rivers and Streams Assessment Tool

2/7/2011 Version 2.1a (Write-Up Updated 3/2/2011)

Parameters, Timeframe

1. Search and find all total phosphorus data (DNR_STORET 665) for all non-lake stations over the years of 2001 – 2010 (previous year and preceding 10 years).
Note: Run analysis by station, not waterbody identification code (wbic), and display with results searchable by assessment Unit (au), wbic and station. If a station is assigned to multiple AUs it will appear more than once in that particular dataset.
2. Summarize only the May - October data from stations with at least a full year of data
Note: use May through Oct. data for a year and use previous year data to fill gaps if needed.
3. In many months with more than one sample use the value closest to the middle of the month**.** For a 30-day month use midnight between the 15th/16th and for 31-day months I use noon of the 16th.

Find Full Growing Seasons within a given year

4. Within the previous 10 years, first use the years that have a full set of growing season data (May to October) (use the most recent full year first, then the 2nd most recent). Once all the full seasons of data have been used, run through the bucket rule, which is described below.

Bucket Rule

5. Begin with the most recent year where an incomplete growing season of data is available. Put acceptable months in a “bucket” or “set” of data and continuing searching in previous years for the missing months of the growing season until a full year of data is compiled. Run through the bucket rule until a full set of data is available for up to 3 years (this includes the use of full growing season data from item #4 above). In other words, where sampling did not occur over all six months in a single year, add data from the missing months in the previous year. For example, at the 14th St. site we used data from May - September 2009, but no October data were available so we added results from October 2008.
To fill in missing months, the rule can uses data within the 10 year time frame prior to the assessment year (i.e., for the 2011 assessment process (now), we used 2000-2010 growing seasons). Datasets can be completed with results from a gap of more than just the previous year. The previous tool (V1.0) pulled out "full" years first, then ran the

bucket rule, ie., it simply starts with the most recent samples and work our way backward as needed to get up to three full 6-month sets. This version (V 2.1a) does pull a full year of data first moving backward before filling the “bucket sets”. Samples where a newer one was collected within 15 days were discarded once the tool grabs samples closest to the middle of the month. So, if the representative September sample is collected 9/22/2010 and the October sample is on 10/1/2010, the 9/22/2010 sample gets discarded.

Minimum Datasets

6. Use the most recent 3 years of data for this calculation (based on the bucket rule).

Presentation of Results

7. Results closest to the middle of each month for the most recent 3 years of data are presented based on whether they clearly meet, may meet, may exceed, or clearly exceed 0.1 mg/L using the protocols.

Confidence Interval Creation Logic:

- For the 6-sample set we use the lowest (rank 1) and highest (rank 6) values.
- For the 12-sample set, we narrow the 95% CI range by "discarding" the lowest *two* values and the highest *two* values (leaving us with everything from rank 3 through rank 10). This is completely symmetric in "discarding" values from the low and high ends.
- For the 18-sample set, we narrow the 95% CI range by "discarding" the lowest *four* values and the highest *five* values (leaving us with everything from rank 5 through rank 13). This is nearly symmetric in "discarding" values from the low and high ends (four vs five).
- *The 24 sample size scenario isn’t used right now because we only use three years of data.*

Special Note: Spatial Data Dependencies.

The TP tool runs on stations but those stations must be applied to assessment units. To do so, we first tried intersecting and relating stations that fell within 100 meters of the centerline of a given river/stream. In some cases, this picked up too many stations that didn’t relate to the water of interest. Therefore, we placed a secondary restriction that requires that the station fall within 100 meters of the centerline of the assessment unit AND that the station and the AU have the same WBIC. This focusing of data integration improved the precision of our results and provides a much better product.

Incorporating New Stations or Changes to Assessment Units

To overcome the challenge of incorporating new stations with data and/or new assessment unit delineations with the proper stations and related data, our Spatial Data Infrastructure Specialist and our SWIMS Developer set up a once weekly routine where the stations / au’s have a fresh intersection run, then the TP package is re-run based on both this new data as well as any user side modifications to the checkboxes incorporated into the WATERS screens. Thus the data is fresh and updated on a continuous basis (weekly) throughout the year.

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Appendix C

Sheboygan River Fish Tumor Evaluation

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Sheboygan River Fish Tumor Evaluation

Causes of Habitat Impairment within AOC Addressed by Project
The International Joint Commission (IJC) lists "fish tumors or other deformities" as a beneficial use impairment (hereafter "fish tumor BUI") within areas of concern (AOC) in Annex 2 of the 1987 Protocol Amending the Great Lakes Water Use Impairment. The IJC subsequently stated that this BUI could be deemed to be not impaired when "the incidence of fish tumors or other deformities do not exceed rates at unimpacted control sites or when survey data confirm the absence of neoplastic or preneoplastic liver lesions in bullheads or suckers" (IJC 1991). The Sheboygan AOC BUI listing includes the fish tumor impairment.

Delisting targets were established by Wisconsin Department of Natural Resources (WDNR) staff in collaboration with numerous partners in 2008 and 2009. The delisting target in the Sheboygan River AOC is as follows:

This BUI can be considered for delisting when

- All known sources of PAHs and chlorinated organic compounds within the AOC and tributary watershed have been controlled through issuance of the appropriate regulatory control document or eliminated; and
- The Superfund PCB cleanup and Manufactured Gas Plant cleanup have been implemented; and
- There have been no reports of external Deformities, Lesions, and Tumors (DLTs) or internal organ/system impacts that have been verified by qualified WDNR personnel to have been caused by chemical contaminants for a period of five years; and
- A fish health survey of resident benthic fish species such as white suckers finds incidences of tumors or other deformities at an incidence rate of less than 5 percent.

OR, in cases where any tumors have been reported:

- A comparison study of resident benthic fish (e.g., brown bullhead or white suckers) of comparable age and at maturity (3 years), or of fish species which have historically been associated with this BUI, in the AOC and a non-impacted control site indicates that there is no statistically significant difference (with a 95% confidence interval) in the incidence of liver tumors or deformities.

However, the delisting targets were intended to provide guidance without creating specific measures that restrict agency regulatory decision-making. Our purpose is to collect sufficient data in a manner that can be utilized to determine the appropriateness of delisting the fish tumor BUI from the Sheboygan AOC as well as developing a generalized framework for methodology and degree of uncertainty acceptable to the WDNR in order to delist any AOC for the fish tumor BUI.

<u>Toxic Sediments</u>
The fish tumor BUI is inherently linked with the association between toxic sediments and fish tumor prevalence including chemical contaminants and polynuclear aromatic hydrocarbons (PAH) (Baumann et al. 1996). As such, the fish tumor BUI will not be considered for delisting until remediation of the associated sediments is complete or substantially accomplished. Substantial remediation has been completed in the Sheboygan AOC and it is possible that fish tumor incidence rates are equivalent to background rates.

Site Specific Population Target for Species
Understanding the extant tumor rate within the Sheboygan AOC is the first priority in determining whether the fish tumor BUI should be delisted once sufficient remediation has occurred. Target rates of 5% of neoplastic tumor incidence were suggested for benthic species in the Great Lakes as indicative of "environmental degradation" (Baumann et al. 1996). Since that time, additional work has been completed to further refine the background tumor incidence rate. Baumann (2010) characterized a background tumor rate of 2% in Great Lakes areas considered as "urban or having a low/moderate pollution level

without a major point source". We view a tumor incidence of 5% or lower with a 95% certainty as a threshold for delisting. If sufficient sampling suggests that the extant fish tumor rate is below 5% we believe that the fish tumor BUI may be considered for delisting.

Several of the delisting targets developed in 2008 and 2009 by the WDNR and their partners suggest that a sample size of 50 fish with a tumor incidence rate of no greater than 5% is a minimum to determine whether tumor incident rate targets have been met. However, there is uncertainty associated with any sample and in the case of tumor incidence. Tumor incidence can be described given the binomial distribution (i.e. a tumor is either present or it is not). For example, with a one sample proportion test the 95% confidence interval associated with an incident rate of 5% from a sample of 60 fish (i.e. 3 fish of the 60 have tumors) is approximately 1% to 14%, while an incidence rate of 5% from a sample of 200 fish is approximately 2% to 8% (R Core Development Team 2010). Similarly, a sample of 50 fish with an incidence rate of 0 has a 95% confidence interval of approximately 0% to 6%. Therefore, with a sample of 50 fish we would be less than 95% certain that the true tumor rate was less than 5%.

Our sampling target is 200 fish. If the 200 fish sample yields below 5% within the 95% CI (i.e. 5 or fewer tumors out of 200) we will consider the site for delisting with regard to the fish tumor BUI. Similarly, if fewer fish are captured, we will consider the AOC for delisting relative to the fish tumor BUI if the 95% confidence interval of the tumor incidence rate is less than or equal to 5%. Although a background tumor incidence rate of approximately 2% may be more appropriate (Baumann 2010), the most likely point estimate of 5 or fewer fish out of 200 is 2.5%. As such, given our conservative approach, we feel that a point estimate of 2.5% with a 95% confidence interval that does not include 5% is sufficient to consider delisting.

Comparison with Reference Site

If results from the intensive AOC sampling suggest that the upper 95% confidence limit of the tumor incidence rate is not below 5%, we will compare data obtained from the AOC with a suitable reference site which has available data (such as Jackfish Bay in Lake Superior) or data will be collected from a suitable reference site again with the target of 200 fish. We acknowledge that with a 200 fish sample, $\alpha = 0.05$ (i.e. there is a 1 in 20 chance that we will incorrectly state that the reference is lower than the AOC), and a power of 0.80 (i.e. there is a 1 in 5 chance that we will incorrectly state that the reference and the AOC are the same) we can expect to detect the similarities or differences between about 10% in the reference and 18% in the AOC using a two-sample proportions test (R Core Development Team 2010) for example. Actual detection probabilities will depend on the values obtained from sampling.

Project Goals

- Determine tumor incidence rate in the Sheboygan River AOC for potential consideration of delisting the Sheboygan AOC relative to the fish tumor BUI.

Project Coordination

One of the primary goals of remediation projects is to eliminate BUIs within AOCs. This project builds upon ongoing projects in this regard and will at the very least provide a basis for quantitative comparison to reference sites or may provide evidence for delisting within the first year depending on the results.

Project Activities

We will collect up to 200 white suckers age-3 and older to and determine tumor incidence rates using methodology developed by Blazer et al. (2006). In addition, 13C content from the collected fish will be analyzed in order to help determine their relative residence time within the Sheboygan River AOC.

Appropriate fish species

Although bullheads *Ameiurus spp*. and suckers *Catostomus spp*. were specifically mentioned in the IJC (1991) BUI definition, numerous species have demonstrated increased tumor rates in association with contaminants. These and other fish species may be appropriate indicators of the toxicity of contaminated sediments. However, while brown bullhead should be utilized when sample sizes are sufficient due to their limited home range and mobility (Sakaris et al. 2005) other species such as white suckers can be used as well. Other species with life history traits that lead to increased transience, such as white sucker and walleye (Becker 1983) can be utilized when it is deemed unlikely that collection of sufficient numbers of brown bullhead. The incidence of brown bullhead is likely low in the Sheboygan AOC and therefore white suckers will be targeted for sampling. However, since white suckers are less resident than bullhead, we plan to attempt to determine the temporal utilization of AOC using isotope analysis.

Covariates

Fish tumors do not develop instantaneously. As such there has been a demonstrated relationship with factors such as fish age and length (which themselves are obviously correlated) and tumor incidence, older and longer fish have a higher tumor incidence rate (Rutter 2010). Similarly, resident fish species will have longer exposures to contaminated sediments than transient fish species. As such, all fish collected for tumor examination will be age-3 or older as this is the age of maturity for many species of fish present in AOC (Becker 1983). In addition, in the case of resident fish such as brown bullhead, covariates such as age and length may be considered. In the case of more transient fish species, covariates of age, length, and proportion of residence within the estuarine environment may be considered. As such, white suckers collected will be measured prior to sample collection, aged after sample collection to confirm the age of each fish, and stable isotope information collected in order help determine relative temporal presence within the AOC.

Tumor definition

The IJC (1991) BUI definition also included the presence of neoplastic and preneoplastic tumors as being evidence for impairment. We will only include neoplastic tumor rates for delisting purposes as defined by Blazer et al. (2006) since factors other than contamination such as viral infection and parasites (Hayes et al. 1990) have been shown to elicit external and preneoplastic tumor responses.

Sampling Strategy and Certainty

There are two nested approaches to statistically determine whether the fish tumor BUI should be delisted. First, intensive sampling within the AOC to determine, with a known level of certainty (outlined above), whether the tumor incidence rate is below established target levels for the appropriate fish species (outlined above). Second, if the intensive sampling results suggest that tumor incidence rates may be above target rates, white sucker collection at an appropriate reference site will be conducted if data from an appropriate reference site does not currently exist.

Budget

Budget (Intensive): $85,900

External lesion and liver histopathology analyses, 200 white suckers $250/fish - $50,000.
-USGS Leetown Science Center
-13C analysis - $17/fish, 200 fish - $3,400
-University of California-Davis Isotope Laboratory
-Sucker collection – 5 days, $1,500/day - $7,500
-Contract or WDNR Fisheries
-Data management, interpretation (including ageing), and reporting - $25,000
-Contract or WDNR

Budget (Comparison with Reference): $82,500

External lesion and liver histopathology analyses, 200 white suckers $250/fish - $50,000.
-USGS Leetown Science Center
-Sucker collection – 5 days, $1,500/day - $7,500
-Contract or WDNR Fisheries
-Data management, interpretation (including ageing), and reporting – $25,000
-Contract or WDNR

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